HALEY & ALDRICH, INC.
426 17th Street
Suite 700
Oakland, CA 94612
510.879.4544

MEMORANDUM

22 September 2021
File No. 0203804-001

TO: Alameda Marina, LLC
1815 Clement Avenue

FROM: Haley & Aldrich, Inc.
Ruth Arestides, Senior Technical Specialist | Risk Assessor
Susan Shiu, Associate | Risk Assessor
Adrienne LaPierre, Principal Consultant

SUBJECT: Health Risk Evaluation - Alameda Marina Redevelopment Site

Haley & Aldrich, Inc. prepared this memorandum to support activities associated with redevelopment of the property located at 1815 Clement Avenue in Alameda, California (Site). The Site is currently undergoing redevelopment to repurpose a 44-acre maritime/commercial facility to mixed-use, including residential units, maritime/commercial space, and park space as well as improvements to an existing Marina.

BACKGROUND

Redevelopment activities at the Site include demolition of an existing asphalt and concrete cover; grading and soil excavation associated with redevelopment or for soil remediation; and construction. Wood Environmental & Infrastructure Solutions, Inc. ("Wood") prepared a Soil and Groundwater Management Plan (SGMP) on behalf of Alameda Marina, LLC, for earthwork activities associated with redeveloping the Site. The SGMP provides guidance for the proper handling and management of contaminated soil and groundwater during redevelopment activities to comply with applicable air quality regulations and includes protocols for controlling the emissions of Site-related chemicals to minimize impacts to the surrounding community, including nearby residents to the south and west of the Site. The SGMP was reviewed and approved by the lead regulatory oversight agency, Alameda County Department of Environmental Health (ACDEH) Local Oversight Program, via email communication on 25 February 2021.

The SGMP established construction dust mitigation measures for the Site to mitigate airborne dust and off-Site emissions in accordance with the Bay Area Air Quality Management District California Environmental Quality Act (CEQA) Air Quality Guidelines (2017)[1]. In accordance with CEQA guidelines, and as specified in the SGMP, stockpiles are required to be covered or otherwise stabilized to mitigate

[1] Bay Area Air Quality Management District. 2017. California Environmental Quality Act, Air Quality Guidelines. May.

the generation of windblown dust. In response to community dust complaints, ACDEH conducted a Site walk on 1 September 2021, during which ACDEH observed uncovered soil stockpiles as well as stockpiles/concrete staging on parts of the property that have not been evaluated for contamination or previously approved by ACDEH.

In accordance with the SGMP, dust monitoring has been conducted on a daily basis during working hours for the first three days of each new potential dust generating activity conducted in impacted soil. Site-related dust concentrations are evaluated as downwind concentration (i.e., concentrations downwind of Site activity) minus upwind concentration (i.e., concentrations upwind of the Site and representative of area conditions not related to Site activity). As set forth in the SGMP, the dust evaluation screening level for the Site is a daily average concentration of 50 micrograms per cubic meter ($\mu g/m^3$) for particulate matter of 10 micrometers or less (PM10; based on the California Environmental Protection Agency Air Resources Board PM10 24-hour standard).

Site-related PM10 concentrations measured during Site redevelopment activities between February and September 2021 did not exceed the dust evaluation screening level established in the SGMP. However, short-term average (i.e., 1-hour average) PM10 concentrations did exceed 50 $\mu g/m^3$ for several days during periods that stockpiles were uncovered (Table 1). These short-term exceedances are likely representative of periods during which dust complaints were recorded. The most recent dust complaint was recorded on 30 August 2021, one day after the highest measured 1-hour average PM10 concentration (Table 1).

OBJECTIVE

The overall objective of this memorandum is to evaluate whether downwind dust concentrations measured between February and September 2021, in accordance with the SGMP for the Site, could pose an unacceptable health risk to residents at off-Site properties located south and west of the Site. In accordance with the SGMP, dust monitoring has been conducted on a daily basis during working hours for the first three days of each new potential dust generating activity conducted in impacted soil, including during periods of time when soil stockpiles were left uncovered at the Site.

Health risks for off-Site residents associated with inhalation exposure to Site-related dust concentrations are assessed by comparing estimated Site-related chemicals of potential concern (COPC) concentrations in airborne particulates to COPC-specific acceptable ambient air concentrations (AACs) developed for the Site. Each AAC represents a conservative estimate of the long-term average concentration of the chemical in air to which off-Site populations could be safely exposed over the duration of redevelopment work in impacted soils.

Acute risks are assessed by comparing estimated short-term (1-hour) particulate concentrations to short-term risk-based screening levels for Site-related COPCs. Short-term screening levels were selected from available acute (1-hour) inhalation reference exposure levels (RELs)[2] or Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs).[3]

[2] Office of Environmental Health Hazard Assessment (OEHHA), California Air Resources Board (ARB). 2020. Consolidated Table of OEHHA/ Approved Risk Assessment Health Values. 2 October.
[3] Agency for Toxic Substances and Disease Registry. 2021. Minimal Risk Levels (MRLs) for Hazardous Substances. July.

HEALTH RISK EVALUATION

Data Included in the Health Risk Evaluation

For the purposes of this health risk evaluation, Site soil is defined as soil disturbed during redevelopment activities or soil stored in uncovered stockpiles as described in detail below.

Soil disturbing activities at the Site during the redevelopment period evaluated in this memorandum (i.e., February 2021 through September 2021) are limited to areas of Wrap A Parcel and the Townhome Seawall (Exhibit 1 of *Alameda Marina - Site Cessation Memorandum. Clement Avenue A-C, Alameda, California,* dated 3 September 2021). There are currently nine stockpiles located at the Site (Stockpile A through I). Stockpiles A, B, and E were generated from areas of the Site where COPCs have been detected in soil. Results of soil samples collected from Stockpile B are not included in this evaluation because Stockpile B was generated and stored in compliance with the SGMP. Stockpiles C, F, G, H, and I are made up of virgin material or concrete debris and thus are not considered to be representative of Site soil.

