ANNUAL GROUNDWATER AND SURFACE WATER MONITORING REPORT
JANUARY 1 THROUGH DECEMBER 31, 2013
CAMPUS BAY, RICHMOND, CALIFORNIA

Prepared for

Zeneca Inc.

Prepared by

Terraphase Engineering Inc.
1404 Franklin Street, Suite 600
Oakland, California

January 31, 2014

Project Number 0009.002.015

terraphase
engineering

January 3, 2014

Ms. Barbara Cook, P.E.
Deputy Director, Cleanup Program
Site Mitigation Branch
C/O Lynn Nakashima
Department of Toxic Substances Control
700 Heinz Avenue, Suite 200
Berkeley, California

Subject: Annual Groundwater and Surface-Water Monitoring Report, January 1 through December 31, 2013, Campus Bay, 1390 South 49th Street, Richmond, California

Dear Ms. Cook:

Terraphase Engineering Inc. (Terraphase) has prepared the enclosed subject report on behalf of Zeneca Inc., to present groundwater and surface water monitoring data collected between January 1, 2013 through December 31, 2013 at the former Zeneca property, now known as Campus Bay, located in Richmond, California ("the Site"). This annual groundwater monitoring report was prepared to meet the requirements of the Site Investigation and Remediation Order, Docket No. IS/E-RAO 06/07-005 ("the Order"), issued by the Department of Toxic Substances Control (DTSC) on September 15, 2006. Terraphase is submitting this report to the DTSC to fulfill the requirements of the respondents under the Order.

If you have any questions or comments regarding the report, please feel free to contact me at 510-326-1473.

Sincerely,

For Terraphase Engineering Inc.

Andrew Romolo, P.G. (8110)
Vice President and Principal Geologist

Enclosure

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CONTENTS

TABLES

FIGURES

APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
1,2-DCA	1,2-dichloroethane
1,1,2,2-TCA	1,1,2,2-tetrachloroethane
AMR	annual groundwater and surface-water monitoring report
AMSL	above mean sea level
BAPB	Biologically Active Permeable Barrier
cis-1,2-DCE	cis-1,2-dichloroethene
CSV	Cherokee Simeon Venture I, LLC
DTSC	Department of Toxic Substances Control
ERD	enhanced reductive dechlorination
ft/ft	foot per foot
FS/RAP	Feasibility Study and Remedial Action Plan
HEA	Habitat Enhancement Area
HHRA	Human Health Risk Assessment
IMW	temporary monitoring well prefix
MW	monitoring well prefix
ORP	oxidation-reduction potential
PCE	tetrachloroethene
PZ	piezometer prefix
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
SSG	Site-Specific Goal
SMR	Semi-Annual Groundwater and Surface Water Monitoring Report
SU	standard unit
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

VC	vinyl chloride

CERTIFICATION

All hydrogeologic and geologic information, conclusions, and recommendations in this document have been prepared under the supervision of and reviewed by a Terraphase Engineering, Inc. California Professional Geologist.

1/31/2014

Andrew Romolo

Date

Principal Geologist
California Professional Geologist (8110)

1.0 INTRODUCTION

Terraphase Engineering Inc. (Terraphase) has prepared this annual groundwater and surface-water monitoring report (AMR) on behalf of Zeneca Inc. for the former Zeneca property, now known as Campus Bay, located in Richmond, California ("the Site"; Figures 1 and 2). Groundwater and surface-water monitoring is being performed in accordance with the requirements of the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) Site Investigation and Remediation Order, Docket No. IS/E-RAO 06/07-005 ("the Order"), which was issued by the DTSC on September 15, 2006. Terraphase has prepared this AMR to fulfill the reporting obligations of the respondents under the Order; namely, Zeneca Inc., The Regents of the University of California, Bayer Crop Science Inc., and Cherokee Simeon Venture I, LLC (CSV).

This AMR presents the data from groundwater and surface-water samples collected from January 1 to December 31, 2013 ("the Reporting Period") and provides the historical chemical concentration data trends from January 2003 through December 2013. Groundwater and surface-water monitoring were conducted in accordance with the "Comprehensive Monitoring Plan, Subunit 1 of Meade Street Operable Unit, Former Zeneca Inc., Richmond Facility, Richmond, California," dated November 7, 2002 (LFR 2002), as modified by the California Regional Water Quality Control Board's review comments.

As discussed in the project monthly update reports and presented in the project schedules submitted to the DTSC, the Feasibility Study (FS) and Remedial Action Plan (RAP) for the Site uplands (Lot 1, Lot 2, and Lot 3) have been prepared and submitted to the DTSC for review. Therefore, the format of the groundwater and surface water monitoring reports were revised to more efficiently communicate concentration trends and therefore allow for a more efficient assessment of future remedial actions that will be implemented in accordance with the FS/RAP. The AMR format will present the results for monitoring data collected during the Reporting Period from groundwater monitoring wells and surface water sampling locations that are part of the regular monitoring program at the Site. The data will be assessed to identify any significant changes in site conditions relative to what was previously reported in the 2012 AMR.

1.1 Site Information

The following summarizes the Site information.

Site Location	Campus Bay 4677 Meade Street Richmond, California 94804
Site Contact	Charles Elmendorf

	Zeneca Inc. 1800 Concord Pike P.O. Box 15437 Wilmington, Delaware 19850-5437
Primary Consultant/Contact Person	Andrew Romolo, P.G. (8110) Vice President and Principal Geologist Terraphase Engineering Inc. 1404 Franklin Street, Suite 600 Oakland California 94612 (510) 326-1473
Lead Regulatory Agency	Department of Toxic Substances Control (DTSC)
Lead Regulatory Agency Contact	Lynn Nakashima Department of Toxic Substances Control 700 Heinz Avenue, Suite 200 Berkeley, California 94710-2721 (510) 540-3839

2.0 WORK PERFORMED THIS MONITORING PERIOD

The following presents the groundwater and surface-water monitoring activities completed at the Site during the Reporting Period. For reference, this section also discusses additional field activities conducted at the Site during the Reporting Period that are not directly related to groundwater and surface-water monitoring.

