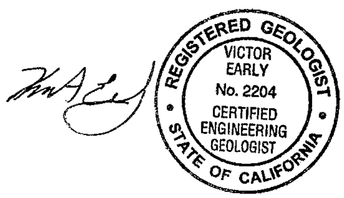
Cover Letter

Document:
ACEH case RO0003168
Draft Investigation Work Plan for the Cross Alameda Trail
City of Alameda Department of Public Works Alameda, California
March 2016

Site Address:
Adjacent to and South of Ralf Appezzato Memorial Parkway between Webster Street and Main Street, Alameda, CA.

Perjury Statement:

"I declare, under penalty of perjury, that the information and/or recommendations contained in the
attached document or report is true and correct to the best of my knowledge."
Signed,



Victor A Early, PG, CEG
Tetra Tech, Inc
1999 Harrison Street, Suite 500
Oakland, CA 94612

Draft

Investigation Work Plan
Cross Alameda Trail

City of Alameda
Department of Public Works
Alameda, California

March 2016

Prepared for:
City of Alameda
Department of Public Works
Alameda, California

Prepared by:
Tetra Tech, Inc.
1999 Harrison Street, Suite 500
Oakland, California 94612

Draft

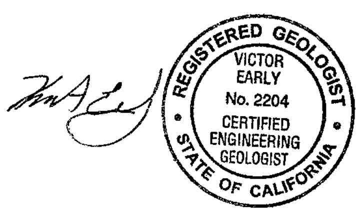
Investigation Work Plan for the Cross Alameda Trail

Alameda, California

PREPARED FOR:

City of Alameda
Department of Public Works
Alameda, California

REVIEW AND APPROVAL



Project Manager: ________ Date: __March 2016____
Victor Early, PG, CEG, Tetra Tech

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ACEH	Alameda County Department of Environmental Health
bgs	Below ground surface
CFR	Code of Federal Regulations
COC	Chemical of concern
DTSC	Department of Toxic Substances Control
EDD	Electronic data deliverable
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
IDW	Investigation-derived waste
mg/kg	Milligrams per kilogram
QA/QC	Quality assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SLHHRA	Screening Level Human Health Risk Assessment
Tetra Tech	Tetra Tech, Inc.
TPH	Total petroleum hydrocarbons
TEPH	Total extractable petroleum hydrocarbons
TPPH	Total purgeable petroleum hydrocarbons
VOC	Volatile organic compound

1.0 INTRODUCTION

Under contract to the City of Alameda, Department of Public Works (Alameda), Tetra Tech is performing a subsurface investigation to further evaluate chemical contamination in soil and groundwater at a former railroad corridor property. The property is between Webster Street and Main Street, along the south side of Ralph Appezzato Memorial Parkway (hereinafter referred to as the site), in Alameda, California (Figure 1). The property is owned by the city of Alameda and is represented by Assessor's Parcel Numbers [APN] 74-905-20-3 and 74-905-20-2. The site includes approximately 13 acres of former railroad right-of-way and is approximately 4,200 feet in length (Figure 2) (Blackie, 2010).

The environmental investigation described in this work plan is related to a planned project at the site called the Cross Alameda Trail. Construction of the Cross Alameda Trail, a typical rail-to-trail project, will add to the San Francisco Bay Trail. The proposed path is approximately 0.8-mile long and would include separate walking and bike paths, bike lockers, trees, and a bioswale for stormwater runoff control. Upon completion, the Cross Alameda Trail would be open for recreational land use.

1.1 PURPOSE, BACKGROUND, AND SCOPE

The purpose of this investigation is to continue the characterization of subsurface contamination at the site. Tetra Tech completed the *Phase II Environmental Site Assessment Report for the Cross Alameda Trail* (Phase II ESA) dated February 3, 2015 (Tetra Tech, 2015a), and further investigated subsurface conditions and risks to human health in the *Investigation and Risk Assessment Report for the Cross Alameda Trail*, dated October 2015 (Tetra Tech, 2015b).

As a part of the investigation described in this work plan, Tetra Tech will generate additional soil and groundwater data to further evaluate the extent of contamination previously identified at the site. The results of the screening level human health risk assessment (SLHHRA) completed in October 2015 identified arsenic and lead as chemicals of concern (COCs) in soil, and diesel and gasoline were identified as COCs in groundwater.

1.2.1 Site History and Previous Investigations

Evidence of railroad tracks are visible in a 1939 aerial photograph but the railroad was also likely present as early as the mid- to late-1910s. The railroad tracks were removed from the parcels in the mid- to late-1950s (Blackie, 2010). Based on observations made on December 29 and 30, 2014 during Tetra Tech's Phase II ESA field work, the site is primarily undeveloped and covered with low vegetation, mulch, and some pavement. The westernmost portion of the site is partially covered by a parking lot for an adjacent business (Tetra Tech, 2015a).

Phase II ESA

The Phase II ESA was done to address recognized environmental conditions (RECs) identified in a Phase I ESA conducted by Belinda P. Blackie, dated March 8, 2010. The Phase I ESA was done for the Alameda Belt Line Parcels (nine non-contiguous parcels comprising 38.81 acres of land including the site), which at the time of the ESA were mostly undeveloped (Blackie, 2010).

The Phase I ESA identified the following RECs for the site:

- Historical railroad tracks;
- Fill, imported soil, and;
- Marsh crust (Blackie, 2010).

Tetra Tech based the initial selection of COCs for the Phase II ESA on the RECs identified for the site in the Phase I ESA (Blackie, 2010), as follows.

- Chlorinated herbicides were selected because products containing these chemicals are known to have been used for weed control along railroad tracks;
- Arsenic and lead were selected because fill material and imported fill was considered likely to be present at the site and similar materials in Alameda are known to contain these chemicals (Blackie, 2010); and
- Petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAH) were selected because the material known as the Marsh Crust is known to contain these chemicals.

The site is possibly within the limit of filling where marsh crust material was disposed, and the original shoreline was approximately within the site or near the southern border of the site with the upland occurring to the south. The marsh crust material was disposed on tidal marshland between 1900 and 1940 to extend dry land from the existing shoreline (City of Alameda, 2015).

A total of 20 soil samples (and one duplicate) were collected from boreholes CAT-B-1 through CAT-B-10 (two soil samples were collected from each borehole using the nomenclature CAT-B-Borehole number-Sample depth in feet, e.g., CAT-B-1). The soil samples were collected from depths ranging from 1 to 8 feet below ground surface (bgs). The borehole locations were selected to be in approximate alignment with the former railroad tracks, as identified on a USGS topographic map from 1959 (Blackie, 2010). The lead, arsenic, diesel, and motor oil analytical results for the soil samples collected during the Phase II ESA (December 29 and 30, 2014) are summarized in Tables 1 and 2, and boreholes CAT-B-1 through CAT-B-10 are shown on Figure 2. Based on the results of the Phase II ESA chlorinated herbicides were excluded as a COC, and it was determined that further investigation of the extent of lead, arsenic, and volatile petroleum hydrocarbons was warranted (Tetra Tech, 2015a).

Additional Investigation and Risk Assessment

Tetra Tech completed step-out boreholes using direct push drilling technology in the vicinity of 5 of 10 Phase II ESA boreholes where COCs were detected at levels warranting further investigation during the Phase II ESA. Four step-out boreholes were completed in the vicinity of each of the following Phase II ESA boreholes: CAT-B-1, CAT-B-2, CAT-B-6, CAT-B-7, and CAT-B-10. The purpose of the step-out boreholes was to (1) confirm the presence of COCs identified during the Phase II ESA, and (2) further define the extent and magnitude of any laterally continuous COCs in soil at the site. Additionally, two temporary groundwater wells were installed in the vicinity of Phase II ESA boreholes CAT-B-1 and CAT-B-10 to determine whether petroleum hydrocarbons are dissolved in groundwater (Tetra Tech, 2015b). Figures 3 through 6 show the approximate locations of the step-out boreholes, and the relevant soil and groundwater data. Tables 1 and 2 show the soil and groundwater data for lead, arsenic, TPPH, and TEPH.

Based on these results and the completion of a SLHHRA, remediation of arsenic and lead in soil was recommended including additional investigation to further investigate the extent of soil that should be remediated (Tetra Tech, 2015b).

1.1.1 Objectives

The primary objectives of this work plan and the proposed field work are described below:

- Provide protocol for soil borehole installation, water level measurement, use of XRF analyzer to screen for metals, the collection of soil and groundwater samples, and the installation of a temporary groundwater well;

- Further investigate site lithology to evaluate the subsurface at the site and correlate site conditions with COC, to the extent posssible;

- Further evaluate extent and concentrations of COCs identified during the Phase II ESA and SLHHRA investigation;

- To define the extent of soil that may require remediation because of an unacceptable risk to human health and the environment.

1.1.2 Scope

To meet the project objectives, the following activities are planned:

- Perform utility clearance and obtain Alameda County Department of Environmental Health (ACEH) permit for drilling and well installation;

- Prepare site specific Health and Safety plan;

- Install soil boreholes and a temporary groundwater well at select locations based on the soil data generated during the Phase II ESA and SLHHRA investigation (Figure 3 through 6);

- Measure water levels, screen soil for arsenic and lead using a handheld XRF, collect soil samples from boreholes, and groundwater samples from temporary wells;

- Evaluate extent and magnitude of COCs using soil (lead and arsenic) and groundwater (VOCs and gasoline) sample data;

- Log and describe soil cores generated during the investigation;

- Decommission soil boreholes and temporary wells with oversight by ACEH, and dispose of investigation derived waste (IDW); and

- Evaluate soil and groundwater data to aid in the completion of a Remedial Action Plan for the site.

