STATE OF CALIFORNIA -- CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY PETE WILSON, *Governor*

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January 5, 1996

To: **San Francisco Bay Area Agencies Overseeing UST Cleanup (see distribution list)**

Subject: **Supplemental Instructions to State Water Board December 8, 1995, Interim Guidance on Required Cleanup at Low Risk Fuel Sites**

As you know, Lawrence Livermore National Laboratory (LLNL) issued its "Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks" (October 16, 1995). In response to this report, State Water Resources Control Board Executive Director Walt Pettit issued an interim guidance letter (attached) dated December 8, 1995, which discussed the regulatory implications of the conclusions and recommendations of the LLNL report. This letter is intended to further amplify the guidance contained in the State Board letter for fuel cleanup sites within the San Francisco Bay Region.

Two documents are enclosed. One we call "Supplemental Instructions", which we recommend for your use in regulating low-risk sites. The other is a fact sheet in question and answer format intended for the interested tank owner or the general public.

In general, we concur with the findings and conclusions of the LLNL study. The LLNL study is consistent with the language approved by the Regional Board in its "non-attainment zone" policy for groundwater cleanup. For both the LLNL study and the Regional Board "non-attainment zone" policy, it is recommended that fuel sites be treated differently and less stringently than solvent sites. In this region we believe that most fuel sites fall into the low-risk category, for which source removal and passive remediation are adequate. At the same time we believe that great care should be used to see that sites which are ***not*** low-risk receive more aggressive treatment. These judgements will always have to be made on a site-by-site basis.

Note that this guidance, like that provided in the State Board's December 8 letter, is only interim. The recommendations of the SB 1764 Scientific Advisory Committee are due this month, and these will presumably be reflected in the pending changes the State Board is considering in its update to its cleanup policy this spring.

If you have questions on the guidance or the supplemental instructions, please call Steve Morse (510-286-0304) or Kevin Graves (510-286-0435) of my staff.

Sincerely,

Lawrence P. Kolb
for
Loretta K. Barsamian
Executive Officer

Attachment (2)

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January 5, 1996

MEMORANDUM

To: San Francisco Bay Area Agencies Overseeing UST Cleanup and Other Interested Parties

Subject: Regional Board Supplemental Instructions to State Water Board December 8, 1995, Interim Guidance on Required Cleanup at Low-Risk Fuel Sites

These supplemental instructions are intended for the regulatory and technical audience[1] to expand on the interim guidance provided in the December 8, 1995, letter from Walt Pettit, Executive Director of the State Water Resources Control Board regarding the findings of the report entitled "Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks (LUFTs)" issued by the Lawrence Livermore National Laboratory (LLNL). Mr. Pettit's letter urges cleanup agencies to proceed aggressively to close low risk soil only cases and not to require active remediation of low risk groundwater cases.

The LLNL report indicates that bioremediation of petroleum is an important factor in stabilizing plumes and may be the only remedial activity necessary in the absence of free product. After a review of existing literature, white papers submitted to the SB1764 committee, and an extensive study of leak cases statewide, the LLNL report found that petroleum plumes tend to stabilize close to the source, generally occur in shallow groundwater and rarely impact drinking water wells in the state.

It is in light of these findings and the "lessons learned" over the past ten years in San Francisco Bay Region that these supplemental instructions are written. Strategies are presented for closing low risk soil only cases and managing low risk groundwater impact cases utilizing natural bioremediation as the preferred remedial alternative.

These two classes of sites, low risk soils and low risk groundwater, are not intended to include the whole universe of petroleum leaks. There are higher risk sites that may require immediate action and remediation to protect human health and the environment. The responsibility still lies with the discharger for investigation of the subsurface to gather the data necessary to make these decisions. It is the responsibility of the regulator to only request that information which is required to make the necessary regulatory decisions regarding the site.

It is the responsibility of everyone in the process, particularly consultants and regulators, to keep up with current research on site investigation, fate and transport of contaminants, analytical methods, and other topics that affect the decision making process. Training and education should be a high priority for all parties participating in the site cleanup process. The State and Regional Boards will be providing training to the local agencies and others affected. In addition, consulting by the Regional Board's toxicologist, Dr. Ravi Arulanantham, is available on a limited basis to local agencies.

