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Via email: pinkost@rb5s.swrcb.ca.gov

Thomas Pinkos, Executive Officer
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Central Valley Region
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Dear Tom:

On March 24, 2003, I sent you a set of comments (see attached) on Tentative Revised Waste Discharge Requirements (WDRs) for the UC Davis Class III Landfill, Yolo County. Mr. Rosenbaum of your staff responded to these comments on March 26. I am providing the following additional comments, since Mr. Rosenbaum/CVRWQCB staff's approach toward addressing the issue of achieving the Chapter 15/Title 27 Performance Standard for a landfill containment system for the UCD landfill expansion has a number of significant technical deficiencies. Since, to my knowledge, this is the first time that the CVRWQCB staff and Board are addressing the issue of compliance with the Chapter 15/Title 27 Performance Standard, it is important that the Board understand the significant deficiencies in the staff's approach. It would be highly inappropriate for the staff's approach to become the standard by which the Board evaluates the adequacy of the containment system for a landfill that is to be sited in the Central Valley, where the natural geological strata underlying the landfill do not provide natural protection of groundwaters from pollution by landfill leachate for as long as the wastes in the landfill represent a threat.

In Mr. Rosenbaum's March 26 response, he states,

> "On 15 September 2000, the Regional Board adopted Resolution No. 5-00-213 *Request For The State Water Resources Control Board To Review The Adequacy Of The Prescriptive Design Requirements for Landfill Waste Containment Systems To Meet The Performance Standards Of Title 27*. The State Board responded, in part, that "a single composite liner system continues to be an adequate minimum standard" however, the Regional Board "may make a determination to impose more stringent requirements as necessary to reasonably protect water quality." The State Board response also pointed out that the containment standards do not apply only to the liner, but apply to the entire waste management unit. The response states that "there is no standard requiring the liner system, in and of itself, to provide such containment except prior to the installation of the final cover". The response goes on to say "The plastic membrane portion of the composite liner, when properly installed, has a design life expectancy of at least several hundred

years, a duration long enough to allow its function to be replaced by a well-designed, -installed, -monitored, and -maintained final cover." Once installed, the final cover will minimize the amount of rainwater percolating into the waste and the subsequent generation of leachate. For this reason, the final cover becomes a principal component of the waste containment system. A copy of the State Board response is enclosed with this letter."

With respect to the statement,

> *"The State Board responded, in part, that 'a single composite liner system continues to be an adequate minimum standard' however, the Regional Board 'may make a determination to impose more stringent requirements as necessary to reasonably protect water quality,'"*

the adoption of this approach is how the original Chapter 15, now Title 27, was intended to be implemented. As I have indicated in previous correspondence, in the mid-1980s I was an advisor to the SWRCB staff in developing Chapter 15. The minimum prescriptive standard set forth in the regulations is not to be interpreted, as it has been by Regional Boards or more recently by the State Board, as being satisfactory at any site. As I have testified at several CVRWQCB meetings, the Regional Board staff have the obligation to make a site-specific evaluation of whether a particular design and associated monitoring are appropriate for the site and type of landfill.

The statement is made that,

> *"The plastic membrane portion of the composite liner, when properly installed, has a design life expectancy of at least several hundred years, a duration long enough to allow its function to be replaced by a well-designed, -installed, -monitored, and –maintained final cover."*

The statement by the State Board staff on this issue is of limited technical merit with respect to the approach that has been used now for almost 20 years in permitting landfills under Chapter 15/Title 27. First, there is no technical basis for stating that the HDPE plastic sheeting liner will function effectively for several hundred years. As part of my university research on landfill liners, which began in the 1970s and continued through the 1980s and continues to date, I had the opportunity to review in detail what is known about the life expectancy of landfill liner systems in terms of their ability to prevent leachate from migrating through them for as long as the wastes in the landfill represent a threat. This topic has been a principal focus of my work on landfills. I can unequivocally say that it is not known how long landfill liner systems will function effectively. This is dependent on design, quality construction and careful waste placement. It is known that the HDPE component of a landfill liner will deteriorate over time, and eventually fail. This may be on the order of a few decades. It could even be a few hundred years. But to make the statement, as is done here, about the life expectancy of a landfill liner being several hundred years, is, at best, speculation, without technical merit. It can be much shorter than that. It is unlikely to be much longer.

The statement,

> *"Once installed, the final cover will minimize the amount of rainwater percolating into the waste and the subsequent generation of leachate,"*

applies only when the cover is new. It does not apply over the period of time that the cover must function to prevent leachate generation – i.e., for as long as the wastes represent a threat. This statement fails to acknowledge the fundamental problem with landfill covers as they are being developed today under the CVRWQCB staff's recommendations to the Regional Board – namely, that the low-permeability layer of the cover will deteriorate over time, which cannot be detected by visual inspection, and there is no requirement that the landfill owner install leak detectable covers, which are available commercially. Therefore, the containment system is fundamentally flawed and cannot possibly achieve the Performance Standard set forth in Chapter 15/Title 27. Mr. Rosenbaum, in responding to my March 24 comments, did not address the issue I raised of how UCD will be able to inspect the low-permeability layer of the cover, to take corrective action when it first starts to leak rainwater into the wastes, which generates leachate that will lead to groundwater pollution. As I discussed in my initial comments, this is an essential component of adequate WDRs. This issue is discussed further below.