1.2 WORK PLAN ORGANIZATION

This work plan is organized as follows:

- Section 1.0 provides an introduction, the purpose and objectives for the project, the work plan organization, site descriptions, and previous investigations.

- Section 2.0 includes a summary of the field program.

- Section 3.0 provides a list of references used in compiling this work plan.

The figures and tables follow the text of this report.

Tables 1 and 2 summarize relevant analytical results for the soil and groundwater samples collected during the Phase II ESA and SLHHRA investigation. Figure 1 shows the site location. Figure 2 shows the proposed step-out soil investigation locations including the COCs that will be evaluated. Figures 3 through 6 show previous step-out borehole locations with soil and groundwater results from the SLHHRA investigation, along with the proposed boreholes and temporary groundwater well to be completed under this work plan.

2.0 DATA GENERATION AND ACQUISITION

The following is a brief summary of the field methods for the investigation at the site.

2.1 INVESTIGATION METHODS

This section describes the methods that will be implemented during the investigation field activities.

2.1.1 Site Access

Each borehole location is accessible to rubber tire drilling equipment.

2.1.2 Utility Clearance

Tetra Tech will mark the site in white paint and notify Underground Service Alert (USA) at least 2 working days (48 hours) before any intrusive activities. USA is responsible to alert utility operators that have utilities in the vicinity of the site. In addition, Tetra Tech will hire a private utility clearance subcontractor to conduct a survey for the presence of discernible subsurface utilities using non-intrusive techniques at the location of each borehole. Tetra Tech field staff will accompany the utility locator to oversee that the drilling locations are cleared. The location of buried utilities identified by the utility clearance subcontractor will be marked on the ground surface with paint.

2.1.3 Step-out Boreholes and Soil Sampling

Tetra Tech proposes to install additional step-out boreholes using direct push drilling technology and hand augering in the vicinity of step-out investigations CAT-B-1, CAT-B-2, CAT-B-6, and CAT-B-7 (Figure 2) where COCs were detected at levels warranting further investigation. Up to 8 step-out boreholes are proposed in the vicinity of each of the step-out investigation locations at the site (a total of up to 32 shallow soil boreholes to a maximum depth of 4 feet bgs). Up to 64 soil samples (2 per borehole) will be collected from the step-out boreholes. Between boreholes the subcontracted drillers will decontaminate the drill rig and Tetra Tech field staff will decontaminate the hand auger. Decontamination will be done by triple rinsing the equipment with distilled water and Liquinox soap.

Tetra Tech will field screen soil from each soil borehole using a handheld X-Ray Fluorescence (XRF) analyzer (Innov-X System). The XRF analyzer will be used to screen site soils for lead and arsenic. The benefit of using the XRF analyzer in the field is that the step-out investigation can be guided by the preliminary data generated using the XRF analyzer, making it more likely that the investigation is successful in delineating the extent of lead and arsenic. The detection limits of the XRF analyzer for lead (< 5 ppm) and arsenic (< 5 ppm) are also presented in an attachment to this work plan.

Soil cores generated by direct push drilling will be collected in driller-supplied acetate liners at approximately 4-foot depth intervals for lithologic description and retention for possible laboratory analysis. Soil will also be generated by hand auguring Borehole logs including detailed lithological descriptions of the soil will be prepared under the supervision of a professional geologist licensed in the State of California.

Discrete soil samples will be collected using laboratory-provided glass jars; labeled with date, sample identification, and time, entered into a chain-of-custody form, and placed on ice in a cooler for shipment to the laboratory. Samples will be delivered via courier or Fedex to an accredited laboratory under chain-of-custody.

2.1.4 Temporary Wells and Groundwater Sampling

Tetra Tech will use direct push drilling technology to collect groundwater samples from one temporary well in the vicinity of step-out investigation CAT-B-1 to evaluate the extent of previously identified petroleum hydrocarbons dissolved in groundwater at the site. Tetra Tech anticipates that groundwater will be encountered before a depth of 15 feet bgs. Temporary well installation and sample collection will conform to applicable state and Environmental Protection Agency (EPA) guidance. The well casing and screen will be made of 1.5-inch diameter rigid polyvinyl chloride (PVC) casing. A 5-foot screened interval (0.02-inch slot) will span the bottom 5 feet of the temporary well to facilitate groundwater sample collection. Groundwater samples will be analyzed for VOCs, TPPH as gasoline, and TEPH as motor oil and diesel. Tetra Tech plans to collect one primary groundwater sample and one duplicate sample from the temporary well.

Before groundwater samples are collected, the static groundwater levels and, if present, free-phase petroleum product thicknesses, will be measured to the nearest 0.01 foot using an oil-water interface probe and electronic water level sounder. The wells will be purged and sampled using the California EPA, Department of Toxic Substances Control (DTSC) guidelines in their Representative Sampling of Groundwater for Hazardous Substances, Guidance Manual for Groundwater Investigations (Cal EPA 2008). A peristaltic pump will be used to purge each well using low-flow purging techniques. During purging of the wells, the water quality parameters temperature, pH, electrical conductivity, oxidation-reduction potential, dissolved oxygen, and turbidity will be measured using a water quality meter. Before sampling, the water quality parameters will be measured until stabilization (See Table for Stabilization Criteria). The groundwater collected will be placed into appropriate sample containers, labeled with a unique identification number, date, and time and placed into an ice-chilled cooler for transportation to the analytical laboratory under chain of custody documentation.

Parameter	Stabilization Criteria
Temperature	± 3% of reading (minimum of ± 0.2° C
pH	± 0.1
Specific electrical conductivity	± 3%

Oxidation-reduction potential (ORP)	± 10 millivolts
Dissolved oxygen (DO)	± 0.3 milligrams per liter
Turbidity	Relatively clear and free of sediment or <100 Nephelometric Turbidity Unit (NTU)

2.1.5 Decommissioning Soil Boreholes and Temporary Groundwater Wells

Tetra Tech proposes to decommission the soil boreholes and temporary well with Type I/II cement-bentonite grout (maximum of 6 gallons of water per 94 pounds of cement, up to 5 percent bentonite) from the bottom of the borehole to the ground surface. Borehole decommissioning will be done according to the requirements of the ACEH. Tetra Tech will schedule accordingly with the ACEH for grout inspections.

2.1.6 Investigation Derived Waste (Waste Management Plan)

Tetra Tech will perform a thorough site inspection at the end of the project field work to ensure all equipment, trash, and investigation materials have been removed from the site.

All waste generated from this project will be transported and disposed of off-site at the appropriate disposal, treatment, or recycling facility in accordance with federal, state, and local regulations. Solid and liquid wastes will be generated during field work. Investigation-derived waste (IDW) that may be generated during the field work includes:

- Decontamination water
- Disposable sampling equipment and personal protective equipment
- Soil and groundwater waste

Any IDW generated will be classified, labeled, managed, and disposed of in accordance with EPA guidance and applicable state and federal regulations. All soil, groundwater, and decontamination water generated from drilling will be drummed on site.

Waste codes applicable to each hazardous waste stream will be identified based on the requirements in 40 Code of Federal Regulations (CFR) 261 or any applicable state or local law or regulation. All applicable treatment standards in 40 CFR 268 and state land disposal restrictions will be identified and a determination will be made as to whether the waste meets or exceeds the standards.

The soil and decontamination water is anticipated to be shipped as Resource Conservation and Recovery Act (RCRA) hazardous waste, non-RCRA hazardous waste, or as nonhazardous waste. The waste will be tracked using hazardous waste and nonhazardous waste manifests, as appropriate. This waste classification will be made by Tetra Tech after the soil has been characterized using the sample data generated during the investigation. A waste disposal subcontractor will profile the waste for disposal. Waste profiles, analyses, classification, and treatment standards will be according to the requirements of the receiving facility. Waste manifests will be signed by an Alameda representative. The IDW will be transported by a subcontracted transporter to the disposal facility within 90 days of generation.

2.2 SAMPLING DESIGN

This section discusses the sampling approach and rationale for the site. Tetra Tech plans to collect soil samples from 4 step-out investigation locations at the site (a total 32 shallow soil boreholes to a maximum depth of 4 feet bgs), as described in Section 2.1.3 and shown on Figure 2. Additionally, Tetra Tech plans to collect groundwater samples from one temporary well, as described in Section 2.1.4, and shown on Figure 3. The maximum soil sample depth of 4 feet represents the maximum depth of contamination that was previously identified. The number of samples per COC, sample type, and location in relation the Phase II ESA investigation areas is tabulated in the following table.