Selection of COPCs

The Site COPCs are those Site-related chemicals (polycyclic aromatic hydrocarbons, total petroleum hydrocarbons as diesel, and metals [antimony, arsenic, cobalt, copper, lead, and nickel]) identified in the SGMP as being present at elevated concentrations in soil within the Wrap A Parcel (i.e., areas of the Site where soil disturbing activities occurred). A full list of COPCs is presented in Table 2.

Development of Ambient Air Screening Levels

AACs for long-term exposure to particulate emissions of Site COPCs in ambient air are derived for potential off-Site receptor populations using human health risk screening exposure assumptions and methodologies[4]. The primary potential off-Site receptors (i.e., surrounding community) are nearby residents and workers at neighboring commercial/industrial buildings whose potential exposures are expected to be 24 hours per day and 8 hours per day, respectively, during redevelopment. The estimated duration of the Site's redevelopment activities is 1.5 years; thus, an exposure duration of 1.5 years was selected for developing these AACs. For the purpose of the development of the AACs, the off-Site residents, including children, are considered to be the most sensitive receptors with assumed exposures of 24 hours per day, 7 days a week for 1.5 years (i.e., it is conservatively assumed that soil disturbance activity is occurring and/or soil stockpiles are uncovered for the entire duration of the redevelopment, including overnight). These exposure assumptions are intentionally conservative and encompass the entire redevelopment period, including days and hours when Site work is not occurring. Actual off-Site exposures would likely be shorter in duration and not continuous (i.e., significant exposure would not likely occur during nights, weekends, or on other days where earth moving activity is not occurring).

[4] Department of Toxic Substances Control. 2020. Office of Human and Ecological Risk, Human Health Risk Assessment Note 3. California Environmental Protection Agency. June.

The COPC-specific AACs represent the anticipated COPC concentration in air that can continuously occur during 1.5 years of exposure at the Site perimeter without resulting in a significant risk to human health for residential populations, including sensitive populations and children. Where applicable, the AAC is represented by the lower (i.e., more conservative) of the COPC-specific carcinogenic or non-carcinogenic risk-based threshold. The COPC-specific AACs are intended to be conservative and consistent with a screening-level human health risk evaluation. Inhalation unit-risk factors (to evaluate potential carcinogenic risks) and reference concentrations (to evaluate potential noncarcinogenic hazards) were selected as presented in Table 3, consistent with California Code of Regulations, Title 22, Division 4.5 Sections 68400.5, 69020-69022.

Table 3 presents the COPC-specific AACs for long-term residential exposure over the 1.5-year redevelopment period to particulate emissions for Site COPCs as well as the equations used to develop the AACs[5].

Screening levels for short-term (1-hour) exposure to particulate emissions of COPCs at the Site are selected from available acute (1-hour) inhalation RELs or ATSDR MRLs. Office of Environmental Health Hazard Assessment/Air Resources Board acute (1-hour) inhalation RELs are currently available for arsenic, copper, and nickel (Table 5). RELs or MRLs are not currently available for any of the other COPCs at the Site.

Particulate Exposure Concentrations of COPCs in Ambient Air

The potential long-term average and maximum short-term (1-hour) average particulate exposure concentrations of COPCs in ambient air are intended to be conservative upper bound estimates of potential exposure and are calculated based on maximum concentrations of COPCs detected in Site soil (Table 2) and Site-related PM10 monitoring results.

As presented in Table 2, exposure point concentrations of COPCs in Site soil are conservatively based on maximum concentrations detected in Stockpile A soil, Stockpile E soil, or any soil that was disturbed during redevelopment activities occurring between February and September 2021 as presented in the Alameda Marina - Site Cessation Memorandum[6] or the Soil and Groundwater Management Plan[7] .

Particulate exposure concentrations of COPCs in ambient air are calculated as shown in Tables 4 and 5 for long-term average and short-term (1-hour) maximum exposure periods, respectively. For the estimation of long-term average particulate exposure concentrations of COPCs in ambient air, it is assumed that Site-related PM10 concentrations are equal to 50 µg/m^3 for the duration of the exposure period (Table 4). A Site-related PM10 concentration of 50 µg/m^3 is a conservative assumption because the maximum daily average of the difference between the upwind and downwind PM10 concentrations

[5] The National Ambient Air Quality Standard of 0.15 µg/m^3 based on a rolling 3-month average concentration is used as the AAC for lead.
[6] Alameda Marina, LLC. 2021. Alameda Marina - Site Cessation Memorandum. Clement Avenue A-C, Alameda, California. September 3.
[7] Wood. 2021. Soil and Groundwater Management Plan, Alameda Marina, 1815 Clement Avenue, Alameda, California. February 8.

of 44.68 µg/m^3 is below the dust evaluation screening level of 50 µg/m^3 (Table 1). In addition, the overall average difference between the upwind and downwind PM10 concentrations was less than zero (i.e., the dust concentrations upwind of the Site and representative of area conditions not related to Site activity were generally higher than dust concentrations downwind of Site activity) indicating that PM10 concentrations measured downwind of the Site were likely from area background sources and not a result of Site redevelopment activity.

For the estimation of short-term (1-hour) average particulate exposure concentrations of COPCs in ambient air, it is assumed that PM10 concentrations are equal to 167 µg/m^3 (Table 5). A Site-related maximum PM10 concentration of 167 µg/m^3 is a reasonable and conservative assumption because this is equal to the maximum difference between 1-hour average upwind and downwind measured PM10 concentrations. In addition, this measurement was recorded the day after the most recent complaint so may be considered a conservative estimate of PM10 concentrations for days when complaints were filed (Table 1; the maximum 1-hour average Site-related PM10 concentration on the day of the complaint was significantly lower [78.58 µg/m^3]).