With respect to Mr. Rosenbaum's response to my specific comments, the final sentence in his response to Comment No. 1 states,

> *"We believe that the barrier layer below the leak detection layer as proposed in the tentative WDRs is adequate."*

As I indicated in my initial comments, the current design is potentially an improvement over no leak detection system. It is significantly deficient compared to what could readily be achieved if, instead of using a 40-mil HDPE liner, at least a 60-mil, and preferably 80-mil, HDPE liner were used, and this was backed by two feet of clay with 10^{-7} cm/sec or less permeability. As I discussed in my initial comments, all HDPE liners are subject to free-radical attack. The 40-mil HDPE liner will deteriorate at a higher rate than the 60-mil. It is extremely important that the base of the leak detection system (i.e., the HDPE liner and the underlying soil layer) have a greater life expectancy than the overlying composite landfill liner. The HDPE layer at the base of the leak detection layer is much more subject to free-radical attack, which is now understood as being one of the primary modes of degradation of HDPE liners.

Rather than being thinner, as the CVRWQCB staff has proposed to allow, in order to improve compliance with the performance requirements, it should be thicker, to insure that, when the single composite landfill liner ultimately fails, the failure will be detected. Under the current situation, the 40-mil HDPE backed by a higher-permeability soil layer will likely readily deteriorate at a faster rate than the composite liner. This means that when the leak through the composite liner occurs, leachate in the leak detection layer might not be detected, because it is no longer functioning properly.

With respect to the Response to Comment No. 4, which states,

> *"The tentative WDRs do not require leak detection for the side-slopes of the WMU-2 landfill because they are to be sloped at approximately 4H:1V. At this slope, we do not anticipate buildup of head on the liner system."*

This approach ignores a fundamental problem with all leachate collection systems – namely, fouling/plugging. What Mr. Rosenbaum has stated with respect to the slope applies only if there is no plugging of the leachate collection layer above the HDPE layer in the composite liner. There will be plugging. There will be head buildup on the side slopes, and this will lead to leakage through the HDPE

composite liner, which does not have a leak detection system under it on the side slopes. This is a fundamentally flawed component of the CVRWQCB staff's approval of the design for the UCD expanded landfill.

With respect to the Response to Comment No. 5 regarding Groundwater Monitoring, the statement is made that,

> *"The combination of the proposed leak detection layer and groundwater monitoring should provide an adequate monitoring system to provide early detection of a release from the landfill."*

This response is not responsive to the issues raised in my comments. As I have repeatedly indicated, the Regional Board members should require that the staff define the expected reliability of the groundwater monitoring well array to detect leachate that passes through the landfill composite liner and is not collected by the leak detection layer. As stated above, the current leak detection layer will deteriorate faster than the landfill composite liner and, therefore, it is likely to not be functioning properly when it is needed.

Therefore, it is imperative that the staff/Board require that a proper analysis be made of the reliability of the groundwater monitoring well array that they are allowing UCD to use to detect when this additional Cell of this landfill ultimately fails to prevent groundwater pollution by landfill leachate. As I indicated in my March 24 comments, UCD and the CVRWQCB staff, independently, should evaluate the reliability of the proposed groundwater monitoring well array to detect, in accord with Subtitle D and Chapter 15/Title 27, leachate-polluted groundwaters when they first reach the point of compliance, that arise from a leak through the liner system that occurs at any location, including the side slopes. This is a statistical problem that is dependent on the hydrogeology of the area underlying the landfill. An off-the-cuff statement such as Mr. Rosenbaum has provided is not adequate to address this issue.

With respect to the Response to Comment No. 8,

> *"The tentative WDRs require UC Davis to install a composite final cover that is not to be more permeable than the Units composite liner. The Standard Provisions and Reporting Requirements require periodic leak searches and repairs as required by Title 27. There are emerging technologies that may allow for more effective leak location during periodic leak searches. We also anticipate that the final cover may need to be periodically reassessed as the synthetic components break down. Therefore an assessment of long-term performance over thousands of years was not required."*

this response fails to address the key issue raised in my initial set of comments – namely, that the leak detection layer in the cover, under the current WDRs, cannot be inspected, and the staff is claiming that they are relying on some emerging technology to address this issue. This is an inappropriate approach on the part of Mr. Rosenbaum and the staff. As I have testified previously before the CVRWQCB and as is well known in the literature, the technologies have been available for many years to install a leak detectable cover on a landfill. The problems are that the regulatory agencies at the federal and state level are unwilling, thus far, to address this issue in a meaningful way. Unless this issue is properly addressed, the landfill cover low-permeability layer's deterioration, which can occur in a relatively short period of time because of the increased stresses on the HDPE layer in the cover and the greater opportunity for

free-radical attack than for the landfill liner system, will not be detected. As I indicated in my initial comments, the WDRs must specify how UCD will detect the failure of the low-permeability layer in the landfill cover to prevent moisture from penetrating through it, which generates leachate that can pollute groundwaters. Under the current approach, there is no way to detect the failure of the low-permeability layer in the cover. Leachate will be generated. The liner system in both the composite liner and the leak detection system will have deteriorated, and groundwater pollution will occur.

The statement in the Response to Comment 9, about the cover being the key component of the landfill containment system, mandates that the inspection for failure of the cover to prevent moisture from passing through it that can generate leachate that can lead to groundwater pollution must be addressed as part of evaluating the performance of a proposed landfill containment system. This evaluation should not be based on a cursory statement by the staff about what they believe. How will the low-permeability layer of the cover be inspected, and what will be done when the low-permeability layer of the cover deteriorates to the point that it fails to prevent moisture from passing through it which generates leachate? These are points I raised in my initial comments that still must be addressed.

The Response to Comment 12 regarding the public's participation in any proposed landfill design changes, again, is an inappropriate response. The public should be informed and allowed the opportunity to comment on any changes that are made in a proposed landfill containment system design, operation, etc.