- Semi-annual groundwater level measurements and sampling took place April 1 through April 10, 2013, and from October 7 to October 17, 2013. The groundwater sampling, monitoring and laboratory analysis were completed in accordance with the sample matrix provided in Appendix A.

- Monitoring of three storm-drain outfall locations took place during rain events. However, rain events that occurred during the Reporting Period did not result in sufficient discharge to allow for sample collection. In November 2013, the tubing attached to the storm water auto samplers was replaced as a best management practice.

- In accordance with the DTSC approved “Work Plan to Conduct Verification Soil and Groundwater Sampling on Lot 3, Campus Bay, Richmond California” (Terraphase 2012), five temporary groundwater monitoring wells (IMW-58, IMW-59, IMW-60, IMW-61, and IMW-62) were installed, developed, and sampled between April 15, 2013 and May 2, 2013. Terraphase submitted to the DTSC an August 2, 2013 technical memorandum (Terraphase 2013b) that summarized the well installation activities and provided the groundwater data collected from the monitoring wells. . The DTSC approved this work with the provision that the five newly installed monitoring wells be added to the groundwater monitoring well network. To accommodate this DTSC requirement, the newly installed wells were included in the October 2013 monitoring event and the sampling results are included in this AMR.

- In accordance with the DTSC approved “Treatability Study Work Plan: Biologically Active Permeable Barrier” (Terraphase 2013a; “the Treatability Study”), soil samples were collected from the BAPB in the vicinity of well MW-9 on April 30, 2013, and groundwater samples were collected from MW-9 and MW-29 on May 13, 2013. In further support of the Treatability Study, additional groundwater was sampled from MW-9 on August 29, 2013.Terraphase continues to work on the treatability study.

- Inspection and repairs of the temporary cap in January and February 2013 (conducted by Arcadis US) as reported in the Arcadis July 31, 2013, “2013 Temporary Cap Inspection Summary, January through June 2013, Lot 3, Campus Bay, Richmond, California, Department of Toxic Substances Control Site Investigation and Remediation Order, Docket No. 06/07-005” (Arcadis 2013b).

- Collected soil and sediment samples from the Habitat Enhancement Area 2 as part of site characterization and pilot study activities in accordance with the “Revised Pre-Design Investigation Work Plan, Habitat Enhancement Area 2, Campus Bay Site, Richmond, California” (Arcadis 2013a).

- The well repairs required by the DTSC in a letter dated June 3, 2013 were completed on June 27, 2013.

- In May 2013, East Bay Municipal Utility District (EBMUD) completed maintenance on an EBMUD owned and operated water main at the Site. The maintenance activities took place from May 6, 2013 through May 8, 2013 on a water main situated along 47th Street at the Site. Prior to the maintenance activities, this water main extended from the Meade Street entrance of the Site, ran along 47th Street and terminated in the northern portion of Lot 3 at the Site.

  During routine temporary cap maintenance activities, a puddle of water was observed in the northern portion of Lot 3, in the area where 47th street would transverse the property. Terraphase retained a contractor to locate the EBMUD water main and perform an acoustical survey to assess if it was leaking. Based on the acoustical survey, EBMUD was contacted to survey the water main to assess if it was leaking. Survey activities performed by EBMUD indicated that the water main may potentially have a slow water leak. Therefore, it was determined to cap the line at a location north of the Lot 3 temporary cap. EBMUD worked with the DTSC to develop a scope of work to cap the line at a location approximately 30 feet south of the Lot 1 and 2 boundary, along the path of 47th street. Prior to mobilizing to the Site, EBMUD prepared a health and safety plan to account for worker exposure to the contaminants of concern identified at the Site. In addition, EBMUD retained a HAZWOPER trained contractor to complete the maintenance activities.

On May 6, 2013, EBMUD mobilized to the Site to expose the area of the water main that would be cut and capped. On May 7, 2013, EBMUD capped the water line and the excavation was backfilled on May 8, 2013. EBMUD was able to use the excavated material as backfill and therefore imported material was not required.

During future temporary cap inspections, the area on Lot 3 corresponding with the water main leak will be monitored. To date, since the repair, there has not been pooling of water observed on Lot 3 in the area of 47th street.

3.0 GROUNDWATER MONITORING SUMMARY

Project Phase	Groundwater Monitoring and Sampling
Number of wells Monitored/Sampled	In April, depth to water measurements were collected from 81 monitoring wells and piezometers. Groundwater samples were collected from 75 monitoring wells and piezometers. Temporary monitoring wells IMW-58, IMW-59, IMW-60, and IMW-61, and IMW-62 were installed after the April sampling event was complete. Therefore, in October, depth to water measurements were collected from 86 monitoring wells and piezometers. Groundwater samples were collected from 80 monitoring wells and piezometers. A map of sample locations within the semi-annual monitoring network is presented in Figure 2. The groundwater monitoring well construction details are summarized in Table 1.
Frequency of Monitoring/Sampling	Semi-annual
Groundwater	Groundwater elevation ranged from 2.47 to 12.01 feet above sea

