FINAL
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Annual Groundwater and Landfill Monitoring Report

2014 Long-Term Monitoring, Operable Unit A

Contract No. N44255-14-D-9011, LTM/OM / Task Order 05

Former Naval Complex

Adak, Alaska

Department of the Navy
Naval Facilities Engineering Command Northwest
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FINAL
ANNUAL GROUNDWATER AND LANDFILL MONITORING REPORT
2014 LONG-TERM MONITORING, OPERABLE UNIT A

FORMER NAVAL COMPLEX
ADAK, ALASKA

CONTRACT NUMBER: N44255-14-D-9011
LONG-TERM MONITORING/OPERATION AND MAINTENANCE/TASK ORDER 05

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EXECUTIVE SUMMARY

The groundwater and landfill monitoring at Operable Unit (OU) A of the Former Naval Complex, Adak, Alaska, was conducted in August and September 2014. The monitoring program for 2014 was implemented as described in the Comprehensive Monitoring Plan (CMP), Revision 6 (Navy 2014a) and the Performance Work Statement and Performance Requirements Summaries in the base contract award (Contract N44255-14-D-9011), Attachment I. Sealaska Environmental Services, LLC conducted the 2014 monitoring activities from August 24 through September 17, 2014.

During the 2014 monitoring event, groundwater, surface water, and sediment samples were collected from 111 monitoring locations at 19 sites. In addition, product thickness and depth-to-water measurements were performed at 158 locations from these sites. Monitoring was conducted to satisfy OU A Record of Decision (ROD; Navy, ADEC, and EPA 2000) remedy requirements and post-free product recovery remedy requirements established under the State-Adak Environmental Restoration Agreement (Navy and ADEC 1994). Monitoring was conducted to assess the remedies of monitored natural attenuation, limited groundwater monitoring, surface water protection, and compliance. Monitoring was also performed at four landfills to meet the objectives specified in the OU A ROD and the landfill closure plans.

Based on the previous monitoring results, the monitored natural attenuation remedies appear to be effective and biodegradation appears to be occurring to varying degrees at all of the monitored natural attenuation sites (Navy 2014d), and contaminant concentration data for 1999 through 2014 provide ample supporting evidence. Monitoring for natural attenuation parameters has been reduced from annually to every 5 years and was conducted at 101 monitoring locations in 2014.

Comparisons to endpoint criteria stated in the CMP, Revision 6 (Navy 2014a) provide the basis for evaluating the effectiveness of the remedy and monitoring program at each site. The monitoring program is modified annually based on long-term monitoring observations and in response to changing site conditions. The endpoint criteria apply human health and ecological risk-based criteria and the Alaska Department of Environmental Conservation (ADEC) (18 Alaska Administrative Code 75.345) groundwater cleanup levels. At sites where groundwater is not considered a drinking water source, 10 times the ADEC groundwater cleanup level is applied as endpoint criteria per decision documents.

Based on the 2014 monitoring program results, recommended changes in site-specific monitoring are presented in the following sections.

Area 303/GCI Compound

For this site, the following changes to the monitoring program are recommended:

- Discontinue sampling wells 03-502, 04-100, 04-202, MW-303-32, MW-303-39, MW-303-40, and MW-303-41.
- Initiate sampling wells 03-103 and 03-518 for DRO, GRO, and BTEX, and add GRO for analysis in well AMW-704.

Former Power Plant, Building T-1451

For this site, the following changes to the monitoring program are recommended:

- Discontinue sampling for indeno(1,2,3-cd)pyrene in surface water in sample NL-08.
- Discontinue sampling for 2-methylnaphthalene and phenanthrene in sediment sample NL-08.

Housing Area (Arctic Acres)

For this site, no changes to the monitoring program are recommended.

Naval Mobile Construction Battalion (NMCB) Building T-1416 Expanded Area

For this site, the following changes to the monitoring program are recommended:

- Discontinue sampling and water-level measurement at wells NMCB-09, 02-461, and E-201.
- Discontinue water-level measurement at well 02-301.

Resident Officer in Charge of Construction (ROICC) Contractor's Area, UST ROICC-7

For this site, no changes to the monitoring program are recommended.

Source Area (SA) 79, Main Road Pipeline, South End

For this site, no changes to the monitoring program are recommended.

SA 80, Steam Plant 4, USTs 27089 and 27090

For this site, no changes to the monitoring program are recommended.

South of Runway 18-36 Area

For this site, the following changes to the monitoring program are recommended:

- Discontinue sampling for DRO in well 02-231.
- Continue sampling for BTEX to support the TAH/TAqH calculations, but not for comparison with specific endpoint criteria.

SWMU 11, Palisades Landfill

For this site, no changes to the monitoring program are recommended.

SWMU 13, Metals Landfill

For this site, the following change to the monitoring program is recommended:

- Groundwater monitoring be changed to a five-year interval (prior to the five-year review) for arsenic and barium.
- Discontinue sampling for water quality parameters at the site (total Kjeldahl nitrogen, ammonia, alkalinity, sulfate, chemical oxygen demand, and total dissolved solids.)

SWMU 14, Old Pesticide Storage and Disposal Area

For this site, no changes to the monitoring program are recommended.

SWMU 17, Power Plant No. 3 Area

For this site, no changes to the monitoring program are recommended.

SWMUs 18/19, White Alice Landfill

For this site, the following changes to the monitoring program are recommended:

- Discontinue sampling for 10 nontarget dissolved and total metals (antimony, beryllium, cadmium, copper, lead, mercury, selenium, silver, thallium, and zinc).
- Discontinue sampling for water quality parameters at the site (total Kjeldahl nitrogen, ammonia, alkalinity, sulfate, chemical oxygen demand, and total dissolved solids).

SWMU 25, Roberts Landfill

For this site, the following changes to the monitoring program are recommended:

- Target VOCs (1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, tetrachloroethene, trichloroethene, and BTEX) in groundwater should be sampled on a once-every-five-year schedule (prior to the five-year review).
- Discontinue sampling for nontarget VOCs.
- Discontinue sampling for water quality parameters at the site (total Kjeldahl nitrogen, ammonia, alkalinity, sulfate, chemical oxygen demand, and total dissolved solids).

SWMU 55, Public Works Transportation Department Waste Storage Area

For this site, the following change to the monitoring program is recommended:

- Discontinue sampling for TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride at the site.

SWMU 60, Tank Farm A

For this site, the following changes to the monitoring program are recommended:

- Discontinue sampling for 2-methylnaphthalene and phenanthrene in sediment sample 852.
- Discontinue surface water sampling at location 852.

SWMU 61, Tank Farm B

For this site, the following changes to the monitoring program are recommended.

- Discontinue sampling surface water and sediment sampling at NL-04.
- Continue the shoreline inspections for visible evidence of contamination.

SWMU 62, New Housing Fuel Leak Area

For this site, the following changes to the monitoring program are recommended:

- Continue sampling for indeno(1,2,3-cd)pyrene in surface water in sample NL-09 to support the TAH/TAqH calculations, but not for comparison with specific endpoint criteria.
- Discontinue sampling for GRO, BTEX, 2-methylnaphthalene, and phenanthrene in sediment sample NL-09.

Tanker Shed, UST 42494

For this site, no changes to the monitoring program are recommended.

CONTENTS

EXECUTIVE SUMMARY ES-1

1 INTRODUCTION 1-1

1.1 PURPOSE OF MONITORING REPORT 1-1
1.2 OBJECTIVES OF MONITORING REPORT 1-1
1.3 REPORT ORGANIZATION 1-2

2 SITE DESCRIPTION AND ENVIRONMENTAL HISTORY 2-1

2.1 SITE DESCRIPTION 2-1
2.2 LONG-TERM MONITORING PROGRAM 2-1
2.2.1 Petroleum-Release and Non-Landfill CERCLA Sites 2-1
2.2.2 Landfill Sites 2-2
2.3 MONITORING PERFORMED IN 2014 2-4
2.3.1 Petroleum-Release and Non-Landfill CERCLA Sites 2-4
2.3.2 Landfill Sites 2-5

3 MONITORING TYPES AND ENDPOINTS 3-1

3.1 PETROLEUM-RELEASE AND NON-LANDFILL CERCLA SITES MONITORING 3-1
3.1.1 Petroleum Monitoring 3-1
3.1.2 Monitored Natural Attenuation Groundwater Sites 3-2
3.1.3 Statistical Trend Analysis Methods 3-5
3.1.4 Surface Water Protection Groundwater Monitoring Endpoint 3-6
3.1.5 CERCLA Compliance Groundwater Monitoring 3-7
3.1.6 Natural Recovery/Sediment and Surface Water Monitoring 3-9
3.2 LANDFILL SITES MONITORING 3-10
3.2.1 SWMU 11, Palisades Landfill 3-11
3.2.2 SWMU 13, Metals Landfill 3-11
3.2.3 SWMUs 18/19, White Alice Landfill 3-11
3.2.4 SWMU 25, Roberts Landfill 3-12
3.2.5 Endpoint Criteria 3-12

4 SAMPLING PROGRAM 4-1

4.1 FIELD ACTIVITIES 4-1
4.1.1 Field Measurements 4-1
4.1.2 Natural Attenuation Parameters Assessment 4-19
4.1.3 Visual Inspections 4-21
4.1.4 Environmental Sampling 4-29
4.1.5 Sample Preservation and Volume Requirements 4-30
4.1.6 Sample Custody and Holding Time Requirements 4-31
4.2 ANALYTICAL METHODS 4-33
4.3 INVESTIGATION-DERIVED WASTE 4-33

CONTENTS (continued)

5 DEVIATIONS 5-1

6 DATA QUALITY ASSESSMENT 6-1

6.1 QUALITY ASSURANCE/QUALITY CONTROL 6-1
6.1.1 Quality Assurance 6-1
6.1.2 Quality Control 6-2
6.1.3 Field Quality Control Samples 6-3
6.2 PRECISION 6-3
6.3 ACCURACY 6-5
6.4 COMPLETENESS 6-5
6.5 COMPARABILITY 6-6
6.6 REPRESENTATIVENESS 6-7

7 AREA 303/GCI COMPOUND, UST GCI-1 7-1

7.1 FIELD MEASUREMENTS 7-1
7.2 TARGET ANALYTE RESULTS 7-5
7.3 MONITORED NATURAL ATTENUATION 7-11
7.4 TREND EVALUATION 7-12
7.5 CONCLUSIONS 7-14
7.6 RECOMMENDATIONS 7-18

8 FORMER POWER PLANT, BUILDING T-1451 8-1

8.1 FIELD MEASUREMENTS 8-1
8.2 TARGET ANALYTE RESULTS 8-3
8.3 MONITORED NATURAL ATTENUATION 8-6
8.4 TREND EVALUATION 8-8
8.5 CONCLUSIONS 8-8
8.6 RECOMMENDATIONS 8-9

9 HOUSING AREA (ARCTIC ACRES) 9-1

9.1 FIELD MEASUREMENTS 9-1
9.2 TARGET ANALYTE RESULTS 9-3
9.3 MONITORED NATURAL ATTENUATION 9-3
9.4 TREND EVALUATION 9-5
9.5 CONCLUSIONS 9-5
9.6 RECOMMENDATIONS 9-6

10 NMCB BUILDING T-1416 EXPANDED AREA 10-1

10.1 FIELD MEASUREMENTS 10-1
10.2 TARGET ANALYTE RESULTS 10-3
10.3 MONITORED NATURAL ATTENUATION 10-5
10.4 TREND EVALUATION 10-6

CONTENTS (continued)

10.5 CONCLUSIONS 10-6
10.6 RECOMMENDATIONS 10-8

11 ROICC CONTRACTOR'S AREA, UST ROICC-7 11-1

11.1 FIELD MEASUREMENTS 11-1
11.2 TARGET ANALYTE RESULTS 11-3
11.3 MONITORED NATURAL ATTENUATION 11-3
11.4 TREND EVALUATION 11-4
11.5 CONCLUSIONS 11-5
11.6 RECOMMENDATIONS 11-5

12 SA 79, MAIN ROAD PIPELINE, SOUTH END 12-1

12.1 FIELD MEASUREMENTS 12-1
12.2 TARGET ANALYTE RESULTS 12-3
12.3 MONITORED NATURAL ATTENUATION 12-3
12.4 TREND EVALUATION 12-5
12.5 CONCLUSIONS 12-7
12.6 RECOMMENDATIONS 12-7

13 SA 80, STEAM PLANT 4, USTS 27089 AND 27090 13-1

13.1 FIELD MEASUREMENTS 13-1
13.2 TARGET ANALYTE RESULTS 13-3
13.3 MONITORED NATURAL ATTENUATION 13-3
13.4 TREND EVALUATION 13-5
13.5 CONCLUSIONS 13-5
13.6 RECOMMENDATIONS 13-6

14 SOUTH OF RUNWAY 18-36 AREA 14-1

14.1 FIELD MEASUREMENTS 14-1
14.2 TARGET ANALYTE RESULTS 14-3
14.2.1 Groundwater 14-4
14.2.2 Sediment 14-4
14.3 MONITORED NATURAL ATTENUATION 14-6
14.4 TREND EVALUATION 14-7
14.5 CONCLUSIONS 14-7
14.6 RECOMMENDATIONS 14-8

15 SWMU 11, PALISADES LANDFILL 15-1

15.1 BACKGROUND 15-1
15.2 SAMPLING HISTORY RELATED TO CLOSURE MONITORING 15-2
15.3 TARGET ANALYTE RESULTS 15-2
15.3.1 Polychlorinated Biphenyls 15-4

CONTENTS (continued)

15.3.2 Total Metals 15-4
15.4 CONCLUSIONS 15-5
15.4.1 Polychlorinated Biphenyls in Sediment 15-5
15.4.2 Total Metals in Sediment 15-5
15.5 RECOMMENDATIONS 15-6

16 SWMU 13 METALS LANDFILL 16-1

16.1 BACKGROUND 16-1
16.2 SAMPLING HISTORY RELATED TO CLOSURE MONITORING 16-2
16.3 TARGET ANALYTE RESULTS 16-2
16.3.1 Metals 16-4
16.3.2 Water Quality Parameters 16-4
16.4 CONCLUSIONS 16-4
16.5 RECOMMENDATIONS 16-4

17 SWMU 14, OLD PESTICIDE STORAGE AND DISPOSAL AREA 17-1

17.1 FIELD MEASUREMENTS 17-1
17.2 TARGET ANALYTE RESULTS 17-3
17.3 MONITORED NATURAL ATTENUATION 17-3
17.4 TREND EVALUATION 17-4
17.5 CONCLUSIONS 17-4
17.6 RECOMMENDATIONS 17-5

18 SWMU 17, POWER PLANT NO. 3 AREA 18-1

18.1 FIELD MEASUREMENTS 18-1
18.2 TARGET ANALYTE RESULTS 18-3
18.3 MONITORED NATURAL ATTENUATION 18-3
18.4 TREND EVALUATION 18-4
18.5 CONCLUSIONS 18-4
18.6 RECOMMENDATIONS 18-5

19 SWMUs 18/19, WHITE ALICE LANDFILL 19-1

19.1 BACKGROUND 19-1
19.2 SAMPLING HISTORY RELATED TO CLOSURE MONITORING 19-1
19.3 DISCUSSION OF RESULTS 19-2
19.3.1 Surface Water 19-2
19.3.2 Groundwater 19-3
19.4 CONCLUSIONS 19-4
19.4.1 Surface Water 19-4
19.4.2 Groundwater 19-5
19.5 RECOMMENDATIONS 19-5

20 SWMU 25, ROBERTS LANDFILL 20-1

CONTENTS (continued)

20.1 BACKGROUND 20-1
20.2 SAMPLING HISTORY RELATED TO CLOSURE MONITORING 20-1
20.3 TARGET ANALYTE RESULTS 20-2
20.3.1 Surface Water 20-2
20.3.2 Groundwater 20-8
20.4 CONCLUSIONS 20-11
20.4.1 Surface Water Metals 20-11
20.4.2 Groundwater Metals 20-13
20.5 RECOMMENDATIONS 20-13

21 SWMU 55, PUBLIC WORKS TRANSPORTATION DEPARTMENT WASTE STORAGE AREA 21-1

21.1 FIELD MEASUREMENTS 21-1
21.2 TARGET ANALYTE RESULTS 21-3
21.3 MONITORED NATURAL ATTENUATION 21-4
21.4 TREND EVALUATION 21-4
21.5 CONCLUSIONS 21-4
21.6 RECOMMENDATIONS 21-5

22 SWMU 60, TANK FARM A 22-1

22.1 FIELD MEASUREMENTS 22-1
22.2 TARGET ANALYTE RESULTS 22-4
22.3 MONITORED NATURAL ATTENUATION 22-6
22.4 TREND EVALUATION 22-7
22.5 CONCLUSIONS 22-9
22.6 RECOMMENDATIONS 22-10

23 SWMU 61, TANK FARM B 23-1

23.1 FIELD MEASUREMENTS 23-1
23.2 TARGET ANALYTE RESULTS 23-3
23.2.1 Groundwater 23-3
23.2.2 Surface Water 23-5
23.2.3 Sediment 23-6
23.3 MONITORED NATURAL ATTENUATION 23-7
23.4 TREND EVALUATION 23-8
23.5 CONCLUSIONS 23-10
23.6 RECOMMENDATIONS 23-11

24 SWMU 62, NEW HOUSING FUEL LEAK 24-1

24.1 FIELD MEASUREMENTS 24-1
24.2 TARGET ANALYTE RESULTS 24-5
24.2.1 Sandy Cove Housing 24-5

CONTENTS (continued)

24.2.2 Eagle Bay Housing 24-8
24.3 MONITORED NATURAL ATTENUATION 24-10
24.4 TREND EVALUATION 24-11
24.5 CONCLUSIONS 24-13
24.6 RECOMMENDATIONS 24-16