COC	**Rationale for Further Investigation**	**Phase II ESA Borehole (Step-out Investigation/Temporary Well)**	**Number of Boreholes/Samples**
TEPH as diesel	Table 1 (TEPH results indicate possible petroleum release and extent of contamination is undefined)	CAT-B-1	One temporary groundwater well location, 2 groundwater samples
TPPH as gasoline	Table 1 (TPPH results indicate possible petroleum release and extent of contamination is undefined)	CAT-B-1	One temporary groundwater well location, 2 groundwater samples
VOCs	Table 1 (TPPH results indicate possible petroleum release and extent of contamination is undefined)	CAT-B-1	One temporary groundwater well location, 2 groundwater samples
Lead	Table 2 (unacceptable risk per SLHHRA)	CAT-B-1, CAT-B-6, and CAT-B-7	Up to 24 step-out boreholes and up to 48 soil samples
Arsenic	Table 2 (unacceptable risk per SLHHRA/exceeds background level)[1]	CAT-B-1 and CAT-B-2	Up to 16 step-out boreholes and up to 32 soil samples

[1] The regional background level for arsenic is 11 mg/kg (Duverge, 2011). Step-out soil investigation is being proposed at Phase II ESA borehole locations where arsenic concentrations exceeded 11 mg/kg, even though concentrations less than background exceed applicable regulatory screening levels.

The rationale for soil and groundwater sampling is based on the Phase II ESA and SLHHRA soil sample data presented in Tables 1 and 2: (1) petroleum hydrocarbons and VOCs in groundwater are included to further evaluate the groundwater that has been contaminated with petroleum constituents, (2) lead in soil is being further investigated to better understand the extent of lead in soil presented a risk to human health per the SLHHRA (Table 2), and (3) arsenic is being investigated in areas of the site where concentrations of arsenic exceed the regional background level for arsenic (Table 2).

2.3 ANALYTICAL METHODS

Analytical methods were selected to obtain the chemical information needed for making decisions at the site. The soil and groundwater samples will be analyzed by a certified State of California, Environmental Laboratory Accreditation Program (ELAP) laboratory on a standard (14-day) turnaround time. The soil and groundwater samples will be analyzed using the following United States Environmental Protection Agency (USEPA) methods covering the COCs for the site:

- TPPH as gasoline in groundwater by EPA Method 8260B;
- TEPH in soil and groundwater by USEPA Method 8015M;
- Volatile organic compounds (VOCs) in groundwater by EPA Method 8260B; and
- Lead and arsenic in soil by USEPA Method 6020.
- .

The subcontracted laboratory will provide electronic data deliverables (EDD) for all analytical results.

2.4 DATA ASSESSMENT AND USE

The data will be fully assessed to confirm the overall data quality. The analytical laboratory will conduct analyses for establishing quality assurance/ quality control (QA/QC) for the sample analyses. Tetra Tech will review the laboratory reports for conformance with the requested analyses. Based on the laboratory QA/QC data, Tetra Tech will determine if the sample data is valid and appropriate for use in risk assessment.

Relative percent difference (RPD) values for duplicate groundwater sample analytical results will be calculated to evaluate the precision of the analyses. The RPD goal, which will only applied to constituents with concentrations greater than 10 times their respective laboratory method detection limits, is 30 percent or less for field duplicates. Based on the results of the RPD evaluation which provides an indication of precision of the sampling and/or analytical methods, Tetra Tech will make a determination about the validity of the groundwater data.

The result of this investigation will be presented in a written report.

3.0 REFERENCES

Blackie, 2010. Belinda P. Blackie, Phase I Environmental Site Assessment, ABL Parcels, Alameda, California. March 8, 2010.

California Environmental Protection Agency (Cal EPA) 2008. California Environmental Protection Agency, Department of Toxic Substances Control. Representative Sampling of Groundwater for Hazardous Substances, Guidance Manual for Groundwater Investigations. July 1995, Revised February 2008.

Code of Federal Regulations (CFR). "Title 40- Protection of Environment, Chapter 1 Environmental Protection Agency, Subchapter 1 Solid Wastes, Part 261- Identification and Listing of Hazardous Waste."

CFR. "Title 40 Protection of Environment, Chapter 1 Environmental Protection Agency, Subchapter 1 Solid Wastes, Part 268- Land Disposal Restrictions."

City of Alameda, 2015. March Crust. http://alamedaca.gov/community-development/building/marsh-crust. Website accessed on January 27, 2015.

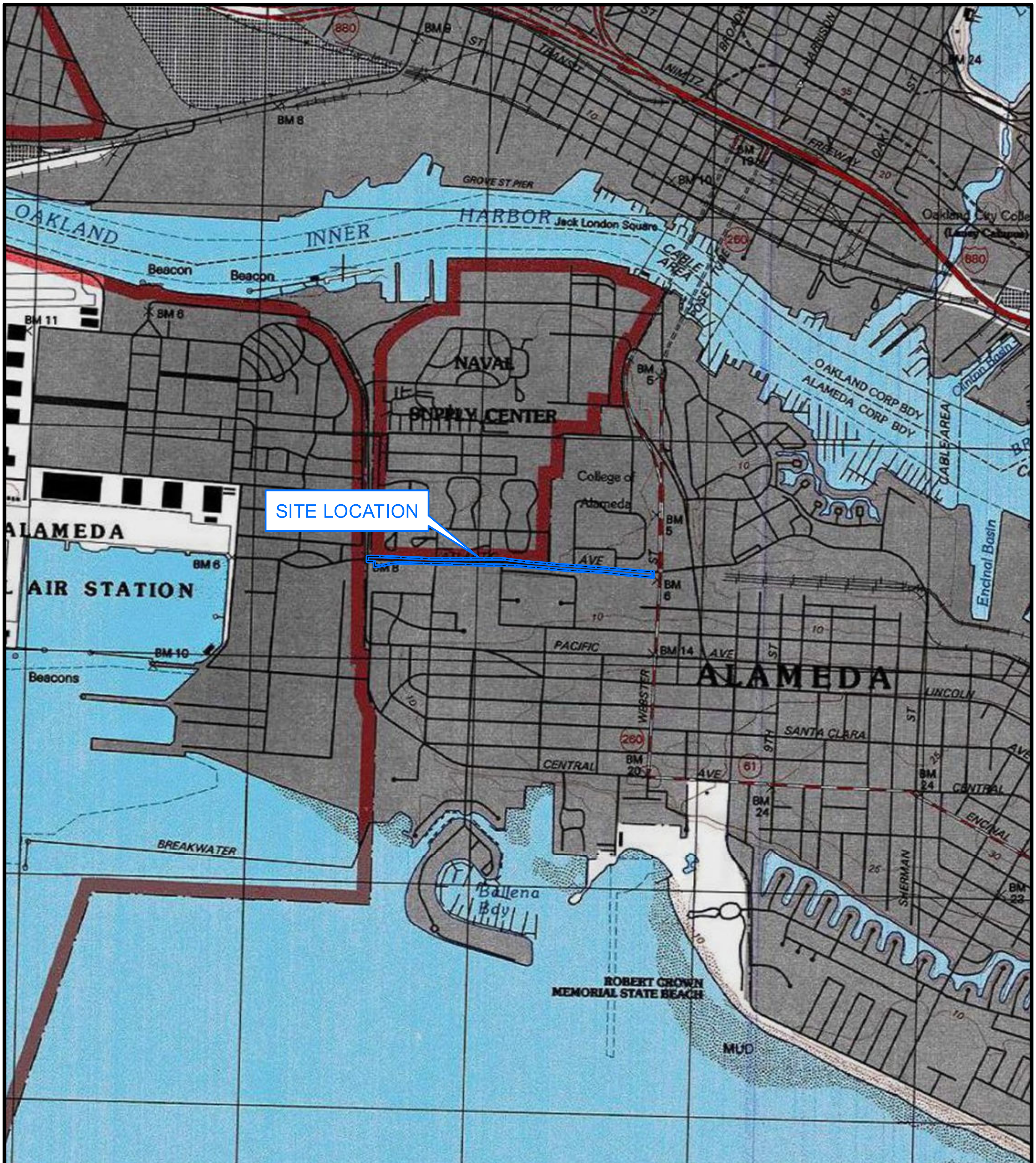
Duverge, 2011. Establishing Background Arsenic in Soil of the Urbanized San Francisco Bay Region, by Dylan Jacques Duverge, San Francisco State University. December 2011.

San Francisco Bay Regional Water Quality Control Board (RWQCB), 2013. Environmental Screening Levels for Specific Concerns. December 2013.

Tetra Tech, 2015a. Phase II Environmental Site Assessment on the Cross Alameda Trail Project, Alameda, California. February 3, 2015.

Tetra Tech, 2015b. Investigation and Risk Assessment Report for the Cross Alameda Trail, Alameda, California. October, 2015.