Elevation Range	level (AMSL) (National Geodetic Vertical Datum) during the April 2013 sampling event. Groundwater elevation ranged from 1.32 to 11.60 feet AMSL during the October 2013 sampling event. Table 2 provides current and historical depth to groundwater and groundwater elevation data for the Site.
Groundwater Horizons	Two water bearing units have previously been identified at the Site (LFR 2007 and 2008): the Upper horizon (defined as groundwater shallower than 25 feet bgs) and the Lower horizon (defined as groundwater greater than 25 feet bgs).
Groundwater Gradient and Flow Direction	**Upper Horizon Groundwater** In April 2013, the hydraulic gradient between wells MW-24 and MW-26 was calculated as 0.0015 ft/ft and the groundwater flow direction was generally to the south. Groundwater generally flowed south at a gradient of approximately 0.0013 ft/ft in the area between wells MW-32A and MW-7. In October 2013, the hydraulic gradient between wells MW-24 and MW-26 was calculated as 0.0028 ft/ft and the groundwater flow direction was generally to the south. Groundwater generally flowed south at a gradient of approximately 0.0033 ft/ft in the area between wells MW-32A and MW-7. In the southern portion of the Site, higher groundwater elevations were reported in the vicinity of well MW-19 during both sampling events. This was likely related to pilot study activities completed in this area in 2010. **Lower Horizon Groundwater** In April 2013, the hydraulic gradient between wells IMW-29 and MW-10B was calculated as 0.0037 ft/ft and the groundwater flow direction was generally to the south. In October 2013, the hydraulic gradient between wells IMW-29 and MW-10B was calculated as 0.0038 ft/ft and the groundwater flow direction was generally to the south. The flow directions and gradient are generally consistent with the measurements collected during previous reporting periods.

	Groundwater elevation contour maps from April 2013 for upper horizon and lower horizon groundwater are provided in Figures 3A and 4A, respectively. Groundwater elevation contour maps from October 2013 for upper and lower horizon groundwater are provided in Figures 3B and 4B, respectively. Groundwater flow is variable due to tidal influences. Tide data is included in Attachment A-2 for April 1, 2013 and for October 17, 2013, the dates on which depth to groundwater measurements were collected.
Upper Horizon/Lower Horizon Vertical Gradient	The vertical gradient between the upper and lower horizons in monitoring well pairs was measured to be downward at three locations (MW-10A/10B, MW-11A/11B, and MW-16A/16B). An upward gradient was measured at well pair MW-32A/32B. It should be noted that vertical gradients in the vicinity of ESM are influenced by the tidal cycle and can vary depending on the time the measurement was collected relative to the tidal cycle.
Field Measurements	The field measurements recorded during the collection of groundwater samples during the Reporting Period are included in Table 6.
Analytical Results	Tables 3 through 6 present groundwater analytical data for groundwater samples collected during the Reporting Period. Details regarding screening criteria are presented in Table 7 and are based on site-specific goals (SSGs) presented in the Revised Human Health Risk Assessment (HHRA) prepared by Erler & Kalinowski, Inc. (EKI 2008) and the revised SSG for TCE prepared by Terraphase (Terraphase 2012a). For reference, the applicable screening criteria presented in Table 7 are also included at the end of Tables 3, 4, 5, and 8. Isoconcentration maps are presented in Figures 5A, 5B, 7A, 7B, 9A, 9B, 11A, 11B, 13A, 13B, 15A, 15B, 17A, 17B, 19A, and 19B, which include results pertaining to upper horizon groundwater concentrations of PCE, TCE, vinyl chloride, 1,2-dichloroethane, arsenic, copper, nickel, and zinc. Corresponding lower horizon groundwater concentrations are presented in Figures 6A, 6B, 8A,

	8B, 10A, 10B, 12A, 12B, 14A, 14B, 16A, 16B, 18A, 18B, 20A and 20B, respectively. Groundwater analytical results for samples collected from each monitoring well since 2003 have been tabulated and are included electronically in Appendix B (on CD). Additionally, concentration-versus-time graphs for chemicals that exceeded screening criteria during the Reporting Period are presented in Appendix C (on CD).
Changes in Site Conditions	No significant changes in Site conditions were noted relative to the conditions reported in the 2012 Annual Monitoring Report or the 2013 Semi-Annual Monitoring Report.

3.1 Volatile Organic Compounds

The following table presents a summary of the wells that exceeded the screening criteria and a brief summary of the observed concentration trends in each well since groundwater monitoring began in the well. The trend analysis is based on a review of a best fit trend line for the data presented in the concentration-versus-time graphs provided in Appendix C (on CD). An 'X' in the table indicates an exceedance of the respective criterion. Subscripts are used in instances where an exceedance occurred during only one sampling event.

Well ID	**Ground-water Horizon**	**Analyte**	**Residential SSG**	**Commercial/ Industrial SSG**	**Groundskeeper/ Maintenance Worker SSG**	**5x, 40x, or 160x Aquatic Criteria**	**Drinking Water Standard**	**Trend**
Lot 1								
Lot 1-2 ERD Pilot Study Area (pilot study implemented in Oct – Nov 2006)								
IMW-1	UH	VC	**X**	**X**			**X**	Increasing trend from August 2007 to November 2010; stabilizing since November 2010
IMW-2	UH	VC	**X**	**X**			**X**	Decreasing since August

Well ID	Ground-water Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
								2009
IMW-3	UH	VC	$\mathbf{X}_A$				**X**	Decreasing since November 2010
IMW-4	UH	VC	**X**	$\mathbf{X}_A$			**X**	Decreasing since April 2011
Lot 1-5 & MW-25 ERD Pilot Study Area (implemented November – December 2009)								
IMW-15	LH	cis-1,2-DCE					**X**	Decreasing since May 2010
		TCE					$\mathbf{X}_O$	First detection above laboratory reporting limit since October 2009
		VC					**X**	Decreasing since May 2010
IMW-16	LH	cis-1,2-DCE					**X**	Increasing since May 2010
		TCE					$\mathbf{X}_A$	Decreasing since October 2009
		VC					**X**	Increasing since October 2010
IMW-17	LH	cis-1,2-DCE					**X**	Increasing since February 2010
		TCE					**X**	Decreasing since September 2006