Overall, I find that Mr. Rosenbaum's responses to several of the issues I raised with respect to the deficiencies in UCD's proposed landfill expansion containment and monitoring system in conforming to the Performance Standard set forth in Chapter 15/Title 27 are superficial. Further, there are a number of key issues, like the issue I raised regarding diffusion as the primary transport mechanism through the geosynthetic clay liner, which he did not address. The staff should be required to adequately address the issues raised in my March 24 comments and in these supplemental comments, under conditions where there is an opportunity for those knowledgeable on these topics to review these issues with the Board, to be sure that the staff's analysis of the issues has a high degree of certainty of developing a landfill containment system that will prevent groundwater pollution by landfill leachate for as long as the wastes represent a threat.

Summary of Deficiencies in the UCD Landfill Expansion WDRs in Complying with the Chapter 15/Title 27 Performance Standard of Protecting Groundwaters from Pollution by Landfill Leachate for as Long as the Wastes in the Landfill will be a Threat

Presented below is a summary of the key issues that need to be addressed as part of developing a UCD landfill expansion that will, with a high degree of reliability, comply with Chapter 15/Title 27 requirements of protecting groundwaters from pollution by landfill leachate for as long as the wastes in the landfill will be a threat.

Inadequate Design of the Leak Detection System. The leak detection system can readily fail to collect leachate and transport it to a sump where leakage through the composite liner can be detected. The 40-mil HDPE liner and the underlying compacted soil layer in the draft WDRs can be expected to fail at a faster rate than a 60-mil HDPE underlain by 2 ft of compacted clay with a permeability of less than 10^{-7} cm/sec. The 40-mil HDPE liner in the leak detection system should be changed to at least 60-mil, and preferably 80-mil. This liner should be backed by at least 2 ft of compacted clay with a permeability of

10^{-7} cm/sec. Adopting this approach would greatly improve the ability of the leak detection liner to transport leachate that passes through the single composite liner to a sump where it can be detected, for as long as the wastes in the landfill will be a threat.

Another deficiency in the design of the leak detection system is that it underlies only part of the landfill liner system. The leak detection should underlie the complete landfill liner system.

Unreliable Groundwater Monitoring. The reliability of the groundwater monitoring system based on vertical monitoring wells to detect leachate-polluted groundwaters in accordance with Subtitle D and Chapter 15/Title 27 requirements should be defined for any location in the landfill, including the side slopes. This evaluation should be based on an analysis of the hydrogeology underlying the landfill and the potential for a leak through the landfill liner at any location within the landfill to generate a plume that would be detected by the vertical monitoring well(s) for the landfill expansion unit when the plume first reaches the point of compliance for groundwater monitoring. Also, as requested in my initial comments, the issue of the point of compliance for groundwater monitoring must be defined in the WDRs.

Landfill Cover. The WDRs must specify how leaks in the low-permeability layer of the landfill cover will be detected with a high degree of reliability over the period of time that the wastes in the landfill will be a threat. It is inappropriate to claim, as Mr. Rosenbaum has done, that some new, yet-to-be-developed technology may be used. The technology exists now to incorporate a leak detectable cover in this landfill. This is what should be required as part of the WDRs. Without this, there is virtually no possibility that this landfill will conform to the Performance Standard set forth in Chapter 15, now Title 27, of protecting groundwaters from pollution by landfill leachate for as long as the wastes in the landfill will be a threat.

The staff's responses on these issues that I raised in my March 24 comments should be based on a proper technical evaluation of the issues, in which the basis for this evaluation is clearly defined and set forth in the responses. It is through this approach that the public will have the opportunity to examine whether the staff have properly addressed the issue of evaluating whether a proposed landfill containment system will conform to Chapter 15/Title 27 requirements of protecting groundwaters from pollution by landfill leachate for as long as the wastes are a threat.

It is extremely important that WDRs for the UCD landfill, as originally proposed and as apparently have been "slightly modified," not become the Performance Standard for the Central Valley Regional Water Quality Control Board's development of landfills at geologically unsuitable sites, where there is not natural protection of groundwaters from pollution by landfill leachate. The staff's proposed WDRs for the UCD landfill expansion fall far short of complying with developing a landfill that will provide a high degree of protection of groundwaters from pollution by landfill leachate for as long as the wastes in the landfill are a threat. As discussed,

- the leak detection system design is inadequate to insure that it will function effectively for as long as the wastes are a threat;
- the groundwater monitoring system, based on vertical monitoring wells, which serve as backup to the leak detection system, has a low probability of detecting liner failure at the point of compliance before widespread groundwater pollution occurs;

- there are no provisions for inspection of the low permeability layer of the landfill cover, to address the inevitable failure of this layer to prevent substantial amounts of moisture entering the landfill, which generates leachate which will lead to groundwater pollution.

I am confident, based on my approximately 40 years of work on landfill issues, that an independent panel of experts, whose income does not depend on their providing support for landfill developers, would conclude that the issues I have raised in this matter are appropriate, and that substantial changes in the UCD landfill WDRs need to be made before this landfill is approved.

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March 24, 2003

Via email: pinkost@rb5s.swrcb.ca.gov

Tom Pinkos, Executive Officer
Central Valley Regional Water Quality Control Board

Dear Tom:

I wish to respond to the request for comments on the "Tentative Revised Waste Discharge Requirements for University of California, Davis – UC Davis Class III Landfill – Construction, Post-Closure Maintenance and Corrective Action – Yolo County," that was issued on February 26, 2003.