FIGURES



Property Boundary

N
W E
S

0 1,000 2,000
Feet

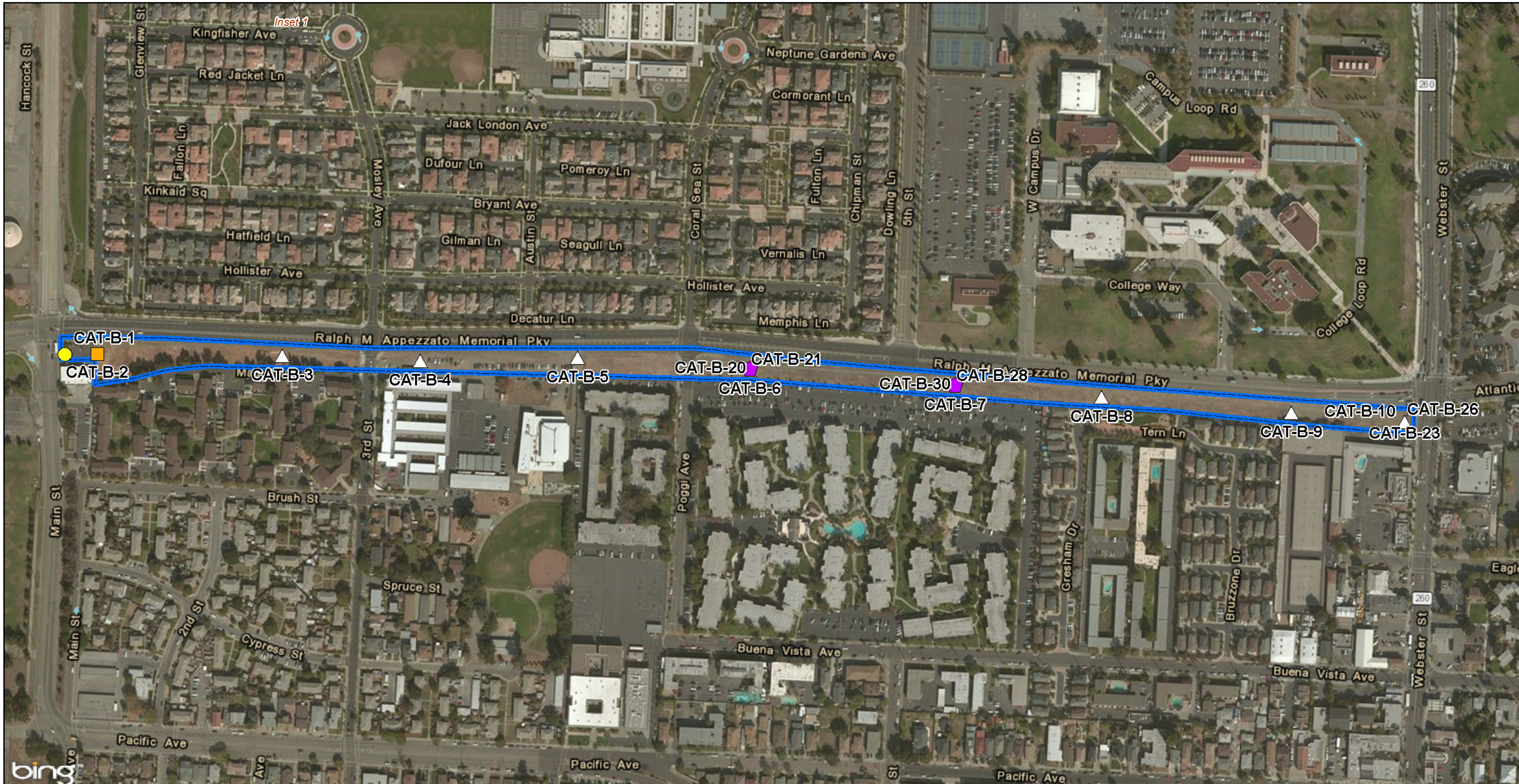
SOURCE: MODIFIED 2013 FROM NATIONAL GEOGRAPHIC SOCIETY, I-CUBED QUADRANGLES INCLUDE: OAKLAND, WEST

TETRA TECH

Cross Alameda Trail
Alameda, California

FIGURE 1
SITE LOCATION

10/14/2015 V:\Alameda\Projects\CrossTrail\GIS\Layouts\SITE LOCATION.mxd yashekia.evans



Property Boundary

COCs to be investigated with step-out soil boreholes (Arsenic, Lead, and TEPH) and a temporary groundwater well (TPPH, TEPH, and VOCs)

COCs to be investigated with step-out soil boreholes (Arsenic)

COCs to be investigated with step-out soil boreholes (Lead)

No Futher Investigation Proposed

Notes:

COC	Chemical of Concern
TEPH	Total Extractable Petroleum Hydrocarbons
TPPH	Total Purgeable Petroleum Hydrocarbon
VOC	Volatile Organic Compound

N S E W

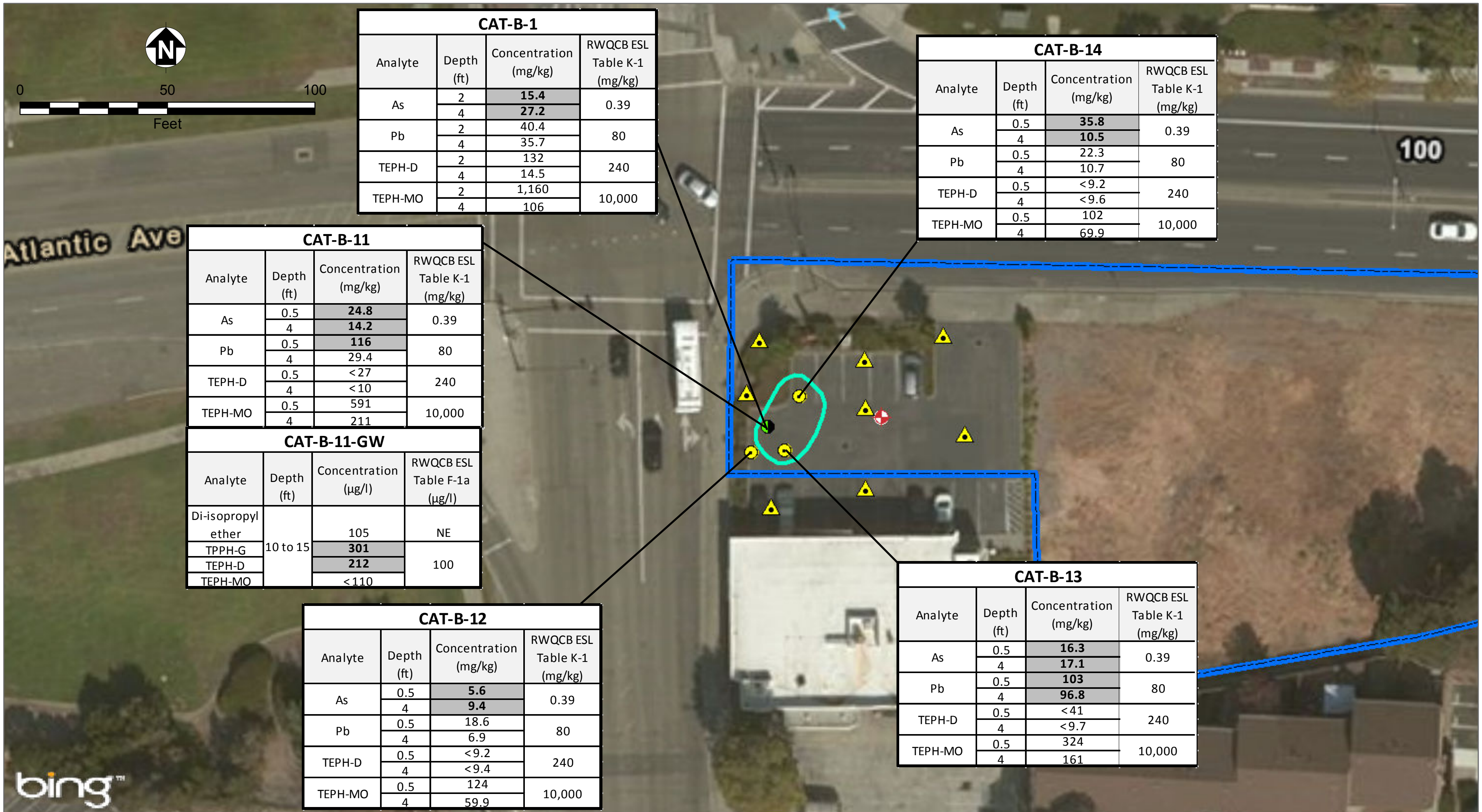
300 150 0 300

Feet

TETRA TECH

Cross Alameda Trail, Site Investigation Work Plan
Alameda, California

FIGURE 2
BORING LOCATIONS & SOIL SCREENING RESULTS



CAT-B-1

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	2	**15.4**	0.39
	4	**27.2**	
Pb	2	40.4	80
	4	35.7	
TEPH-D	2	132	240
	4	14.5	
TEPH-MO	2	1,160	10,000
	4	106	

CAT-B-14

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	**35.8**	0.39
	4	**10.5**	
Pb	0.5	22.3	80
	4	10.7	
TEPH-D	0.5	<9.2	240
	4	<9.6	
TEPH-MO	0.5	102	10,000
	4	69.9	

CAT-B-11

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	**24.8**	0.39
	4	**14.2**	
Pb	0.5	**116**	80
	4	29.4	
TEPH-D	0.5	<27	240
	4	<10	
TEPH-MO	0.5	591	10,000
	4	211	

CAT-B-11-GW

Analyte	Depth (ft)	Concentration (µg/l)	RWQCB ESL Table F-1a (µg/l)
Di-isopropyl ether	10 to 15	105	NE
TPPH-G		**301**	100
TEPH-D		**212**	
TEPH-MO		<110	

CAT-B-12

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	**5.6**	0.39
	4	**9.4**	
Pb	0.5	18.6	80
	4	6.9	
TEPH-D	0.5	<9.2	240
	4	<9.4	
TEPH-MO	0.5	124	10,000
	4	59.9	

CAT-B-13

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	**16.3**	0.39
	4	**17.1**	
Pb	0.5	**103**	80
	4	**96.8**	
TEPH-D	0.5	<41	240
	4	<9.7	
TEPH-MO	0.5	324	10,000
	4	161	

- Step-Out Soil Borehole (September 2015)
- Represents Two Co-located Soil Borehole Locations
- Approximate Proposed Step-Out Soil Borehole
- Approximate Location of Proposed Temporary Groundwater Well
- Property Boundary
- Preliminary Area for Soil Remediation
- **5.6** Shaded concentration indicates a result that exceeds the RWQCB ESL shown.

