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In reply, please refer to:
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SUBJECT: Proposed dioxin action levels for East Kapolei Brownfield Site

This memo presents an approach for assessing dioxin contamination at the East Kapolei brownfield site and identifying areas where remedial actions may be required for future residential land use. For the purposes of this memo, parks, playgrounds and other open public spaces that residents may visit on a regular basis should be initially assessed in the same manner as a residential backyard, although final remedial approaches may vary. The approach combines dioxin toxicity factors presented by the USEPA and the Minnesota Department of Health (MDH) and guidance prepared by the Agency For Toxic Substances and Disease Registry (ATSDR).

Recommended actions can be summarized as follows. Determine the background concentration of dioxin (TEQ) in former agricultural field areas (approximately 400 acres). Data from the pesticide mixing site should not be included in estimating background. If background is below 42 ng/kg, identify the extent of the former pesticide mixing area contaminated above this action level. If background dioxin is greater than 42 ng/kg, identify the extent of the former pesticide mixing area contaminated above background. The portion of the former pesticide mixing area that exceeds 390 ng/kg dioxins should similarly be identified and clearly delineated. Removal or capping of soil that exceeds 390 ng/kg dioxins should be required. The feasibility of removal or capping of soil that exceed 42 ng/kg dioxins or background, if higher, should be evaluated with respect to the factors discussed below and any other pertinent site-specific considerations that may apply.

TCDD Toxicity Equivalent (TEQ) Concentration

The Minnesota Department of Health document referenced above provides a good summary of methods used to evaluate human health risks posed by dioxins (MDH 2003). The term "dioxins"

is used to refer to a family of chlorinated compounds with similar chemical structures and mechanisms of toxicity, referred to as “congeners.” The evaluation of risk to human health focuses on seventeen specific congeners - seven polychlorinated dibenzo-p-dioxins (PCDDs) and ten polychlorinated dibenzofurans (PCSFs). Individual congeners are not equally toxic. The toxicity of specific congeners is assigned a value relative to the toxicity of 2,3,7,8-TCDD, the most potent carcinogen of the 17 congeners studied. These values are referred to as “Toxicity Equivalence Factors” or “TEFs.” The reported concentration of an individual congener is multiplied by its respective TEF to produce a Toxicity Equivalent (TEQ) concentration. The TEQ concentrations for individual congeners are then added together to calculate a total 2,3,7,8-TCDD TEQ concentration for the sample.

Recommended Action Levels For Dioxins

USEPA Region IX refers to a cancer slope factor of 1.5 E+05 (mg/kg-day)⁻¹ to in their Preliminary Remediation Goals for dioxins, evaluated as 2,3,7,8 TCDD Toxic Equivalent Concentration (USEPA 2004). A toxicity review published by the Minnesota Department of Health presents an alternative cancer slope factor of 1.4E+06 (mg/kg-day)⁻¹ for 2,3,7,8 TCDD, or approximately nine times more stringent than the slope factor currently used in the USEPA Region IX PRGs (MDH 2003). At a target 10⁻⁴ excess cancer risk, the USEPA and MDH cancer slope factors equate to residential soil screening levels of 42 ng/kg and 390 ng/kg, respectively (ng/kg = parts-per-trillion). There is a potential that USEPA will move toward the more stringent cancer slope factor in the near future. It is important, therefore, to take the soil action level based on this slope factor into account at the East Kapolei brownfield site.

The ASTM document “Dioxin and Dioxin-Like Compounds in Soil” provides a useful approach to do this (ASTM 1997). The guidance uses lower and upper bound, dioxin action levels to recommend three potential options at dioxin-contaminated sites. A modification of this approach using the action levels noted above is summarized in the following table:

Dioxins (2,3,7,8 TCDD TEQ)	Action
Low Risk ≤42 ng/kg	No further action required.
Intermediate Risk >42 but ≤390 ng/kg	<p>Determine area-wide background total dioxins (e.g, across the 400-acre site as a whole). If background is <42 ng/kg, identify “hot spots” as areas that exceed 42 ng/kg TEQ dioxins. Evaluate the feasibility of removing or capping soil in these areas to reduce long-term exposure (see below). If background is ≥42 but ≤390, identify “hot spots” as areas that exceed background and similarly evaluate the feasibility of remove or capping soil in these areas.</p> <p>For areas that exceed 42 ng/kg dioxins (2,3,7,8 TCDD TEQ) but are within background, recommend (but don’t require) exposure minimization measures and provide notice to future homeowners of potential health risks (include in CC&Rs, notice to deeds, etc.).</p>
High Risk >390 ng/kg	Residential use not recommended in absence of remedial actions to reduce potential exposure.

For comparison purposes, correlative TCDD TEQ action levels for commercial/industrial land use based on the same target risk ranges are:

- Low Risk: <170 ng/kg;
- Intermediate Risk: >170 ng/kg but \leq 1,600 ng/kg; and
- High Risk: >1,600 ng/kg.