Note that the evaluation of Site COPCs using maximum detected soil concentrations is a screening level approach. This approach represents an estimate of a worst-case scenario for maximum short-term exposure and is not representative of expected long-term average exposure concentrations that may occur for the duration of the Site redevelopment. Average concentrations of COPCs in soil disturbed across the Site during redevelopment would be lower and would be more representative of the concentrations of COPCs that may become airborne over the entire redevelopment period of 1.5 years.

RESULTS

As shown in Table 4, with the exception of lead, the maximum estimated particulate exposure concentrations of COPCs in ambient air, assuming a daily average PM10 concentration of 50 µg/m^3, are below the applicable AACs for long-term exposures.

The maximum estimated particulate exposure concentration for lead in ambient air assuming a PM10 concentration of 50 µg/m^3 is 0.18 µg/m^3, slightly above the AAC, which is equal to the National Ambient Air Quality Standard (NAAQS) of 0.15 µg/m^3. The NAAQS for lead is based on a rolling 3-month average concentration. As noted above, average concentrations of COPCs in soil disturbed across the Site during redevelopment would be lower than those estimated assuming maximum concentrations and would be more representative of the concentrations of COPCs that may become airborne over a 3-month period.

The 95 percent upper confidence limit of the mean lead concentration, which is an upper-bound estimate of the average concentration[8], in Stockpiles A and E combined is equal to 114 milligrams per kilogram (Attachment 1), which corresponds to an estimated particulate exposure concentration of 0.0057 µg/m^3, far below the NAAQS of 0.15 µg/m^3.

[8] Per the United States Environmental Protection Agency ProUCL Version 5.1.00 Technical Guide dated October 2015, the 95 percent upper confidence limit of the mean concentration may be used to calculate an upper bound estimate of an average exposure point concentration for an exposure area. The 95 percent upper confidence limit for lead was calculated using United States Environmental Protection Agency ProUCL Version 5.1.002. Downloaded from: https://www.epa.gov/land-research/proucl-software.

As shown in Table 5, the maximum estimated particulate exposure concentrations of arsenic, copper, and nickel in ambient air assuming a 1-hour average PM10 concentration of 167 µg/m^3 are below the applicable risk-based screening levels (i.e., acute [1-hour] inhalation RELs).

CONCLUSION

In accordance with the SGMP, dust monitoring has been conducted on a daily basis during working hours for the first three days of each new potential dust generating activity conducted in impacted soil between February and September 2021, including during periods of time when soil stockpiles were left uncovered at the Site. This health risk evaluation errs on the side of conservatism and is based on assumptions of the worst-case upper-end dust levels measured at the Site during this period: the dust screening level of 50 µg/m^3 for long-term exposures[9] and the maximum 1-hour average concentration of 167 µg/m^3 for short-term (1-hour) exposure. In addition, exposure concentrations are conservatively based on maximum concentrations of COPCs detected in soil which represents an estimate of a worst-case scenario for maximum short-term exposure and is not representative of expected long-term average exposure concentrations that may occur for the duration of the Site redevelopment.

Based on the results of the health risk evaluation, inhalation exposure to Site-related dust generated during redevelopment activities occurring between February and September 2021 has not posed an unacceptable health risk to residents at off-Site properties downwind of Site activity. Furthermore, the results of the health risk evaluation confirms that the dust evaluation screening level for PM10 of 50 µg/m^3 set forth in the SGMP is protective for managing the risk of long-term exposure to particulate emissions of Site-related COPCs in soil over the duration of the Site redevelopment.

Attachments:

- Table 1 – Summary of PM10 Results
- Table 2 – Selection of Soil Exposure Point Concentrations
- Table 3 – Derivation of Acceptable Ambient Air Concentrations
- Table 4 – Comparison of Particulate Concentrations and AACs for Site COPCs
- Table 5 – Comparison of Particulate Concentrations and Acute RELs for Site COPCs
- Attachment 1 – ProUCL Output for Lead (Stockpile A and Stockpile E Combined)

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[9] The maximum daily average of the difference between the upwind and downwind PM10 concentrations of 44.68 µg/m^3 on days when downwind dust concentrations were monitored at the Site is below the dust evaluation screening level of 50 µg/m^3 (Table 1).