Well ID	Ground-water Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
		VC					$\mathbf{X_O}$	Decreasing since November 2010
IMW-23	UH	TCE					**X**	Decreasing since February 2010
IMW-26	UH	cis-1,2-DCE					**X**	Increasing since August 2010
		VC	$\mathbf{X_O}$	$\mathbf{X_O}$			$\mathbf{X_O}$	First exceedance since installation in 2009
IMW-27	UH	cis-1,2-DCE					**X**	Increasing since August 2010
		PCE	$\mathbf{X_O}$	$\mathbf{X_O}$	**X**		**X**	Increasing since October 2009
		TCE	**X**				**X**	Concentration fluctuates, but overall decreasing since May 2010
		VC	$\mathbf{X_O}$				$\mathbf{X_O}$	First exceedance since installation in 2009
IMW-28	UH	cis-1,2-DCE					**X**	Decreasing since November 2010
		TCE	$\mathbf{X_A}$	$\mathbf{X_A}$			**X**	Decreasing since October 2009

Well ID	Groundwater Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
		VC	**X**	**X**	X_o		**X**	Increasing since November 2010
IMW-29	LH	cis-1,2-DCE					**X**	Decreasing since November 2010
		TCE					X_o	Decreasing since October 2009
		VC					**X**	Increasing since August 2010
IMW-30	UH	cis-1,2-DCE					**X**	Increasing since February 2010
IMW-31	UH	cis-1,2-DCE					**X**	Fluctuates, but overall stable since February 2010
		VC	**X**	X_o			**X**	Decreasing trend from February 2010 to October 2011; increasing since October 2011
IMW-33	LH	cis-1,2-DCE					**X**	Fluctuates, but overall stable since May 2010
		TCE					**X**	Decreasing since October 2009
MW-25R	UH	cis-1,2-DCE					**X**	Increasing since May 2010
		PCE	**X**	**X**	**X**		**X**	Fluctuates (no

Well ID	Ground-water Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
								observable trend since monitoring began in October 2009)
		TCE	**X**	**X_O**			**X**	Concentrations fluctuate, but overall decreasing since October 2009
		VC	**X_O**	**X_O**			**X_O**	Fluctuates
MW-27	UH	TCE					**X**	Decreasing since December 2005
MW-33	UH	TCE					**X**	Decreasing since November 2009
PZ-11	UH	cis-1,2-DCE					**X**	Increasing since October 2009
		PCE					**X**	Decreasing from October 2009 to April 2011; stable since April 2011
		trans-1,2-DCE					**X**	Stable**
		TCE	**X**	**X_O**			**X**	Decreasing since October 2009
		VC	**X_A**				**X_A^***	NA - First detection in recent years
PZ-12	UH	cis-1,2-DCE					**X_O**	Fluctuates, but overall stable

Well ID	Ground-water Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
								since October 2009
		VC	**X**	**X**			**X**	Increasing since May 2011
Lot 2								
Lot 2-27 ERD Pilot Study Area (pilot study implemented November 2006)								
IMW-22	UH	cis-1,2-DCE					**X**	Increasing since November 2010
		VC	**X**	**X**			**X**	Increasing since May 2010
IMW-5	UH	VC	X_O				**X**	Decreasing since August 2008 (approaching laboratory detection limit)
IMW-6	UH	1,2-DCA					**X**	Decreasing since August 2008
		cis-1,2-DCE					X_O	Decreasing since March 2007
		TCE					X_O	Decreasing since March 2007
		VC	**X**				**X**	Stable since April 2010
IMW-7	UH	1,2-DCA	**X**	X_A			**X**	Decrease from September 2006 to August 2008. Stable since August 2008

Well ID	Ground-water Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
		cis-1,2-DCE					**X_A* X_O**	Increase from September 2006 to March 2007 followed by sharp decrease from March 2007 to August 2007; Concentrations stable since August 2007
		VC					**X_A***	Concentrations fluctuate, but overall decrease since March 2007
IMW-8	UH	cis-1,2-DCE					**X**	Increase from September 2006 to March 2007 followed by decrease from March 2007 to August 2008; Concentrations stable since August 2008
		VC	**X**	**X**			**X**	Stable since February 2008
MW-31	UH	1,2-DCA					**X**	Decreasing since November 2006
		TCE					**X**	Decrease from April 2006 to February 2008. Stabilizing since February 2008

Well ID	**Ground-water Horizon**	**Analyte**	**Residential SSG**	**Commercial/ Industrial SSG**	**Groundskeeper/ Maintenance Worker SSG**	**5x, 40x, or 160x Aquatic Criteria**	**Drinking Water Standard**	**Trend**
WRC-1 Area (soil removal in 2001)								
MW-24	UH	Toluene					X_A	Decreasing
Lot 3								
MW-18	UH	PCE	X_A		**X**			Increasing since July 2003
MW-22	UH	1,2-DCA	X_A					Decreasing since August 2003
		TCE	**X**	**X**				Decreasing since August 2009
		VC	**X**	**X**				Concentrations fluctuates, but overall decreasing since July 2003
Immediately Upgradient of BAPB								
MW-13	UH	PCE	X_O	X_O	X_O			Concentrations fluctuate, but overall decrease since July 2004
MW-29	UH	Benzene	X_O					Fluctuates since monitoring began in April 2006
		PCE	**X**	X_O	**X**			Fluctuates since monitoring began in April 2006; increase from April 2013 to October 2013
Within BAPB								

Well ID	Ground-water Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
MW-3	UH	VC	X_A					Not detected from January 2003 to October 2011; increase since October 2011
Downgradient of BAPB								
MW-16A	UH	PCE	X_O		X_O			Concentrations fluctuate, but overall decrease since October 2003
MW-28	UH	PCE			X_A			Decreasing since February 2007
MW-19 ERD Pilot Study Area (Implemented January – February 2011)								
MW-19	UH	VC	X	X	X			Not detected from January 2003 to October 2011; increasing since October 2011
MW-32A	UH	1,1,2,2-TCA	X_A					Increasing**
		Chloroform	X	X_A				Stable/ Increasing
		PCE	X		X			Stable
IMW-42	UH	PCE	X	X	X			--
		TCE	X_A	X_A				--
MW-21 ERD Pilot Study Area (implemented November – December 2010)								
MW-21	UH	PCE	X	X	X			Stable/Increasing
IMW-45	UH	VC	X	X				--
IMW-48	UH	PCE	X_O		X			--