25 TANKER SHED, UST 42494 25-1

25.1 FIELD MEASUREMENTS 25-1
25.2 TARGET ANALYTE RESULTS 25-3
25.3 MONITORED NATURAL ATTENUATION 25-3
25.4 TREND EVALUATION 25-3
25.5 CONCLUSIONS 25-5
25.6 RECOMMENDATIONS 25-6

26 REFERENCES 26-1

CONTENTS (continued)

APPENDICES
(PROVIDED ON DISC)

APPENDIX A FIELD FORMS AND LOGBOOKS

APPENDIX B SAMPLING DEVIATION FORMS

APPENDIX C-1 GROUNDWATER SITES DATA SUMMARY TABLE – 1999 THROUGH 2014

APPENDIX C-2 LANDFILL SITES DATA SUMMARY TABLE – 1996 THROUGH 2014

APPENDIX D-1 SUMMARY OF 2014 DEPTH-TO-WATER MEASUREMENTS

APPENDIX D-2 HISTORICAL DEPTH-TO-WATER MEASUREMENTS

APPENDIX D-3 2014 LANDFILL SITES FIELD PARAMETERS

APPENDIX E 2014 WELL MAINTENANCE AND REPAIR LIST

APPENDIX F 2014 DATA VALIDATION REPORTS AND LABORATORY ANALYTICAL DATA

APPENDIX G DATA QUALITY ASSESSMENT SUMMARIES

APPENDIX H STATISTICAL CALCULATIONS

APPENDIX I PHOTOGRAPHIC LOG

APPENDIX J FREE PRODUCT RECOVERY SUMMARY

APPENDIX K TIDE CHARTS

APPENDIX L RESPONSE TO REGULATOR COMMENTS

CONTENTS (continued)

FIGURES

Figure 1-1. Location Map, Adak Island, Alaska 1-4
Figure 2-1. 2014 Groundwater and Landfill Monitoring Sites, Adak Island, Alaska 2-39
Figure 2-2. Landfill Monitoring Sites, Adak Island, Alaska 2-41
Figure 7-1. Area 303/GCI Compound Potentiometric Surface 7-21
Figure 7-2. Area 303/GCI Compound Sampling Locations 7-22
Figure 8-1. Former Power Plant, Building T-1451 Potentiometric Surface 8-12
Figure 8-2. Former Power Plant, Building T-1451 Sample Locations 8-13
Figure 9-1. Housing Area (Arctic Acres) Sample Locations 9-8
Figure 10-1. NMCB Building T-1416 Expanded Area Sample Locations 10-9
Figure 11-1. ROICC Contractor's Area, UST ROICC-7 Sample Locations 11-7
Figure 12-1. SA 79, Main Road Pipeline, South End Sample Locations 12-8
Figure 13-1. SA 80, Steam Plant 4, USTs 27089 and 27090 Sample Locations 13-8
Figure 14-1. South of Runway 18-36 Area Sample Locations 14-11
Figure 15-1. SWMU 11, Palisades Landfill Sample Locations 15-7
Figure 16-1. SWMU 13, Metals Landfill Sample Locations 16-6
Figure 17-1. SWMU 14, Old Pesticide Storage and Disposal Area Sample Locations 17-7
Figure 18-1. SWMU 17, Power Plant No. 3 Area Sample Locations 18-7
Figure 19-1. SWMUs 18/19, White Alice Landfill Sample Locations 19-8
Figure 20-1. SWMU 25, Roberts Landfill Sample Locations 20-15
Figure 20-2. SWMU 25, Roberts Landfill Overland Surface Water Pathway and Sample Locations 20-16
Figure 21-1 SWMU 55, Public Works Transportation Department Waste Storage Area Sample Locations 21-7
Figure 22-1. SWMU 60, Tank Farm A Sample Locations 22-11
Figure 23-1. SWMU 61, Tank Farm B Sample Locations 23-13
Figure 24-1. SWMU 62, New Housing Fuel Leak (Sandy Cove Housing) Sample Locations 24-19
Figure 24-2. SWMU 62, New Housing Fuel Leak (Eagle Bay Housing) Sample Locations 24-20
Figure 25-1. Tanker Shed, UST 42494 Sample Locations 25-9

CONTENTS (continued)

TABLES

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 2-7
Table 2-2. Landfill Monitoring Sampling Schedule to Date 2-29
Table 2-3. Summary of Landfill Sampling Frequency by Medium and Analyte 2-31
Table 2-4. Summary of Long-Term Monitoring Petroleum-Release and Non-Landfill CERCLA Monitoring Sites and Remedies for 2014 2-32
Table 2-5. Summary of ROD Remedy and Intended Long-Term Monitoring Purpose for 2014 Petroleum-Release and Non-Landfill CERCLA Sites 2-33
Table 2-6. Adak OU A and OU B-1 Long-Term Monitoring Program Schedule 2-37
Table 3-1. Petroleum and Non-Landfill CERCLA Site Monitoring Endpoints for Target Analytes in Groundwater 3-3
Table 3-2. Sediment and Surface Water Cleanup Levels for South of Runway 18-36, South Sweeper Creek 3-10
Table 3-3. Sediment Endpoint Criteria for SWMU 11, Palisades Landfill 3-13
Table 3-4. Endpoint Criteria for Groundwater at SWMU 13, Metals Landfill 3-13
Table 3-5. Endpoint Criteria for Fresh Surface Water at SWMUs 18/19, White Alice 3-14
Table 3-7. Surface Water and Groundwater Monitoring Endpoints for SWMU 25, Roberts Landfill 3-15
Table 4-1. Summary of 2014 Field Activities by Site and Location 4-4
Table 4-2. Environmental Quantities and Laboratory Analytical Methods for Groundwater, Surface Water and Sediment Samples by Location for Petroleum-Release and Non-Landfill CERCLA Sites 4-13
Table 4-3. Environmental Quantities and Laboratory Analytical Methods for Groundwater, Surface Water and Sediment Samples by Location for Landfill Sites 4-16
Table 4-4. 2014 Shoreline Surface Water Sample and Sediment Sample Visual Inspection Results 4-23
Table 7-1. 2014 Field Measurements for Area 303/GCI Compound 7-3
Table 7-2. Analytical Results for Petroleum-Related Chemicals at Area 303/GCI Compound 7-6
Table 7-2. Analytical Results for Petroleum-Related Chemicals at Area 303/GCI Compound (continued) 7-10
Table 7-3. 2014 Analytical and Field Measurement Data for NAPs for Area 303/GCI Compound 7-12
Table 7-4. Concentration Trend Evaluation for Area 303/GCI Compound 7-19
Table 8-1. 2014 Field Measurements for Former Power Plant, Building T-1451 8-2

CONTENTS (continued)

Table 8-2. Analytical Results for Petroleum-Related Chemicals at Former Power Plant, Building T-1451 8-5
Table 8-3. Analytical Results for Surface Water at Former Power Plant, Building T-1451 8-6
Table 8-4. Analytical Results for Sediment at Former Power Plant, Building T-1451 8-6
Table 8-5. 2014 Analytical and Field Measurement Data for NAPs for Former Power Plant, Building T-1451 8-7
Table 8-6. Concentration Trend Evaluation for Former Power Plant, Building T-1451 8-11
Table 9-1. 2014 Field Measurements for Housing Area (Arctic Acres) 9-2
Table 9-2. Analytical Results for Petroleum-Related Chemicals for Housing Area (Arctic Acres) 9-4
Table 9-3. Analytical and Field Measurement Data for NAPs for Housing Area (Arctic Acres) 9-5
Table 9-4. Concentration Trend Evaluation for Housing Area (Arctic Acres) 9-7
Table 10-1. 2014 Field Measurements for NMCB Building T-1416 Expanded Area 10-2
Table 10-2. Analytical Results for Petroleum-Related Chemicals at NMCB 10-4
Table 10-3. 2014 Analytical and Field Measurement Data for NAPs for NMCB 10-6
Table 11-1. 2014 Field Measurements for ROICC Contractor's Area, UST ROICC-7 11-2
Table 11-2. Analytical Results for Petroleum-Related Chemicals for ROICC Contractor's Area, UST ROICC-7 11-3
Table 11-3. Analytical and Field Measurement Data for NAPs for ROICC Contractor's Area, UST ROICC-7 11-4
Table 11-4. Concentration Trend Evaluation for ROICC Contractor's Area, UST ROICC-7 11-6
Table 12-1. 2014 Field Measurements for SA 79, Main Road Pipeline, South End 12-2
Table 12-2. Analytical Results for Petroleum-Related Chemicals for SA 79, Main Road Pipeline, South End 12-4
Table 12-3. 2014 Analytical and Field Measurement Data for NAPs for SA 79, Main Road Pipeline, South End 12-5
Table 12-4. Concentration Trend Evaluation for SA 79, Main Road Pipeline, South End 12-6
Table 13-1. 2014 Field Measurements for SA 80, Steam Plant 4 13-2
Table 13-2. Analytical Results for Petroleum-Related Chemicals for SA 80, Steam Plant 4 13-4
Table 13-3. 2014 Analytical and Field Measurement Data for NAPs for SA 80, Steam Plant 4 13-5

CONTENTS (continued)

Table 13-4. Concentration Trend Evaluation for SA 80, Steam Plant 4 13-7
Table 14-1. 2014 Field Measurements for South of Runway 18-36 Area 14-2
Table 14-2. Analytical Results for Petroleum-Related Chemicals in Groundwater at South of Runway 18-36 Area 14-5
Table 14-3. Analytical Results for Sediment at South of Runway 18-36 Area 14-6
Table 14-4. 2014 Analytical and Field Measurement Data for NAPs for South of Runway 18-36 Area 14-7
Table 15-1. Summary of Sediment Analytical Results at SWMU 11, Palisades Landfill, 2014 LTM 15-4
Table 16-1. Summary of Groundwater Analytical Results at SWMU 13, Metals Landfill, 2014 LTM 16-5
Table 17-1. 2014 Field Measurements for SWMU 14, Old Pesticide Storage and Disposal Area 17-2
Table 17-2. Analytical Results for Petroleum-Related Chemicals and Metals for SWMU 14, Old Pesticide Storage and Disposal Area 17-3
Table 17-3. 2014 Analytical and Field Measurement Data for NAPs for SWMU 14, Old Pesticide Storage and Disposal Area 17-4
Table 17-4. Concentration Trend Evaluation for SWMU 14, Old Pesticide Storage and Disposal Area 17-6
Table 18-1. 2014 Field Measurements for SWMU 17, Power Plant No. 3 Area 18-2
Table 18-2. Analytical Results for Volatile Organic Compounds for SWMU 17, Power Plant No. 3 Area 18-3
Table 18-3. 2014 Analytical and Field Measurement Data for NAPs for SWMU 17, Power Plant No. 3 Area 18-4
Table 18-4. Concentration Trend Evaluation for SWMU 17, Power Plant No. 3 Area 18-6
Table 19-1. Summary of Surface Water Analytical Results at SWMU 19/19, White Alice Landfill, 2014 LTM 19-6
Table 19-2. Summary of Groundwater Analytical Results at SWMU 18/19, White Alice Landfill, 2014 LTM 19-7
Table 20 1. Summary of Surface Water Analytical Results at SWMU 25, Roberts Landfill, 2014 LTM 20-6
Table 20-2. Summary of Groundwater Analytical Results at SWMU 25, Roberts Landfill, 2014 LTM 20-10
Table 21-1. 2014 Field Measurements for SWMU 55 Public Works Transportation Department Waste Storage Area 21-2
Table 21-2. Analytical Results for Volatile Organic Compounds for SWMU 55, Public Works Transportation Department Waste Storage Area 21-3

CONTENTS (continued)

Table 21-3. 2014 Analytical and Field Measurement Data for NAPs for SWMU 55, Public Works Transportation Department Waste Storage Area 21-4
Table 21-4. Concentration Trend Evaluation for SWMU 55, Public Works Transportation Department Waste Storage Area 21-6
Table 22-1. 2014 Field Measurements for SWMU 60, Tank Farm A 22-2
Table 22-2. Analytical Results for Petroleum-Related Chemicals for Groundwater at SWMU 60, Tank Farm A 22-5
Table 22-3. Analytical Results for Petroleum-Related Chemicals in Surface Water at SWMU 60, Tank Farm A 22-6
Table 22-4. Analytical Results for Sediment at SWMU 60, Tank Farm A 22-6
Table 22-5. 2014 Analytical and Field Measurement Data for NAPs for SWMU 60, Tank Farm A 22-7
Table 22-6. Concentration Trend Evaluation for SWMU 60, Tank Farm A 22-8
Table 23-1. 2014 Field Measurements for SWMU 61, Tank Farm B 23-2
Table 23-2. Analytical Results for Petroleum-Related Chemicals for Groundwater Samples at SWMU 61, Tank Farm B 23-4
Table 23-3. Analytical Results for Petroleum-Related Chemicals in Surface Water at SWMU 61, Tank Farm B 23-6
Table 23-4. Analytical Results for Petroleum-Related Chemicals in Sediment Samples at SWMU 61, Tank Farm B 23-6
Table 23-5. 2014 Analytical and Field Measurement Data for NAPs for SWMU 61, Tank Farm B 23-7
Table 23-6. Concentration Trend Evaluation for SWMU 61, Tank Farm B 23-9
Table 24-1. 2014 Field Measurements for SWMU 62, New Housing Fuel Leak 24-2
Table 24-2. Analytical Results for Petroleum-Related Chemicals at SWMU 62, New Housing Fuel Leak – Sandy Cove Housing 24-6
Table 24-3. Analytical Results for Petroleum-Related Chemicals at SWMU 62, New Housing Fuel Leak – Eagle Bay Housing 24-8
Table 24-4. Analytical Results for Surface Water at SWMU 62, New Housing Fuel Leak 24-9
Table 24-5. Analytical Results for Sediment at SWMU 62, New Housing Fuel Leak 24-10
Table 24-6. 2014 Analytical and Field Measurement Data for NAPs for SWMU 62, New Housing Fuel Leak 24-11
Table 24-7. Concentration Trend Evaluation for SWMU 62, New Housing Fuel Leak 24-12
Table 25-1. 2014 Field Measurements for Tanker Shed, UST 42494 25-2
Table 25-2. Analytical Results for Petroleum-Related Chemicals for Tanker Shed, UST 42494 25-4

CONTENTS (continued)

Table 25-3. 2014 Analytical and Field Measurement Data for NAPs for Tanker Shed, UST 42494 25-5

Table 25-4. Concentration Trend Evaluation for Tanker Shed, UST 42494 25-7

ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
avgas	aviation gasoline
bgs	below ground surface
BKG	background
BTEX	benzene, toluene, ethylbenzene and total xylenes
BTOC	below top of casing
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
C.I.	confidence interval
cis-1,2-DCE	cis-1,2-dichloroethene
CMP	Comprehensive Monitoring Plan
COD	chemical oxygen demand
°C	degrees Celsius
D-Sb	dissolved antimony
DCE	dichloroethene
DO	dissolved oxygen
DRO	diesel-range organics
EPA	U.S. Environmental Protection Agency
FP	free product
ft	feet
GCI	General Communications, Inc.
GRO	gasoline-range organics
GW	groundwater
IC	institutional control
ICMP	Institutional Control Management Plan
IDW	investigation-derived waste

ACRONYMS AND ABBREVIATIONS (continued)

IRA	interim remedial action
JP-5	jet fuel no. 5
kg/m^3	kilograms per cubic meter
LGM	limited groundwater monitoring
LTM	long-term monitoring
µg/L	micrograms per liter
MeCl2	methylene chloride
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MLLW	mean lower low water
MNA	monitored natural attenuation
mS/cm	milliSiemens per centimeter
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolts
NA	not applicable or not available
NAP	natural attenuation parameter
NAVFAC	Naval Facilities Engineering Command
Navy	U.S. Navy
NC	not calculated or not collected
NIRIS	Naval Installation Restoration Information Solution
NMCB	Naval Mobile Construction Battalion
NP	not planned
NR	natural recovery
NS	not sampled
NTU	nephelometric turbidity units
ORP	oxidation-reduction potential
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl

ACRONYMS AND ABBREVIATIONS (continued)

PCE	tetrachloroethylene
PR	percent recovery
PSE-2	Preliminary Source Evaluation 2
QA	quality assurance
QC	quality control
RAO	remedial action objective
RBSC	risk-based screening concentration
ROD	Record of Decision
ROICC	Resident Officer in Charge of Construction
RPD	relative percent difference
S	Mann-Kendall statistic; the number of positive differences minus negative differences between sequential sampling results
SA	source area
SAERA	State-Adak Environmental Restoration Agreement
SD	sediment
Sealaska	Sealaska Environmental Services, LLC
SIM	selected ion monitoring
SOP	standard operating procedure
SU	standard unit
SVOCs	semivolatile organic compounds
SW	surface water
SWMU	solid waste management unit
SWP	surface water protection
T	trace
TAC	The Aleut Corporation
TAH	total aromatic hydrocarbons
TAqH	total aqueous hydrocarbons
TCE	trichloroethylene
T/D-Mn	total and dissolved manganese
T/D-Pb	total and dissolved lead

ACRONYMS AND ABBREVIATIONS (continued)

TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TSS	total suspended solids
T-Tl	total thallium
USGS	United States Geological Survey
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
WQP	water quality parameters

DATA QUALIFIER DEFINITIONS

B	The analyte was detected in an associated laboratory blank.
D	The reported result is from a dilution.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
J	The reported result is an estimated concentration.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
U	Analyte was not detected. Reported value is the quantitation limit.
UJ	Analyte was not detected. Reported value is the quantitation limit, which is estimated.
X	The reported result may have a slight high bias due to the presence of non-target components.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

1 INTRODUCTION

The 2014 annual groundwater and landfill monitoring at the Former Naval Complex located on Adak Island in southwest Alaska (Figure 1-1) was conducted during the months of August and September. Sealaska Environmental Services, LLC (Sealaska) performed groundwater monitoring, surface water sampling, sediment sampling, and inspection activities for Naval Facilities Engineering Command (NAVFAC) Northwest as part of the monitoring program for Operable Unit (OU) A. Groundwater, surface water, and sediment samples were collected at 15 non-landfill Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and petroleum-release sites, and four landfill sites in accordance with the Comprehensive Monitoring Plan (CMP), Revision 6 (Navy 2014a). This report presents the results of the 2014 long-term monitoring (LTM) field event.