As you know, I have been a reviewer of the University of California, Davis (UCD) landfilling of wastes for about 10 years. I have testified before the CVRWQCB on several occasions on the deficiencies of the past, current and proposed approaches that the UCD administrations have followed in landfilling of the campus wastes. My previous testimony is on my website, www.gfredlee.com, in the Landfills/Groundwater, Examples of Specific Landfill Studies section. That testimony serves as the basis for comments herein, which I will not repeat, although if there is need to have background information, I wish to incorporate the past testimony into this record. Specifically, on my website are the following:

> Lee, G.F., "Comments on the University of California Davis Proposed Campus Landfill Expansion," G. Fred Lee & Associates, El Macero, CA, July/August (2000).
>
> Lee, G.F., "Comments on Tentative Revised Waste Discharge Requirements for the University of California Davis (UCD) Class III Landfill, Yolo County, Dated June 2, 2000," submitted to Central Valley Regional Water Quality Control Board, Sacramento, CA, July 5, 2000.
>
> Lee, G. F., "Petition to the State Water Resources Control Board to Review California Regional Water Quality Control Board Waste Discharge Requirements for University of California, Davis Class III Landfill Yolo County Order 96-228 Adopted on August 9, 1996," Submitted to State Water Resources Control Board, Sacramento, CA, September (1996).

As discussed in my previous testimony, the University of California, Davis, administration, in an attempt to save a few dollars at the time of campus solid waste management, has created three landfills and several waste burial pits in the LEHR area, which are now part of a national

Superfund site, which is costing the taxpayers of California many tens of millions of dollars for cleanup. The University of California, Davis, in its fourth landfill (WMU-1), developed on the west campus, is polluting groundwaters with landfill leachate and waste chloroform, with a plume that extends over a mile. While it is under corrective action of the CVRWQCB, it should be part of the state "Superfund" program.

WMU-2, Cell 6 (which was approved by the CVRWQCB) with its single composite liner, will, as I testified and by its own staff's admission, and obviously, to anyone who understands these issues, become another Superfund-like situation where eventually the single composite liner will fail, and groundwater pollution will occur at that landfill. Unfortunately, because it is a single composite liner and the University administration, with the approval of the Central Valley Board, allowed a groundwater monitoring system for that landfill which is largely cosmetic – i.e., has a low probability of detecting when the liner system first fails – as I testified, the initial leakage will produce finger-like plumes of leachate that will readily pass undetected between the monitoring wells at the point of compliance for monitoring.

It is somewhat encouraging to see that the CVRWQCB staff have now recognized that a single composite liner is not adequate to protect groundwater from pollution by landfill leachate at geologically unsuitable sites for a minimum Subtitle D landfill. The proposed leak detection system can be, if modified as requested herein and properly implemented, an important step toward providing the University of California, Davis, and the people of California with a landfill that will be protective of groundwater resources.

Page 15 of the Tentative Order, item number 4 under "Construction Specifications" states,

> *"4. The **base liner system** for all new cells of WMU-2 shall be constructed in accordance with one of the following composite liner designs:*
>
> *a. The prescriptive standard design that consists of a lower compacted soil layer that is a minimum of two feet thick with a hydraulic conductivity of 1 x 10^{-7} cm/sec or less and has a minimum relative compaction of at least 90%. Immediately above the compacted soil layer, and in direct and uniform contact with the soil layer, shall be a synthetic flexible membrane component, which is immediately overlain with an LCRS. An operations layer shall be placed above the leachate collection and removal system. The entire base liner system shall be underlain by a leak detection layer and a moisture barrier that shall be extended up the side slope to a minimum elevation of 50 feet MSL. Components of the base liner system and leak detection layer shall be (from top to bottom):*
>
> *1. A minimum 1-foot operations layer of soil or chipped tires;*
> *2. A minimum 1-foot drainage layer of gravel or chipped tires underlain by gravel;*
> *3. A geotextile cushion layer;*
> *4. A minimum 60-mil HDPE geomembrane layer;*
> *5. A minimum of 2-feet of compacted clay (k = 1x10^{-7} cm/s or less);*
> *6. A minimum 1-foot earthfill layer;*
> *7. A geocomposite or sand leak detection layer;*

8. A minimum 40-mil HDPE geomembrane layer;
9. Fine grained smooth rolled subgrade soil;

or

b. An engineered alternative composite liner system that consists of a geosynthetic clay liner (GCL) that is at least 7 millimeters (mm) thick (after hydration) and that has a maximum permeability of 5 x 10^{-9} cm/sec.

Immediately above the GCL layer, and in direct and uniform contact with the GCL layer, shall be a synthetic flexible membrane component, which is immediately overlain with an LCRS. An operations layer shall be placed above the leachate collection and removal system. The entire base liner system shall be underlain by a leak detection layer and a moisture barrier that shall be extended up the side slope to a minimum elevation of 50 feet MSL. Components of the base liner system and leak detection layer shall be (from top to bottom):

1. A minimum 1-foot operations layer of soil or chipped tires;
2. A minimum 1-foot drainage layer of gravel or chipped tires underlain by gravel;
3. A geotextile cushion layer;
4. A minimum 60-mil HDPE geomembrane layer;
5. A minimum 7 mm thick geosynthetic clay liner;
6. A minimum of 1.5 feet of compacted fine-grained earthfill;
7. A geocomposite or sand leak detection layer;
8. A minimum 40-mil HDPE geomembrane layer;
9. Fine grained smooth rolled subgrade soil;"

The proposed landfill liner system for the new cells of WMU-2 is considerably improved over the previously requested and approved liner system for WMU-2. That liner system involved a single composite liner, which, as I testified, is fundamentally flawed at this site, since the groundwaters at the site have already been polluted by leachate from previous UCD landfills constructed in the area. This situation leads to the need to develop a leak detection system to detect when the single composite liner fails to prevent leachate from passing through it.