Well ID	Ground-water Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
Lot 3 Subarea ERD Pilot Study Area (implemented January 2011)								
IMW-50	UH	VC	**X**	**X**				--
IMW-57	UH	Benzene	**X**	**X**				--
		VC	**X**	**X**				--
Lot 3 Groundwater Investigation (Implemented April-May 2013)								
IMW-58	UH	VC	**X**					--
IMW-59	UH	VC	**X**	X_O				--
IMW-60	UH	PCE	**X**	X_O	**X**			--
		VC	X_M					--
IMW-61	UH	VC	**X**	X_M				--
IMW-62	UH	PCE	**X**		**X**			--
		VC	**X**	**X**	X_O			--

Table Notes:

X = exceedance during April and October sampling events (or May and October sampling events, as in the case of the five Lot 3 Groundwater investigation temporary monitoring wells initially sampled in May)

X_A = exceedance during April sampling event

X_M = exceedance during May sampling event (only applies to the five Lot 3 Groundwater investigation temporary monitoring wells initially sampled in May)

X_O = exceedance during October sampling event

UH = upper horizon
LH = lower horizon
ERD = enhanced reductive dechlorination
1,2-DCA = 1,2-dichloroethane
cis-1,2-DCE = cis-1,2-dichlorothene

1,1,2,2-TCA = 1,1,2,2-tetrachloroethane
PCE = tetrachloroethene
TCE = trichloroethene
trans-1,2-DCE = trans-1,2-dichloroethene
VC = vinyl chloride

* = the analytical result exceeded the indicated screening criteria for either the primary or duplicate sample, but not both.

** = the analyte is rarely detected at concentrations exceeding screening criteria and therefore time-concentration charts are not included in Appendix C

-- = these wells were recently installed and there is not enough data at this time to report on the presence of a concentration trend. Concentration trends will be identified upon further data collection.

3.2 Metals

The following table presents a summary of the wells that exceeded the screening criteria and a brief summary of the observed concentration trends in each well since groundwater monitoring began in the well. The trend analysis is based on a review of a best fit trend line for the data presented in the concentration-versus-time graphs provided in Appendix C (on CD). An 'X' in the table indicates an exceedance of the respective criterion. Subscripts are used in instances where an exceedance occurred during only one sampling event.

Well ID	**Groundwater Horizon**	**Analyte**	**Residential SSG**	**Commercial/ Industrial SSG**	**Groundskeeper/ Maintenance Worker SSG**	**5x, 40x, or 160x Aquatic Criteria**	**Drinking Water Standard**	**Trend**
Lot 1								
Lot 1-2 Pilot Study Area								
IMW-1	UH	Arsenic					**X**	Decreasing since January 2007
IMW-2	UH	Arsenic					**X**	Decreasing since April 2007
IMW-3	UH	Arsenic					**X**	Decreasing since August 2008
IMW-4	UH	Arsenic					**X**	Decreasing since May 2008

Well ID	**Groundwater Horizon**	**Analyte**	**Residential SSG**	**Commercial/ Industrial SSG**	**Groundskeeper/ Maintenance Worker SSG**	**5x, 40x, or 160x Aquatic Criteria**	**Drinking Water Standard**	**Trend**
Lot 1-5 & MW-25 Pilot Study Area								
IMW-29	LH	Arsenic					**X**	Stabilizing/decreasing since April 2011
MW-30	UH	Arsenic					**X**	Decreasing since November 2006
PZ-11	UH	Cadmium					**X_A**	Stable**
	UH	Nickel					**X**	Increasing since February 2010
Lot 2								
Lot 2-27 Pilot Study Area								
IMW-5	UH	Arsenic					**X**	Fluctuates since September 2006
IMW-6	UH	Arsenic					**X**	Fluctuates, but overall decreasing since August 2007
IMW-8	UH	Arsenic					**X**	Fluctuates, but stable since May 2007
Lot 3								
MW-18	UH	Copper				**X**		Fluctuates, but overall increasing since July 2003
		Nickel				**X**		Fluctuates, but generally stable since May 2009
		Zinc				**X**		Fluctuates, but stable since January 2004
Immediately Upgradient of BAPB								
MW-2	UH	Arsenic			**X**	**X**		Increasing since March 2003
MW-6	UH	Arsenic			**X**	**X**		Fluctuates, but overall decreasing since June 2006. The most previous

Well ID	Groundwater Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
								sampling event showed an increase relative to the recent previous events.
		Copper				X_O		Fluctuates
MW-13	UH	Nickel				X_O		Fluctuates
		Zinc				X_O		Fluctuates
MW-29	UH	Zinc				X_O		Fluctuates
Within BAPB								
MW-9	UH	Arsenic			**X**	**X**		Increase from January 2003 to November 2006, but stable since November 2006
Downgradient of BAPB								
MW-1	UH	Arsenic			**X**			Fluctuates, but overall decreasing since October 2004
MW-10B	LH	Copper				X_A		Fluctuates, but overall increasing since February 2005
MW-11A	UH	Copper				**X**		Fluctuates, but stable since February 2007
		Zinc				X_O		Fluctuates; stable since April 2011
MW-11B	LH	Copper				X_A		Decreasing since January 2004
MW-16A	UH	Arsenic			**X**	**X**		Stable since August 2006
		Nickel				X_O		Fluctuates; October 2013 result is the first detection since November 2010