TABLES

TABLE 1
SUMMARY OF PM_{10} RESULTS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Location and Date	Daily Average Difference in Upwind and Downwind Concentrations (µg/m^3)	Maximum 1-Hour Average Difference in Upwind and Downwind Concentration (µg/m^3)	Downind Monitor Locations	Stockpiles Uncovered
Townhome Seawall				
2/3/2021	8.12	14.01	East of Stockpile A (Marina)	None
2/4/2021	12.33	35.37	East of Stockpile A (Marina)	None
2/5/2021	4.04	26.14	East of Stockpile A (Marina)	None
2/8/2021	-11.03	-6.44	East of Stockpile A (Marina)	None
2/9/2021	-6.19	1.26	East of Stockpile A (Marina)	None
2/10/2021	2.07	12.69	East of Stockpile A (Marina)	None
2/11/2021	-2.45	7.30	East of Stockpile A (Marina)	None
2/12/2021	4.69	8.79	East of Stockpile A (Marina)	None
2/16/2021	5.06	15.56	East of Stockpile A (Marina)	None
2/17/2021	-2.57	17.87	East of Stockpile A (Marina)	None
2/18/2021	3.51	41.93	East of Stockpile A (Marina)	None
2/19/2021	16.27	31.81	East of Stockpile A (Marina)	None
2/22/2021	-3.14	32.60	East of Stockpile A (Marina)	None
2/23/2021	-23.70	14.99	East of Stockpile A (Marina)	None
3/1/2021	-0.76	20.35	East of Stockpile A (Willow St Extension)	None
3/2/2021	16.39	32.17	East of Stockpile A (Willow St Extension)	None
3/3/2021	0.48	4.69	East of Stockpile A (Willow St Extension)	None
4/7/2021	-13.50	-7.56	East of Stockpile A (Willow St Extension)	None
4/8/2021	-22.39	-14.21	East of Stockpile A (Willow St Extension)	None
4/9/2021	22.02	32.35	East of Stockpile A (Willow St Extension)	None
4/14/2021	-215.27	-211.00	East of Stockpile A (Willow St Extension)	None
7/21/2021	-55.28	0.00	East of Stockpile A (Willow St Extension)	A
7/22/2021	-12.42	0.00	East of Stockpile A (Willow St Extension)	A
7/23/2021	-35.41	0.00	East of Stockpile A (Willow St Extension)	A
7/26/2021	44.68	69.86	East of Stockpile A (Willow St Extension)	A
7/29/2021	26.20	55.89	East of Stockpile A (Willow St Extension)	A
7/30/2021	38.29	134.05	East of Stockpile A (Willow St Extension)	A
8/2/2021	-5.09	78.61	East of Stockpile A (Willow St Extension)	A
8/3/2021	-9.13	40.92	East of Stockpile A (Willow St Extension)	A
8/4/2021	-50.42	-16.63	East of Stockpile A (Willow St Extension)	A
8/5/2021	-54.44	-12.90	East of Stockpile A (Willow St Extension)	A
8/6/2021	-39.68	26.64	East of Stockpile A (Willow St Extension)	A
8/9/2021	-1.16	13.37	East of Stockpile A (Willow St Extension)	A
8/10/2021	-2.21	65.88	East of Stockpile A (Willow St Extension)	A
8/13/2021	-32.53	13.58	East of Stockpile A (Willow St Extension)	A
8/16/2021	-12.33	11.37	East of Stockpile A (Willow St Extension)	A
8/17/2021	-19.44	38.46	East of Stockpile A (Willow St Extension)	A
8/18/2021	-13.81	-14.15	East of Stockpile A (Willow St Extension)	A
8/19/2021	-48.60	0.28	East of Stockpile A (Willow St Extension)	A, E
8/20/2021	20.17	111.50	East of Stockpile A (Willow St Extension)	A, E, I
8/23/2021	-75.08	-5.87	East of Stockpile A (Willow St Extension)	A, E, I
8/24/2021	-97.69	-13.10	East of Stockpile A (Willow St Extension)	A, E, I
8/25/2021	-77.98	-28.43	East of Stockpile A (Willow St Extension)	A, E, I, G
8/26/2021	17.11	90.99	East of Stockpile A (Willow St Extension)	A, E, I, G
8/27/2021	-41.60	0.00	East of Stockpile A (Willow St Extension)	A, E, I, G
8/30/2021	-15.84	78.58	East of Stockpile A (Willow St Extension)	A, E, I, G, F
8/31/2021	7.57	167.38	East of Stockpile A (Willow St Extension)	A, E, I, G, F
9/1/2021	3.32	122.80	East of Stockpile A (Willow St Extension)	A, E, I, G, F
9/2/2021	-46.53	-33.41	East of Stockpile A (Willow St Extension)	None
The Launch				
3/8/2021	-1.79	3.87	Eastern Corner of Wrap A	None
3/11/2021	-4.20	0.10	Eastern Corner of Wrap A	None
3/12/2021	0.31	5.77	Eastern Corner of Wrap A	None
3/16/2021	0.53	8.02	Eastern Corner of Wrap A	None
3/17/2021	4.27	21.05	Eastern Corner of Wrap A	None
3/19/2021	-1.52	2.79	Eastern Corner of Wrap A	None
3/22/2021	-8.77	3.64	Eastern Corner of Wrap A	None

TABLE 1
SUMMARY OF PM_{10} RESULTS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Location and Date	Daily Average Difference in Upwind and Downwind Concentrations (µg/m^3)	Maximum 1-Hour Average Difference in Upwind and Downwind Concentration (µg/m^3)	Downind Monitor Locations	Stockpiles Uncovered
3/23/2021	1.69	14.41	Eastern Corner of Wrap A	None
3/24/2021	-2.96	4.41	Eastern Corner of Wrap A	None
3/25/2021	-4.26	2.46	Eastern Corner of Wrap A	None
3/26/2021	18.62	43.02	Eastern Corner of Wrap A	None
3/29/2021	-6.55	2.85	Eastern Corner of Wrap A	None
3/30/2021	-8.30	4.80	Eastern Corner of Wrap A	None
3/31/2021	5.81	20.93	Eastern Corner of Wrap A	None
4/1/2021	12.79	131.66	Eastern Corner of Wrap A	None
4/2/2021	-3.58	1.75	Eastern Corner of Wrap A	None
4/5/2021	2.19	18.31	Eastern Corner of Wrap A	None
4/7/2021	6.54	11.52	Eastern Corner of Wrap A	None
4/8/2021	0.93	16.23	Eastern Corner of Wrap A	None
4/9/2021	3.16	11.66	Eastern Corner of Wrap A	None
4/10/2021	-2.35	15.72	Eastern Corner of Wrap A	None
4/12/2021	6.12	107.07	Eastern Corner of Wrap A	None
4/13/2021	2.80	29.67	Eastern Corner of Wrap A	None
4/14/2021	13.15	34.23	Eastern Corner of Wrap A	None
4/15/2021	-1.89	12.39	Eastern Corner of Wrap A	None
4/16/2021	-2.10	6.11	Eastern Corner of Wrap A	None
4/19/2021	-2.90	7.21	Eastern Corner of Wrap A	None
4/21/2021	0.06	15.62	Eastern Corner of Wrap A	None
4/26/2021	3.43	11.82	Eastern Corner of Wrap A	None
4/27/2021	8.69	26.25	Eastern Corner of Wrap A	None
4/29/2021	-1.92	6.44	Eastern Corner of Wrap A	None
5/3/2021	-0.22	12.26	Eastern Corner of Wrap A	None
5/4/2021	-2.70	4.23	Eastern Corner of Wrap A	None
5/12/2021	-2.35	3.98	Eastern Corner of Wrap A	None
5/18/2021	20.45	30.79	Eastern Corner of Wrap A	None
5/19/2021	18.61	31.97	Eastern Corner of Wrap A	None
5/24/2021	-5.34	-0.38	Eastern Corner of Wrap A	None