1.1 PURPOSE OF MONITORING REPORT

The purpose of this annual groundwater and landfill monitoring report is to present the 2014 monitoring results for the petroleum-release sites, the non-landfill CERCLA sites, and the CERCLA and State of Alaska Class I/II Municipal Solid Waste Landfills. This report summarizes the methods and results associated with sample collection, evaluates whether the remedies selected for the non-landfill CERCLA and petroleum-release sites to address the impacted groundwater have met the specified endpoint criteria, and evaluates whether landfills are meeting post-closure care requirements.

1.2 OBJECTIVES OF MONITORING REPORT

This annual groundwater and landfill monitoring report has the following objectives:

- Summarize the 2014 annual groundwater, surface water, and sediment monitoring and field sampling activities at landfill and non-landfill CERCLA and petroleum-release sites at the Former Naval Complex;
- Present results of groundwater, surface water, and sediment sample analyses, and present results of shoreline inspections at landfill and non-landfill CERCLA and petroleum-release sites at the Former Naval Complex;
- Identify locations where target analytes exceed endpoint criteria;
- Evaluate the available data and any existing historical data for trends in concentrations of target analytes;
- Summarize free product recovery conducted for LTM in 2014;

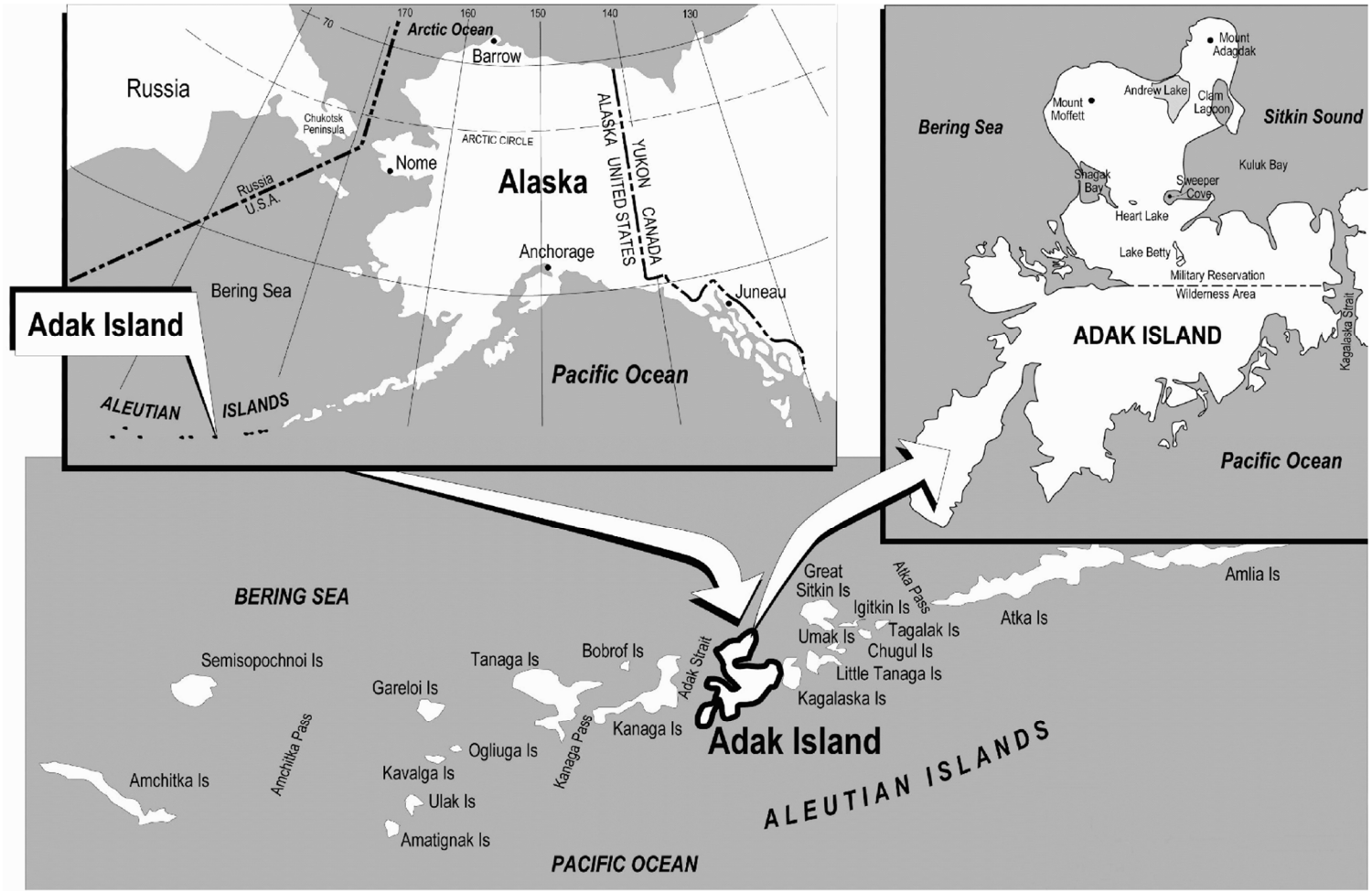
- Evaluate landfill monitoring data to ensure that the environmental cleanup remedies and the landfill closure actions remain compliant with the applicable laws and regulations and are protective of human health and the environment;
- Recommend modifications to sample collection activities for subsequent monitoring events in response to changing site conditions;
- Collect data to support the 5-year review estimate of time required to reach endpoint criteria for those locations with a statistically significant downward trend for target analyte results; and
- Present site-specific recommendations to reduce monitoring frequency, terminate monitoring, or adjust monitoring, if appropriate.

1.3 REPORT ORGANIZATION

This annual groundwater and landfill monitoring report includes the following sections:

- Section 1 introduces the report and includes purpose and monitoring objectives.
- Section 2 presents a discussion of the LTM history and current LTM program.
- Section 3 presents monitoring endpoint criteria.
- Section 4 presents a summary of field activities associated with the groundwater, surface water, and sediment monitoring performed during 2014 at the landfill sites, petroleum-release sites, and selected non-landfill CERCLA sites on the Former Naval Complex.
- Section 5 presents a summary of deviations from the CMP, Revision 6 (Navy 2014a).
- Section 6 presents the assessment of quantity and quality of the analytical results obtained from the 2014 monitoring, and evaluates the usability of the data for the intended purpose.
- Sections 7 through 25 present, on a site-specific basis, the resulting data obtained during 2014 monitoring activities; a statistical review of the current and historical data with respect to trend determination and slope forecasting; a discussion of how analytical data compare with endpoint criteria; conclusions derived from natural attenuation monitoring; and recommendations for further monitoring activities based on groundwater monitoring results.
- Section 26 contains references used in the development of this report.

- The appendices include the following additional documentation:
  - Appendix A, Field Forms and Logbook
  - Appendix B, Sampling Deviation Forms
  - Appendix C, Data Summary Tables – through 2014
  - Appendix D, Summary of 2014 and Historical Depth-to-Water Measurements and Landfill Sites Field Parameters
  - Appendix E, 2014 Well Maintenance and Repair List
  - Appendix F, 2014 Data Validation Reports and Laboratory Analytical Data
  - Appendix G, Data Quality Assessment Summaries
  - Appendix H, Statistical Calculations
  - Appendix I, Photographic Log
  - Appendix J, Free Product Recovery Summary
  - Appendix K, Tide Charts
  - Appendix L, Response to Regulator Comments



U.S. NAVY	SEALASKA	Not to Scale	**Figure 1-1** **Location Map, Adak Island, Alaska**	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

P:\SEALASKA\ADAK\TO 05\2014 GW\FIG 1-1.TIF
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2 SITE DESCRIPTION AND ENVIRONMENTAL HISTORY

2.1 SITE DESCRIPTION

Adak Island is remotely located in the Aleutian Island chain in the Bering Sea, approximately 1,500 miles southwest of Anchorage, Alaska (Figure 1-1). Adak is surrounded by other islands, most notably Great Sitkin Island on the east and the volcanically active Kasatochi, 40 miles to the northeast. Adak Island is mountainous with rugged terrain and is approximately 15 miles in length. Because Adak typically experiences severe weather (cold and high winds), the island is naturally treeless and is covered by tundra typified by waist-high, hardy grass, lupine, fireweed, and cow parsnips.

The City of Adak is located on the northern half of the island and includes a commercial airfield and airport, school, health clinic, two general stores, a liquor store, two active restaurants, and several small businesses. In 2014, approximately 100 residents lived on the island full- or part-time. The main commercial industry is fishing and fish processing, followed by tourism. Numerous structures remain on the island that were built to support the former naval complex and which are now owned by The Aleut Corporation (TAC). Some structures are still being used, but many are abandoned, dilapidated, and continue to deteriorate each year. Resources on the island are limited and expensive. Typical access to the island is by commercial air service, which is offered twice a week by Alaska Airlines. A health clinic provides limited medical services, and emergency air-lift medical services are available from Anchorage.

Adak Island was first used by military forces of the United States in 1942. Various branches of the military used the island beginning in 1942, and in 1950 the facility became a naval complex. Military use of the island has resulted in environmental impacts to soil and groundwater by several chemicals and products, including petroleum hydrocarbon compounds. A number of environmental restoration programs were initiated as early as 1986 to address these issues, and this monitoring program is part of the remedies implemented under the OU A Record of Decision (ROD; Navy, ADEC, and EPA 2000).

2.2 LONG-TERM MONITORING PROGRAM

2.2.1 Petroleum-Release and Non-Landfill CERCLA Sites

The monitoring program reported herein addresses historical and ongoing monitoring requirements for 25 petroleum-release and non-landfill CERCLA sites. Since long-term

monitoring commenced in 2003, eight of the 25 sites have met endpoint criteria and have received conditional closure or closure is pending. In addition, monitoring at many wells has been discontinued or reduced to biennial sampling because endpoints have been met or contaminant concentrations have exhibited decreasing trends. One new site, Area 303, was added to the LTM program in 2013 per the Final Technical Memorandum, Proposed Long-Term Monitoring Program for Area 303 (Navy 2012a) and the CMP, Revision 6 (Navy 2014a). Table 2-1 lists the monitoring history for the 25 petroleum-release and non-landfill CERCLA sites since 2003, including changes to the sampling protocols as endpoints were met or site conditions were changed. Figure 2-1 shows the locations for all Adak sites monitored in 2014.

CERCLA sites not associated with landfills and which are included in this report are:

- Solid Waste Management Unit (SWMU) 14, Old Pesticide Disposal Area
- SWMU 17, Power Plant No. 3 Area
- SWMU 55, Public Works Transportation Department Waste Storage Area

All of the selected remedies described for the non-landfill CERCLA sites in the OU A ROD (Navy, ADEC, and EPA 2000) include institutional controls (ICs). An Institutional Control Management Plan (ICMP) consistent with the OU A ROD was prepared by the U.S. Navy (Navy), and approved by the U.S. Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC) in 2000. The ICMP was updated by the Navy in 2014 and is included in the CMP, Revision 6 (Navy 2014a). IC inspections occurred concurrently with LTM field activities in 2014 and results of the inspections are presented in the IC Inspection Report (Navy 2014b).

2.2.2 Landfill Sites

The OU A ROD identified seven landfills requiring further action:

- SWMU 2, Causeway Landfill
- SWMU 4, South Davis Road Landfill
- SWMU 11, Palisades Landfill
- SWMU 13, Metals Landfill
- SWMUs 18/19, White Alice Landfill

- SWMU 25, Roberts Landfill
- SWMU 29, Finger Bay Landfill

Of these seven landfills, environmental media sampling is required at only four (Palisades, Metals, White Alice, and Roberts). Monitoring at White Alice and Metals Landfills are required every 5 years only; these landfills were sampled in 2014 and are scheduled to be sampled in 2019 and 2024 to support the 5-year reviews (Table 2-6). Therefore, only the four landfills requiring environmental media sampling were sampled during this event. The remaining three landfills (Causeway, South Davis Road, and Finger Bay) are inspected periodically for compliance with ICs and are reported separately as per the CMP, Revision 6 (Navy 2014a).

All four landfills (Palisades, Roberts, White Alice, and Metals) are regulated by the EPA under CERCLA and have undergone remedial actions in accordance with the OU A ROD (Navy, ADEC, and EPA 2000). Roberts and White Alice Landfills were also operated as Class I/II Municipal Solid Waste Landfills under the State of Alaska's solid waste disposal regulations (18 Alaska Administrative Code [AAC] 60), and all four landfills have been closed under these regulations. All four landfills are also in the post-closure care period. As part of the post-closure care, monitoring of groundwater, sediment, and surface water is required in accordance with the CMP, Revision 6 (Navy 2014a). The monitoring program was developed to meet the objectives specified in the OU A ROD and the landfill closure plans. The locations of the four landfills at which monitoring is still required are presented on Figure 2-2.

Historical changes to the landfill monitoring program are summarized in Table 2-2. Table 2-3 summarizes the current frequency of sampling by medium and by analyte for each of the four landfills per the CMP, Revision 6 (Navy 2014a). Changes made to the monitoring program were based on the recommendations presented in the 2010 Landfill Monitoring Report (Navy 2011a) and 2011 Landfill Monitoring Report (Navy 2012b). Sampling was not conducted at any landfill in 2012. Changes to the monitoring program that were implemented in 2014 since the last sampling event in 2013 are summarized below:

- SWMU 11, Palisades Landfill
  - Reduce sampling frequency to every other year.
- SWMU 13, Metals Landfill
  - Reduce monitoring at the site to once every 5 year period.

- SWMU 25, Roberts Landfill
  - Reduce sampling frequency to every other year.
  - Continue surface water sampling at seep location NL-14 in 2014 and analyze for total and dissolved metals, aluminum, and water quality parameters (WQPs).
- SWMUs 18/19, White Alice Landfill
  - Reduce monitoring at the site to once every 5 year period.

2.3 MONITORING PERFORMED IN 2014

2.3.1 Petroleum-Release and Non-Landfill CERCLA Sites

Table 2-4 summarizes the 2014 LTM petroleum-release and non-landfill CERCLA sites with their current remedies that have not yet received closure or are scheduled to be monitored biennially only. Table 2-4 also identifies the petroleum sites with no unacceptable risks for which groundwater is not considered a drinking water source. Endpoint criteria for this category are established at 10 times the ADEC cleanup levels (see Section 3 for a more in-depth discussion of endpoint criteria).

Table 2-5 summarizes interim and current remedies and the monitoring purpose for each sampling location for the 2014 sampling event. The types of monitoring implemented at the OU A sites in 2014 include:

- Monitored natural attenuation (MNA)
- Free product recovery
- Compliance monitoring
- Natural recovery (for surface water bodies)
- Surface water protection monitoring

The purpose of the MNA, free product recovery, compliance monitoring, and natural recovery is to determine whether the selected remedy is effective and endpoint criteria have been met. The purpose for surface water protection monitoring is to detect migration of petroleum hydrocarbons into unaffected areas and to verify that petroleum-related chemicals are not migrating toward downgradient surface water bodies (i.e., Sweeper Cove, Sweeper Creek, Kuluk Bay, and Clam Lagoon).

2.3.2 Landfill Sites

The landfill sampling program performed during the 2014 annual monitoring event is summarized in Table 2-2. Figure 2-2 shows the locations for all landfill sites monitored in 2014. The scope of the 2014 landfill monitoring activities was to collect samples at Palisades Landfill (sediment), White Alice Landfill (surface water and groundwater), Metals Landfill (groundwater), and Roberts Landfill (surface water and groundwater); to inspect wells, collect depth-to-groundwater measurements, and monitor methane in wells at White Alice, Metals, and Roberts Landfills; and to summarize the analytical results for the collected samples as required in the CMP, Revision 6 (Navy 2014a). For all media, sampling locations were selected to provide representative coverage of landfill conditions, with an emphasis on sample collection in areas immediately downgradient of the landfills that could be impacted by releases from the landfills. Findings from this monitoring event will be used to determine if changes to the monitoring program are needed to continue to protect potential downgradient receptors and meet post-closure monitoring objectives.