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1 Additional supplemental information is also provided from the Regional Board in the form of a Fact Sheet in a "Question and Answer" format.

LOW RISK SOILS CASE

Definition:

1) **The leak has been stopped and ongoing sources, including free product, removed or remediated.**

The tank or appurtenant structure that leaked must be repaired or permanently closed per Chapter 7, Section 2672 of the UST regulations. Free product shall be removed to the extent practicable per Chapter 5, Section 2655 of the UST regulations.

Free product or soil which contains sufficient mobile constituents (leachate, vapors, or gravity flow) to degrade groundwater quality above water quality objectives or result in a significant threat to human health or the environment should be considered a source.

For old releases, the absence of current groundwater impact is often a good indication that residual concentrations present in the soil are not a source of pollution. In general, if impacted soil is not in contact, or expected to come in contact, with or very close to the groundwater, it is unlikely that it is a significant source of pollution.

2) **The site has been adequately characterized.**
The extent of the subsurface impact should be defined to the degree that is necessary to determine if the site poses a threat to human health, the environment, or other sensitive nearby receptors. The level of detail required at a given site will depend upon the presence or absence of potential receptors and exposure pathways. Delineating plumes to non-detect levels is not required at all sites.

It is assumed that subsurface conditions are highly variable and that there is always some uncertainty associated with evaluating data at a site. However, the cost of obtaining additional data must be weighed against the benefit of obtaining that data and the effect the data may have on the certainty of decisions to be made at the site.

3) **Little or no groundwater impact currently exists and no contaminants are found at levels above established MCLs or other applicable water quality objectives.**

By definition, soils only cases do not have significant groundwater impacts.

4) **No water wells, deeper drinking water aquifers, surface water, or other sensitive receptors are likely to be impacted.**

5) **The site presents no significant risk to human health.**

The American Society of Testing and Materials' (ASTM) standard for Risked Based Corrective Action (RBCA), ASTM E-1739-95, details a framework and provides a methodology to perform a tiered risk analysis at petroleum release sites. This methodology incorporates EPA risk assessment practices to determine non-site specific (tier 1 look up table which provides generic risk based screening levels) and site specific (tier 2 and tier 3) clean up levels that are protective of public health and environmental resources.

In addition to the various methods of contaminant transport described in the ASTM standard, other methods may also be acceptable in determining health and environmental protective levels.

When using the ASTM lookup table risk based screening levels (RBSLs) one has to multiply the RBSL value for benzene by a factor of 0.29 to obtain the corrected value for California (CAL EPA has a higher toxicity value of 0.1 as compared to the USEPA value of 0.029 for benzene). All other values in the table remain the same.

6) **The site presents no significant risk to the environment.**
RBCA has no specific guidance for evaluating environmental risk although the basic framework is appropriate if site specific exposure pathways and ecological receptors are included. If the site has a potential to significantly impact surface water, wetlands, other sensitive receptors, it should not be considered low risk.

Management Strategy

Low risk soils cases should be closed when it is determined that site conditions conform to the above criteria. Further remediation or monitoring is not required. If the highest permitted use (e.g., residential) is not protected by the chosen cleanup levels, then land use restrictions or notifications for the site may be appropriate.

LOW RISK GROUNDWATER CASE

Definition

1) **The leak has been stopped and ongoing sources, including free product, have been removed or remediated** (see Low Risk Soils Case Definition #1).

2) **The site has been adequately characterized** (see Low Risk Soils Case Definition #2).

   The presence or absence of horizontal and vertical conduits which could act as preferential pathways for the dissolved plume should be evaluated as a part of the site characterization process.

3) **The dissolved hydrocarbon plume is not migrating.**
   The LLNL report found that petroleum plumes in the subsurface tend to stabilize once the source is removed. Natural biodegradation of hydrocarbons is the main reason why this stability occurs.