Abbreviations:

µg/m^3 = micrograms per cubic meter
PM_{10} = Inhalable coarse particulate of 10 micrometer or less in diameter

Notes:

The maximum daily average of the difference between the upwind and downwind PM10 concentrations of 44.68 µg/m^3 is below the dust evaluation screening level of 50 µg/m^3

TABLE 2
SELECTION OF SOIL EXPOSURE POINT CONCENTRATIONS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Chemical	Maximum Concentration in Disturbed or Stockpiled Soil (mg/kg)	Location Description
Polycyclic Aromatic Hydrocarbons		
Acenaphthene	1.5	Stockpile A
Acenaphthylene	0.15	Stockpile A
Anthracene	1.2	Stockpile A
Benzo(a)anthracene	1.66	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 1.1 mg/kg
Benzo(a)pyrene	1.58	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 0.98 mg/kg
Benzo(b)fluoranthene	1.35	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 1.0 mg/kg
Benzo(g,h,i)perylene	0.879	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 0.63 mg/kg
Benzo(k)fluoranthene	0.66	Stockpile A
Chrysene	1.4	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 0.88 mg/kg
Dibenz(a,h)anthracene	0.25	Stockpile A
Fluoranthene	4.4	Stockpile A
Fluorene	5.29	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 1.7 mg/kg
Indeno(1,2,3-cd)pyrene	0.79	Stockpile A
Naphthalene	41	Stockpile A
Phenanthrene	5.4	Stockpile A
Pyrene	10.2	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 3 mg/kg
Total Petroleum Hydrocarbons		
TPH-Diesel	17300	GH tar Excavation Confirmation in Wrap A / Stockpile A Max is 4,140 mg/kg
Metals		
Antimony	44	Stockpile A
Arsenic	100	B-69 Townhome Seawall; Stockpile A Max is 26 mg/kg
Cobalt	35	Stockpile A
Copper	1200	Stockpile A
Lead	3500	Stockpile A
Nickel	220	Stockpile A

Abbreviations:
mg/kg = milligrams per kilogram

Note:
[a] Maximum chemical concentration (mg/kg) detected in Stockpile A soil or soil that was disturbed during redevelopment activities as presented in the Alameda Marina - Site Cessation Memorandum (Alameda Marina, LLC, 2021) or the Soil and Groundwater Management Plan (Wood, 2021).

References:
Alameda Marina, LLC. 2021. Alameda Marina - Site Cessation Memorandum. Clement Avenue A-C, Alameda, California. September 3.
Wood. 2021. Soil and Groundwater Management Plan, Alameda Marina, 1815 Clement Avenue, Alameda, California. February 8.

TABLE 3
DERIVATION OF ACCEPTABLE AMBIENT AIR CONCENTRATIONS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Property-Specific Remedial Action Parameters		Value	Basis
Exposure Frequency (dy/yr)	$EF_{residential}$	365	Site-specific assumption (7 days per week/52 weeks per year for the duration of redevelopment)
Exposure $Duration_{noncancer}$ (yrs)	$ED_{residential}$	1.5	Site-specific assumption (1.5 years - duration of redevelopment activities)
Fraction of Day (unitless)	$FD_{residential}$	1	Site-specific assumption = (Soil potentially exposed 24 hr / 24 hrs)
Target Hazard $Index_{noncancer}$	THI	1	Default assumption
Target $Risk_{carcinogenic}$	TR	1.0E-06	Default assumption

COPC	IUR Factor		RfC_{inh}		Carcinogenic RBC	Noncarcinogenic RBC	AAC	
	$(\mu g/m^3)^{-1}$	Basis	(mg/m^3)	Basis	$(\mu g/m^3)$	$(\mu g/m^3)$	$(\mu g/m^3)$	Basis
Polycyclic Aromatic Hydrocarbons								
Acenaphthene	NP	--	2.4E-01	IRIS - route	--	240	240	nc
Acenaphthylene	NP	--	2.4E-01	[a]	--	240	240	nc
Anthracene	NP	--	1.2E+00	IRIS - route	--	1,200	1,200	nc
Benzo(a)anthracene	1.1E-04	OEHHA/ARB	1.2E-01	[b]	0.042	120	0.042	c
Benzo(a)pyrene	1.1E-03	OEHHA/ARB	2.0E-06	IRIS	0.0042	0.0020	0.0020	nc
Benzo(b)fluoranthene	1.1E-04	OEHHA/ARB	1.2E-01	[b]	0.042	120	0.042	c
Benzo(b,k)fluoranthene	1.1E-04	OEHHA/ARB	1.2E-01	[b]	0.042	120	0.042	c
Benzo(g,h,i)perylene	NP	--	1.2E-01	[b]	--	120	120	nc
Benzo(k)fluoranthene	1.1E-04	OEHHA/ARB	1.2E-01	[b]	0.042	120	0.042	c
Chrysene	1.1E-05	OEHHA/ARB	1.2E-01	[b]	0.42	120	0.42	c
Dibenz(a,h)anthracene	1.2E-03	OEHHA/ARB	2.0E-06	[c]	0.0039	0.0020	0.0020	nc
Fluoranthene	NP	--	1.6E-01	IRIS - route	--	160	160	nc
Fluorene	NP	--	1.6E-01	IRIS - route	--	160	160	nc
Indeno(1,2,3-cd)pyrene	1.1E-04	OEHHA/ARB	1.2E-01	[b]	0.042	120	0.042	c
Naphthalene	3.4E-05	OEHHA/ARB	3.0E-03	IRIS	1.37	3.0	1.37	c
Phenanthrene	NP	--	1.2E+00	[d]	--	1,200	1,200	nc
Pyrene	NP	--	1.2E-01	IRIS - route	--	120	120	nc
Total Petroleum Hydrocarbons								
TPH-diesel	NP	--	2.6E-01	ESL	--	260	260	nc
Metals								
Antimony	NP	--	NP	--	--	--	--	--
Arsenic	4.3E-03	IRIS	1.5E-05	OEHHA/ARB	0.011	0.015	0.011	c
Cobalt	7.7E-03	OEHHA/ARB	6.0E-06	PPRTV	0.006	0.006	0.006	nc
Copper	--	--	1.6E-01	HEAST - route	--	160.000	160	nc
Lead	NA	NA	NA	NA	NA	--	0.15	NAAQS
Nickel	2.6E-04	OEHHA/ARB	1.4E-05	REL	0.2	0.014	0.01	nc