The action levels noted above are intended to be used as guidelines only and do not represent strict, regulatory, cleanup standards. Conditions that could warrant remedial actions in areas that fall in the middle category of dioxin-contaminated soil include:

- Area to be used for very sensitive purposes (playgrounds, daycare center, medical center, etc.);
- Contaminated soil limited in extent and easily accessible (e.g., within three feet of the ground surface);
- Offsite disposal option available at acceptable cost;
- Onsite area(s) for consolidation and capping of soil available;
- Well maintained landscaping to reduce exposure and dust emissions not planned.

A minimum cap thickness of twenty-four inches is recommended for on-site isolation of soils with TEQ concentrations of dioxins greater than 390 ng/kg due to the heightened health risk posed by the soil (e.g., refer to guidance for lead-contaminated sites in USEPA 2003). A clearly identifiable marker barrier should be placed between the contaminated soil and the overlying clean fill material (e.g., orange, plastic, construction fencing). Onsite isolation of soil with dioxin TEQ concentrations that could pose unacceptable health risks to future construction and utility trench workers is not recommended (e.g., >21,000 ng/kg, action level for construction worker exposure at target 10^{-4} excess cancer risk and MDH cancer slope factor; after HDOH 2005).

Dioxin Test Methods

Use of bioassay methods (e.g., XDS-CALUX Bioassay tests) for total dioxins is acceptable for initial screening of soils, provided that adequate supporting documentation for the test has been submitted to HDOH for review. Reported levels of total dioxins based on bioassay tests should include a GCMS correction factor, as appropriate for the test method used. If the reported total dioxin concentration exceeds 42 ng/kg, then the concentration of individual congeners should be determined and the TCDD TEQ concentration for the sample calculated. The action levels noted above should then be used to determine appropriate actions. Confirmation analyses using GC/MS analysis should be provided for 10% of the samples tested or a minimum of two samples (e.g., USEPA Method 8290). Relatively inexpensive bioassay tests may also be useful for the investigation of large sites where a clear relationship between screening methods and GC/MS data has been established. Use of this approach should be discussed with HDOH on a site-by-site basis.

Soil Sampling Plan

The soil sampling plan for the East Kapolei Brownfield Site has not been finalized. Based on discussions to date, the plan will include the collection of multi-increment samples from 59 5,000 ft² areas (simulating residential lots) in the 400-acre agricultural field. The pesticide mixing site and other sites where past activities may have led to distinctly different dioxin levels will be sampled and investigated separately. A final sampling plan should be presented to HDOH for review prior to collection of the samples.

1998 USEPA OSWER Directive

A 1998 directive from USEPA recommends “preliminary remediation goals” for dioxins in soil of 1,000 ng/kg (1.0 ug/kg) for residential land use and 5,000 ng/kg (5 ug/kg) to 20,000 ng/kg (20 ug/kg) for commercial/industrial land use (USEPA 1998). These action levels reflect excess cancer risks of 2.5×10^{-4} and 1.3×10^{-4} to 5.2×10^{-4} , respectively, marginally over the maximum target cancer risk of 10^{-4} recommended in USEPA guidance for human health risk assessment (e.g., USEPA 1989).

The recommendation for action levels outside of the normal, acceptable risk range reflects a policy decision on the part of USEPA to strike a balance between the increased toxicity of dioxins identified in studies during the 1990s and exposures to dioxins in food and other sources. The action levels are used to help identify very-high-risk sites and focus initial State and Federal resources on these areas. ATSDR uses an action level of 1,000 ng/kg to identify very-high-risk sites where health studies of residents may be needed (ATSDR 1997). The USEPA directive notes that this does not necessarily exclude an evaluation of sites with dioxin levels below 1,000 ng/kg. Final cleanup standards for a given site could be lower and are dependent on site-specific considerations, including land use, anticipated exposure, the extent and magnitude of contamination and the feasibility of meeting more stringent cleanup standards.

The dioxin action levels are not recommended for use in Hawai'i. The number of sites in Hawai'i with significantly elevated levels of dioxins is expected to be relatively small in comparison to the mainland. Action levels presented in this memo are considered feasible and appropriate for identification of high-risk sites. Former pesticide mixing areas at agricultural sites have been identified as the primary areas of concern. Based on a review of data from these sites, the effort required to meet the action levels presented in this memo and further reduce health risks to future residents and workers is not likely to be significantly greater than the effort required to meet the action levels proposed in the USEPA directive.

References:

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- MDH, 2003, *Cancer Risk Assessment for Dioxins* (March 2003): Minnesota Department of Health, Risk Evaluation/Air Monitoring Unit, www.canceractionny.org/cancerriskassessment.htm
- USEPA, 1989, *Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual (Part A)*: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Publication EPA/540/1-89/092.
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- USEPA, 2004, *Preliminary Remediation Goals*: U.S. Environmental Protection Agency, Region IX, October 2004, www.epa.gov/region09/waste/sfund/prg/index.htm.