Well ID	Groundwater Horizon	Analyte	Residential SSG	Commercial/ Industrial SSG	Groundskeeper/ Maintenance Worker SSG	5x, 40x, or 160x Aquatic Criteria	Drinking Water Standard	Trend
MW-17	UH	Arsenic			**X**	**X**		Decreasing since October 2011
MW-28	UH	Zinc				**X**		Fluctuates, but increasing since November 2009
MW-4	UH	Arsenic			**X**	**X**		Fluctuates, but overall decreasing since January 2004
MW-5	UH	Arsenic			**X**	X_A		Increasing since February 2008
PZ-14	UH	Arsenic			**X**	**X**		Increasing since November 2009
MW-19 Pilot Study Area								
MW-32A	UH	Nickel				**X**		Increasing since August 2008
		Zinc				X_A		Increasing since August 2008
MW-32B	LH	Copper				**X**		Increasing since August 2008
		Nickel				**X**		Decreasing since August 2008
		Zinc				**X**		Decreasing since August 2008
IMW-42	UH	Nickel				X_O		--
MW-21 Pilot Study Area								
IMW-48	UH	Copper				**X**		--
		Nickel				**X**		--
		Zinc				**X**		--

Table Notes:

X = exceedance during April and October sampling events

X_A = exceedance during April sampling event

X_O = exceedance during October sampling event

UH = upper horizon
LH = lower horizon

** = the analyte is rarely detected at concentrations exceeding screening criteria and therefore time-concentration charts are not included in Appendix C

3.3 Pesticides

Concentrations of pesticides exceeded the site-specific screening criteria in the sample collected from 1 monitoring well during the Reporting Period (Table 5). The well and the applicable screening criterion which was exceeded are indicated in the following table.

Well ID	**Groundwater Horizon**	**Analyte**	***Residential SSG***	**Commercial/ Industrial SSG**	**Groundskeeper/Maintenance Worker SSG**	**5x, 40x, or 160x Aquatic Criteria**	**Drinking Water Standard**	**Trend**
Lot 3								
Downgradient of the BAPB								
PZ-14	UH	Pebulate				**X**		Fluctuates

Table Notes:
X = exceedance during April and October sampling events
UH = upper horizon

4.0 SURFACE WATER MONITORING SUMMARY

Project Phase	Surface Water Monitoring
Sampling Locations	Depending on weather conditions, surface-water monitoring may be conducted at the three storm-drain outfall locations shown on Figure 2 (001, 002, and 003). Outfall 001 is located at the lower Freshwater Lagoon (FWL) and Outfall 002 is located at the upper FWL. Outfalls 001 and 002 discharge to East Stege Marsh (ESM). Outfall 003 discharges to San Francisco Bay ("the Bay") in the tidal mud flats immediately south of ESM (LFR 2008a).
Frequency of	As-needed based on weather conditions. No surface water samples

Sampling	were collected during this Reporting Period.
Analytical Results	No surface water samples were collected during this Reporting Period.
Changed Conditions	During the reporting period, standing water in the Upper Lagoon has evaporated. This may be the result of the December 2012 installation of the valve in the outlet pipe of the storm water interceptor manhole #2. This valve was installed to replace the malfunctioning valve at the end of the outlet pipe for storm water interceptor manhole #2 located within East Stege Marsh. Prior to the repair, due to the malfunctioning valve, water during high tide conditions was flowing from ESM into storm water interceptor manhole #2 through the outlet pipe. This condition would raise the water level within storm water interceptor #2 to an elevation that would trigger the pumps to activate and discharge water into the Upper Lagoon. The new valve installed within storm water interceptor manhole #2 is designed to intercept the backflow of bay water into the manhole and therefore may reduce the quantity of water discharged into the upper lagoon. During the reporting period, no standing water was observed in the Upper Lagoon.

5.0 INDICATOR PARAMETERS AND DISSOLVED METAL ANALYTICAL RESULTS FOR BAPB CLUSTER WELLS

The primary objective for the biologically active permeable barrier (BAPB) located at the Site (Figure 2) is to reduce the concentrations of divalent metals (cadmium, copper, nickel, lead, and zinc) in groundwater. Table 4 presents dissolved metals data, and Table 6 presents data for general minerals and pH for groundwater samples collected from monitoring wells at the Site. The combination of three wells positioned upgradient, within, and downgradient of the BAPB constitutes what is referred to in this AMR as a well cluster.[1] Table 8 summarizes the data specifically for the BAPB monitoring well clusters.

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[1] Terraphase recognizes that groundwater in the vicinity of the BAPB may not flow directly from an upgradient well, to the BAPB well, and then to the well downgradient from the BAPB. However, concentrations measured in a sample collected from a given well are assumed to be representative of the general conditions in the vicinity of that well. Therefore, conditions within the cluster wells are used to assess the general efficacy of the BAPB.

Project Phase	BAPB Cluster Wells
Sampling Locations	Well Cluster MW-8/-9/-28 Well Cluster MW-2/-3/-4 Well Cluster MW-13/-14/-15
Analytical Results	Table 8 presents the dissolved metals concentrations in the BAPB cluster wells. The applicable screening criteria are also provided in Table 8. A discussion of the metal concentrations detected in the BAPB cluster wells is provided below.
Geochemical /Biochemical Parameters	The objective of the BAPB is to reduce concentrations of dissolved divalent metals in groundwater migrating toward ESM by altering the geochemistry of the groundwater. Sulfate-reducing bacteria use organic carbon as a food source (electron donor) to create anaerobic conditions within the BAPB. The oxidation of the organic carbon by the sulfate-reducing bacteria is coupled with the reduction of sulfate to sulfide. The sulfides then react with dissolved iron and metals to create a low-solubility metal-iron-sulfide precipitate, thereby lowering the dissolved metals concentrations in groundwater passing through the BAPB. Organic carbon is supplied by leafy compost that is a major component of the BAPB. The BAPB was not specifically designed to reduce organic chemicals migrating in upper horizon groundwater, but organic chemicals may undergo reductive dehalogenation when they enter the reducing zone created by the BAPB. In addition to measuring metals and VOC concentrations in groundwater, geochemical and biochemical indicator parameters are monitored in BAPB cluster wells to assist in evaluating the effectiveness of the BAPB in buffering groundwater and creating reducing conditions necessary for the precipitation of dissolved metals as groundwater migrates through the BAPB. These parameters, which include pH, ORP, alkalinity, and ferrous iron, provide an indication of geochemical conditions in the groundwater. The ORP, iron, sulfate, and sulfide measurements provide an indication of groundwater redox conditions. Alkalinity and pH measure the effectiveness of the BAPB in buffering any remaining acid in the groundwater. Alkalinity is also an indirect measure of

biological activity due to carbon dioxide production by microorganisms.