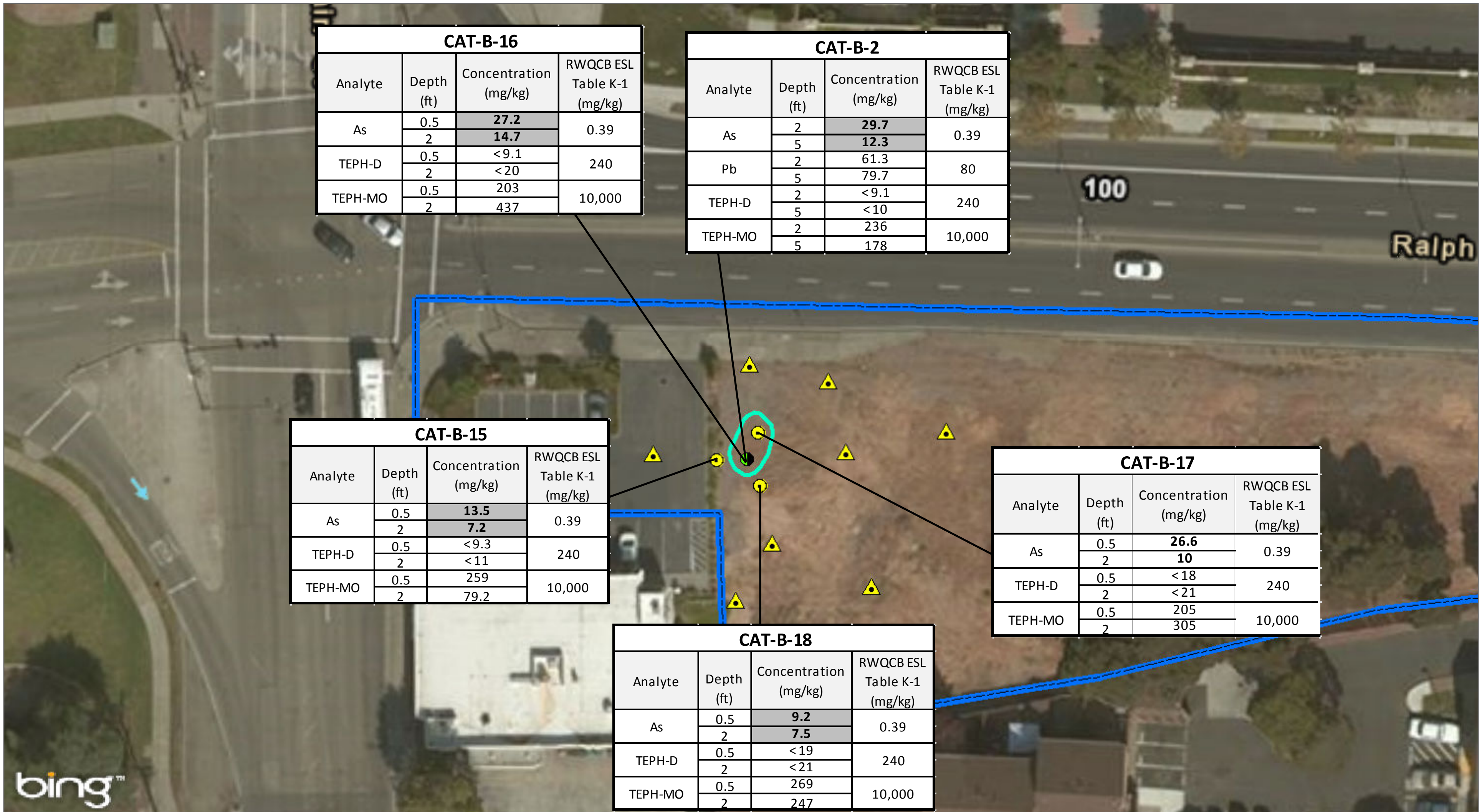
As	Arsenic
ft	Feet
mg/kg	Milligram per kilogram
NE	Not Established
Pb	Lead
RWQCB ESL	Regional Water Quality Control Board Environmental Screening Level
TPPH-G	Total purgeable petroleum hydrocarbons as gasoline
TEPH-D	Total extractable petroleum hydrocarbons as diesel
TEPH-MO	Total extractable petroleum hydrocarbons as motor oil

TETRA TECH

Cross Alameda Trail
Alameda, California

FIGURE 3
STEP-OUT BOREHOLE LOCATIONS WITH SOIL AND GROUNDWATER RESULTS (CAT-B-1)

3/1/2016 V:\Alameda\Projects\CrossTrail\GIS\Layouts\STEP-OUT BORING LOCATIONS 1.mxd yashekia.evans



CAT-B-16

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	27.2	0.39
	2	14.7	
TEPH-D	0.5	<9.1	240
	2	<20	
TEPH-MO	0.5	203	10,000
	2	437	

CAT-B-2

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	2	29.7	0.39
	5	12.3	
Pb	2	61.3	80
	5	79.7	
TEPH-D	2	<9.1	240
	5	<10	
TEPH-MO	2	236	10,000
	5	178	

CAT-B-15

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	13.5	0.39
	2	7.2	
TEPH-D	0.5	<9.3	240
	2	<11	
TEPH-MO	0.5	259	10,000
	2	79.2	

CAT-B-17

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	26.6	0.39
	2	10	
TEPH-D	0.5	<18	240
	2	<21	
TEPH-MO	0.5	205	10,000
	2	305	

CAT-B-18

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
As	0.5	9.2	0.39
	2	7.5	
TEPH-D	0.5	<19	240
	2	<21	
TEPH-MO	0.5	269	10,000
	2	247	

Step-Out Soil Borehole (September 2015)
Represents Two Co-located Soil Borehole Locations
Approximate Proposed Step-Out Soil Borehole
Property Boundary

Preliminary Area for Soil Remediation

9.2 Shaded concentration indicates a result that exceeds the RWQCB ESL shown.

As	Arsenic
ft	Feet
mg/kg	Milligram per kilogram
NE	Not Established
Pb	Lead
RWQCB ESL	Regional Water Quality Control Board Environmental Screening Level
TPPH-G	Total purgeable petroleum hydrocarbons as gasoline
TEPH-D	Total extractable petroleum hydrocarbons as diesel
TEPH-MO	Total extractable petroleum hydrocarbons as motor oil

N

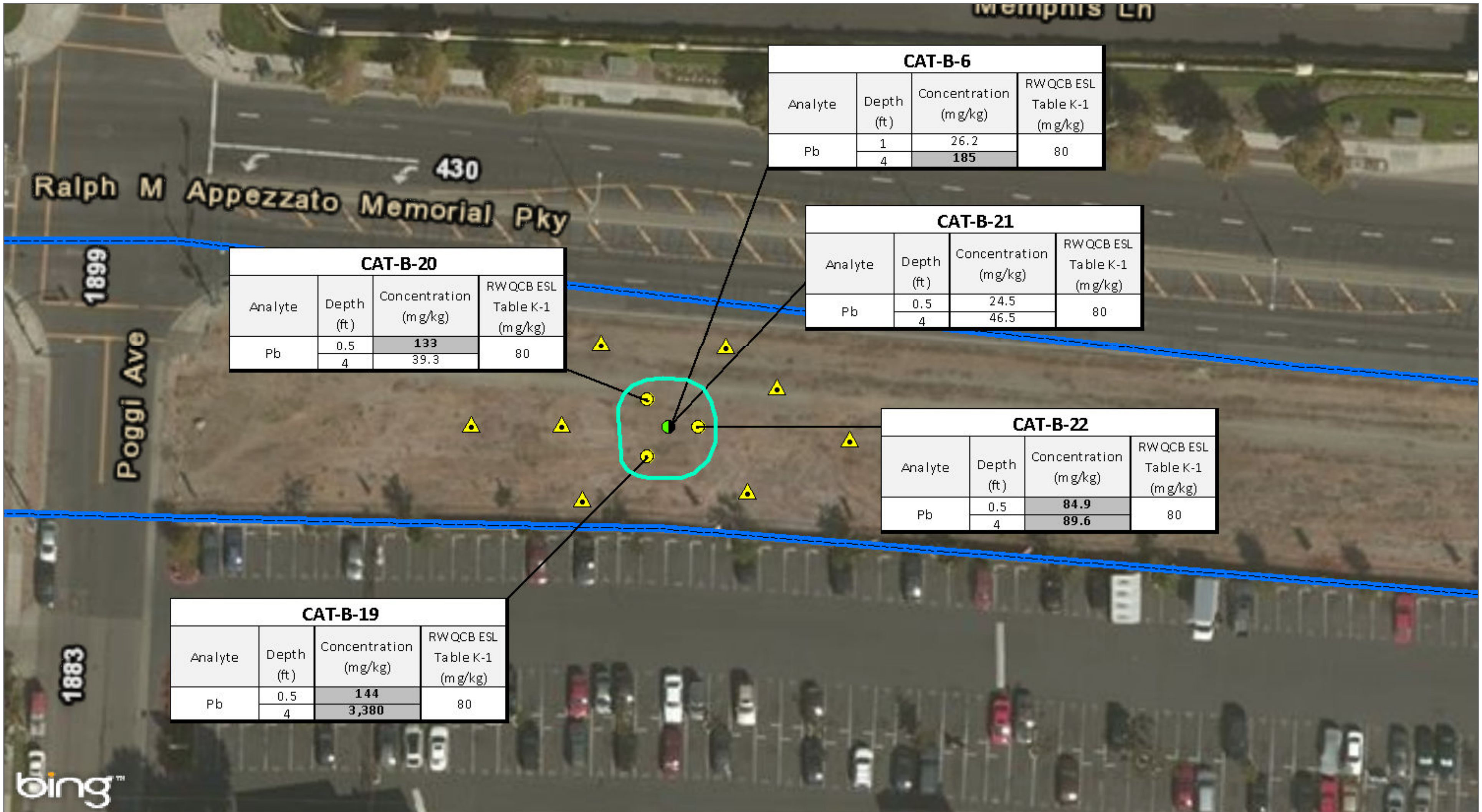
0 50 100
Feet

TETRA TECH

Cross Alameda Trail
Alameda, California

FIGURE 4
STEP-OUT BOREHOLE LOCATIONS WITH SOIL AND GROUNDWATER RESULTS (CAT-B-2)