The proposed liner system includes a leak detection layer of sand, which is underlain by a 40-mil HDPE geomembrane layer. I recommend against this approach, since it is not a true double composite liner, which would involve a sand leak detection layer, a 60-mil HDPE geomembrane layer, underlain by two feet of compacted clay, with a maximum permeability of 10^{-7} cm/sec. A 40-mil geomembrane HDPE liner will deteriorate faster due to free-radical attack than the normal 60-mil HDPE liner that is used in a true double composite liner.

The rolled compacted soil layer is significantly deficient in preventing the leakage that will occur through the HDPE liner in holes, points of deterioration, rips or tears, so that the leachate that is collected in the leak detection sand layer may not be transported to a sump where it could be collected. This collection is the key to indicating that the single composite liner overlying the leak detection system has failed.

The other major deficiency in this proposed approach is that there are no explicit requirements as to what will be done when leachate is detected in the leak detection layer. Based on past approaches of the UCD/Vanderhoef administration, such a detection would likely be denied as representing a failure of the upper composite liner. This WDR must specify that finding leachate in the leak detection layer requires that the university administration immediately undertake a program that will stop further generation of leachate. What should be done is to find the area of the cover that is allowing moisture to enter into the landfill, which then generates leachate that is leaking through the single composite liner into the leak detection layer. Since finding a leak in the cover will be difficult, based on conventional cover design, University of California, Davis, should be required to completely replace the cover, preferably with a leak-detectable cover that will be operated and maintained in perpetuity for the purpose of preventing further leachate from being generated within the landfill that will eventually lead to groundwater pollution.

Page 15, at the bottom of the page, states,

> "*b. An engineered alternative composite liner system that consists of a geosynthetic clay liner (GCL) that is at least 7 millimeters (mm) thick (after hydration) and that has a maximum permeability of 5 x 10^{-9} cm/sec."*

This so-called "engineered alternative" approach substitutes the geosynthetic clay liner for the two feet of compacted clay with a permeability of 10^{-7} cm/sec or less. While, as I indicated in my previous testimony before the Board on these issues, regulatory agencies are approving this approach, it should be understood that this approach is not equivalent in terms of providing the same protection. As discussed in the papers on my website, the statement about how a geocomposite liner system has a permeability of 10^{-9} cm/sec is highly misleading with respect to interpreting that advective permeability to mean the rate at which leachate components would pass through the liner. As Dr. David Daniel pointed out many years ago (Daniel and Shackelford, 1989), thin layers of clay such as in a geosynthetic clay liner will allow the passage of leachate-derived constituents through the liner as a result of diffusional transport. The controlling rate of transport of leachate constituents through thin layers is through diffusion, not advective transport.

I am also concerned that the leak detection liner system extends only part-way up the side slopes. It should be required to extend all the way to the surface. Otherwise, leaks can occur through the side slopes through the single composite liner, which would lead to largely undetected groundwater pollution.

On page 1 of the Notice of Public Hearing on this Order, the first paragraph states,

> *"The proposed Order finds that at this facility, the proposed liner system design meets the performance standard for a Class III landfill that is given in Title 27, California Code of Regulations."*

That statement is not accurate. While the proposed liner is considerably improved over previously approved single composite liners in being able to detect single composite liner failure, it is deficient. As documented in previous testimony, Chapter 15, now Title 27, requires protection of groundwater from impaired use for as long as the waste in the landfill will be a

threat. Many components of the waste in the proposed UCD landfill will be a threat forever. The liner system that is proposed is deficient in being able to achieve that level of protection. A true double composite liner of the type recommended would significantly improve the ability to achieve this level of protection.

On page 4 of the Tentative Order, with respect to item 23 under Groundwater Monitoring, as I testified previously, UCD and its consultants should be required to do an analysis of the ability of the proposed groundwater monitoring well array to detect leachate-polluted groundwaters when they first reach the point of compliance, in accordance with Subtitle D and Chapter 15, now Title 27, requirements, where the leak could occur at any location within the landfill, including the side slopes. A sufficient understanding of the groundwater hydrology, the advective transport and lateral spread of a plume arising from a 2-ft-wide rip, tear or point of deterioration in the liner system, should be used to determine whether the proposed monitoring well array will, in fact, detect the leachate pollution plumes that are first generated when the upper composite liner and the leak detection liner eventually fail.

It is somewhat misleading, as occurs on page 5, item 28, to spend so much time on statistical aspects of the groundwater monitoring, *"In order to provide the best assurance of the earliest possible detection of a release of non-naturally occurring waste constituents from a Unit…,"* when the groundwater monitoring well array is significantly deficient in being able to detect polluted groundwaters in accordance with the "best assurance of earliest possible detection" approach, since the groundwater monitoring wells have zones of capture of about 1 ft, and downgradient monitoring wells are located 100 or more feet apart.

Examination of Attachment B shows that WMU-2, for Cells 7 and 8, has one downgradient monitoring well, MW-35, which is to cover a distance of 300 ft. There are obviously many areas of Cells 7 and 8 where leakage could occur from the new Cells, as well as Cell 6, where the monitoring well array will not detect leakage. The Board and the public should be informed about the unreliability of this monitoring system. It is also unclear to me where the point of compliance for the new Cells is to be located.