   Chemical concentrations of hydrocarbons in groundwater that decrease or do not change with time are the best indicators of a stable plume. Comparison of background and hydrocarbon plume concentrations of inorganic ions such as oxygen, iron, nitrate, sulfate, and others, can provide evidence of biodegradation at a given site. These data may not be required to determine plume stability but can supplement other lines of evidence.

   Stable or decreasing plumes often display short term variability in groundwater concentrations. These effects are due to changes in groundwater flow, degradation rates, sampling procedures, and other factors which are inherently variable. This behavior should not necessarily be construed as evidence of an unstable plume but may be the natural variations of a stable plume in the environment.

4) **No water wells, deeper drinking water aquifers, surface water, or other sensitive receptors are likely to be impacted.**

5) **The site presents no significant risk to human health.**

   For this analysis, the groundwater ingestion pathway need not be considered if the groundwater is not currently used as a source of drinking water or projected to be used within the life of the plume. (See Low Risk Soils Case Definition #5)

6) **The site presents no significant risk to the environment.**

   RBCA has no specific guidance for evaluating environmental risk although the basic framework is appropriate if site specific exposure pathways and ecological receptors are included. If the site has a potential to significantly impact surface water, wetlands, other sensitive receptors, it should not be considered low risk. (See Low Risk Soils Case Definition #6)

Management Strategy

1) **Passive bioremediation should be the preferred remedial alternative unless there is a compelling reason to do otherwise.**

A partial list of reasons that may justify active remediation are listed below:

- Groundwater within the plume is likely to be used before natural biodegradation is projected to complete the cleanup.
- Sensitive receptors have been identified and are projected to be adversely impacted.
- The plume is migrating significantly.
- Another remedial alternative is shown to be more cost effective.

Generally, if any of these conditions or others deemed to be compelling are met, a more aggressive remedial approach may be appropriate.

2) **Monitor the site to determine plume stability and the effectiveness of the remedial strategy.**

Monitoring is necessary to determine if site conditions will remain stable or improve over time. One hydrologic cycle (four quarters) of monitoring data is usually considered to be the minimum necessary to determine site conditions. This assumes depth to groundwater has significant seasonal variation and that no longer term variation occurs. If little seasonal fluctuation is expected, then one year of monitoring may not be required. Conversely, if depth to groundwater is expected to change significantly from year to year due to droughts, adjacent pumping, or other factors, then one year of monitoring may not be adequate.

Data from adjacent or nearby sites may be useful in determining groundwater fluctuations and other regional aquifer characteristics. Frequency of monitoring and the number of monitoring points may be adjusted after site characterization is completed. At many existing sites, these data may already have been collected.

Coordinated & Prepared by: Kevin L. Graves, P.E.
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January 5, 1996

Concur: Stephen I. Morse, P.E.
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January 5, 1996

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Fact Sheet
Questions and Answers
on the
"Interim Guidance on Low-Risk Petroleum Hydrocarbon Cleanups"

Lawrence Livermore National Laboratory (LLNL) issued its "Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks" (October 16, 1995). In response to this report, State Water Resources Control Board Executive Director Walt Pettit issued an interim guidance letter dated December 8, 1995, which discussed the regulatory implications of the conclusions and recommendations of the LLNL report.

From the December 8, 1995, letter:

"In the interim and in light of the findings and recommendations in the LLNL report, we believe cleanup oversight agencies should proceed aggressively to close low risk soil only cases. For cases affecting low risk groundwater (for instance, shallow groundwater with maximum depth to water less than 50 feet and no drinking water wells screened in the shallow groundwater zone within 250 feet of the leak) we recommend that active remediation be replaced with monitoring to determine if the fuel leak plume is stable. Obviously good judgment is required in all of these decisions. However, that judgment should now include knowledge provided by the LLNL report."

This Fact Sheet is intended to further amplify the guidance contained in the State Board letter for fuel cleanup sites within the San Francisco Bay Region through the form of "Answers" to frequently asked questions regarding implementation of the new petroleum cleanup interim guidance.