10/27/2015 V:\Alameda\Projects\CrossTrail\GIS\Layouts\STEP-OUT BORING LOCATIONS 2.mxd yashekia.evans



CAT-B-6

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	1	26.2	80
	4	185	

CAT-B-21

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	24.5	80
	4	46.5	

CAT-B-20

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	133	80
	4	39.3	

CAT-B-22

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	84.9	80
	4	89.6	

CAT-B-19

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	144	80
	4	3,380	

Step-Out Soil Borehole (September 2015)
Represents Two Co-located Soil Borehole Locations
Approximate Proposed Step-Out Soil Borehole
Property Boundary

Preliminary Area for Soil Remediation

144 — Shaded concentration indicates a result that exceeds the RWQCB ESL shown.

Notes:

ft	Feet
mg/kg	Milligram per kilogram
Pb	Lead
RWQCB ESL	Regional Water Quality Control Board Environmental Screening Level

N

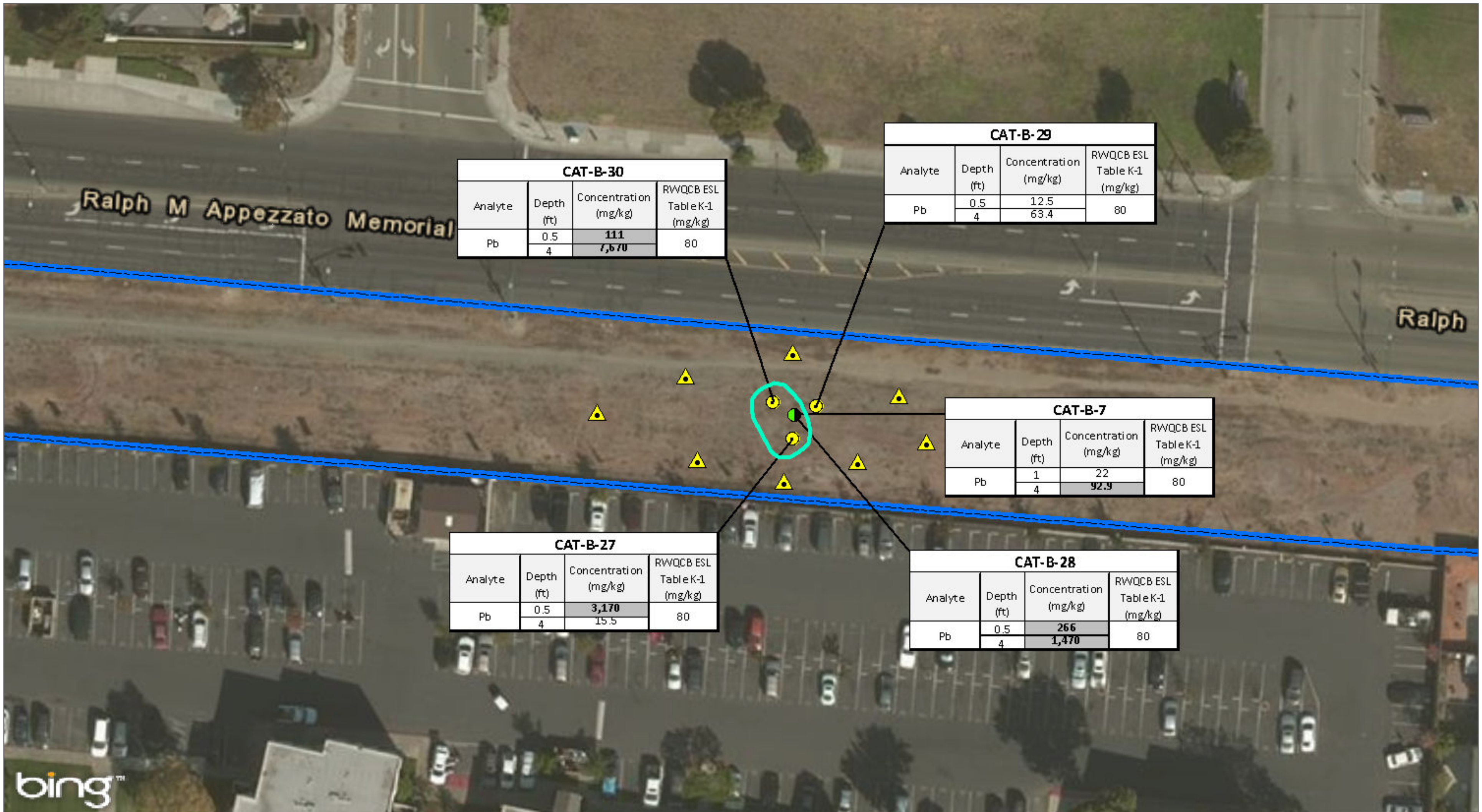
0 50 100
Feet

TETRA TECH

Cross Alameda Trail
Alameda, California

FIGURE 5
STEP-OUT BOREHOLE LOCATIONS WITH SOIL RESULTS (CAT-B-6)

3/1/2016 V:\Alameda\Projects\CrossTrail\GIS\Layouts\STEP-OUT BORING LOCATIONS 3.mxd yashekia.evans



CAT-B-30

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	111	80
	4	7,670	

CAT-B-29

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	12.5	80
	4	63.4	

CAT-B-7

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	1	22	80
	4	92.9	

CAT-B-27

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	3,170	80
	4	15.5	

CAT-B-28

Analyte	Depth (ft)	Concentration (mg/kg)	RWQCB ESL Table K-1 (mg/kg)
Pb	0.5	266	80
	4	1,470	

Step-Out Soil Borehole (September 2015)
Represents Two Co-located Soil Borehole Locations
Approximate Proposed Step-Out Soil Borehole
Property Boundary

Preliminary Area for Soil Remediation

92.9 Shaded concentration indicates a result that exceeds the RWQCB ESL shown.

Notes:

ft Feet
mg/kg Milligram per kilogram
Pb Lead
RWQCB ESL Regional Water Quality Control Board Environmental Screening Level

N

0 60 120
Feet

TETRA TECH

Cross Alameda Trail
Alameda, California

FIGURE 6
STEP-OUT BOREHOLE LOCATIONS WITH SOIL RESULTS (CAT-B-7)

3/1/2016 V:\Alameda\Projects\CrossTrail\GIS\Layouts\STEP-OUT BORING LOCATIONS 4.mxd yashekia.evans