TABLE 3
DERIVATION OF ACCEPTABLE AMBIENT AIR CONCENTRATIONS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Calculation of AACs (DTSC, 2020)

Noncarcinogenic

$$RBC_{nc}\ (\mu g/m^3) = \frac{THI * AT_{nc}\ (365\ d/yr * 1\ yr) * CF\ (1000\ \mu g/mg)}{EF\ (d/yr) * ED\ (yr) * FD\ (1) * 1/RfC\ (mg/m^3)}$$

Carcinogenic

$$RBC_{c}\ (\mu g/m^3) = \frac{TR * AT_{c}\ (365\ d/yr * 70\ yr)}{EF\ (d/yr) * ED\ (yr) * FD\ (1) * IUR\ (\mu g/m^3)^{-1}}$$

Carcinogenic (mutagens)

$$RBC_{c\text{-}mut}\ (\mu g/m^3) = \frac{TR * AT_{c}\ (365\ d/yr * 70\ yr)}{EF\ (d) * FD * [(ED_{0\text{-}2}(1.5\ yr) * IUR\ (\mu g/m^3)^{-1} * ADAF\ (10)]}$$

Abbreviations:

$\mu g/m^3$ = micrograms per cubic meter
µg/mg = micrograms per milligram
-- = Not needed
- route = The chronic RfC was calculated from the chronic oral reference dose (RfD) as follows (RfC = RfD [mg/kg/day] x 80 kg/20 m^3 -day).
AAC = Acceptable ambient concentration
ADAF = Age-dependent adjustment factor. In accordance with current DTSC recommendation (DTSC, 2020), cancer-based RBSLs for these chemicals utilize ADAFs which account for early life susceptibility. As noted above, redevelopment activities at the Site are expected to be completed within 1.5 years. The most conservative ADAF value of 10, corresponding to a residential receptor age of 0 to 2 years is applied in calculating cancer-based AACs for mutagenic carcinogens.
AT = Averaging time
c = Carcinogenic
CF = Conversion factor
COPC = Chemical of potential concern
d = Days
ED = Exposure duration
$ED_{0\text{-}2}$ = Exposure duration, child 0 to 2 years
FD = Fraction of day
hr = Hours
IUR = Inhalation unit risk
MAF = Mutagenic adjustment factor
mg/m^3 = milligrams per cubic meter
NAAQS = National Ambient Air Quality Standard
nc = Noncarcinogenic
NP = Not published
RBC = Risk-based concentration
RfC_{inh} = Reference concentration
THI = Target hazard index
TR = Target risk
yr = Years

TABLE 3
DERIVATION OF ACCEPTABLE AMBIENT AIR CONCENTRATIONS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Notes:
[a] = Value for acenaphthene used as a surrogate for this compound.
[b] = Value for pyrene used as a surrogate for this compound.
[c] = Value for benzo(a)pyrene used as a surrogate for this compound.
[d] = Value for anthracene used as a surrogate for this compound.

Sources:

ATSDR	*Agency for Toxic Substances and Disease Registry Minimal Risk Level. 2021. Available at: https://wwwn.cdc.gov/TSP/MRLS/mrlsListing.aspx. May.*
OEHHA/ARB	*Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values; Table 1. Updated 2 October 2020. Available at: https://ww2.arb.ca.gov/sites/default/files/classic//toxics/healthval/contable.pdf*
IRIS	*United States Environmental Protection Agency (USEPA). 2021. Integrated Risk Information System. Available at: https://www.epa.gov/iris.*
PPRTV	*Provisional Peer Reviewed Toxicity Values, as presented in: USEPA. 2021. Regional Screening Levels. May.*

References:
DTSC. 2020. Office of Human and Ecological Risk (HERO), Human Health Risk Assessment (HHRA) Note 3. California Environmental Protection Agency (Cal/EPA). June.
USEPA. 2021. Regional Screeening Levels for Chemical Contaminants at Superfund Sites. May. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

TABLE 4
COMPARISON OF PARTICULATE CONCENTRATIONS AND AACS FOR SITE COPCS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