Q **What is considered a "source" when completing source removal?**

A Leaking tanks and appurtenant structures must be removed or repaired. Free product or soil which contains sufficient mobile constituents (leachate, vapors, or gravity flow) to degrade groundwater quality above water quality objectives or provide a significant threat to human health or the environment should be considered a source.

Gasoline or diesel free product fits this definition at virtually all sites. Oil and grease, degraded crude oil, and degraded diesel may not be soluble enough to be considered a significant source and often do not degrade water quality or present a significant risk to human health or the environment.

Many factors need to be considered when determining if a given petroleum release constitutes a source.

- Depth of the affected soil below ground surface
- Depth to groundwater below ground surface
- Soil type and physical properties
- Presence of preferential pathways (ie. old wells, utility trenches, etc.)
- Type of petroleum released
- Infiltration rate
- Spatial distribution of petroleum concentrations
- Total mass of petroleum released
- Trends in monitoring data
- Chemical and physical properties of any residual hydrocarbons

Good judgment must be used when weighing these and other factors. For old releases, the absence of current groundwater degradation often is a good indication that residual concentrations present in the soil are not a source of pollution. In general, if impacted soil is not in contact or expected to come in contact with the groundwater, it is unlikely that it is a significant source of pollution.

Q **What is meant by "low risk groundwater sites"?**

A An example of a low risk groundwater site is described in the State Board letter as a site with maximum depth to groundwater less than 50 feet and no drinking water wells screened in the shallow groundwater zone within 250 feet of the leak. In addition, there should be no surface water or other sensitive habitat that may be adversely impacted by the release.

These criteria are not hard and fast rules. They are meant to recognize that shallow groundwater is rarely used as a drinking water source, that biodegradation in most cases will stabilize a plume within 250 feet of the leak, and that the plume will likely remediate itself due to natural biodegradation. However, if the plume is not stable, preferential pathways exist at the site, or sensitive receptors are near the end of the plume, then the site should not be considered low risk.

Q **How do we determine if there is a significant risk to human health at a site?**

A The American Society of Testing and Materials (ASTM) standard for Risk Based Corrective Action, ASTM E-1739-95, (RBCA) provides look up tables for various exposure pathways that contains conservative screening levels (when modified for California's benzene standard) for comparison with values existing at the site. The standard also contains a methodology for determining site specific levels that are protective of public health and the environment. The SWRCB/RWQCB is now offering two day classes for all interested parties in risk-based decision making at soil and groundwater impacted sites. Please contact the UC

Riverside Extension at 909-787-4105 to obtain further information on upcoming classes.

Q What is a sensitive receptor?

A Water wells, deeper drinking water aquifers, surface water bodies, sensitive habitats such as wetlands, marshes, or mudflats, human beings, aquatic plants and animals, and other wildlife are all sensitive receptors. Property lines and other political or administrative boundaries are not considered to be sensitive receptors for the purposes of this guidance.

Q **How do we determine if there is significant ecological risk at the site?**

A There is not currently a standard method for determining potential threats to the environment or aquatic receptors. When appropriate, ASTM RBCA would identify this as a potential exposure pathway that is not included in the current "look up tables" and will therefore require a higher tier analysis. This analysis may require additional evaluation of migration pathways such as storm drains and other manmade conduits. Currently, evaluation protocols are being developed, and look up tables for ecological receptors may be added to ASTM RBCA in the future. The lack of a standard protocol or look up table does not eliminate the requirement to evaluate this pathway, especially in nearshore or Bay front locations.

Q **The State Board letter states that active remediation should be replaced with monitoring at low risk sites. What technologies are considered "active remediation"?**

A Active remediation refers to remediation of dissolved groundwater plumes. Mechanical systems that inject or remove material from the dissolved phase plume are considered active remediation. Examples of active remediation include groundwater extraction systems, air sparging systems, and hydrogen peroxide injection systems. Vapor extraction, bioslurping and other source removal systems are not considered active remediation if they are removing a source of pollution as defined in Question 1 above.

Q What technologies for free product removal are currently considered practicable?