TABLES

TABLE 1

SUMMARY OF CHEMICAL ANALYSES OF SOIL SAMPLES FOR METALS AND TEPH

City of Alameda, Cross Alameda Trail

Alameda, California

Well/Sample ID	Sample Date	Metals (mg/kg)		TEPH (mg/kg)	
		Arsenic	Lead	Diesel	Motor Oil
CAT-B-1-2	12/29/2014	15.4	40.4	132	1,160
CAT-B-1-4	12/29/2014	27.2	35.7	14.5	106
CAT-B-2-2	12/29/2014	29.7	61.3	< 9.1	236
CAT-B-2-5	12/29/2014	12.3	79.7	< 10	178
CAT-B-3-1	12/29/2014	8.0	24.0	42.7	78.2
CAT-B-3-4	12/29/2014	7.2	2.6	< 4.1	15.3
CAT-B-4-2	12/29/2014	6.8	37	8.76	28.2
CAT-B-4-5	12/29/2014	6.3	36.6	11.7	26.6
CAT-B-5-1	12/29/2014	6.2	68.4	6.17	22.7
CAT-B-5-5	12/29/2014	1.7	3	< 1.8	< 3.6
CAT-B-6-1	12/29/2014	5.3	26.2	8.22	36.5
CAT-B-6-4	12/29/2014	3.9	185	5.74	9.43
CAT-B-7-1	12/30/2014	4.3	22	6.52	16.0
CAT-B-7-4	12/30/2014	5.1	92.9	8.49	19.9
CAT-B-8-2	12/30/2014	6.5	40.5	7.35	31.8
CAT-B-8-8	12/30/2014	2.7	16.9	< 2.2	< 4.3
CAT-B-9-1	12/30/2014	7.8	54.6	6.39	30.3
CAT-B-9-6	12/30/2014	4.9	6.9	< 2.1	< 4.1
CAT-B-10-2	12/30/2014	6.2	126	129	609
CAT-B (Duplicate)	12/30/2014	4.9	170	188	922
CAT-B-10-5	12/30/2014	1.4	26	88.2	164
CAT-B-11-0.5	9/1/2015	24.8	116	< 27	591
CAT-B-11-4	9/1/2015	14.2	29.4	< 10	211
CAT-B-12-0.5	9/1/2015	5.6	18.6	< 9.2	124
CAT-B-12-4	9/1/2015	9.4	6.9	< 9.4	59.9
CAT-B-13-0.5	9/1/2015	16.3	103	< 41	324
CAT-B-13-4	9/1/2015	17.1	96.8	< 9.7	161
CAT-B-14-0.5	9/1/2015	35.8	22.3	< 9.2	102
CAT-B-14-4	9/1/2015	10.5	10.7	< 9.6	69.9
CAT-B-15-0.5	9/1/2015	13.5	NA	< 9.3	259
CAT-B-15-2	9/1/2015	7.2	NA	< 11	79.2
CAT-B-16-0.5	9/1/2015	27.2	NA	< 9.1	203
CAT-B-16-2	9/1/2015	14.7	NA	< 20	437
CAT-B-17-0.5	9/1/2015	26.6	NA	< 18	205
CAT-B-17-2	9/1/2015	10	NA	< 21	305
CAT-B-18-0.5	9/1/2015	9.2	NA	< 19	269
CAT-B-18-2	9/1/2015	7.5	NA	< 21	247
CAT-B-19-0.5	9/1/2015	NA	144	NA	NA
CAT-B-19-4	9/1/2015	NA	3,380	NA	NA
CAT-B-20-0.5	9/1/2015	NA	133	NA	NA
CAT-B-20-4	9/1/2015	NA	39.3	NA	NA

TABLE 1
SUMMARY OF CHEMICAL ANALYSES OF SOIL SAMPLES FOR METALS AND TEPH
City of Alameda, Cross Alameda Trail
Alameda, California

Well/Sample ID	Sample Date	Metals (mg/kg)		TEPH (mg/kg)	
		Arsenic	Lead	Diesel	Motor Oil
CAT-B-21-0.5	9/1/2015	NA	24.5	NA	NA
CAT-B-21-4	9/1/2015	NA	46.5	NA	NA
CAT-B-22-0.5	9/1/2015	NA	84.9	NA	NA
CAT-B-22-4	9/1/2015	NA	89.6	NA	NA
CAT-B-23-0.5	9/2/2015	1.4	65.1	< 17	438
CAT-B-23-2	9/2/2015	0.71	91	< 36	784
CAT-B-24-0.5	9/2/2015	7.8	52	< 72	1,310
CAT-B-24-2	9/2/2015	0.72	50.7	< 9.6	314
CAT-B-25-0.5	9/2/2015	10.6	86.9	< 36	311
CAT-B-25-2	9/2/2015	4.7	112	< 37	1,120
CAT-B-26-0.5	9/2/2015	7.2	76.1	< 35	668
CAT-B-26-2	9/2/2015	8	160	< 56	2,210
CAT-B-27-0.5	9/2/2015	NA	3,170	NA	NA
CAT-B-27-4	9/2/2015	NA	15.5	NA	NA
CAT-B-28-0.5	9/2/2015	NA	266	NA	NA
CAT-B-28-4	9/2/2015	NA	1,470	NA	NA
CAT-B-29-0.5	9/2/2015	NA	12.5	NA	NA
CAT-B-29-4	9/2/2015	NA	63.4	NA	NA
CAT-B-30-0.5	9/2/2015	NA	111	NA	NA
CAT-B-30-4	9/2/2015	NA	7,670	NA	NA
RWQCB ESL (Table K-1) [1]		*0.39*	*80*	*240*	*10,000*
RWQCB ESL (Table K-3) [2]		*10*	*320*	*900*	*28,000*
Cal/EPA CHHSL (Table 1) [3]		*0.070*	*80*	*NE*	*NE*

Notes:

(Light grey shading) Light grey shading indicates a detection at or above one or more of the RWQCB ESL values present

NA Not Analyzed

NE Not established

TEPH Total extractable petroleum hydrocarbons

< detection is less than the laboratory method detection limit

mg/kg Milligrams per kilogram

1 California Regional Water Quality Control Board, Environmental Screening Levels for Soil (RWQCB ESL), residenital direct exposure to soil scenario (Table K-1; RWQCB 2013).

2 California Regional Water Quality Control Board, Environmental Screening Levels for Soil (RWQCB ESL), construction/trench worker direct exposure to soil scenario (Table K-3; RWQCB 2013).

3 California Environmental Protection Agency (Cal/EPA), California Human Health Screening Levels (CHHSL), Soil Screening Numbers for Nonvolatile Chemicals, Residential Scenario (Table 1; Updated 2010)

TABLE 2

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FOR VOCs, TPPH AND TEPH

City of Alameda, Cross Alameda Trail
Alameda, California

Well/Sample ID	Sample Date	VOCs (µg/l)	TPPH (µg/l)	TEPH (µg/l)	
		Di-Isopropyl ether	Gasoline	Diesel	Motor Oil
CAT-B-11-GW	9/1/2015	105	301	212	< 110
CAT-B-23-GW	9/1/2015	< 0.22	< 25	< 51	< 100
CAT-B	9/1/2015	< 0.22	< 25	< 53	< 110
RWQCB ESL (Table F-1a) [1]		*NE*	*100*	*100*	*100*
RWQCB ESL (Table F-1b) [2]		*NE*	*500*	*640*	*640*

Notes:

(light grey shading) Light grey shading indicates a detection at or above one or more of the RWQCB ESL values presented

NA Not Analyzed

NE Not established

TPPH Total purgeable petroleum hydrocarbons

TEPH Total extractable petroleum hydrocarbons

VOC Volatile organic compound

< Detection is less than the laboratory method detection limit (table includes only analytes detected above the laboratory reporting limit)

mg/kg Milligrams per kilogram

1 California Regional Water Quality Control Board, Environmental Screening Levels for Groundwater (RWQCB ESL), grounwater is a current or potential drinking water resource (Table F-1a; RWQCB 2013).

2 California Regional Water Quality Control Board, Environmental Screening Levels for Groundwater (RWQCB ESL), grounwater is not a current or potential drinking water resource (Table F-1b; RWQCB 2013).

ELEMENTS DETECTABLE

BY INNOV-X SYSTEMS HANDHELD XRF ANALYZERS

INNOV-X SYSTEMS

	IIA	IIIB	IVB	VB	VIB	VIIB	Group VIII	Group VIII	Group VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	
H 1																	He 2
0.05 Li 3	0.11 Be 4											0.18 B 5	0.28 C 6	0.39 N 7	0.52 O 8	0.68 F 9	0.85 Ne 10
1.04 1.07 Na 11	1.25 1.3 Mg 12											1.49 1.56 Al 13	1.74 1.84 Si 14	2.01 2.14 P 15	2.31 2.46 S 16	2.62 2.82 Cl 17	2.96 3.19 Ar 18
3.31 3.59 K 19	3.69 4.01 Ca 20 0.34 0.34	4.09 4.46 Sc 21 0.4 0.4	4.51 4.93 Ti 22 0.45 0.46	4.95 5.43 V 23 0.51 0.52	5.41 5.95 Cr 24 0.57 0.58	5.9 6.49 Mn 25 0.64 0.65	6.4 7.06 Fe 26 0.71 0.72	6.93 7.65 Co 27 0.78 0.79	7.48 8.26 Ni 28 0.85 0.87	8.05 8.91 Cu 29 0.93 0.95	8.64 9.57 Zn 30 1.01 1.03	9.25 10.26 Ga 31 1.1 1.12	9.89 10.98 Ge 32 1.19 1.22	10.54 11.73 As 33 1.28 1.32	11.22 12.5 Se 34 1.38 1.42	11.92 13.29 Br 35 1.48 1.53	12.65 14.11 Kr 36 1.59 1.64
13.4 14.96 Rb 37 1.69 1.75	14.17 15.84 Sr 38 1.81 1.87	14.96 16.74 Y 39 1.92 2	15.78 17.67 Zr 40 2.04 2.12	16.62 18.62 Nb 41 2.17 2.26	17.48 19.61 Mo 42 2.29 2.39	18.37 20.62 Tc 43 2.42 2.54	19.28 21.66 Ru 44 2.56 2.68	20.22 22.72 Rh 45 2.83	21.18 23.82 Pd 46 2.84 2.99	22.16 24.94 Ag 47 2.98 3.15	23.17 26.1 Cd 48 3.13 3.32	24.21 27.28 In 49 3.29 3.49	25.27 28.49 Sn 50 3.44 3.66	26.36 29.73 Sb 51 3.6 3.84	27.47 31 Te 52 3.77 4.03	28.61 32.29 I 53 3.94 4.22	29.78 33.62 Xe 54 4.11 4.42
30.97 34.99 Cs 55 4.29 4.62	32.19 36.38 Ba 56 4.47 4.83		55.79 63.23 Hf 72 7.9 9.02	57.53 65.22 Ta 73 8.15 9.34	59.32 67.24 W 74 8.4 9.67	61.14 69.31 Re 75 8.65 10.01	63 71.41 Os 76 8.91 10.36	64.9 73.56 Ir 77 9.18 10.71	66.83 75.75 Pt 78 9.44 11.07	68.8 77.98 Au 79 9.71 11.44	70.82 80.25 Hg 80 9.99 11.82	72.87 82.58 Tl 81 10.27 12.21	74.97 84.94 Pb 82 10.55 12.61	77.11 87.34 Bi 83 10.84 13.02	79.29 89.8 Po 84 11.13 13.45	81.52 92.3 At 85 11.43 13.88	83.78 94.87 Rn 86 11.73 14.32
86.1 97.47 Fr 87 12.03 14.77	88.47 100.13 Ra 88 12.34 15.24																