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Antenna Field, USTs ANT-1, ANT-2, ANT-3, and ANT-4													
ANT-601	MNA	DRO RRO NAPs	DRO RRO NAPs	DRO	DRO	DRO NAPs	DRO NAPs	DRO NAPs	DRO	Site Closure	Site Closure	Site Closure	Site Closure
Area 303/GCI Compound													
03-107	MNA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	GRO Benzene T/D-Pb NAPs	GRO Benzene T/D-Pb NAPs
03-012	MNA/SWP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs
04-211	MNA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	GRO NAPs	GRO NAPs
03-104	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO NAPs
03-778	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO NAPs
03-502	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	GRO	GRO T/D-Pb NAPs
MW-303-28	MNA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	GRO T/D-Pb NAPs	GRO T/D-Pb NAPs
MW-303-30	MNA/FP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	GRO BTEX T/D-Pb dibenz(a,h)anthracene NAPs	GRO BTEX T/D-Pb NAPs
MW-303-31	MNA/FP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	GRO BTEX T/D-Pb dibenz(a,h)anthracene NAPs	GRO BTEX T/D-Pb PAHs (for TAH and TAqH) dibenz(a,h)anthracene NAPs

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Area 303/GCI Compound (continued)													
MW-303-32	MNA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	DRO GRO Benzene NAPs	DRO BTEX PAHs (for TAH and TAqH) NAPs
MW-303-33	MNA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	GRO Benzene NAPs	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs
MW-303-37	MNA/SWP	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs
MW-303-38	MNA/FP	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	GRO BTEX T/D-Pb dibenz(a,h)anthracene NAPs	GRO BTEX T/D-Pb PAHs (for TAH and TAqH) dibenz(a,h)anthracene NAPs
MW-303-39	MNA/FP	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	GRO BTEX T/D-Pb dibenz(a,h)anthracene NAPs	GRO BTEX T/D-Pb PAHs (for TAH and TAqH) dibenz(a,h)anthracene NAPs
MW-303-40	MNA/FP	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	GRO BTEX T/D-Pb dibenz(a,h)anthracene NAPs	GRO BTEX T/D-Pb PAHs (for TAH and TAqH) dibenz(a,h)anthracene NAPs
MW-303-41	MNA/FP	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	GRO BTEX T/D-Pb dibenz(a,h)anthracene NAPs	GRO BTEX T/D-Pb PAHs (for TAH and TAqH) dibenz(a,h)anthracene NAPs

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Area 303/GCI Compound (continued)													
MW-303-42	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	GRO Benzene NAPs	DRO GRO NAPs
MW-303-43	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	GRO NAPs	GRO NAPs
MW-303-44	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	GRO NAPs	GRO NAPs
MRP-MW2	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX T/D Pb[1] NAPs[1]	DRO GRO BTEX T/D-Pb PAHs (for TAH and TAqH) NAPs
MRP-MW3	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX T/D-Pb PAHs (for TAH and TAqH) NAPs
04-100	MNA	DRO GRO BTEX NAPs	DRO GRO BTEX NAPs	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	GRO benzene NAPs	GRO benzene	GRO	DRO GRO	GRO	GRO
04-202	MNA	NS	NS	DRO GRO BTEX NAPs	GRO BTEX	GRO BTEX	GRO BTEX	GRO benzene NAPs	GRO benzene	GRO	DRO GRO	GRO	GRO
04-204	MNA	NS	NS	NS	DRO GRO BTEX	GRO BTEX	GRO BTEX	GRO benzene NAPs	DRO GRO	DRO GRO	DRO GRO	GRO	GRO
04-210	MNA	NS	NS	GRO BTEX NAPs	GRO BTEX	GRO BTEX	GRO BTEX	GRO benzene NAPs	GRO	GRO	DRO GRO	GRO	GRO
04-213	MNA	NS	NS	NS	DRO GRO BTEX	GRO	GRO	GRO	GRO	GRO	DRO GRO	GRO	GRO
MRP-MW9	MNA	NS	NS	NS	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued	DRO	Discontinued	Discontinued	Discontinued
04-701	MNA	GRO BTEX NAPs	GRO BTEX NAPs	GRO BTEX NAPs	GRO BTEX	NS	GRO benzene (even years)	NAPs	GRO benzene	NS	GRO	GRO	GRO

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Former Power Plant, Building T-1451													
01-118	MNA	DRO RRO NAPs	DRO RRO NAPs	DRO RRO	DRO RRO	DRO RRO	DRO RRO	DRO NAPs	DRO	DRO	DRO	DRO NAPs	DRO NAPs
01-150	MNA	DRO RRO NAPs	DRO RRO NAPs	DRO	DRO	DRO	DRO	DRO NAPs	DRO	DRO	DRO	DRO NAPs	DRO NAPs
01-151	MNA/SWP	DRO RRO NAPs	DRO RRO NAPs	DRO	DRO	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH TAqH) NAPs	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Well removed	Well removed	Well removed
E-701	MNA/BKG	DRO GRO BTEX NAPs	DRO GRO BTEX NAPs	NAPs	NAPs	NAPs	NAPs	NAPs (every 5 years)	NS	NS	NS	NAPs	NAPs
MW-1451-1	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO NAPs	DRO NAPs
MW-1451-2	MNA/SWP	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO BTEX PAHs (for TAH and TAqH) NAPs	DRO NAPs
MW-1451-3	MNA/SWP	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO BTEX PAHs (for TAH and TAqH) NAPs	DRO NAPs
MW-1451-4	MNA/SWP	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO BTEX PAHs (for TAH and TAqH) NAPs	DRO NAPs
MW-1451-5	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO NAPs	DRO NAPs
MW-1451-6	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO NAPs	DRO NAPs
MW-1451-7		Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO NAPs	DRO NAPs
MW-1451-8	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO NAPs	DRO NAPs
MW-1451-9	MNA	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	Non-Existent	DRO NAPs	DRO NAPs

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Former Power Plant, Building T-1451 (continued)													
NL08 (SW)	SWP	NS	NS	NS	NS	NS	NS	NS	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)
NL-08 (SD)	SWP	NS	NS	NS	NS	NS	NS	NS	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs
Housing Area (Arctic Acres)													
03-416	MNA	DRO RRO NAPs	DRO RRO NAPs	NS	DRO (even years)	NS	DRO	NAPs	DRO	NS	NS	DRO	DRO NAPs
03-420	MNA	DRO RRO NAPs	DRO RRO NAPs	DRO	DRO	DRO	DRO	DRO (odd years) NAPs	NS	DRO	NS	DRO	DRO NAPs
03-421	MNA	NS	NS	DRO	DRO	DRO	DRO	DRO NAPs	DRO	DRO (odd years)	NS	DRO	DRO NAPs
03-422	5-year review	NS	NS	NS	NS	NS	NS	NS	DRO	Discontinued	Discontinued	Discontinued	Discontinued
03-890	MNA	NS	NS	DRO	DRO	DRO	DRO	DRO NAPs	DRO	DRO (odd years)	NS	DRO	DRO NAPs
AA-01	MNA	DRO RRO NAPs	DRO RRO NAPs	NS	DRO	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
AA-02	5-year review	NS	NS	NS	NS	NS	NS	NS	DRO	Discontinued	Discontinued	Discontinued	Discontinued
AA-06	5-year review	NS	NS	NS	NS	NS	NS	NS	DRO	Discontinued	Discontinued	Discontinued	Discontinued
NMCB Building T-1416 Expanded Area													
02-451	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene (odd years)	NS	GRO	Discontinued
02-452	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued
02-453	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued
02-455	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
NMCB Building T-1416 Expanded Area (continued)													
02-461	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	GRO	GRO NAPs
02-478	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued
02-479	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene (odd years)	NS	GRO	Discontinued
02-489	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
02-813	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
02-817	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued
02-818	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	GRO	GRO NAPs
E-201	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	GRO	GRO NAPs
NMCB-04	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued
NMCB-05	MNA	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
NMCB Building T-1416 Expanded Area (continued)													
NMCB-07	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	GRO	GRO NAPs
NMCB-08	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued
NMCB-09	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene (odd years)	NS	GRO	GRO NAPs
NMCB-10	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	GRO	GRO NAPs
NMCB-11	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	GRO	GRO NAPs
NMCB-12	MNA/SWP	NS	NS	NS	DRO GRO T-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX	DRO GRO T/D-Pb BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	Discontinued	Discontinued
NL-05 (SD)	SWP	NS	NS	NS	NS	NS	NS	DRO GRO T/D-Pb BTEX	DRO GRO benzene	DRO GRO benzene	DRO GRO benzene	GRO	Discontinued
North Pacific (NORPAC) Hill Seep Area													
04-145	LGM	NS	NS	DRO	DRO	DRO	Discontinued	Discontinued	Discontinued	Site Closure	Site Closure	Site Closure	Site Closure
04-146	SWP	NS	NS	DRO	DRO	DRO	DRO	DRO	DRO				
04-147	SWP	NS	NS	DRO	DRO	DRO	DRO (even years)	NS	DRO				
04-403	LGM	NS	NS	DRO	DRO	DRO	DRO (even years)	NS	DRO				
04-405	LGM	NS	NS	DRO	DRO	DRO	DRO (even years)	NS	DRO				
NS-2	LGM	NS	NS	DRO	DRO	DRO	Discontinued	Discontinued	Discontinued				
NL-06 (SW)	SWP	NS	NS	NS	NS	NS	NS	NS	DRO				

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
ROICC Contractor's Area, UST ROICC-7													
08-175	MNA	GRO BTEX NAPs	GRO BTEX NAPs	NS	BTEX	GRO	benzene (even years)	NAPs	benzene	NS	benzene	Discontinued	Discontinued
08-200	MNA	GRO BTEX NAPs	GRO BTEX NAPs	GRO BTEX	GRO BTEX	GRO BTEX	benzene	benzene NAPs	benzene (even years)	NS	benzene	benzene	benzene
08-202	MNA	GRO BTEX NAPs	GRO BTEX NAPs	GRO BTEX	GRO BTEX	GRO BTEX	benzene	benzene NAPs	benzene (even years)	NS	benzene	benzene	benzene
Runway 5-23 Avgas Valve Pit													
14-100	MNA	GRO GRO fractions BTEX NAPs	GRO GRO fractions BTEX NAPs	GRO BTEX	GRO BTEX (even years)	GRO	GRO BTEX	GRO NAPs	GRO (even years)	NS	GRO	GRO	Site Closure
14-110	MNA	GRO GRO fractions BTEX NAPs	GRO GRO fractions BTEX NAPs	GRO BTEX	BTEX	GRO	GRO (even years)	NAPs	GRO	NS	GRO	Discontinued	
SA 78, Old Transportation Building, USTs 10583 and 10584 and ASTs													
12-145	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO benzene (even years)	NS	DRO GRO benzene	Site Closure	Site Closure
12-152	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO	DRO GRO	Discontinued	Discontinued	Discontinued	Discontinued		
MW-116	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	NS	DRO GRO BTEX NAPs	DRO (even years)	NS	DRO		
MW-117	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX (even years)	DRO GRO BTEX NAPs (5 years)	Discontinued	Discontinued	Discontinued		
12-801	SWP	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX (even years)	NS	DRO GRO BTEX	NAPs	Discontinued	Discontinued	Discontinued		
12-802	SWP/BKG	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX NAPs	DRO GRO BTEX (even years) NAPs	NAPs	DRO GRO BTEX NAPs	NAPs	DRO GRO BTEX	NS	DRO GRO benzene		

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SA 79, Main Road Pipeline													
02-230	SWP/MNA	DRO GRO BTEX NAPs	DRO NAPs	DRO	DRO	DRO	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO	DRO	DRO	DRO	DRO NAPs
MRP-MW8	MNA	DRO GRO BTEX NAPs	DRO NAPs	DRO	DRO	DRO	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH) NAPs	DRO	DRO	DRO	DRO	DRO NAPs
601	MNA	NS	NS	NS	NS	NS	NS	NS	NS	DRO	DRO	DRO	DRO NAPs
602	MNA	NS	NS	NS	NS	NS	NS	NS	NS	DRO	Discontinued	Discontinued	Discontinued
NL-01	MNA/SWP	NS	NS	NS	NS	DRO	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
E-403	MNA	NS	NS	NS	NS	NS	DRO	DRO	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
SA 80, Steam Plant 4, USTs 27089 and 27090													
04-103	MNA	DRO NAPs	DRO NAPs	DRO	DRO (even years)	NS	DRO	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
04-158	MNA	NS	NS	DRO	DRO	DRO	DRO	DRO NAPs	DRO	DRO	DRO	DRO	DRO NAPs
04-159	MNA	NS	NS	DRO	DRO	DRO	DRO	DRO NAPs	DRO	DRO	DRO	DRO	DRO NAPs
04-173	MNA	NS	DRO GRO BTEX	DRO	DRO	DRO	DRO	DRO NAPs	DRO	DRO	DRO	DRO	DRO NAPs
04-801	MNA	NS	NS	DRO	DRO	DRO	DRO	DRO NAPs	DRO	DRO	DRO	Discontinued	Discontinued
SP4-3	MNA	DRO NAPs	DRO NAPs	DRO	DRO	DRO	DRO	NAPs	DRO (even years)	NS	DRO	DRO	DRO NAPs
SA 82, P-80/P-81 Buildings, UST 10587 and AST 10333													
12-170	LGM	NS	NS	DRO	DRO (even years)	NS	DRO	Site Closure	Site Closure	Site Closure	Site Closure	Site Closure	Site Closure
12-172	LGM	NS	NS	DRO	DRO (even years)	NS	DRO						
12-180	LGM	NS	NS	DRO	DRO	DRO	DRO						
12-194	LGM	NS	NS	NS	NS	NS	DRO						
12-401	SWP	DRO	DRO	DRO	DRO	Discontinued	Discontinued						

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SA 88, P-70 Energy Generator, UST 10578													
12-162	LGM	NS	DRO GRO BTEX	DRO	DRO	DRO	DRO	DRO	DRO				
12-163	LGM	NS	DRO GRO BTEX	DRO	DRO	DRO	DRO	DRO	DRO				
12-197	LGM	NS	NS	DRO	DRO	DRO	DRO	DRO	DRO				
12-198	LGM	NS	DRO GRO BTEX	DRO	DRO	DRO	DRO	DRO	DRO	Site Closure	Site Closure	Site Closure	Site Closure
12-252	LGM	NS	DRO GRO BTEX	DRO	DRO	DRO	DRO	DRO	DRO				
12-253	LGM	NS	NS	NS	NS	DRO	DRO	DRO	DRO				
12-701	SWP	DRO	DRO	DRO	DRO	DRO	DRO	DRO	Discontinued				
12-702	LGM	NS	NS	NS	NS	DRO	DRO	DRO	Discontinued				
South of Runway 18-36 Area													
02-231	MNA/SWP	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH) NAPs
02-232	MNA /SWP	NS	NS	NS	NS	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX (even years) PAHs (for TAH and TAqH)	DRO GRO PAHs NAPs	DRO BTEX PAHs (for TAH and TAqH; even years)	DRO	BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH) NAPs
18/36-05	MNA	NS	NS	NS	DRO	DRO (odd years)	NS	DRO NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
AS-1	MNA/SWP	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH) NAPs
E-206	MNA	NS	NS	NS	DRO	DRO	DRO	DRO NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
South of Runway 18-36 Area (continued)													
E-208	MNA /SWP	DRO	DRO	DRO	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH; odd years)	NS	DRO (odd years) NAPs	NS	DRO	Discontinued	Discontinued	Discontinued
E-218	MNA /SWP	DRO	DRO	DRO	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX (even years) PAHs (for TAH and TAqH)	DRO GRO PAHs NAPs	DRO BTEX PAHs (for TAH and TAqH; even years)	DRO	Discontinued	Discontinued	Discontinued
MRP-12	MNA /SWP	DRO	DRO	DRO	DRO	DRO (odd years)	NS	DRO NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
RW-18/36-03	MNA /SWP	NS	NS	NS	NS	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued
NSWSD-1 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH) NAPs	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-2 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-3 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-4 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
South of Runway 18-36 Area (continued)													
NSWSD-5 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-6 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-7 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued
NSWSD-8 (SW)	NR	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	Discontinued
NL-02 (SW)	SWP	NS	NS	NS	NS	TSS DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-1 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-2 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs NAPs
NSWSD-3 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-4 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs NAPs
NSWSD-5 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs NAPs
NSWSD-6 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
South of Runway 18-36 Area (continued)													
NSWSD-7 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	Discontinued	Discontinued	Discontinued	Discontinued
NSWSD-8 (SD)	NR	NS	NS	NS	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	Discontinued	Discontinued	Discontinued	Discontinued
SWMU 14, Old Pesticide Storage and Disposal Area													
01-153	MNA	DRO GRO GRO fractions BTEX NAPs	DRO GRO GRO fractions BTEX NAPs	GRO BTEX	DRO (even years) GRO BTEX	NS	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
	Compliance	T/D-Pb T-Tl TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	T/D-Pb T-Tl TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	T/D-Pb TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	T/D-Pb TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	T/D-Pb TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	T/D-Pb TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	T/D-Pb TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC NAPs	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2- DCE VC (even years)	NS	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	Discontinued
MW-14-5	MNA	DRO GRO GRO fractions BTEX T/D-Pb NAPs	DRO GRO GRO fractions BTEX T/D-Pb NAPs	DRO GRO BTEX T/D-Pb	DRO GRO BTEX T/D-Pb	DRO GRO T/D-Pb	DRO GRO T/D-Pb	DRO GRO T/D-Pb NAPs	DRO GRO T/D-Pb (even years)	DRO GRO	DRO GRO	DRO GRO T/D-Pb	DRO GRO T/D-Pb NAPs
	Compliance	T-Tl TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	T-Tl TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	MeCl2	NS	NS	NS	NS	NS	NS	NS	Discontinued
MW-15-3	5-year review	NS	NS	NS	NS	NS	NS	NS	DRO GRO T/D-Pb	Discontinued	Discontinued	Discontinued	Discontinued
55-145	5-year review	NS	NS	NS	NS	NS	NS	NS	DRO GRO T/D-Pb	Discontinued	Discontinued	Discontinued	Discontinued
55-146	MNA/SWP	NS	NS	NS	NS	NS	NS	DRO GRO T/D-Pb	DRO GRO T/D-Pb	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 15, Future Jobs/ Defense Reutilization and Marketing Office (DRMO)													
MW-15-3	MNA	DRO GRO GRO fractions BTEX NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Site Closure	Site Closure	Site Closure
	Compliance	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC NAPs	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC			
SWMU 17, Power Plant No. 3 Area													
05-375	SWP/MNA	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO NAPs	DRO (even years)	NS	DRO	Discontinued	Discontinued
05-735	Compliance	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC NAPs
HC-02	MNA	NS	NS	NS	NS	DRO	DRO	DRO NAPs	DRO	Discontinued	Discontinued	Discontinued	Discontinued
HC-03	MNA	NS	NS	NS	NS	DRO	DRO	DRO NAPs	DRO	Discontinued	Discontinued	Discontinued	Discontinued
PP-05	MNA	NS	NS	NS	NS	DRO	DRO	DRO NAPs	DRO (even years)	NS	DRO	Discontinued	Discontinued
R-1	MNA	DRO RRO TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	DRO RRO bis(2-EH)PHT	DRO RRO bis(2-EH)PHT	DRO	DRO	DRO (even years)	NAPs	DRO	NS	DRO	Discontinued	Discontinued
R-2	MNA	NS	NS	NS	NS	DRO	DRO (even years)	NAPs	DRO	Discontinued	Discontinued	Discontinued	Discontinued
R-5	MNA	NS	NS	NS	NS	DRO	DRO	DRO NAPs	DRO	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 17, Power Plant No. 3 Area (continued)													
R-6	MNA	DRO RRO TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	DRO RRO bis(2-EH)PHT	DRO RRO bis(2-EH)PHT	DRO	DRO	DRO	DRO NAPs	DRO	Discontinued	Discontinued	Discontinued	Discontinued
SWMU 55, Public Works Transportation Department Waste Storage Area													
55-145	Compliance	D-Sb TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2- DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC (odd years)	NS	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC NAPs
55-146	Compliance	D-Sb TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC MeCl2 bis(2-EH)PHT	NS	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC (even years)	NS	TCE PCE 1,1-DCE cis-1,2-DCE trans-1,2-DCE VC	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
SWMU 58/SA 73, Heating Plant 6													
12-101	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued		
12-105	MNA	NS	NS	NS	NS	NS	NS	DRO NAPs (replaces 12-110)	DRO	DRO	DRO		
12-110	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Site Closure	Site Closure
12-114	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX (even years)	NS	DRO GRO BTEX	NAPs	DRO	NS	DRO		
12-120	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued		