A Appropriate excavation of the impacted material surrounding the leak is one of the best source removal technologies available. Manual bailing, passive skimming, and pumping of groundwater are only marginally effective at removing free product. Vacuum enhanced free product recovery (ie. vapor extraction, bioslurping, etc.) has been shown to be a highly effective method for removing mobile free product. Each site needs a determination of the cost-effectiveness of the various techniques taking into account the soil type, amount of free product present, potential for the free product to act as a source, preferential pathways, and other factors that affect hydrocarbon movement at the site.

Q What 'reasonable justification' would be compelling enough to use active remediation on the dissolved hydrocarbon plume?

A A partial list of reasons that may be compelling are listed below:

- Groundwater within the plume is likely to be used before natural biodegradation is projected to complete the cleanup.
- Sensitive receptors have been identified and are projected to be adversely impacted.
- The plume is migrating significantly.
- Another remedial alternative is shown to be more cost effective.

Generally, if any of these conditions or others deemed to be reasonable justification are met, a more aggressive remedial approach may be appropriate.

Q **What criteria are used to determine plume stability?**

A The LLNL report found that petroleum plumes in the subsurface tend to stabilize once the source is removed. Natural biodegradation of hydrocarbons is the main reason this stability occurs.

Many factors influence plume stability including hydrogeology and those listed in Question 1. However, chemical concentrations of hydrocarbons in groundwater that decrease or do not change with time are the best indicator of a stable plume. Comparison of background and hydrocarbon plume concentrations of inorganic ions such as oxygen, iron, nitrate, sulfate, and others, can provide evidence of biodegradation at a given site. These data may not be required to determine plume stability, but can supplement other lines of evidence.

Stable or decreasing plumes often display short term variability in groundwater concentrations. These effects are due to changes in groundwater flow, degradation rates, sampling procedures, and other factors which are inherently variable. This behavior should not necessarily be construed as evidence of an unstable plume but may be the natural variability of a stable plume in the environment.

Q What should the monitoring frequency be?

A The frequency of monitoring should be commensurate with the need for data to make required decisions at the site. Quarterly monitoring may be appropriate in the early stages of investigation when extent of contamination, seasonal groundwater fluctuations, and other site specific factors are being evaluated. After these have been determined, monitoring frequency may be reduced to perhaps annually and number of monitoring points reduced to selected wells only. Long term monitoring should be limited to collecting only the minimum data needed to verify that site conditions are stable or improving. Much of this information has already been collected at many existing sites.

Q Can existing active remediation systems at low risk sites be turned off even though established remedial goals have not been reached?

A Yes. If the site is evaluated using the new guidance and active remediation is not indicated, then active treatment at the site should be terminated. If the extraction system is necessary to provide hydraulic control of the plume which prevents contaminants from reaching a sensitive receptor, then continued pumping may be warranted.

Q When can adjacent site data be used in lieu of site specific data?

A Local hydrogeologic data can often be inferred from data collected at adjacent sites. Depth to groundwater, depth to regional aquifer, groundwater gradient, soil types that may be present, and chemical concentrations may all be of value in directing an investigation. A conceptual model of the site may be formed using local or adjacent site data. Data collected during a site investigation should clarify the conceptual model and help to guide any further work at the site.

Q If a site is only monitoring and no active remediation is anticipated, can the site be closed?

A Regulatory agencies have broad discretion to determine whether or not regulatory action is necessary and appropriate at a given site. Under current policies, the monitoring period could be many years depending upon the magnitude of the release, remedial actions taken, and biodegradation rates at the site. Closure of low risk UST sites would be appropriate as soon as enough data supported the conclusion that the source had been removed, the plume had stabilized, and bioremediation was expected to achieve water quality objectives (e.g. MCLs) in a reasonable time.

The State Board has indicated that policies regarding petroleum cleanup standards will be reviewed in 1996 pursuant to SB1764 requirements. Changes in closure policy regarding low risk groundwater cases may be a result of that review.

Q What action should be taken if a responsible party refuses to take any action at a site and cites this guidance as the reason for inaction?