Another complicating factor will be that there is already so much pollution of groundwaters by other UCD landfills in the area that, if future UCD administrations are like the current L. Vanderhoef administration, UCD will argue that the pollution is from the old landfill, and not the new one. In fact, it will be from both.

On page 6, item 32, mention is made that,

> *"On 28 January 2003, Regional Board staff approved the installation of one C-zone extraction well (EW-1C) near MW-16C as part of a response to increasing concentrations of chloroform in that well."*

Why was the public not informed of this situation? The public who are concerned about groundwater quality protection issues should be made aware of these issues, and it should not be something that just occurs between the CVRWQCB staff and UCD. This is one of the

significant deficiencies in how the CVRWQCB administers the implementation of WDRs, where the public is not involved.

Page 6, item 36 states,

> *"Resolution No. 93-62 requires the construction of a specified single composite liner system at new municipal solid waste landfills, or expansion areas of existing municipal solid waste landfills, that receive wastes after 9 October 1993."*

The statement, as worded, is somewhat incorrect. The Resolution requires that, as a minimum, a single composite liner system be used. The Resolution does not preclude requiring more than a single composite liner at geologically unsuitable sites for landfills where the eventual failure of the liner system will lead to groundwater pollution, such as the UCD site.

Page 7, item 40, regarding the substitution of GCLs for a landfill liner or clay cover, the staff need to critically review whether it is properly considering diffusional transport through the GCL, as the primary mode of transport, and not the advective transport, which would be predicted based on a 10^{-9} cm/sec permeability.

Page 9, item 49 makes reference to the US EPA 2002 *Assessment and Recommendations for Improving the Performance of Waste Containment Systems*. Great caution needs to be used in relying on that document, for a number of reasons. First, there are significant technical errors made in it. Included within this document is unreliable information that municipal solid waste in a "dry tomb" landfill will be a threat to pollute groundwaters for only 200 years. Since the authors of the section in which this error occurs estimate that the HDPE liner will function as an effective liner, collecting all leachate, for 1000 years, landfills with a single composite liner will be "safe." This is nothing more than blatant propaganda in an attempt to support a single composite liner. The 200-year estimate neglects the fact that metals, salts and many organics in a "dry tomb" landfill will not decompose, and will obviously be a threat forever. Second, the approach that was used to estimate the 1000-year effective useful lifetime of a single HDPE layer in a composite liner is based on inappropriate extrapolation of limited-term studies to 1000 years, by using the Arrhenius equation. Those familiar with this equation know that extrapolations of this type are likely to have limited reliability and should not be done.

Page 9, item 51 discusses "initial" rates of leakage of approximately 5.5 gallons of leachate per year. It is stated (on page 10),

> *"The discharger has estimated that the total leakage through the entire system including the geomembrane under the leak detection layer would be approximately 0.000011 gpad or 0.012 gallons per year from Cells 7 and 8 during the operational life of the landfill. The Discharger reported that after closure, the leachate generation rates would decrease to an average of 5 gpad during the first 9 years of post-closure maintenance and be essentially zero after 9 years."*

This is an example of the inadequate reporting of issues that the CVRWQCB staff provide to the Board. The issue is not the initial rate of leakage of the liner, but the long-term rates of leakage.

Why did the staff not require that UCD discuss what will happen over the thousands of years that the landfill cover, landfill liner and leachate collection and removal system will have to function as designed to generate the kind of leachate plume that is described in this section? The statement that,

> *"The Discharger reported that after closure, the leachate generation rates would decrease to an average of 5 gpad during the first 9 years of post-closure maintenance and be essentially zero after 9 years,"*

is a distortion of facts, if it is intended to mean that after 9 years there will be no leakage of moisture through the landfill cover. It is obvious that the low-permeability layer of the landfill cover will eventually develop cracks. Since these cracks are not detectable from the surface, and since UCD does not propose to install a leak detection system in the cover, eventually the landfill will start to generate leachate again, because of leakage of moisture into the landfill through the low-permeability layer of the cover. This rate of leakage will certainly be considerably above the estimated leakage rates presented in this report, under items 51 and 52.

Item 52 is nothing more than speculation, with respect to the characteristics of the leachate plume that will occur over the period of time that the wastes in this landfill will be a threat.

Item 53 states,

> *"The Discharger also performed a cost/benefit analysis of single, double and triple composite liner systems. Based on the results of this analysis, the Discharger concluded that while the cost of more stringent liner systems increases significantly, the leakage potential remains essentially zero."*

That statement reflects only a short period of time, with high-quality construction, that the liner system will have to function effectively, compared to the period of time that the landfill waste will be a threat. This is another example of the past problems with the staff allowing dischargers to only consider an initial period of landfill liner and cover performance, and not (as required by Chapter 15, now Title 27) consider the full period of time that the landfill wastes will be a threat to pollute groundwaters.

Page 10, item 55, states,

> *"Based on the information presented in the liner performance demonstration report submitted by the Discharger, the Regional Board finds that the single composite liner system with underlying leak detection layer that is required by this Order meets the Title 27 Class III performance standard at the UC Davis Class III Landfill."*

The CVRWQCB staff should not be relying on a discharger's assessment. The CVRWQCB staff should be performing their own independent assessment of whether the liner performance is adequate to meet Title 27.

On pages 10 and 11, item 56 states that the requirement for an unsaturated zone monitoring system is waived. As I have testified, the unsaturated zone monitoring systems that the CVRWQCB staff have been recommending to the Board, and that the Board has been approving, are largely a waste of money, because of their grossly deficient design compared to that needed to properly conduct vadose zone monitoring. These issues are discussed in detail in my previous testimony.