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 58/SA 73, Heating Plant 6 (continued)													
12-121	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO NAPs	DRO	DRO	DRO	Site Closure	Site Closure
12-203	MNA	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO NAPs	DRO	DRO	DRO		
12-601	SWP	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	Discontinued	Discontinued		
12-604	SWP	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX (even years)	NS	DRO GRO BTEX	NS	DRO	Discontinued	Discontinued		
12-611	SWP	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO	Discontinued		
NL-07 (SW)	SWP	NS	NS	NS	NS	NS	NS	DRO	DRO	DRO	Discontinued		
NL-07 (SD)	SWP	NS	NS	NS	NS	NS	NS	DRO	DRO	DRO	Discontinued		
SWMU 60, Tank Farm A													
LC5A	MNA/SWP	DRO GRO BTEX NAPs	DRO NAPs	DRO	DRO	DRO BTEX PAHs (for TAH and TAqH)	DRO	DRO BTEX PAHs (for TAH and TAqH) NAPs	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH)	BTEX PAHs (for TAH and TAqH) NAPs
MW E006	MNA	DRO GRO BTEX NAPs	BTEX NAPs	BTEX	BTEX	BTEX	BTEX	BTEX NAPs	Benzene	Benzene	Benzene	Benzene	Discontinued
852 (SW)	NR/SWP	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)
852 (SD)	NR/SWP	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO GRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs	DRO PAHs
650	MNA/SWP	NS	NS	NS	NS	NS	NS	NS	NS	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH) NAPs

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 60, Tank Farm A (continued)													
651	MNA/SWP	NS	NS	NS	NS	NS	NS	NS	NS	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH) NAPs
652	MNA/SWP	NS	NS	NS	NS	NS	NS	NS	NS	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH) NAPs
653	MNA/SWP	NS	NS	NS	NS	NS	NS	NS	NS	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH)	DRO BTEX PAHs (for TAH and TAqH) NAPs
NL-03 (SW)	SWP	NS	NS	NS	DRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
NL-03 (SD)	SWP	NS	NS	NS	BTEX DRO	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
SWMU 61, Tank Farm B													
14-113	MNA /SWP	GRO BTEX NAPs	GRO BTEX NAPs	GRO BTEX	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH) T/D-Mn NAPs	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH) NAPs
14-210	MNA/SWP	GRO BTEX NAPs	GRO BTEX NAPs	GRO BTEX	GRO BTEX	GRO BTEX	GRO BTEX	DRO GRO BTEX T/D-Mn NAPs	GRO BTEX	GRO BTEX	GRO BTEX	GRO BTEX	GRO BTEX NAPs
TFB-MW4B	MNA	GRO BTEX NAPs	GRO BTEX NAPs	GRO BTEX	GRO BTEX	GRO BTEX	GRO BTEX	DRO GRO BTEX T/D-Mn NAPs	GRO BTEX	GRO BTEX	GRO BTEX	GRO BTEX	GRO BTEX NAPs
NL-04 (SW)	SWP/NR	NS	NS	NS	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 61, Tank Farm B (continued)													
NL-04 (SD)	SWP/NR	NS	NS	NS	GRO BTEX	GRO BTEX	GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	GRO BTEX	GRO BTEX	GRO BTEX
NL-D-04 (Down-gradient SW)	SWP/NR	NS	NS	NS	NS	NS	NS	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	GRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued
NL-D-04 (Down-gradient SD)	SWP/NR	NS	NS	NS	NS	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	GRO BTEX	Discontinued	Discontinued
NL-U-04 (Upgradient SW)	SWP/NR	NS	NS	NS	NS	NS	NS	DRO GRO BTEX PAHs (for TAH and TAqH)	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
NL-U-04 (Upgradient SD)	SWP/NR	NS	NS	NS	NS	NS	NS	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
SWMU 62, New Housing Fuel Leak, Sandy Cove													
03-155	MNA	DRO GRO BTEX NAPs	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO NAPs
03-619	MNA	NS	NS	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO NAPs
03-697	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	Discontinued	Discontinued	Discontinued
03-802	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO	DRO	Discontinued	Discontinued
03-808	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 62, New Housing Fuel Leak, Sandy Cove (continued)													
03-895	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	Discontinued	Discontinued
HMW-102-6	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO	Discontinued	Discontinued	Discontinued
HMW-107-2	MNA	NS	NS	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO	Discontinued	Discontinued	Discontinued
HMW-139-3	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO	Discontinued	Discontinued	Discontinued
HMW-146-3	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	Discontinued	Discontinued
HMW-184-1	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
HMW-102-8	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
MW-107-1	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO	DRO	DRO	DRO NAPs
MW-107-4	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 62, New Housing Fuel Leak, Sandy Cove (continued)													
MW-134-3	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
MW-134-11	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO NAPs
MW-146-1	MNA	NS	NS	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO	DRO	DRO	DRO NAPs
MW-187-1	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO benzene	DRO	DRO NAPs
SWMU 62, New Housing Fuel Leak, Eagle Bay													
03-103	MNA	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX PAHs NAPs	Switched to MW-134-11	Switched to MW-134-11	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	Discontinued	Discontinued
03-109	MNA/SWP	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	Discontinued	Discontinued
03-898	MNA/SWP	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	Discontinued	Discontinued
AMW-704	MNA/SWP	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO NAPs
MW-303-7	MNA	NS	NS	NS	NS	NS	NS	NS	NS	DRO GRO BTEX	DRO	DRO	DRO NAPs

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SWMU 62, New Housing Fuel Leak, Eagle Bay (continued)													
HMW-303-12	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued
MW-139-2	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued	Discontinued
MW-303-14	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	Discontinued	Discontinued	Discontinued	Discontinued
RW-303-16	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO NAPs
RW-303-13	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO	DRO NAPs
RW-303-14	MNA	NS	NS	NS	DRO GRO BTEX PAHs NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO	Discontinued	Discontinued
NL-09 (SW)	NS	NS	NS	NS	NS	NS	NS	NS	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)	DRO GRO BTEX PAHs (for TAH and TAqH)
NL-09 (SD)	NS	NS	NS	NS	NS	NS	NS	NS	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs	DRO GRO BTEX PAHs

Table 2-1. Monitoring History for Petroleum-Release and Non-Landfill CERCLA Sites from 2003 through 2014 (continued)

Location Cross-Reference	Monitoring Purpose	Sampling Program Analytes											
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Tanker Shed, UST 42494													
04-175	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO	DRO NAPs	DRO	DRO	DRO	DRO	DRO NAPs
04-290	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO	DRO	DRO NAPs
04-306	MNA	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX NAPs	DRO GRO benzene	DRO GRO benzene	DRO GRO	DRO	DRO NAPs
04-601	MNA/SWP	DRO GRO BTEX NAPs	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO NAPs	DRO GRO benzene (even years)	DRO	DRO GRO	DRO	DRO NAPs
TS-01	SWP	DRO GRO BTEX NAPs	DRO GRO BTEX NAPs	DRO GRO BTEX	DRO GRO BTEX	DRO GRO BTEX	DRO GRO (even years)	NS	DRO GRO	Discontinued	Discontinued	Discontinued	Discontinued
TS-05	SWP	NS	NS	NS	DRO GRO BTEX	DRO GRO BTEX	DRO GRO (even years)	NS	DRO GRO	Discontinued	Discontinued	Discontinued	Discontinued
Yakutat Hangar, UST 2039-A													
05-221	LGM	NS	NS	DRO	DRO	Site Closure	Site Closure	Site Closure	Site Closure	Site Closure	Site Closure	Site Closure	Site Closure
05-244	LGM	NS	NS	DRO	DRO								
05-250	LGM	NS	NS	DRO	DRO								
05-389	SWP	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO								
05-801	SWP	DRO GRO BTEX	DRO GRO BTEX	DRO	DRO								
MW-2	LGM	NS	NS	DRO	DRO								

Table 2-2. Landfill Monitoring Sampling Schedule to Date

	Dates of Sampling[1]																											
Site Name	**March 1996**	**May 1996**	**June 1996**	**July 1996**	**Aug 1996**	**Sept 1996**	**Oct 1996**	**Nov 1996**	**Feb 1997**	**May 1997**	**Dec 1997**	**June 1998**	**Sept 1999**	**Nov 2000**	**Sept 2001**	**Oct 2002**	**Oct 2003**	**Sept 2004**	**Sept 2005**	**Sept 2006**	**Sept 2007**	**Sept 2008**	**Sept 2009**	**Sept 2010**	**Sept 2011**	**Sept 2012**	**Sept 2013**	**Sept 2014**
Palisades Landfill	-	•	-	-	•	-	-	•	•	•	-	•	•	•	•	•	•	•	•	•	•	•	•	•	•	-[3]	•	•
Metals Landfill	-	-	-	•	-	-	-	•	-	•	•	•	•	•	•	•	•	•	•	•	-	•	-	•	-[2]	-[2]	-[2]	•
Roberts Landfill	•	-	•	-	-	•	•	-	-	-	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	-[3]	•	•
White Alice Landfill	•	-	•	-	-	•	•	-	-	-	•	•	•	•	•	•	•	•	-	•	-	•	-	•	-[2]	-[2]	-[2]	•

Notes:
[1] Sampling dates include only those dates on which groundwater, surface water, or sediment samples were obtained.
[2] White Alice and Metals Landfills are scheduled to be sampled once per every 5-year review period. Next scheduled sampling events are in 2018 and 2022.
[3] Palisades and Roberts Landfills are scheduled to be sampled every other year.
• Completed sampling event
- Sampling event not scheduled or performed

Table 2-3. Summary of Landfill Sampling Frequency by Medium and Analyte

Medium	Dissolved Metals	Total Metals	VOCs	SVOCs	PCBs	WQPs[1]
Palisades Landfill						
Sediment	NA	Biennially[2]	NA	NA	Biennially	NA
Metals Landfill						
Groundwater	Every 5 years[3]	Every 5 years[3]	NA	NA	NA	Every 5 years
Roberts Landfill						
Groundwater	Biennially[4]	Biennially[4]	Every 5 years	NA	NA	Biennially
Surface Water	Biennially[4]	Biennially[4]	Every 5 years	NA	NA	Biennially
White Alice Landfill						
Groundwater	Every 5 years[5]	Every 5 years[5]	NA	NA	NA	Every 5 years
Surface Water	Every 5 years[5]	Every 5 years[5]	NA	NA	NA	Every 5 years

Notes:
[1] Alkalinity, sulfate, total dissolved solids, ammonia, total Kjeldahl nitrogen, and chemical oxygen demand
[2] Samples analyzed for target analytes only (antimony, arsenic, and nickel).
[3] Samples analyzed for arsenic and barium only.
[4] Samples analyzed for aluminum plus priority pollutant metals.
[5] Samples analyzed for barium plus priority pollutant metals.

Table 2-4. Summary of Long-Term Monitoring Petroleum-Release and Non-Landfill CERCLA Monitoring Sites and Remedies for 2014

Site Name	Monitored Natural Attenuation	Free Product Recovery	Natural Recovery (SW/SD Sampling)	CERCLA Compliance	Surface Water Protection	No Unacceptable Risk Site (10 times cleanup levels)
Downtown Area Sites						
Area 303/GCI Compound	X	X			X	
Former Power Plant, Building T-1451	X		X		X	
Housing Area (Arctic Acres)	X					
NMCB Building T-1416 Expanded Area	X				X	X
ROICC Contractor's Area, UST ROICC-7	X					
SA 79, Main Road Pipeline	X				X	
SA 80, Steam Plant 4	X					
South of Runway 18-36 Area	X		X		X	X
SWMU 14, Old Pesticide Disposal Area	X			X	X	
SWMU 17, Power Plant No. 3 Area				X	X	X
SWMU 55, Public Works Transportation Department Waste Storage Area				X		
SWMU 60, Tank Farm A	X		X		X	
SWMU 61, Tank Farm B	X		X		X	
SWMU 62, New Housing Fuel Leak	X	X	X		X	
Tanker Shed	X				X	

Table 2-5. Summary of ROD Remedy and Intended Long-Term Monitoring Purpose for 2014 Petroleum-Release and Non-Landfill CERCLA Sites

Site Name	Remedy (Interim and Final)	Location Cross-Reference	Intended Purpose of Monitoring
Area 303/GCI Compound	Free product recovery; MNA selected as the post-free product recovery remedy	03-107	Natural attenuation
		03-012	Natural attenuation/Surface water protection
		04-211	Natural attenuation
		03-104	Natural attenuation
		03-778	Natural attenuation
		03-502	Natural attenuation
		MW-303-28	Natural attenuation
		MW-303-30	Natural attenuation/Free product recovery
		MW-303-31	MNA/FP
		MW-303-32	Natural attenuation
		MW-303-33	Natural attenuation
		MW-303-37	Natural attenuation/Surface water protection
		MW-303-38	Natural attenuation/Free product recovery
		MW-303-39	Natural attenuation/Free product recovery
		MW-303-40	Natural attenuation/Free product recovery
		MW-303-41	Natural attenuation/Free product recovery
		MW-303-42	Natural attenuation
		MW-303-43	Natural attenuation
		MW-303-44	Natural attenuation
		MRP-MW2	Natural attenuation
		MRP-MW3	Natural attenuation
		04-100	Natural attenuation
		04-202	Natural attenuation
		04-204	Natural attenuation
		04-210	Natural attenuation
		04-213	Natural attenuation
		04-701	Natural attenuation

Table 2-5. Summary of ROD Remedy and Intended Long-Term Monitoring Purpose for 2014 Petroleum-Release and Non-Landfill CERCLA Sites (continued)

Site Name	Remedy (Interim and Final)	Location Cross-Reference	Intended Purpose of Monitoring
Former Power Plant, Building T-1451	MNA	01-118	Natural attenuation
		01-150	Natural attenuation
		MW-1451-1	Natural attenuation
		MW-1451-2	Natural attenuation/Surface water protection
		MW-1451-3	Natural attenuation/Surface water protection
		MW-1451-4	Natural attenuation/Surface water protection
		MW-1451-5	Natural attenuation
		MW-1451-6	Natural attenuation
		MW-1451-7	Natural attenuation
		MW-1451-8	Natural attenuation
		MW-1451-9	Natural attenuation
		NL-08	Natural recovery/Surface water protection
		E-701	Background
Housing Area (Arctic Acres)	MNA	03-416	Natural attenuation
		03-420	Natural attenuation
		03-421	Natural attenuation
		03-890	Natural attenuation
NMCB Building T-1416 Expanded Area	Free product recovery; MNA selected as the post-free product recovery remedy	02-451	Natural attenuation
		02-461	Natural attenuation
		02-479	Natural attenuation
		02-818	Natural attenuation/Surface water protection
		E-201	Natural attenuation
		NMCB-07	Natural attenuation/Surface water protection
		NMCB-09	Natural attenuation/Surface water protection
		NMCB-10	Natural attenuation/Surface water protection
		NMCB-11	Natural attenuation/Surface water protection
ROICC Contractor's Area, UST-ROICC-7	Limited groundwater monitoring followed by MNA	08-200	Natural attenuation
		08-202	Natural attenuation
SA 79, Main Road Pipeline, South End	Limited groundwater monitoring followed by MNA	02-230	Natural attenuation/Surface water protection
		601	Natural attenuation
		MRP-MW8	Natural attenuation

Table 2-5. Summary of ROD Remedy and Intended Long-Term Monitoring Purpose for 2014 Petroleum-Release and Non-Landfill CERCLA Sites (continued))

Site Name	Remedy (Interim and Final)	Location Cross-Reference	Intended Purpose of Monitoring
SA 80, Steam Plant 4, USTs 27089 and 27090	Free product recovery; MNA selected as the post-free product recovery remedy	04-158	Natural attenuation
		04-159	Natural attenuation
		04-173	Natural attenuation
		SP4-3	Natural attenuation
South of Runway 18-36 Area	Free product recovery, natural recovery for surface water and sediment and MNA	02-231	Natural attenuation/Surface water protection
		02-232	Natural attenuation/Surface water protection
		AS-1	Natural attenuation/Surface water protection
		NSWSD-2	Natural recovery
		NSWSD-4	Natural recovery
		NSWSD-5	Natural recovery
SWMU 14, Old Pesticide Storage and Disposal Area	MNA and CERCLA compliance	MW-14-5	Natural attenuation
SWMU 17, Power Plant No. 3 Area	Free product recovery; MNA selected as the post-free product recovery remedy and CERCLA compliance	05-735	Compliance
SWMU 55, Public Works Transportation Department Waste Storage Area	CERCLA compliance	55-145	Compliance
SWMU 60, Tank Farm A	MNA	LC5A	Natural attenuation/Surface water protection
		650	Natural attenuation/Surface water protection
		651	Natural attenuation/Surface water protection
		652	Natural attenuation/Surface water protection
		653	Natural attenuation/Surface water protection
		852	Natural recovery/Surface water protection
SWMU 61, Tank Farm B	MNA	14-113	Natural attenuation/Surface water protection
		14-210	Natural attenuation/Surface water protection
		TFB-MW4B	Natural attenuation
		NL-04	Surface water protection/Natural recovery