A Responsible parties are required to comply with all regulatory requirements. If they disagree with a directive or think it is in violation of current regulatory practice, they have the opportunity to appeal that directive through the proper channels. Responsible parties may face enforcement actions if they disregard regulatory requirements and do not appeal using the appropriate procedures.

Q If a responsible party wants to pursue a more aggressive remedial strategy than stated in the State Board letter, will the Cleanup Fund pay for the additional remediation?

A The Cleanup Fund manager has indicated that the Fund will only reimburse costs for those activities that are required by regulatory agencies. For low risk cases, regulatory agencies should not approve work plans for active remediation unless adequate justification is provided. Article 11, section 2727f of the Underground Storage Tank Regulations requires that responsible parties propose the most cost-effective corrective action. This will be monitoring, without active remediation, in many cases.

Q What public notification is required when implementing this guidance?

A The implementation of the LLNL recommendations suggested by the State Board letter does not change the public notification requirements already stated in the UST regulations in Chapter 11, Section 2728. That section requires that the public must be informed of the proposed activities contained in a site's corrective action plan. If a site's corrective action plan is modified to the extent that it is essentially a new corrective action plan, then it may be appropriate for the public to be notified of the new plan.

Q Will future use of an impacted property be restricted by implementation of State Boards' recommendations?

A No change in current practice is expected. Generally, sites are remediated to either residential or commercial/industrial requirements based on current and projected future land uses. If a site is cleaned up to commercial/industrial standards and the land use changes to residential, then further risk assessment and possibly mitigation or remediation may be required.

The current UST "no further action" letter requires that the implementing agency be notified if a change in land use occurs.

Q How does this guidance fit with existing and future policy?

A From the December 8, 1995 letter, "What I propose to you is not in any way inconsistent with existing policies or regulations. However, it does represent a major departure from how we have viewed the threat from leak USTs." Under the requirements of SB 1764 the legislature expects the State Water Resources Control Board to propose and make further permanent changes to the interim guidance, perhaps as early this spring. Meanwhile, the Regional Board and the local regulating agencies will be implementing the interim guidance.

For further information or questions, please contact the Regional Board. Initial contact should be Wil Bruhns, the Regional Board's Ombudsman at 510-286-0838. He can give you further general information and direct your questions to the appropriate staff persons. It should be noted that most fuel cleanup sites in the Bay Area are regulated by local agencies.

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PETE WILSON, *Governor*

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DEC - 8 1995

LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) REPORT ON LEAKING UNDERGROUND STORAGE TANK (UST) CLEANUP

In October 1995, the LLNL presented to the State Water Resources Control Board (SWRCB) its final report, Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks. The LLNL team found that the impacts to the environment from leaking USTs were not as severe as we once thought. The report also presents a convincing argument that passive bioremediation should be considered as the primary remediation tool in most cases once the fuel leak source has been removed.

The LLNL report has also been presented to the SWRCB's SB 1764 Advisory Committee which will, in turn, provide recommendations to the SWRCB by the end of January 1996. The SWRCB may choose to implement recommendations from the LLNL report and the SB 1764 Advisory Committee through revisions to SWRCB Resolution 92-49 in early 1996.

In the interim and in light of the findings and recommendations in the LLNL report, we believe cleanup oversight agencies should proceed aggressively to close low risk soil only cases. For cases affecting low risk groundwater (for instance, shallow groundwater with maximum depth to water less than 50 feet and no drinking water wells screened in the shallow groundwater zone within 250 feet of the leak) we recommend that active remediation be replaced with monitoring to determine if the fuel leak plume is stable. Obviously good judgment is required in all of these decisions. However, that judgment should now include knowledge provided by the LLNL report.

What I propose to you is not in any way inconsistent with existing policies or regulations. However, it does represent a major departure from how we have viewed the threat from leaking USTs. This guidance is consistent with the results of a discussion of this subject among the State Board Chair and Regional Board Chairs on December 5, 1995. If you have any questions on this matter please call Mr. James Giannopoulos, our manager of the underground storage tank program, at (916) 227-4320.

Sincerely,

Walt Pettit
Executive Director

cc: All Regional Water Board/LOP UST Program Managers