Page 11, item 61, states,

> *"These requirements implement the prescriptive standard and performance goals of Title 27, California Code of Regulations, §20005 et seq. (Title 27)."*

That statement is not necessarily true. While it is improved over a single composite liner, it is still deficient compared to what could be readily implemented if a proper analysis of the long-term performance of the liner, leachate collection and removal system, groundwater monitoring system and landfill cover were conducted in support of this application.

Top of page 15, item 2c states that an unsaturated zone monitoring system is to be installed, yet an earlier section said that it was waived. It appears that there is a contradiction here between the various sections of this Tentative Revised Order.

Page 16, under 5b, indicates that,

> *"An engineered alternative composite liner system that consists of a geosynthetic clay liner (GCL) that is at least 7 millimeters (mm) thick (after hydration) and that has a maximum permeability of 5 x 10^{-9} cm/sec"*

shall be used on side slopes. In addition to the issues discussed above about diffusion transport through this thin layer of clay being the dominant mode of transport through the layer, rather than advective transport, based on the 5 x 10^{-9} cm/sec permeability, there is also an important issue of structural stability of these geosynthetic layers, especially on side slopes. As discussed above, a double composite lined system should go all the way to the surface, based on clay, and not geosynthetic layers for the clay components.

Page 17, item 8 states, *"The Discharger may propose changes to the liner system design prior to construction ...."* It is important, if any changes are made, that the proposed changes are made available to the public so that they can review the adequacy of the staff's conclusions regarding the proposed changes. Approval by the executive officer is not adequate to protect the public's interests. The executive officer is relying on staff, who may not have the expertise and experience of some members of the public in addressing these issues.

Page 19, under item F (Post-Closure Maintenance Specifications), item 2 states,

> *"The Discharger shall, in a timely manner, repair any areas of the final cover that have been damaged by erosion, cracking, differential settlement, subsidence or any other*

causes that could allow ponding of surface water or percolation of surface water into the wastes."

There is no discussion in this section about how the Regional Board staff will require that UCD inspect, maintain and repair, for as long as the wastes in this landfill will be a threat, the low-permeability layer which is located below the topsoil layer and drainage layer of the cover. This is the key layer that has to be maintained. I have discussed this issue in previous presentations on UCD's landfill applications. They still are not being addressed by the staff. This is a significant deficiency in this proposed WDR Order. The Board must require that the staff develop detailed specifications on how the low-permeability (HDPE) layer in the cover of this proposed landfill expansion will be inspected for as long as the wastes are a threat, in order to detect when the liner in the cover no longer prevents moisture, which penetrates through the topsoil layer and drainage layer, from entering the wastes. Without this detailed specification of inspection of a reliable system of low-permeability layer integrity, this landfill expansion will become another of UCD's "Superfund" sites, or the equivalent, since the low-permeability layer will deteriorate over time. This will not be detected by the proposed monitoring approach set forth in this section, of visually examining the surface of the topsoil layer.

Page 20, item 8 states,

"For each monitoring event the Discharger shall determine whether the landfill is in compliance with the Water Quality Protection Standard using procedures specified in Monitoring and Reporting Program No. _____ and §20415(e) of Title 27."

In those reports, UCD should be required to provide an estimate of the reliability of this assessment of compliance, by discussing the probability that leachate-polluted groundwaters have reached the point of compliance for groundwater monitoring in narrow plumes that have not been detected by the monitoring wells – i.e., the current groundwater monitoring system based on vertical monitoring wells is cosmetic, at best, and is significantly deficient in providing true, reliable groundwater monitoring at the point of compliance. An assessment needs to be made, before developing the landfill, and thereafter, which informs the Regional Board and the public of the unreliability of the monitoring system for complying with Title 27 requirements for monitoring of groundwaters to detect leachate pollution for as long as the wastes in the landfill will be a threat (i.e., forever). These issues have been discussed in detail in my previous testimony, and by Cherry (1990).

This draft WDR Order, starting on page 19, goes on for pages (through page 30) concerning the details of monitoring. Further, there is a monitoring and reporting program appended to this draft WDR Order, which might lead those who do not understand the fundamental deficiencies in this program to believe that the monitoring program is highly reliable. In fact, it is not. This is more of the superficial approach toward reliable monitoring, when the monitoring program that is approved by the staff and recommended to the Board is fundamentally flawed in being able to comply with the Chapter 15/Title 27 and Subtitle D requirements of detecting pollution of groundwaters at the point of compliance when it first occurs. No amount of statistical analysis of data will eliminate this fundamentally flawed characteristic of this monitoring program.

Leachate plumes have a high probability of passing between the monitoring wells and not being detected by the sampling that is proposed under this WDR Order.

Overall, the inclusion of a leak detection layer under the proposed expansion Cells 7 and 8 is a significant improvement. However, the draft WDR Order, as proposed, has a number of significant deficiencies that need to be addressed before it is approved by the Board. Failure to do so will lead to yet another UCD landfill that is on the Superfund site list, or the equivalent.

Questions on these comments should be directed to Dr. G. Fred Lee, at gfredlee@aol.com.

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Supplemental References that Provide Background Information to these Comments

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Lee, G. F., "Problems with Landfills for Superfund Site Remediation," Presentation at the US EPA National Superfund Technical Assistance Grant (TAG) Workshop, Albuquerque, NM, February (2003).

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Lee, G. F. and Jones-Lee, A, "Deficiencies in Subtitle D Landfill Liner Failure and Groundwater Pollution Monitoring," Presented at the NWQMC National Conference "Monitoring: Critical Foundations to Protect Our Waters," US Environmental Protection Agency, Washington, D.C., July (1998).