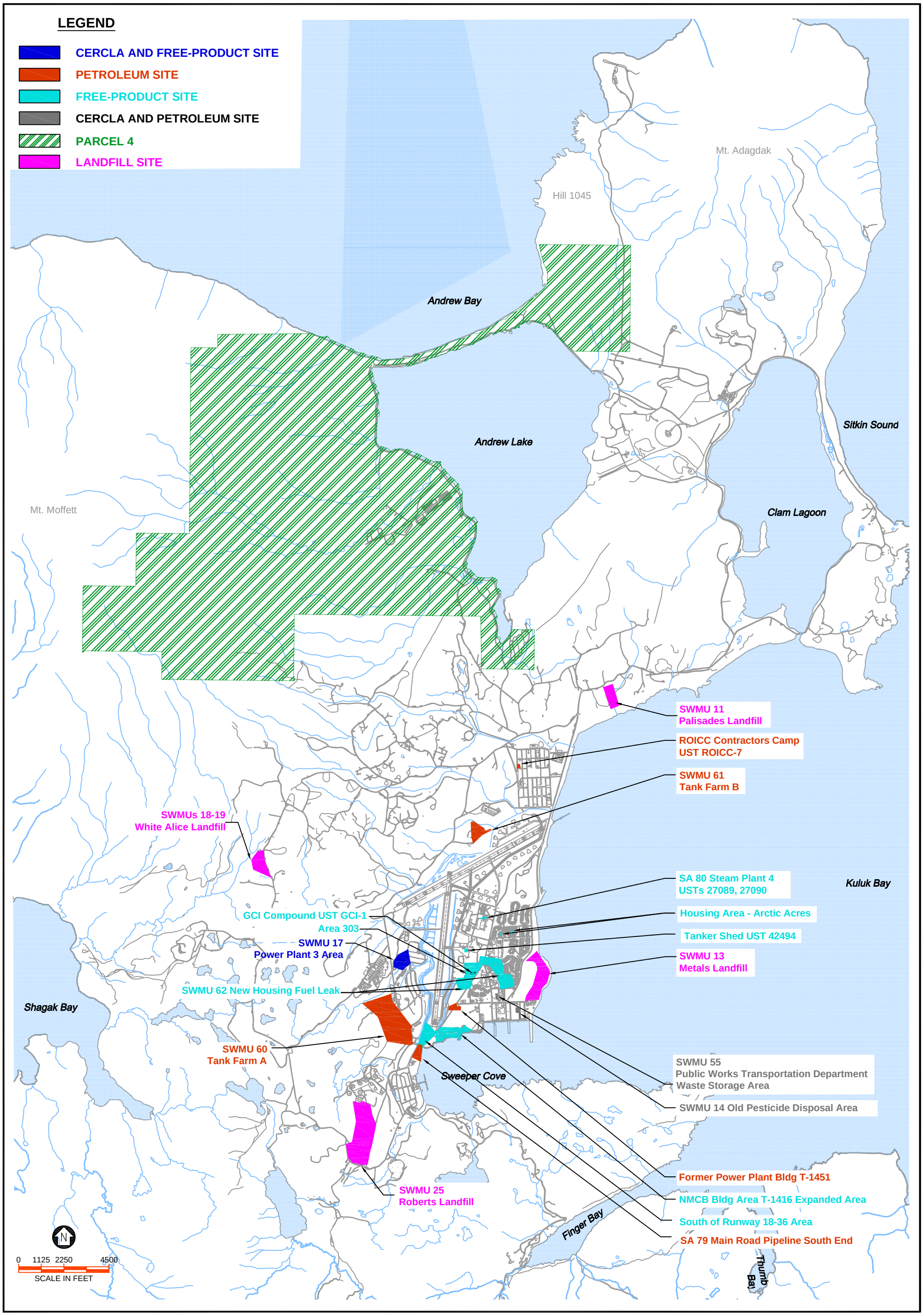
Table 2-5. Summary of ROD Remedy and Intended Long-Term Monitoring Purpose for 2014 Petroleum-Release and Non-Landfill CERCLA Sites (continued)

Site Name	Remedy (Interim and Final)	Location Cross-Reference	Intended Purpose of Monitoring
SWMU 62, New Housing Fuel Leak	Free product containment and passive recovery, surface soil excavation and MNA	**Sandy Cove Housing Complex**	
		03-155	Natural attenuation
		03-619	Natural attenuation
		MW-107-1	Natural attenuation
		MW-134-11	Natural attenuation
		MW-146-1	Natural attenuation
		MW-187-1	Natural attenuation
		Eagle Bay Housing Complex	
		AMW-704	Natural attenuation/Surface water protection
		MW-303-7	Natural attenuation
		RW-303-13	Natural attenuation/Surface water protection
		RW-303-16	Natural attenuation/Surface water protection
		NL-09	Natural recovery/Surface water protection
Tanker Shed, UST 42494	Free product recovery; MNA selected as the post-free product recovery remedy	04-175	Natural attenuation
		04-290	Natural attenuation
		04-306	Natural attenuation
		04-601	Natural attenuation/Surface water protection

Table 2-6. Adak OU A and OU B-1 Long-Term Monitoring Program Schedule

	Groundwater Monitoring			Landfill Monitoring		Institutional Controls Inspections				
Year	**Annual Sites[1]**	**Biennial Sites**	**NAPs[2]**	**Biennial Sites[3]**	**5 Year Sites[4]**	**Annual [5]**	**Biennial Sites**	**5-Year IC and OU B-1 Sites**	**Marine Monitoring**	**5-Year Review**
2014	X	X	X	X	X	X		X		
2015	X					X	X		X	
2016	X	X		X		X				X
2017	X					X	X		X	
2018	X	X	X	X	X	X				
2019	X					X	X	X	X	
2020	X	X		X		X				
2021	X					X	X		X	X
2022	X	X		X		X				
2023	X					X	X		X	
2024	X	X	X	X	X	X		X		
2025	X					X	X		X	
2026	X	X		X		X				X

Notes:
[1] Area 303/GCI Compound; Former Power Plant, Building T-1451; and SWMU 60, Tank Farm A sites
[2] Natural attenuation parameters sampling conducted at all sites
[3] Palisades and Roberts Landfills
[4] Metals and White Alice Landfills and VOC sampling at Roberts Landfill
[5] Education program, excavation restrictions monitoring, and Downtown Area groundwater use restriction monitoring
Gray – 5-year monitoring conducted on alternating 4- and 6-year intervals to coincide with biennial monitoring
Yellow – 5 year review



U.S.NAVY	SEALASKA	Figure 2-1 2014 Groundwater and Landfill Monitoring Sites Adak Island, Alaska	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

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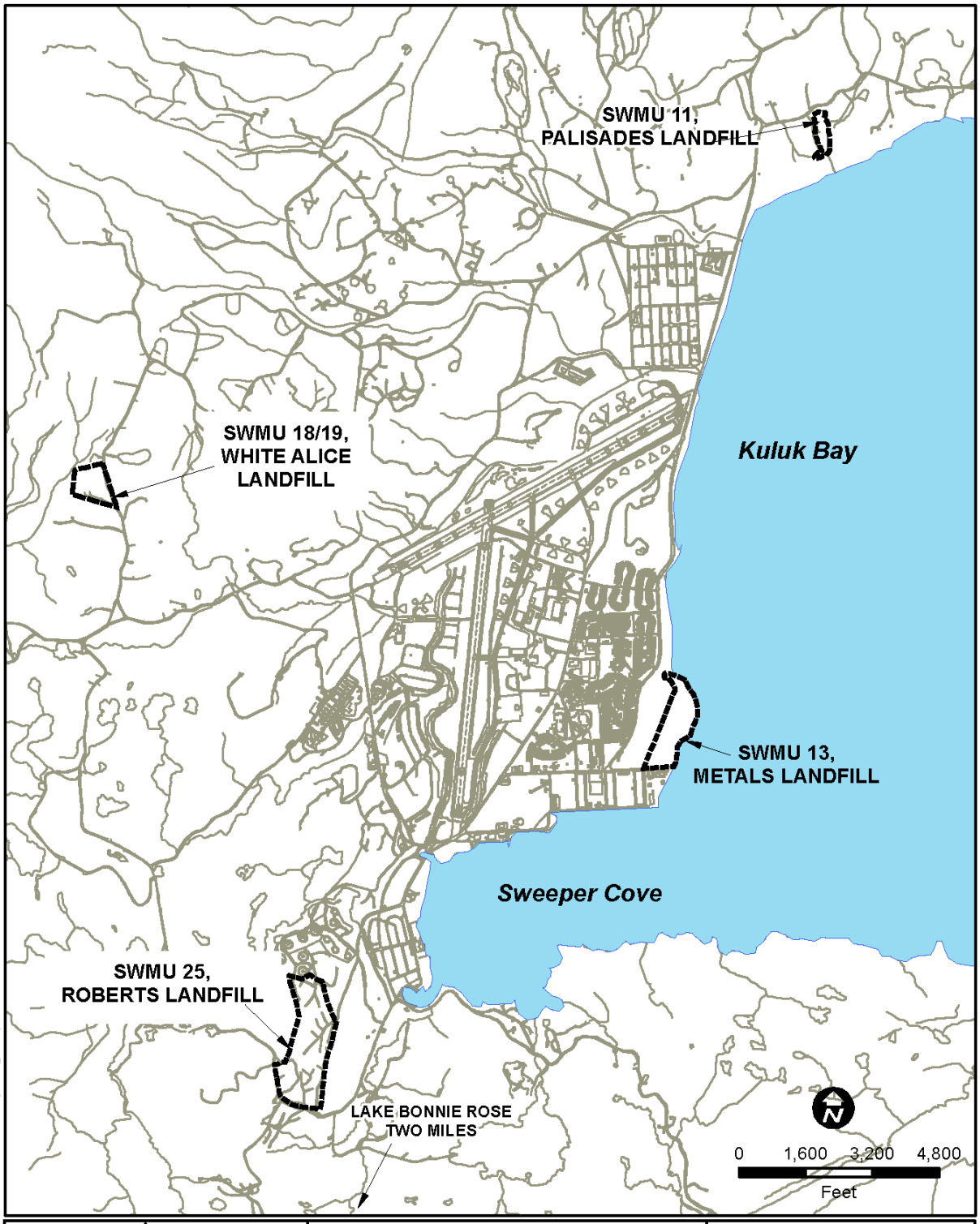

U.S. NAVY	SEALASKA	Figure 2-2 Landfill Monitoring Sites Adak Island, Alaska	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

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3 MONITORING TYPES AND ENDPOINTS

3.1 PETROLEUM-RELEASE AND NON-LANDFILL CERCLA SITES MONITORING

Monitoring endpoints are specified in the CMP, Revision 6 (Navy 2014a). Chemical-specific criteria are used as a means of quantitatively evaluating the progress of a remedy toward achieving the remedial action objectives (RAOs) stated in the OU A ROD (Navy, ADEC, and EPA 2000). Therefore, environmental restoration requires regular monitoring of groundwater at petroleum and non-landfill CERCLA sites to assess concentrations and trends relative to monitoring endpoints. Endpoint criteria are represented by a set of chemical-specific conditions that indicate whether the RAO has been met and monitoring can be terminated. Whether endpoints are met is evaluated on a chemical-specific basis. Specific endpoint criteria are described herein by monitoring type.

3.1.1 Petroleum Monitoring

The following five separate conditions are possible regarding monitoring endpoints at petroleum sites:

- Conditions meet endpoint criteria, and monitoring may be reduced or terminated.
- Conditions meet endpoint criteria, and monitoring is continued due to other existing conditions at the site (e.g., contaminated upgradient wells).
- Conditions do not meet endpoint criteria, and monitoring will continue at the existing frequency.
- Conditions do not meet endpoint criteria, but conditions are such that monitoring frequency can be reduced.
- Conditions do not meet endpoint criteria, but conditions are such that the site remedy will be evaluated.

Target analytes for petroleum monitoring sites are specified in the OU A ROD, and not all ROD-listed target analytes are analyzed at every site (Navy, ADEC, and EPA 2000). The site-specific analyses selected for the monitoring program of each site are based on historical results and the nature of the release. The following are the 2014 target analytes for petroleum monitoring sites:

- Gasoline-range organics (GRO)
- Benzene, toluene, ethylbenzene, and total xylenes (BTEX)

- Diesel-range organics (DRO)
- Total and dissolved lead
- Dibenz(a,h)anthracene

3.1.2 Monitored Natural Attenuation Groundwater Sites

Natural attenuation monitoring is conducted at sites with the OU A ROD- and State Adak Environmental Restoration Agreement (SAERA)-selected remedy of MNA. The LTM at MNA sites include the following:

- Track contaminant concentrations in groundwater, surface water, and sediment (depending on the site) over time at the monitored sites;
- Monitor remedy performance and compliance;
- Evaluate contaminant concentrations and trends in these media relative to monitoring endpoints; and
- Document the current status of each monitored site or monitoring location relative to the chemical- and media-specific endpoints and RAOs stated in the OU A ROD based on the evaluation of contaminant concentrations and trends by media relative to monitoring endpoints.

MNA has been selected as the final remedy for 15 sites. Monitoring is considered complete at a given location if chemical concentrations are below the primary endpoint criteria for two consecutive monitoring events, with the exception of sites Area 303/General Communications, Inc. (GCI) Compound; Naval Mobile Construction Battalion (NMCB) Building T-1416 Expanded Area; South of Runway 18-36 Area; and SWMU 62, New Housing Fuel Leak Area, all of which require three consecutive monitoring events. Table 3-1 lists the groundwater chemical endpoint criteria for petroleum and non-landfill CERCLA sites.

Two petroleum sites (NMCB Building T-1416 Expanded Area and South of Runway 18/36 Area) were identified as having no unacceptable human health and ecological risks, and groundwater at those sites is not considered a current or potentially future drinking water source. Endpoint criteria for these sites are established at 10 times the groundwater chemical endpoint criteria and are identified in the list below. MNA sampling was conducted at the following sites during August and September 2014:

- Area 303/GCI Compound, Underground Storage Tank (UST) GCI-1
- Former Power Plant, Building T-1451

- Housing Area (Arctic Acres)
- NMCB Building T-1416 Expanded Area (10 times cleanup levels)
- Resident Officer in Charge of Construction (ROICC) Contractor's Area, UST ROICC-7
- Source Area (SA) 79, Main Road Pipeline, South End
- SA 80, Steam Plant 4, USTs 27089 and 27090
- South of Runway 18-36 (10 times cleanup levels)
- SWMU 14, Old Pesticide Storage and Disposal Area
- SWMU 60, Tank Farm A
- SWMU 61, Tank Farm B
- SWMU 62, New Housing Fuel Leak
- Tanker Shed, UST 42494

Table 3-1. Petroleum and Non-Landfill CERCLA Site Monitoring Endpoints for Target Analytes in Groundwater

Target Analyte	Alaska Cleanup Levels 18 AAC 75.345 (µg/L)[1]
Volatile Organic Compounds	
1,1-Dichloroethene	7
Cis-1,2-dichloroethene	70
Trans-1,2-dichloroethene	100
Benzene	5
Ethylbenzene	700
Tetrachloroethylene	5
Toluene	1,000
Total xylenes	10,000
Trichloroethylene	5
Vinyl chloride	2
Semivolatile Organic Compounds	
Dibenz(a,h)anthracene	0.12
Petroleum Hydrocarbons	
Gasoline-range organics	2,200[2] (13,000[3])
Diesel-range organics	1,500
Metals	
Lead	15

Notes:
[1] Cleanup levels shown are applicable if groundwater is a source of drinking water at the site. A concentration equal to 10 times the concentration shown may be used if groundwater is not a current source of drinking water, or groundwater is not a reasonably expected future source of drinking water.
[2] Standard is based on estimated solubility.
[3] Cleanup level for GRO at a site for which groundwater is not expected to be a future source of drinking water (10 times cleanup level) is 13,000 µg/L.

Natural attenuation of petroleum hydrocarbons has been demonstrated on Adak Island. As a result, the CMP, Revision 6 (Navy 2014a) prescribed natural attenuation parameter (NAP) monitoring once every 5 years. This monitoring was conducted in 2014 at all MNA sites.

One of the stated objectives in the OU A ROD for these sites is to estimate the rate of natural attenuation to demonstrate achievement of the primary endpoint criteria within 75 years. As a secondary endpoint criteria, monitoring at a specific location could be substantially reduced if it can be demonstrated that:

- The concentrations are decreasing at a predictable rate with a degree of confidence of at least 80 percent; and
- The exceedance poses no reasonable threat to downgradient receptors.

If monitoring demonstrates that both of these secondary endpoint criteria are met, then it will be concluded that natural attenuation is progressing as predicted, groundwater in the area poses no threat to humans or the environment, and further monitoring can be substantially reduced (e.g., in frequency, location, or analyte).

To determine whether secondary endpoint criteria are achieved, a trend evaluation was performed for well locations where exceedances of the primary endpoint criteria have occurred. As specified by the CMP, Revision 6 (Navy 2014a), trend evaluations were performed when at least four monitoring data points were available. Trend evaluations were performed on concentrations of at least one analyte in a total of 39 wells at 13 sites during 2014.

Monitoring will be continued if the trend evaluation determines that the primary endpoint criteria are not met, as evidenced by:

- Decrease in concentrations over time, but non-demonstrability that the exceedances pose no reasonable threat to downgradient receptors; or
- No significant change in concentrations observed, and no trend line found outside the confidence interval (i.e., the concentration trend is uncertain).

If the data tests indicate that the concentrations are increasing, an evaluation will be performed to determine whether to continue monitoring or take additional action.