Lanthanides 57-71	33.44 37.8 La 57 4.65 5.04	34.72 39.26 Ce 58 4.84 5.26	36.03 40.75 Pr 59 5.03 5.49	37.36 42.27 Nd 60 5.23 5.72	38.72 43.83 Pm 61 5.43 5.96	40.12 45.41 Sm 62 5.64 6.21	41.54 47.04 Eu 63 5.85 6.46	43 48.7 Gd 64 6.06 6.71	44.48 50.38 Tb 65 6.27 6.98	46 52.12 Dy 66 6.5 7.25	47.55 53.88 Ho 67 6.72 7.53	49.13 55.68 Er 68 6.95 7.81	50.74 57.52 Tm 69 7.18 8.1	52.39 59.37 Yb 70 7.42 8.4	54.07 61.28 Lu 71 7.66 8.71
Actinides 89-103	90.88 102.85 Ac 89 12.65 15.71	93.35 105.61 Th 90 12.97 16.2	95.87 108.43 Pa 91 13.29 16.7	98.44 111.3 U 92 13.61 17.22	101.00 114.18 Np 93 13.95 17.74	103.65 117.15 Pu 94 14.28 18.28	106.35 120.16 Am 95 14.62 18.83	109.10 123.24 Cm 96 14.96 19.39	111.90 126.36 Bk 97 15.31 19.97	114.75 129.54 Cf 98 15.66 20.56	117.65 132.78 Es 99 16.02 21.17	120.60 136.08 Fm 100 16.38 21.79	Md 101	No 102	Lr 103

Alloy Analysis:

Elements detected: Magnesium (Mg, Z=12) through Sulfur (S, Z=16) and Titanium (Ti, Z=22) through Plutonium (Pu, Z=94).

Please see separate Alloy Analysis LOD Specifications.

Low-Density Sample Types (Soils, powders, liquids)

Key: $K_{\alpha 1}$ $K_{\beta 1}$ — Principal lines keV; Symbol — Ag; 47 — Atomic Number; $L_{\alpha 1}$ $L_{\beta 1}$ — Principal lines keV

<1% in air

<5 ppm

<10 ppm

<20 ppm

<50 ppm

<200 ppm

Not Measured

Detection limits are a function of testing time, sample matrix and presence of interfering elements.
Detection limits are estimates based on 1-2 minutes test times and detection confidence of 3σ (99.7% confidence).
Interference-free detection limits are intended as guidelines: please contact Innov-X Systems to discuss your specific application.

PHOTON ENERGIES, IN ELECTRON VOLTS, OF PRINCIPAL K- AND L-SHELL EMISSION LINES

Element	Symbol	Atomic #	$K_{\alpha 1}$	$K_{\beta 1}$	$L_{\alpha 1}$	$L_{\beta 1}$
Actinium	Ac	89	90.88	102.85	12.65	15.71
Aluminum	Al	13	1.49	1.56	0	0
Antimony	Sb	51	26.36	29.73	3.6	3.84
Argon	Ar	18	2.96	3.19	0	0
Arsenic	As	33	10.54	11.73	1.28	1.32
Astatine	At	85	81.52	92.3	11.43	13.88
Barium	Ba	56	32.19	36.38	4.47	4.83
Beryllium	Be	4	0.11	0	0	0
Bismuth	Bi	83	77.11	87.34	10.84	13.02
Boron	B	5	0.18	0	0	0
Bromine	Br	35	11.92	13.29	1.48	1.53
Cadmium	Cd	48	23.17	26.1	3.13	3.32
Calcium	Ca	20	3.69	4.01	0.34	0.34
Carbon	C	6	0.28	0	0	0
Cerium	Ce	58	34.72	39.26	4.84	5.26
Cesium	Cs	55	30.97	34.99	4.29	4.62
Chlorine	Cl	17	2.62	2.82	0	0
Chromium	Cr	24	5.41	5.95	0.57	0.58
Cobalt	Co	27	6.93	7.65	0.78	0.79
Copper	Cu	29	8.05	8.91	0.93	0.95
Dysprosium	Dy	66	46	52.12	6.5	7.25
Erbium	Er	68	49.13	55.68	6.95	7.81
Europium	Eu	63	41.54	47.04	5.85	6.46
Fluorine	F	9	0.68	0	0	0
Francium	Fr	87	86.1	97.47	12.03	14.77
Gadolinium	Gd	64	43	48.7	6.06	6.71
Gallium	Ga	31	9.25	10.26	1.1	1.12
Germanium	Ge	32	9.89	10.98	1.19	1.22
Gold	Au	79	68.8	77.98	9.71	11.44
Hafnium	Hf	72	55.79	63.23	7.9	9.02
Holmium	Ho	67	47.55	53.88	6.72	7.53
Indium	In	49	24.21	27.28	3.29	3.49
Iodine	I	53	28.61	32.29	3.94	4.22
Iridium	Ir	77	64.9	73.56	9.18	10.71
Iron	Fe	26	6.4	7.06	0.71	0.72
Krypton	Kr	36	12.65	14.11	1.59	1.64
Lanthanum	La	57	33.44	37.8	4.65	5.04
Lead	Pb	82	74.97	84.94	10.55	12.61
Lithium	Li	3	0.05	0	0	0
Lutetium	Lu	71	54.07	61.28	7.66	8.71
Magnesium	Mg	12	1.25	1.3	0	0
Manganese	Mn	25	5.9	6.49	0.64	0.65
Mercury	Hg	80	70.82	80.25	9.99	11.82
Molybdenum	Mo	42	17.48	19.61	2.29	2.39
Neodymium	Nd	60	37.36	42.27	5.23	5.72
Neon	Ne	10	0.85	0	0	0
Nickel	Ni	28	7.48	8.26	0.85	0.87
Niobium	Nb	41	16.62	18.62	2.17	2.26
Nitrogen	N	7	0.39	0	0	0
Osmium	Os	76	63	71.41	8.91	10.36
Oxygen	O	8	0.52	0	0	0
Palladium	Pd	46	21.18	23.82	2.84	2.99
Phosphorus	P	15	2.01	2.14	0	0
Platinum	Pt	78	66.83	75.75	9.44	11.07
Polonium	Po	84	79.29	89.8	11.13	13.45
Potassium	K	19	3.31	3.59	0	0
Praseodymium	Pr	59	36.03	40.75	5.03	5.49
Promethium	Pm	61	38.72	43.83	5.43	5.96
Protactinium	Pa	91	95.87	108.43	13.29	16.7
Radium	Ra	88	88.47	100.13	12.34	15.24
Radon	Rn	86	83.78	94.87	11.73	14.32
Rhenium	Re	75	61.14	69.31	8.65	10.01
Rhodium	Rh	45	20.22	22.72	2.7	2.83
Rubidium	Rb	37	13.4	14.96	1.69	1.75
Ruthenium	Ru	44	19.28	21.66	2.56	2.68
Samarium	Sm	62	40.12	45.41	5.64	6.21
Scandium	Sc	21	4.09	4.46	0.4	0.4
Selenium	Se	34	11.22	12.5	1.38	1.42
Silicon	Si	14	1.74	1.84	0	0
Silver	Ag	47	22.16	24.94	2.98	3.15
Sodium	Na	11	1.04	1.07	0	0
Strontium	Sr	38	14.17	15.84	1.81	1.87
Sulfur	S	16	2.31	2.46	0	0
Tantalum	Ta	73	57.53	65.22	8.15	9.34
Technetium	Tc	43	18.37	20.62	2.42	2.54
Tellurium	Te	52	27.47	31	3.77	4.03
Terbium	Tb	65	44.48	50.38	6.27	6.98
Thallium	Tl	81	72.87	82.58	10.27	12.21
Thorium	Th	90	93.35	105.61	12.97	16.2
Thulium	Tm	69	50.74	57.52	7.18	8.1
Tin	Sn	50	25.27	28.49	3.44	3.66
Titanium	Ti	22	4.51	4.93	0.45	0.46
Tungsten	W	74	59.32	67.24	8.4	9.67
Uranium	U	92	98.44	111.3	13.61	17.22
Vanadium	V	23	4.95	5.43	0.51	0.52
Xenon	Xe	54	29.78	33.62	4.11	4.42
Ytterbium	Yb	70	52.39	59.37	7.42	8.4
Yttrium	Y	39	14.96	16.74	1.92	2
Zinc	Zn	30	8.64	9.57	1.01	1.03
Zirconium	Zr	40	15.78	17.67	2.04	2.12

Innov-X Systems, Inc. World Headquarters | 100 Sylvan Road, Suite 500 | Woburn, MA 01801 USA | Tel: 1-781-938-5005 | Fax: 1-781-938-0128 | innovx.com