The pH and alkalinity data indicate that the BAPB appears to be effectively buffering groundwater. During the Reporting Period, the pH in groundwater samples from BAPB wells MW-3, MW-9, and MW-14 ranged from 6.42 SU to 6.93 SU. The pH range in the corresponding upgradient wells, wells MW-2, MW-8, and MW-13, was 5.90 SU (measured in well MW-13 in October 2013) to 6.65 SU (measured in well MW-8 in October 2013). In all three well clusters, the pH values in the wells within the BAPB were higher than the pH in the corresponding upgradient well.

In the well cluster MW-8/9/28, alkalinity was lower in the groundwater samples from the BAPB well compared to the upgradient well (130 µg/L and 140 µg/L, respectively in April 2013, and 210 and 220 µg/L, respectively in October 2013). In the well cluster MW-2/3/4, alkalinity was higher in the BAPB well as compared to the upgradient well (650 µg/L and 230 µg/L, respectively in April 2013, and 1,500 and 310 µg/L, respectively in October 2013). In April 2013, at well cluster MW-13/14/15, alkalinity was lower in the BAPB well as compared to the upgradient well (230 µg/L and 440 µg/L, respectively). In October 2012, alkalinity was higher in the BAPB well compared to the upgradient well (1,400 µg/L and 32 µg/L, respectively).

The ORP results indicate that the BAPB is creating reducing conditions near all three well clusters as shown by the negative ORP values (Table 8). Ferrous iron concentrations were lower in groundwater samples from within the BAPB wells than in samples from their corresponding upgradient wells. Ferrous iron concentrations are decreasing either because ferrous iron is being further reduced or because it is precipitating with sulfides (as ferrous sulfide).

Sulfate concentrations were lower or similar in groundwater samples from BAPB wells relative to their corresponding upgradient wells in all three well clusters. Decreasing sulfate concentrations are an indication of sulfate-reducing conditions.

	In the MW-2/3/4 and MW-8/9/28 wells clusters, sulfide concentration in the BAPB increased compared to the concentrations observed upgradient of the BAPB. In the MW-12/13/14 well cluster, sulfide concentrations upgradient of the BAPB were below the laboratory reporting limit during both sampling events, and sulfide concentrations in the BAPB were below the laboratory reporting limit in April 2013 and 0.2 µg/L in October 2013. The downgradient sulfide concentrations were below the laboratory reporting limit for all three well clusters. The presence of dissolved sulfide is an indication of strongly reducing conditions and the activity of sulfate reducing bacteria. Table 8 presents geochemical/biochemical indicator parameters in the BAPB cluster wells. When comparing the indicator parameter data in the upgradient wells to those within the BAPB and downgradient from the BAPB, the data generally indicate that the BAPB continues to function as intended. Indicator parameters will continue to be monitored and evaluated during future monitoring events.
BAPB Function	When comparing the metals concentrations in the upgradient wells to those within the BAPB and downgradient from the BAPB, the data indicate that the BAPB continues to function as intended.
Divalent Metal Concentrations at the BAPB	<u>Well Cluster MW-2/-3/-4</u> Nickel was detected in well MW-2 in April 2013 at a concentration of 5.7 µg/L. Divalent metal concentrations in all other samples collected from this well cluster during the Reporting Period did not exceed the laboratory reporting limit. <u>Well Cluster MW-8/-9/-28</u> Copper and lead were not detected above the laboratory reporting limit in samples collected from this well cluster in April or October 2013. Nickel was not detected in wells MW-8 or MW-9, but was detected in well MW-28 in April and October 2013 at concentrations of 17 µg/L and 19 µg/L, respectively. During both sampling events, zinc was detected in the sample collected from the well upgradient of the BAPB, but was not detected above the laboratory reporting limit in the sample collected from the well within the BAPB. Zinc was detected in the

sample collected from the well downgradient of the BAPB at concentrations that were greater than those in the well upgradient of the BAPB. The increase in zinc concentration was 691 µg/L in April 2013 and 636 µg/L in October 2013. An evaluation of the concentration trend graphs presented in Appendix C indicates that zinc concentrations in well MW-28 during the Reporting Period have decreased relative to results since 2009. Zinc results for this well cluster during the Reporting Period are presented in Table 8.

Well Cluster MW-13/-14/-15

Copper and lead were not detected above the laboratory reporting limit in samples collected from this well cluster in April and October 2013.

Nickel was not detected above the laboratory reporting limit in samples collected from this well cluster in April 2013. In October 2013, nickel concentrations decreased from 150 µg/L to <5 µg/L in the samples collected from the wells upgradient and downgradient of the BAPB, respectively. An evaluation of the concentration trend graphs provided in Appendix C indicates that the nickel data collected in April 2013 at this well cluster are consistent with recent monitoring results, but that nickel concentrations in the samples collected from wells MW-13 and MW-14 in October 2013 have increased relative to recent years. In October 2013, nickel was detected above the laboratory reporting limit for the first time since November 2010 in the sample collected from MW-13, at a concentration of 150 µg/L. Nickel was detected in the sample collected from well MW-14 at a concentration of 25 µg/L. Nickel results for this well cluster during the Reporting Period are presented in Table 8.