The effectiveness of the selected remedies will be evaluated during the 5-year reviews. NAP sampling will be conducted once every 5 year period to coincide with the 5-year reviews (see Table 2-6) and was conducted during the 2014 field event. The MNA remedy for these

sites was last evaluated during the 5-year review in 2011 to determine whether natural attenuation is still being demonstrated in groundwater. The 5-year review presents the results of monitoring conducted up to that time and identifies future actions as necessary. If the 5-year review demonstrates that MNA of petroleum and VOCs will not achieve the primary endpoint criteria within the 75-year time frame at a site, enhancement of MNA or the use of alternative remedial actions will be evaluated and discussed with ADEC and EPA for SWMU 14.

3.1.3 Statistical Trend Analysis Methods

Prior to the statistical trend analysis being performed, the applicable chemical data from the monitoring wells for the 1999 through 2014 period were compiled and reviewed for a qualitative assessment of the suitability, comparability, and representativeness of the historical data (i.e., a historical data usability assessment). For the statistical analysis, this time frame was selected because it would allow capture of four to ten sampling periods (to meet the minimum number of four data points required for the Mann-Kendall test) and exhibit any long-term characteristics or trends in the data. Statistical trend analysis for the compounds of interest occurring in samples from the site monitoring wells was accomplished using the Mann-Kendall test, which is a non-parametric statistical test used to evaluate trends in data over time. It tests the null hypothesis (H0) at both the 80 and 95 percent confidence intervals. Trend analysis was performed for analytes in groundwater which exceeded endpoint criteria during the previous two sampling events. The analysis output indicates whether parameter trends are increasing, decreasing, or exhibiting no trend. If no trend is indicated, a coefficient of variation assessment is made to evaluate parameter stability and determine whether concentrations are stable or unstable. Because the chemical data were collected in August and September of each year, no analysis of seasonal trend can be conducted, and the Mann-Kendall test rather than a Seasonal Kendall test is appropriate.

If a statistically significant decreasing trend was identified in the Mann-Kendall trend analysis, Sen's slope estimate was used to calculate the overall median slope. Sen's procedure is a non-parametric statistical test that calculates the slope of a trend by evaluating the median slope for all the pairs of samples as an estimate of the overall slope. This methodology is less sensitive to outliers or missing data as compared to conventional linear regression techniques. To ensure the calculated confidence intervals were relevant, Sen's evaluation was performed on data for which sampling events were not more than 2 years apart. One-half the detection limit was used if analytical results were not detected. Statistical calculations for each site are listed in Appendix H.

3.1.4 Surface Water Protection Groundwater Monitoring Endpoint

The OU A ROD (Navy, ADEC, and EPA 2000) specifies that groundwater monitoring will be conducted for CERCLA and petroleum-related chemicals at sites where concentrations in groundwater exceed water quality criteria and groundwater could discharge into a regulated surface water body. In general, surface water protection monitoring is being conducted at a limited number of wells positioned downgradient of free product sites between the source area and a surface water body. The purpose of surface water protection monitoring is to watch for migration of free product or dissolved contaminants into an area that is currently not impacted and thus to provide an early warning of potential migration to the associated surface water body. The surface water bodies located downgradient of actively monitored sites include Sweeper Cove, North Sweeper Creek, and South Sweeper Creek.

Because several petroleum release sites on Adak Island are located upgradient from these three water bodies, selected monitoring locations at these sites are designated for surface water protection monitoring. This monitoring was planned at the following 24 sampling locations during the 2014 monitoring event:

- Area 303/GCI Compound, locations 03-012 and MW-303-37
- Former Power Plant, Building T-1451, locations MW-1451-2, MW-1451-3, MW-1451-4, and NL-08
- NMCB Building T-1416 Expanded Area, locations 02-818, NMCB-07, NMCB-9, NMCB-10, and NMCB-11
- SA 79, Main Road Pipeline, South End, location 02-230
- South of Runway 18-36 Area, locations 02-231, 02-232, and AS-1
- SWMU 60, Tank Farm A, location LC5A
- SWMU 61, Tank Farm B, locations 14-113, 14-210, and NL-04
- SWMU 62, New Housing Fuel Leak, locations AMW-704, RW-303-13, RW-303-16, and NL-09
- Tanker Shed, UST 42494, location 04-601

The chemical-specific criteria applicable to surface water are specified in the Alaska Water Quality Standards (18 AAC 70.020[b][5][A][iii]). For sites with BTEX and GRO as contaminants of concern, the criteria specify that total aqueous hydrocarbons (TAqH) (sum of BTEX and polycyclic aromatic hydrocarbon [PAH] concentrations) in the water column may not exceed 15 micrograms per liter (µg/L) and total aromatic hydrocarbons (TAH)

(sum of BTEX concentrations) may not exceed 10 µg/L. The point of compliance for achieving these surface water criteria is established at the soil/surface water interface by ADEC (ADEC 2001).

The surface water protection monitoring regime uses analytical results for groundwater samples collected from wells adjacent to or upgradient from receiving surface water bodies. The evaluation compares analytical results for petroleum compounds to the Alaska Water Quality Standards (18 AAC 70; ADEC 2009). If this comparison indicates an exceedance and a significant increase in concentrations over three measurements at a surface water protection monitoring location, the following actions will be initiated:

- Evaluation of chemicals and their concentrations identified in surface water protection wells relative to the potential for a reasonable threat to downgradient aquatic receptors;
- Evaluation and planning for collection of one upgradient and one downgradient surface water sample at the soil/surface water interface closest to the subject sentinel well location;
- Review of the final remedy selected for the nearest upgradient site, and evaluation of the remedy performance relative to surface water protection criteria; and
- Initiation of free product recovery in surface water protection wells where the presence of free product is indicated by an interface probe.

The endpoint for surface water protection monitoring depends directly on the associated upgradient site achieving the remedial endpoint criteria. Once the upgradient site has achieved the remedial endpoint and it can be demonstrated that no reasonable threat to the downgradient receptor exists, surface water monitoring at the associated location will be terminated.

3.1.5 CERCLA Compliance Groundwater Monitoring

Compliance monitoring is conducted at sites where CERCLA-regulated chemicals have been identified as target analytes. The purpose of compliance monitoring is to evaluate whether target analyte concentrations in the groundwater comply with the endpoint criteria.

CERCLA groundwater monitoring was conducted at the following non-landfill sites during the 2014 monitoring event:

- SWMU 14, Old Pesticide Storage and Disposal Area; location MW 14-5
- SWMU 17, Power Plant No. 3 Area; location 05-735

- SWMU 55, Public Works Transportation Department Waste Storage Area; location 55-145

Target analytes for CERCLA groundwater monitoring include chlorinated volatile organic compounds (VOCs) and daughter products (see Tables 2-1 and 3-1). Compounds detected during each CERCLA monitoring event are evaluated for inclusion or removal as target analytes, based on a comparison to endpoint criteria. Revisions to the target analyte list and monitoring frequency are made in the negotiated recommendations in the annual groundwater monitoring reports, 5-year reviews, and revisions to the CMP.

The groundwater monitoring program was expanded, on a site-specific basis, to include the monochlorinated and dichlorinated daughter product compounds of the target analytes specified in the OU A ROD. In general, remedy evaluations and trends are conducted using only those analytes specified in the OU A ROD. In some cases, however (e.g., SWMU 17), trend analysis also included additional chlorinated VOC daughter products.

Compliance monitoring will be considered complete at a given location if concentrations of the target analytes are below the endpoint criteria as specified by 18 AAC 75.345 (Table 3-1) for two consecutive sampling rounds. A secondary endpoint can be established based on the trend evaluation discussed in Section 3.1.2, if the following can be demonstrated (Navy, ADEC, and EPA 2000):

- The concentrations are decreasing at a predictable rate with a degree of confidence of at least 80 percent; or
- The exceedance poses no reasonable threat to downgradient receptors.

Generally, if the trend evaluation does not indicate that an endpoint has been met, monitoring will continue as required. Additional data reviews will be performed after every fifth year until a monitoring endpoint is reached. If the analysis indicates that the concentration is increasing, the Navy, in consultation with ADEC and EPA, will determine the appropriate course of action. Trend evaluations for chlorinated VOCs are performed in the same manner as for petroleum compounds.

The results and analyses of the compliance monitoring are summarized annually. Discussion of the need for continued compliance monitoring and recommended changes to the compliance monitoring program (i.e., increase frequency, decrease frequency, or discontinue) will be presented in this report and the 5-year review document.

3.1.6 Natural Recovery/Sediment and Surface Water Monitoring

Based on the Final Decision Document South of Runway 18-36 (Navy 2006a), natural recovery with monitoring was the selected remedy. Sediment (SD) and surface water (SW) monitoring was conducted at the following two sites during the 2014 monitoring event in South Sweeper Creek:

- South of Runway 18-36 Area, locations NSWSD-2 (SD), NSWSD-4 (SD), and NSWSD-5 (SD)
- SWMU 60, Tank Farm A, location 852 (SW & SD)

Additionally, surface water sampling, sediment sampling, or both were conducted at shoreline locations downstream of identified or suspected petroleum seeps at the following sites:

- Former Power Plant, Building T-1451, location NL-08 (SW & SD; East Canal)
- SWMU 61, Tank Farm B, location NL-04 (SW & SD; North Sweeper Creek)
- SWMU 62, New Housing Fuel Leak Area, location NL-09 (SW & SD; East Canal)

For sites with natural recovery as a remedy, surface water and sediment monitoring is conducted until petroleum concentrations in surface water and sediment are below the risk-based cleanup levels, as established by the risk assessment, and petroleum concentrations in surface water are below ADEC water quality standards. The purpose of the sediment monitoring is to demonstrate that petroleum hydrocarbons in shoreline or bottom sediments are not causing deleterious effects to aquatic life. The purpose of the surface water monitoring is to demonstrate that surface waters and adjoining shorelines remain free from floating oil, film, sheen, or discoloration and meet the cleanup levels established in 18 AAC 70 for TAH and TAqH.

All surface water and sediment samples were collected at the same locations as in previous years. Sample locations were determined through negotiations with EPA and ADEC and guided by the observable presence of petroleum contamination, groundwater seep or both.

Chemicals of concern in sediment and surface water for these sites and cleanup levels have been established for South Sweeper Creek at the South of Runway 18-36 Area (Table 3-2). The cleanup levels for both sediment and surface water at this site are based on the results of the risk assessment (Navy and ADEC 2005). These risk-based cleanup levels were set at the risk-based screening criteria for the chemicals that potentially pose an unacceptable ecological risk. Because no criteria have been established for other sites, analytical results for the surface water and sediment samples at the other sites were compared to South of Runway 18-36 Area

cleanup levels; however, these cleanup levels may not correlate to the ecological risks associated with the other sites and may not accurately reflect whether surface water and sediments are being impacted by on-site contamination at unacceptable levels of risk.

Table 3-2. Sediment and Surface Water Cleanup Levels for South of Runway 18-36, South Sweeper Creek

	Sediment	Surface Water	
Chemical	**Risk-Based Cleanup Levels[1,2] (mg/kg)**	**Risk-Based Cleanup Levels[1,2] (µg/L)**	**ADEC Quality Standards[2] (µg/L)**
Total Petroleum Hydrocarbons			
DRO	90.6	250	NA
GRO	12.2	114	NA
TAH	NA	NA	10
TAqH	NA	NA	15
Polycyclic Aromatic Hydrocarbons			
2-Methylnaphthalene	0.0202	NC	NA
Indeno(1,2,3-cd)pyrene	NC	0.28	NA
Phenanthrene	0.225	NC	NA

Notes:
[1] Used as screening criteria to determine potential extent of contamination.
[2] Used as cleanup levels for remediation.

In addition, the ADEC surface water quality standards, established by Alaska Regulation 18 AAC 70, are applicable to surface water at all sites. These standards include numerical criteria for TAH and TAqH (Table 3-2) and the following standards:

- Petroleum hydrocarbons in shoreline or bottom sediments may not cause deleterious effects to aquatic life; and
- Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.

Natural recovery monitoring will be conducted until petroleum concentrations in surface water and sediment are below the risk-based cleanup levels, as established by the risk assessment, and petroleum concentrations in surface water are below ADEC water quality standards (TAqH and TAH). Natural recovery will be discontinued once the risk-based cleanup levels for surface water and sediment and the ADEC water quality standards for sheen, TAqH, and TAH, are achieved during three consecutive monitoring events in all samples collected at the site.

3.2 LANDFILL SITES MONITORING

Remedial actions completed under the 1995 interim action ROD for the SWMU 11, Palisades Landfill and SWMU 13, Metals Landfill and the remedial actions completed under the closure plans for the SWMUs 18/19, White Alice Landfill and SWMU 25, Roberts

Landfill were selected as the final remedies in the OU A ROD. The ROD was signed by all parties on April 13, 2000 (Navy, ADEC, and EPA 2000).

3.2.1 SWMU 11, Palisades Landfill

As specified in the ROD, the RAOs for SWMU 11, Palisades Landfill are to protect human health and ecological receptors from exposure to landfill debris and soil that could result in a cancer risk greater than $1x10^{-5}$, or a non-cancer risk above a hazard index of 1.0. Palisades Landfill was included in the 1995 interim action ROD that specified the placement of a cover over the landfill, monitoring, and ICs. The OU A ROD selected the interim actions as the final remedy for Palisades Landfill. The capping, surface water/sediment monitoring, and IC actions performed under the interim action ROD were evaluated and determined to be protective. The landfill is now in the post-closure care period and sampling has been reduced to biennially.

3.2.2 SWMU 13, Metals Landfill

As specified in the ROD, the RAOs for SWMU 13, Metals Landfill are to protect human health and ecological receptors from exposure to landfill debris and soil which could result in a cancer risk greater than $1x10^{-5}$, or a non-cancer risk above a hazard index of 1.0. Metals Landfill was included in the 1995 interim action ROD that specified the placement of a cover over the landfill, monitoring, and ICs. The OU A ROD selected the interim actions as the final remedy for Metals Landfill. The capping, groundwater monitoring, and IC actions completed under the interim action ROD were evaluated and determined to be protective. Historically the northern edge of Metals Landfill was partially eroded by winter ocean storms. The Navy has evaluated the best methods to stop the erosion and protect this area from future storms. The Navy implemented initial erosion controls in 2000 and has since maintained these controls as defined by the CMP, Revision 6 (Navy 2014a). In 2010, repairs were made to the armor rock along the western shoreline and other erosion controls on the basis of landfill inspection observations (Navy 2010). Additional IC repairs are scheduled for 2015. The landfill is now in the post-closure care period, and sampling has been reduced to once every 5 years.

3.2.3 SWMUs 18/19, White Alice Landfill

The SWMUs 18/19, White Alice Landfill was permitted and closed under the State of Alaska solid waste regulations (18 AAC 60). The RAOs for the White Alice Landfill are to meet the post-closure care requirements of ADEC solid waste regulations (18 AAC 60) by maintaining the surface water/erosion controls, access restrictions, and vegetative cover, and by performing periodic groundwater and surface water monitoring. These selected remedies complied with 18 AAC 60 and the permit requirements for closure of the sites. These actions were also

consistent with presumptive remedies for landfills under EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-67FS – 1996. Repairs to eroded areas, erosion controls, and access restrictions were completed in 2010 (Navy 2010). The landfill is now in the post-closure care period, and sampling has been reduced to once every 5 years.

3.2.4 SWMU 25, Roberts Landfill

The SWMU 25, Roberts Landfill was permitted and closed under State of Alaska solid waste regulations (18 AAC 60). The RAOs for Roberts Landfill are to meet the post-closure care requirements of Alaska solid waste regulations by maintaining the surface water/erosion controls, access restrictions, and vegetative cover, and by performing periodic groundwater and surface water monitoring. These selected remedies complied with 18 AAC 60 and the permit requirements for closure of the site. These actions were also consistent with presumptive remedies for landfills under EPA OSWER Directive 9355.0 67FS – 1996. In addition, annual site inspections for the Roberts Landfill have been prescribed for the past 5 years. Repairs to eroded areas, erosion controls, and access restrictions were completed in 2010 (Navy 2010). A 5-year review was completed in December 2011. The landfill is now in the post-closure care period and sampling has been reduced to biennially.

3.2.5 Endpoint Criteria

For the purposes of this report and for consistency with previous monitoring events, the analytical results for each media type (groundwater, surface water, and sediment) were compared with the endpoint criteria presented in Tables 3-3 through 3-7 for Palisades, Metals, White Alice, and Roberts Landfills which were the four landfills sampled in 2014. Monitoring endpoints are specified in the CMP, Revision 6 (Navy 2014a). Endpoint criteria are also presented in the analytical results tables for each landfill in their separate sections along with references for each endpoint source or justification. Endpoint criteria were established only for target analytes as per the OU A ROD (Navy, ADEC, and EPA 2000).

Palisades Landfill sediment criteria were revised in 2007 (CMP, Revision 3; Navy 2007). Those endpoint criteria were derived from the ecological and human health risk-based screening concentrations (RBSCs) provided in the Preliminary Source Evaluation 2 (PSE-2) Guidance Document (Navy 1996) and from the studies of Long, MacDonald, Smith, and Calder (1995) which requires the summation of six select PAHs—benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene—for comparison to one endpoint criteria. Contaminant concentrations reported below reporting limits are not included in the summation.

Table 3-3. Sediment Endpoint Criteria for SWMU 11, Palisades Landfill

	Endpoint Criteria[3]	
Chemical	**Long et. al. 1995 Freshwater and Marine[1]**	**Ecological RBSC[2]**
Total Metals (mg/kg)		
Antimony	none	2
Arsenic	8.2	none
Nickel	20.9	none
PCBs (Aroclors) (µg/kg)		
Aroclor 1016	Sum of Aroclors	none
Aroclor 1221		none
Aroclor 1232		none
Aroclor 1242		none
Aroclor 1248		none
Aroclor 1254		none
Aroclor 1260		none
Sum[4] of Above Aroclors	22.7[2]	

Notes:
[1] Marine sediment (Long et al. 1995)
[2] Final PSE-2 Guidance Document for Adak (Navy 1996)
[3] Total organic carbon normalization is not required for comparison to endpoint criteria.
[4] Non-detected results are assumed to be zero and are not included in the summation.