COPC	Exposure Point Concentration for Soil [a] (mg/kg)	Exposure Point Concentration as PM_{10} [a] (mg/m^3)	Residential Health-Based AAC (mg/m^3)	Potential Air Concentration Exceeds the AAC?
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	1.5	7.5E-08	2.4E-01	No
Acenaphthylene	0.2	7.5E-09	2.4E-01	No
Anthracene	1.2	6.0E-08	1.2E+00	No
Benzo(a)anthracene	1.7	8.3E-08	4.2E-05	No
Benzo(a)pyrene	1.6	7.9E-08	2.0E-06	No
Benzo(b)fluoranthene	1.4	6.8E-08	4.2E-05	No
Benzo(g,h,i)perylene	0.9	4.4E-08	1.2E-01	No
Benzo(k)fluoranthene	0.7	3.3E-08	4.2E-05	No
Chrysene	1.4	7.0E-08	4.2E-04	No
Dibenz(a,h)anthracene	0.3	1.3E-08	2.0E-06	No
Fluoranthene	4.4	2.2E-07	1.6E-01	No
Fluorene	5.3	2.6E-07	1.6E-01	No
Indeno(1,2,3-cd)pyrene	0.8	4.0E-08	4.2E-05	No
Naphthalene	41	2.1E-06	1.4E-03	No
Phenanthrene	5.4	2.7E-07	1.2E+00	No
Pyrene	10	5.1E-07	1.2E-01	No
Total Petroleum Hydrocarbons				
TPH-diesel	17,300	8.7E-04	2.6E-01	No
Metals				
Arsenic	100	5.0E-06	1.1E-05	No
Cobalt	35	1.8E-06	6.0E-06	No
Copper	1,200	6.0E-05	1.6E-01	No
Lead - max [b]	3,500	1.8E-04	1.5E-04	**Yes [b]**
Lead - 95UCL [b]	114	5.7E-06	1.5E-04	No
Nickel	220	1.1E-05	1.4E-05	No

Calculation of Predicted Concentration in Air

C_{air} = (Action $Level_{PM10}$ x C_{soil}) x ($1x10^{-6}$ kg/mg)

where:

C_{air} = Maximum predicted concentration in air (mg/m^3)
Action $Level_{PM10}$ = Maximum particulate concentration action level (0.050 mg/m^3)
C_{soil} = Chemical exposure point concentration (mg/kg) detected in Stockpile A soil or soil that was disturbed during redevelopment activities as presented in the Alameda Marina - Site Cessation Memorandum (Alameda Marina, LLC, 2021) or the Soil and Groundwater Management Plan (Wood, 2021).

TABLE 4
COMPARISON OF PARTICULATE CONCENTRATIONS AND AACS FOR SITE COPCS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Abbreviations:

AAC = Acceptable ambient air concentration
COPC = Chemical of potential concern
kg/mg = kilograms per milligram
mg/kg = milligrams per kilogram
mg/m^3 = milligrams per cubic meter
PM_{10} = Inhalable coarse particulate of 10 micrometer or less in diameter
TPH-diesel = Total petroleum hydrocarbons, diesel range

Note:

[a] Unless otherwise noted, the maximum detected concentration in soil that has been disturbed at the Site was selected as the exposure point concentration in soil and used to estimate the maximum concentration as PM10. The estimated concentration as PM10 is therefore a worst-case scenario short-term maximum concentration and not representative of expected long-term average exposure point concentrations.

[b] For lead, the results for both the maximum detected concentration and the 95 percent upper confidence limit of the mean (95UCL) concentration for soil samples representative of uncovered stockpiles at the Site are presented. As noted above, the maximum concentration represents worst-case scenario, short-term maximum intended to be used as an initial screening criteria and is not an estimate of potential long-term exposures. See page 5 of the text for details.

References:

Alameda Marina, LLC. 2021. Alameda Marina - Site Cessation Memorandum. Clement Avenue A-C, Alameda, California. September 3.
Wood. 2021. Soil and Groundwater Management Plan, Alameda Marina, 1815 Clement Avenue, Alameda, California. February 8.

TABLE 5
COMPARISON OF PARTICULATE CONCENTRATIONS AND ACUTE RELS FOR SITE COPCS
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

COPC	Exposure Point Concentration for Soil [a] (mg/kg)	Exposure Point Concentration as PM_{10} (mg/m^3)	Acute Inhalation REL (mg/m^3)	Basis	Maximum Potential Air Concentration Exceeds the Acute Inhalation REL?
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	1.5	2.5E-07	--	--	No
Acenaphthylene	0.15	2.5E-08	--	--	No
Anthracene	1.2	2.0E-07	--	--	No
Benzo(a)anthracene	1.7	2.8E-07	--	--	No
Benzo(a)pyrene	1.6	2.6E-07	--	--	No
Benzo(b)fluoranthene	1.4	2.3E-07	--	--	No
Benzo(g,h,i)perylene	0.88	1.5E-07	--	--	No
Benzo(k)fluoranthene	0.66	1.1E-07	--	--	No
Chrysene	1.4	2.3E-07	--	--	No
Dibenz(a,h)anthracene	0.25	4.2E-08	--	--	No
Fluoranthene	4.4	7.3E-07	--	--	No
Fluorene	5.3	8.8E-07	--	--	No
Indeno(1,2,3-cd)pyrene	0.79	1.3E-07	--	--	No
Naphthalene	41	6.8E-06	--	--	No
Phenanthrene	5.4	9.0E-07	--	--	No
Pyrene	10	1.7E-06	--	--	No
Total Petroleum Hydrocarbons					
TPH-diesel	17,300	2.9E-03	--	--	No
Metals					
Antimony	44	7.3E-06	--	--	No
Arsenic	100	1.7E-05	2.0E-01	REL	No
Cobalt	35	5.8E-06	--	--	No
Copper	1,200	2.0E-04	1.0E-01	REL	No
Lead	3,500	5.8E-04	--	--	No
Nickel	220	9.7E-05	2.0E-04	REL	No

Calculation of Maximum Predicted Concentration in Air

$C_{air} = (PM10_{MAX} \times C_{soil}) \times (1x10^{-6}\ kg/mg)$

where:
C_{air} = Maximum predicted concentration in air (mg/m^3)
$PM10_{MAX}$ = Maximum 1-hour average particulate concentration measured at the Site (0.167 mg/m^3)
C_{soil} = Maximum chemical concentration (mg/kg) detected in Stockpile A soil or soil that was disturbed during redevelopment activities as presented in the Alameda Marina - Site Cessation Memorandum (Alameda Marina, LLC, 2021) or the Soil and Groundwater Management Plan (Wood, 2021).