Zinc was detected in all 3 samples collected from this well cluster in April 2013 at concentrations of approximately the same magnitude (30 µg/L, 23 µg/L, and 59 µg/L for the wells upgradient of the BAPB, within the BAPB, and downgradient of the BAPB respectively). The greatest difference in divalent metals concentrations from the upgradient well to the wells within and downgradient of the BAPB was observed in this well cluster in October 2013. Zinc was detected at a concentration of 2,800 µg/L in the sample collected from well MW-13 upgradient of the BAPB, but was not detected

	above the laboratory reporting limit in the samples collected from wells MW-14 or MW-15. An evaluation of the concentration trend graphs provided in Appendix C indicates that the zinc data collected at this well cluster are consistent with previous monitoring results. Zinc results for this well cluster during the Reporting Period are presented in Table 8.
Arsenic Concentrations at the BAPB	The BAPB may be less effective in treating metalloids such as arsenic, which generally occurs as an oxyanion in groundwater. Arsenic is redox-sensitive and can be precipitated as sulfide compounds. However, under mildly reducing conditions, arsenic solubility can increase. Therefore, the BAPB may not be capable of maintaining dissolved arsenic concentrations below the ecological screening criteria for wells within or downgradient from the BAPB. Arsenic concentrations varied among the BAPB cluster wells during the Reporting Period and are discussed below. <u>Well Cluster MW-2/-3/-4</u> In April and October 2013, arsenic was detected in samples collected from the wells upgradient and downgradient of the BAPB. Arsenic concentrations in samples collected downgradient of the BAPB were slightly lower than arsenic concentrations in samples collected upgradient of the BAPB. An evaluation of the concentration trend graphs presented in Appendix C indicate that although arsenic concentrations at well MW-2 have increased over time, the arsenic concentrations at well MW-3 have decreased. The arsenic trend graph for well MW-4 indicates that overall concentrations have been decreasing, but appear to be on an increasing trend since April 2012. Overall, seasonal variation is observed in arsenic concentrations; however the seasonal concentration peaks have attenuated over time. Arsenic results for this well cluster during the Reporting Period are presented in Table 8. <u>Well Cluster MW-8/-9/-28</u> An evaluation of the concentration trend graph for well MW-8 (upgradient of the BAPB) indicates that from August 2006 through April 2011, arsenic concentrations were at or above the screening

criteria of 5X the AWQC (180 µg/L). However, arsenic concentrations for samples collected at MW-8 from October 2011 through October 2013 are below both the 5XAWQC criteria and the GMW criteria. At MW-9, within the BAPB, a review of the concentration trend graph indicates that since August 2006, arsenic concentrations in groundwater at MW-9 range between 470 µg/L and 690 µg/L. During the Reporting Period, arsenic was detected at 520 µg/L in April and 610 µg/L in October. At MW-28, downgradient of the BAPB, the arsenic concentration trend shows seasonal variability. However the concentration peaks have attenuated since 2006. During the Reporting Period, arsenic was detected at 74 µg/L in April and at 83 µg/L in October at MW-28, below the applicable screening criteria. Arsenic results for this well cluster during the Reporting Period are presented in Table 8.

Well Cluster MW-13/-14/-15

Arsenic was detected in all 3 samples collected from this well cluster in April 2013, at concentrations of approximately the same magnitude (6.3 µg/L, 29 µg/L and 31 µg/L for the wells upgradient of the BAPB, within the BAPB, and downgradient of the BAPB respectively). In October 2013, arsenic was not detected above the laboratory reporting limit in the sample collected from the well upgradient of the BAPB, but was detected in the samples collected from the wells within and downgradient of the BAPB at concentrations of 11 µg/L and 12 µg/L, respectively.

An evaluation of the concentration trend graphs for well MW-13 indicates that arsenic concentrations have remained at or slightly above laboratory reporting limits since 2004. Arsenic was not detected above the laboratory reporting limit in October 2011, April 2012, or October 2013, but in October 2012 and April 2013, the concentration slightly exceeded the reporting limit. At wells MW-14 and MW-15, the arsenic trend graphs indicate seasonal variability. However, since August of 2010, arsenic concentrations at well MW-14 have increased from below laboratory reporting limits (5 µg/L) to 62 µg/L in October 2011, then decreased to 29 µg/L in April 2012, and then increased to 57 µg/L in October 2012. Since October 2012, arsenic concentration in well MW-14 decreased to 29 µg/L in April 2013 and 11 µg/L in October 2013. Arsenic concentration at well

	MW-15 increased from 26 µg/L in May 2010 to 71 µg/L in October 2011, and has generally decreased since October 2011. Arsenic results for this well cluster during the Reporting Period are presented in Table 8.

6.0 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

Terraphase performed a quality assurance/quality control (QA/QC) evaluation of the data generated during the Reporting Period in general accordance with the Quality Assurance Project Plan (QAPP), dated July 18, 2005 (LFR 2005).

Equipment blanks collected on April 3, April 8, and April 9, 2013 had detections of arsenic, barium and molybdenum. The results for the groundwater samples collected on those days were consistent with the analytical results collected in previous sampling events and it is believed the metals detected in the equipment blank samples may been contained in the water used for the equipment blank sample. MTBE was detected in the equipment blank samples collected on April 4 and April 10, 2013. MTBE was not detected in the groundwater samples collected. Therefore, it is believed the MTBE was contained in the laboratory-supplied water used for the equipment blank sample. The data has been qualified, but the data is still valid and available for use in this report. The distilled water used for the equipment blank samples has been discarded and fresh distilled water will be obtained from the laboratory prior to future sampling events. In addition, the analytical data has been discussed with the laboratory in an effort to mitigate potential contamination in future containers of distilled water.

Data from the October sampling event was not qualified.

The results of the QA/QC evaluation are presented in Appendix D.

7.0 WORK PLANNED FOR THE FIRST HALF OF 2014

The following field activities are currently anticipated to occur during the first half of 2014:

- Upkeep and maintenance of the temporary cap will continue;
- Additional activities at the Site are summarized in monthly reports submitted to the DTSC by the Respondents on approximately the 15th of each month.
- Conduct semi-annual groundwater monitoring activities in April 2014.

8.0 REFERENCES

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