Subj:	**Re: Participation in the CVRWQCB April 24/25 Review of UCD Landfill WDRs**
Date:	3/27/2003 2:54:26 PM Pacific Standard Time
From:	RosenbS@rb5s.swrcb.ca.gov
To:	Gfredlee@aol.com
CC:	BrattaB@rb5s.swrcb.ca.gov, PinkosT@rb5s.swrcb.ca.gov
Sent from the Internet (Details)	

Fred,

Thanks for your prompt response. We'll put the WDRs with the consent items on the April agenda. The consent items will be considered by the Board on Friday morning.

Steve

>>> <Gfredlee@aol.com> 03/27/03 11:32AM >>>
Steve Rosenbaum
CVRWQCB

Steve,

In your fax of yesterday responding to my March 24 comments on the UCD landfill WDRs, you asked if I would want to testify at the Board meeting on this issue on April 24/25.

First, I do not consider myself a "party" on the UCD landfill matter. I have used this matter as an opportunity to continue my now-20-year effort to try to get the regulatory agencies in California to implement Chapter 15, now Title 27, in accord with its original intent and requirements.

As you may recall from our previous discussions of this issue, in the early 1980s, while a professor in the University of Texas system, I was asked by the California State Water Resources Control Board staff to assist the staff in developing what became Chapter 15. I worked closely with Gil Torres on this matter. I also assisted Darlene Ruiz, then a State Board member, in getting Chapter 15 approved by the State Board in 1984.

In 1989, while holding a university professorial position in New Jersey, I was contacted by the Metropolitan Water District of Southern California to assist in helping MWD protect groundwaters from landfill leachate generated by the Azusa landfill. This landfill is located in the San Gabriel Basin of Southern California. It was at that time that I became familiar with how the Regional Boards had been implementing Chapter 15, where the Regional Board staff, over the objections of the State Board staff, had decided that the minimum prescriptive standards set forth in Chapter 15 for landfill liner design of 1 ft of clay with a permeability of 10-6 cm/sec, satisfied the explicit requirements set forth in Chapter 15 of preventing groundwater pollution by leachate for as long as the wastes in the landfill were a threat.

It should have been obvious to the Regional Board staff who understood these issues and Darcy's Law that that liner system could only delay by a few months when pollution of groundwaters under the landfill would occur. The subsequent SWRCB staff SWAT review confirmed this situation, where it was reported that landfills with this liner were polluting to the same extent as those without it.

In 1989 both the State Board staff and I testified at a State Board hearing on the Azusa landfill expansion that that landfill expansion would lead to further groundwater pollution. It was also at that time that I learned that the State Board staff had become highly disillusioned about the approach that had been

taken by the Regional Board staff in interpretation of Chapter 15's performance standards of groundwater quality protection for as long as the wastes were a threat.

Subsequently I became involved in several Central Valley landfill siting matters, and in addition, the adoption of Subtitle D requirements into Chapter 15, now Title 27. It was through this activity that I learned of the H. Schueller position statement, in which the State Board had adopted the position without public review, that a minimum Subtitle D landfill, sited at any location in the state, satisfied the Chapter 15, now Title 27, requirements of protecting groundwaters from pollution by landfill leachate for as long as the wastes were a threat. It is obvious to anyone who understands these issues that such an interpretation is in error.

As an individual, I filed a petition with the State Water Resources Control Board, asking that this "position" be reviewed for its technical validity. After 4 years of no action on my petition, the State Board attorney notified me that, since 270 days had passed since I had submitted the petition, the Board was not going to act on it. At that time I became convinced that there was no possibility under that Board to get the State Water Resources Control Board to start to protect groundwaters from pollution by landfill leachate.

Last summer, as a result of attending a CVRWQCB meeting, I became aware that this Regional Board finally was requesting that its staff evaluate whether a recommended landfill containment system could achieve the groundwater quality performance standards of protecting groundwaters from pollution by waste-derived constituents for as long as the wastes are a threat. This is the issue I had been trying to get the Regional Board and State Board to consider since the early 1990s.

It was through my participation in this effort that I learned that the State Board's position was now that the Regional Board "may make a determination to impose more stringent requirements as necessary to reasonably protect water quality" -- i.e., implement Chapter 15/Title 27 as it requires, and as it was originally intended.

With the recent release of the draft WDRs for the UCD landfill expansion, I (again, without support) took the time to provide the comments that I recently submitted to Mr. Pinkos. As indicated, I strongly support the significant advance that was made in these draft WDRs in improving water quality protection by the UCD landfill. There are several problem areas that still need to be addressed. These were discussed in my comments.

While I am not a party who is directly affected by the UCD landfill, I, as well as all others in California, am impacted, as a taxpayer who will ultimately have to pay for groundwater remediation for an improperly designed, constructed, operated, closed and maintained landfill.

With respect to the April 24/25 Board meeting, I cannot participate in the meeting on April 24, since that conflicts with my activities in support of the Board's San Joaquin River DO TMDL effort. I am available on April 25, and plan to be available at that meeting, should the UCD landfill matter be reviewed on that date, to answer questions on my comments.

I will be providing Mr. Pinkos and Chairman Schneider with followup comments on a couple of issues that have surfaced as a result of your responses to my comments. I hope to be able to send those next week. I do not request that these supplemental comments be included in the record; however, I do want the Board to have the opportunity to review the issues that need to be considered in reviewing the UCD and other landfills for their ability to achieve the performance standards set forth in Chapter 15, now Title 27.

If you have questions about this matter, please contact me.

Fred