Abbreviations:
-- = Not available
COPC = Chemical of potential concern
kg/mg = kilograms per milligram
mg/kg = milligrams per kilogram
mg/m^3 = milligrams per cubic meter
PM_{10} = Inhalable coarse particulate of 10 micrometer or less in diameter
REL = Reference exposure level (OEHHA, 2021)
TPH-diesel = Total petroleum hydrocarbons, diesel range

Notes:
[a] The maximum detected concentration in soil that has been disturbed at the Site was selected as the exposure point concentration to represent the worst-case scenario for COPC concentrations in particulate matter as PM_{10}.

References
Alameda Marina, LLC. 2021. Alameda Marina - Site Cessation Memorandum. Clement Avenue A-C, Alameda, California. September 3.
Office of Environmental Health Hazard Assessment (OEHHA). 2021. Chronic Reference Exposure Level. Available at: https://oehha.ca.gov/air/chemicals. Accessed September 2021.

Wood. 2021. Soil and Groundwater Management Plan, Alameda Marina, 1815 Clement Avenue, Alameda, California. February 8.

ATTACHMENT 1

ProUCL Output for Lead
(Stockpile A and Stockpile E Combined)

ATTACHMENT 1
PROUCL OUTPUT FOR LEAD (STOCKPILE A AND STOCKPILE E COMBINED)
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.19/20/2021 9:11:44 AM
From File	ProUCL_Input_Stockpiles_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	76	Number of Distinct Observations	63
		Number of Missing Observations	1
Number of Detects	75	Number of Non-Detects	1
Number of Distinct Detects	62	Number of Distinct Non-Detects	1
Minimum Detect	1.46	Minimum Non-Detect	1
Maximum Detect	3500	Maximum Non-Detect	1
Variance Detects	169969	Percent Non-Detects	1.316%
Mean Detects	100.3	SD Detects	412.3
Median Detects	19	CV Detects	4.109
Skewness Detects	7.866	Kurtosis Detects	64.81
Mean of Logged Detects	3.102	SD of Logged Detects	1.512

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.23	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.405	Lilliefors GOF Test
5% Lilliefors Critical Value	0.102	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	99.04	KM Standard Error of Mean	47
KM SD	407	95% KM (BCA) UCL	195.5
95% KM (t) UCL	177.3	95% KM (Percentile Bootstrap) UCL	184.2
95% KM (z) UCL	176.3	95% KM Bootstrap t UCL	559.4
90% KM Chebyshev UCL	240	95% KM Chebyshev UCL	303.9
97.5% KM Chebyshev UCL	392.5	99% KM Chebyshev UCL	566.7

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.09	Anderson-Darling GOF Test
5% A-D Critical Value	0.834	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.174	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.11	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

ATTACHMENT 1
PROUCL OUTPUT FOR LEAD (STOCKPILE A AND STOCKPILE E COMBINED)
HEALTH RISK EVALUATION
ALAMEDA MARINA REDEVELOPMENT SITE
ALAMEDA, CALIFORNIA

Gamma Statistics on Detected Data Only

k hat (MLE)	0.431	k star (bias corrected MLE)	0.423
Theta hat (MLE)	232.6	Theta star (bias corrected MLE)	237.2
nu hat (MLE)	64.72	nu star (bias corrected)	63.46
Mean (detects)	100.3		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	99.02
Maximum	3500	Median	19
SD	409.7	CV	4.137
k hat (MLE)	0.411	k star (bias corrected MLE)	0.403
Theta hat (MLE)	241	Theta star (bias corrected MLE)	245.5
nu hat (MLE)	62.44	nu star (bias corrected)	61.31
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (61.31, α)	44.3	Adjusted Chi Square Value (61.31, β)	44.03
95% Gamma Approximate UCL (use when n>=50)	137	95% Gamma Adjusted UCL (use when n<50)	137.9

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	99.04	SD (KM)	407
Variance (KM)	165624	SE of Mean (KM)	47
k hat (KM)	0.0592	k star (KM)	0.0657
nu hat (KM)	9.001	nu star (KM)	9.979
theta hat (KM)	1672	theta star (KM)	1508
80% gamma percentile (KM)	30.39	90% gamma percentile (KM)	202.7
95% gamma percentile (KM)	564.6	99% gamma percentile (KM)	1921

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.98, α)	3.929	Adjusted Chi Square Value (9.98, β)	3.856
95% Gamma Approximate KM-UCL (use when n>=50)	251.6	95% Gamma Adjusted KM-UCL (use when n<50)	256.3

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.964	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.102	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.066	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.102	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	99.03	Mean in Log Scale	3.049
SD in Original Scale	409.7	SD in Log Scale	1.571
95% t UCL (assumes normality of ROS data)	177.3	95% Percentile Bootstrap UCL	188.1

95% BCA Bootstrap UCL	277	95% Bootstrap t UCL	584.2
95% H-UCL (Log ROS)	122.4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.061	KM Geo Mean	21.35
KM SD (logged)	1.533	95% Critical H Value (KM-Log)	2.843
KM Standard Error of Mean (logged)	0.177	95% H-UCL (KM -Log)	114.3
KM SD (logged)	1.533	95% Critical H Value (KM-Log)	2.843
KM Standard Error of Mean (logged)	0.177		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	99.03	Mean in Log Scale	3.052
SD in Original Scale	409.7	SD in Log Scale	1.563
95% t UCL (Assumes normality)	177.3	95% H-Stat UCL	120.8

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	114.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.