Table 3-4. Endpoint Criteria for Groundwater at SWMU 13, Metals Landfill

	Endpoint Criterion
Total and Dissolved Metals (µg/L)	**Alaska Cleanup Level 18 AAC 75.345**
Arsenic	10
Barium	2,000

Table 3-5. Endpoint Criteria for Fresh Surface Water at SWMUs 18/19, White Alice Landfill

	Endpoint Criteria	
	Alaska Water Quality Standards, 18 AAC 70[1]	
Total and Dissolved Metals (µg/L)	**Aquatic Life**	**Human Health (Organisms Only)**
Arsenic	190 (As III) dissolved	1.4[2]
Barium	None	2,000[3]
Chromium III	210 total recoverable at 100 mg/L hardness	None
Chromium VI	11 total recoverable	None
Nickel	160	100

Notes:

[1] Criteria existing in 18 AAC 70 when ROD for OU A and landfills were signed. (Changes to some of these criteria were adopted in an 18 AAC 70 amendment on March 24, 2003.)

[2] Human health criteria for carcinogens come from EPA promulgation of human health criteria for carcinogens for Alaska at the 10^{-5} risk level in the National Toxics Rule (40 CFR 131.36) in accordance with ADEC guidance.

[3] Barium was identified as an analyte in the OU A ROD for this site. Monitoring is conducted to identify concentration changes over time. The groundwater to surface water pathway is considered to be the pathway of concern. Therefore the groundwater cleanup level is applied to the human health column for a relative comparator.

Table 3-6 Endpoint Criteria for Groundwater at SWMUs 18/19, White Alice Landfill

	Endpoint Criterion
Total and Dissolved Metals (µg/L)	**Alaska Cleanup Level 18 AAC 75.345[1]**
Arsenic	10
Barium	2,000
Chromium	100
Nickel	100

Table 3-7. Surface Water and Groundwater Monitoring Endpoints for SWMU 25, Roberts Landfill

	Surface Water		Groundwater
	Alaska Cleanup Levels 18 AAC 75.345 (µg/L)[1]		Alaska Cleanup Levels 18 AAC 75.345 (µg/L)
Target Analyte	**Aquatic Life**	**Human Health**	
Volatile Organic Compounds (µg/L)			
1,1-Dichloroethene	None	320	7
Benzene	None	710[2]	5
Cis-1,2-dichloroethene	None	None	70
Ethylbenzene	None	3,280	700
Tetrachloroethylene	None	88.5	5
Toluene	None	424,000	1,000
Trans-1,2-dichloroethene	None	None	100
Trichloroethene	None	810	5
Total xylenes	None	None	10,000
Total Metals (µg/L)			
Aluminum	87	None	None
Antimony	None	45,000	6
Arsenic	190	1.4[2]	50
Beryllium	190	1.4	4
Cadmium	1.1[3]	None	5
Chromium	210[3,4]	None	100
Copper	12[3]	None	1,000
Lead	3.2[3]	None	15
Mercury	0.012	0.15	2
Nickel	160[3]	100	100
Selenium	5	None	50
Silver	0.12	None	180
Thallium	None	48	2
Zinc	110[3]	None	5,000

Notes:
[1] Criteria that was existing in 18 AAC 70 when ROD for OU A and landfills were signed. (Changes to some of these criteria were adopted in an 18 AAC 70 amendment on March 24, 2003.)
[2] Human health criteria for carcinogens comes from EPA promulgation of human health criteria for carcinogens for Alaska at the 10^{-5} risk level in the National Toxics Rule (40 Code of Federal Regulations [CFR] 131.36) in accordance with ADEC guidance.
[3] At 100 m/L hardness
[4] Value provided is for chromium III. The criteria for chromium VI is 11 µg/L.

4 SAMPLING PROGRAM

This section describes the sampling program, including field procedures and sampling requirements, for the 2014 annual groundwater and landfill monitoring at the OU A sites. Field activities included groundwater sampling, collection of groundwater quality parameter measurements, surface water sampling, sediment sampling, product thickness measurements, depth-to-groundwater measurements, shoreline inspections, well inspections, and handling of investigation-derived waste (IDW). All 2014 monitoring activities followed the CMP, Revision 6 (Navy 2014a). Updates to the CMP Appendix A and B tables were based on the recommendations in the Final 2013 Groundwater and Landfill Monitoring Report (Navy 2014d), which was negotiated with ADEC and EPA.

Monitoring activities occurred from August 24 through September 17, 2014. During the monitoring event, groundwater sample collection was performed at 101 groundwater monitoring locations for 18 sites (Figure 2-1), and 14 surface water and 10 sediment samples were collected from locations at seven of the sites. Product thickness and depth-to-water measurements were performed at 158 locations from these sites. Standard Operating Procedures (SOPs) and Stand-Alone Specific Instructions from the CMP, Revision 6 (Navy 2014a) were followed for sample collection activities. Copies of the field forms and logbooks documenting 2014 field activities are included in Appendix A.

4.1 FIELD ACTIVITIES

Table 4-1 summarizes the 2014 field activities by site and location. Table 4-2 summarizes the environmental samples and laboratory analytical methods performed on groundwater, surface water, and sediment from petroleum-release and non-landfill CERCLA sites that were collected in 2014 by location. Table 4-3 summarizes the environmental samples and laboratory analytical methods performed on groundwater, surface water, and sediment from petroleum-release and non-landfill CERCLA sites that were collected in 2014 by location.

4.1.1 Field Measurements

Field measurements recorded during 2014 groundwater monitoring activities included the physical measurements of depth-to-groundwater and product thickness. Water level and free product measurements were taken at 158 wells. NAVFAC SOP I-D-5 (Water Level Measurements) and Stand-Alone Specific Instruction #3 (Well Measurements) were followed during the collection of depth-to-groundwater and product thickness measurements. Water

levels and product thicknesses are presented in Appendix D-1. Water levels were corrected if floating product was observed in the wells by using the following equation:

$$DTW_C = DTW_M - ([\rho_{lnapl} / \rho_{water}] * MPT)$$

Where: ρ_{lnapl} – density of light non-aqueous phase liquid
ρ_{water} – density of water (1,000 kilograms per cubic meter [kg/m^3])
DTW_C – corrected depth-to-water
DTW_M – measured depth-to-water
MPT – measured product thickness

The type of product present in each affected well was determined to be either diesel or gasoline, and the appropriate light non-aqueous phase liquid density was used in the correction equation. The density used was 820 kilograms per cubic meter (kg/m^3) for diesel and 737.22 kg/m^3 for gasoline (SImetric 2007). Analytical results for each affected well were reviewed and the fuel with the highest concentration was selected. If equal concentrations of gasoline and diesel were found, diesel was selected based on the assumption that the gasoline was weathered and had a higher density and therefore, the density of diesel best approximated that of the product in the well. If a well had no analytical results associated with it, results for nearby wells at the same site were used for the product selection.

Corrected groundwater elevations were used to interpret groundwater flow direction based on potentiometric surface. For some sites, an insufficient number of wells exist to calculate a potentiometric surface, so at these sites, groundwater flow direction was estimated based on historical studies and topographic surface. Groundwater flow direction at most LTM sites (except Area 303/GCI Compound and Former Power Plant, Building T-1451) has been well established through the collection of groundwater elevation data since 2005. Since then, groundwater flow direction has not varied at these sites. Groundwater elevations collected in 2014 were compared to historical elevations presented in Appendix D-2. For all LTM sites monitored in 2014, groundwater flow directions remained consistent with previous interpreted flow directions.

During the summer of 2012 and in April 2013, the Navy performed cleanup actions and subsurface soil and groundwater investigation to further assess type and extent of groundwater contamination at Area 303/GCI Compound and Former Power Plant, Building T-1451 (Navy 2013c). As a result of these investigations, the remedy of free product recovery and long-term groundwater monitoring was selected for Area 303/GCI Compound and monitoring at 17 wells at this site were added to the LTM sampling program for the 2013 and subsequent field events. Similarly, nine newly installed monitoring wells at Former Power Plant,

Building T-1451 were added in 2013 to the LTM program to better assess the progression of the remedy of MNA at the site. Since historical groundwater elevations do not exist for these wells, potentiometric surfaces were calculated for these two sites (Figures 7-1 and 8-1) to determine and verify groundwater flow directions.

Field measurements recorded during 2014 groundwater monitoring activities also included the collection of the water quality parameter measurements of pH, oxidation-reduction potential (ORP), specific conductance, turbidity, dissolved oxygen (DO), temperature, and salinity. Methane was also measured in well headspace at SWMUs 18/19, White Alice Landfill; SWMU 13, Metals Landfill; and SWMU 25, Roberts Landfill wells prior to the collection of water quality parameters. NAVFAC SOP I-D-7 (Field Parameter Measurement) was followed for all WQP measurements. Measurements of WQPs were recorded approximately every 3 minutes during evacuation of water from each well to determine that groundwater parameters had stabilized before the groundwater sample was collected. These field measurements were collected using a Horiba U-22 water quality meter. Once each parameter stabilized or three well casing volumes were removed (by low-flow sampling method), a sample was collected for laboratory analysis. The resultant data were used to verify samples representative of actual groundwater conditions. Final water quality parameter measurements are presented for each petroleum-release and non-landfill CERCLA well by site in Sections 7 through 25. Field measurements collected at landfill sites including water quality parameters and methane well headspace measurements are presented in Appendix D-3.

Table 4-1. Summary of 2014 Field Activities by Site and Location

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
Area 303/GCI Compound, UST GCI-1	Groundwater	03-107	X	X	X			X	X	
	Groundwater	03-012	X	X	X	X	X	X	X	
	Groundwater	03-104	X	X	X			X	X	
	Groundwater	03-778	X	X	X			X	X	
	Groundwater	03-502	X	X	X			X	X	
	Groundwater	MRP-MW2	X	X	X			X	X	
	Groundwater	MRP-MW3	X	X	X			X	X	
	Groundwater	RW-102-4		X						
	Groundwater	MW-303-28	X	X	X			X	X	
	Groundwater	MW-303-30	X	X	X			X	X	
	Groundwater	MW-303-31	X	X	X			X	X	
	Groundwater	MW-303-32	X	X	X			X	X	
	Groundwater	MW-303-33	X	X	X			X	X	
	Groundwater	MW-303-37	X	X	X	X		X	X	
	Groundwater	MW-303-38	X	X	X			X	X	
	Groundwater	MW-303-39	X	X	X			X	X	
	Groundwater	MW-303-40	X	X	X			X	X	
	Groundwater	MW-303-41	X	X	X			X	X	
	Groundwater	MW-303-42	X	X	X			X	X	
	Groundwater	MW-303-43	X	X	X			X	X	
	Groundwater	MW-303-44	X	X	X			X	X	
	Groundwater	04-100	X	X	X			X	X	
	Groundwater	04-201		X						
	Groundwater	04-202	NC	X	NC			NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Groundwater	04-203		X						
	Groundwater	04-204	X	X	X			X	X	
	Groundwater	04-210	X	X	X			X	X	
	Groundwater	04-211	X	X	X			X	X	
	Groundwater	04-213	X	X	X			X	X	
	Groundwater	04-701	X	X	X			X	X	

Table 4-1. Summary of 2014 Field Activities by Site and Location (continued)

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
Former Power Plant, Building T-1451	Groundwater	01-118	X	X	X			X	X	
	Groundwater	01-150	NC	X	NC				NC	Product thickness ≥0.02 feet. No sample collected.
	Groundwater	MW-1451-1	X	X	X		X	X	X	
	Groundwater	MW-1451-2	X	X	X	X	X	X	X	
	Groundwater	MW-1451-3	X	X	X	X	X	X	X	
	Groundwater	MW-1451-4	X	X	X	X	X	X	X	
	Groundwater	MW-1451-5	X	X	X			X	X	
	Groundwater	MW-1451-6	X	X	X			X	X	
	Groundwater	MW-1451-7	NC	X	NC			NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Groundwater	MW-1451-8	X	X	X			X	X	
	Groundwater	MW-1451-9	X	X	X			X	X	
	Groundwater	E-701	X	X	X			X	X	Background well.
	Surface Water	NL-08	X		X		X			
	Sediment	NL-08			X		X			
Housing Area (Arctic Acres)	Groundwater	03-416	X	X	X			X	X	
	Groundwater	03-420	X	X	X			X	X	
	Groundwater	03-421	X	X	X			X	X	
	Groundwater	03-890	NC	X	NC			NC	NC	Product thickness ≥0.02 feet. No sample collected.
NMCB Building T-1416 Expanded Area	Groundwater	02-300		X						
	Groundwater	02-301		X						
	Groundwater	02-451		X			X			
	Groundwater	02-452		X						
	Groundwater	02-453		X			X			
	Groundwater	02-455		X			X			
	Groundwater	02-461	X	X	X			X	X	

Table 4-1. Summary of 2014 Field Activities by Site and Location (continued)

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
NMCB Building T-1416 Expanded Area (continued)	Groundwater	02-463		X						
	Groundwater	02-478		X						
	Groundwater	02-479		X	X		X			
	Groundwater	02-497		X						
	Groundwater	02-815		X			X			
	Groundwater	02-816		X						
	Groundwater	02-817		X						
	Groundwater	02-818	X	X	X		X	X	X	
	Groundwater	02-819		X						
	Groundwater	E-201	X	X	X		X	X	X	
	Groundwater	NMCB-04		X						
	Groundwater	NMCB-07	NC	X	NC		X	NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Groundwater	NMCB-08		X			X			
	Groundwater	NMCB-09	X	X	X			X	X	
	Groundwater	NMCB-10	NC	X	NC		X	NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Groundwater	NMCB-11	NC	X	NC		X	NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Groundwater	NMCB-12		X			X			
ROICC Contractor's Area, UST ROICC-7	Groundwater	08-200	X	X	X			X	X	
	Groundwater	08-202	X	X	X			X	X	
SA 79, Main Road Pipeline, South End	Groundwater	02-230	X	X	X		X			
	Groundwater	MRP-MW8	X	X	X		X			
	Groundwater	601	X	X	X		X			

Table 4-1. Summary of 2014 Field Activities by Site and Location (continued)

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
SA 80, Steam Plant 4	Groundwater	04-155		X						
	Groundwater	04-157		X						
	Groundwater	04-158	X	X	X			X	X	
	Groundwater	04-159	X	X	X			X	X	
	Groundwater	04-164		X						
	Groundwater	04-173	X	X	X			X	X	
	Groundwater	SP4-3	X	X	X			X	X	
South of Runway 18-36 Area	Groundwater	02-231	X	X	X	X	X			
	Groundwater	02-232	X	X	X	X	X			
	Groundwater	18/36-02		X						
	Groundwater	AS-1	X	X	X	X	X			
	Groundwater	E-213		X						
	Groundwater	E-216		X			X			
	Groundwater	E-217		X						
	Groundwater	RW-18/36-03		X						
	Groundwater	RW-18/36-04		X						
	Groundwater	RW-18/36-05		X						
	Groundwater	Z3-6		X						
	Groundwater	Z4-2		X						
	Sediment	NSWSD-2			X		X			
	Sediment	NSWSD-4			X		X			
	Sediment	NSWSD-5			X		X			
SWMU 11, Palisades Landfill	Sediment	101			X					
	Sediment	102			X					
	Sediment	103			X					
SWMU 13, Metals Landfill	Groundwater	MW13-1	X	X	X			X		
	Groundwater	MW13-2	X	X	X			X		
	Groundwater	MW13-3	X	X	X			X		
	Groundwater	MW13-4	X	X	X			X		
	Groundwater	MW13-5	X	X	X			X		

Table 4-1. Summary of 2014 Field Activities by Site and Location (continued)

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
SWMU 13, Metals Landfill (continued)	Groundwater	MW-603	X	X	X			X		
	Groundwater	MW-604	X	X	X			X		
	Groundwater	MW-605	X	X	X			X		
SWMU 14, Old Pesticide Storage and Disposal Area	Groundwater	MW-14-5	X	X	X			X	X	
	Groundwater	MW-15-3		X						
	Groundwater	MW-15-424		X						
SWMU 17, Power Plant No. 3 Area	Groundwater	05-735	X	X	X			X	X	
SWMUs 18/19, White Alice Landfill	Groundwater	21-4	X	X	X			X		
	Groundwater	21-3	X	X	X			X		
	Surface Water	WASW01	X		X					
	Surface Water	WASW02	X		X					
	Surface Water	WASW03	X		X					
SWMU 25, Roberts Landfill	Groundwater	A-2	X	X	X			X		
	Groundwater	A-3	X	X	X			X		
	Groundwater	A-5	X	X	X			X		
	Groundwater	B-1	X	X	X			X		
	Surface Water	RLSW01	NC		NC					No sample collected. Location was dry.
	Surface Water	RLSW02	X		X					
	Surface Water	RLSW03	X		X					
	Surface Water	RLSW04	X		X					
	Surface Water	RLSW05	X		X					

Table 4-1. Summary of 2014 Field Activities by Site and Location (continued)

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
SWMU 25, Roberts Landfill (continued)	Surface Water	NL-11	X		X					
	Surface Water	NL-12	X		X					
	Surface Water	NL-14	X		X					Blue seep sample
SWMU 55, Public Works Transportation Department Waste Storage Area	Groundwater	55-145	X	X	X			X	X	
	Groundwater	55-146		X						
SWMU 60, Tank Farm A	Groundwater	LC5A	X	X	X	X	X	X	X	
	Groundwater	650	X	X	X	X	X	X	X	
	Groundwater	651	X	X	X	X	X	X	X	
	Groundwater	652	X	X	X	X	X	X	X	
	Groundwater	653	NC	X	NC	NC	X	NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Surface Water	852	X		X	X	X			
	Sediment	852			X		X			
SWMU 61, Tank Farm B	Groundwater	TFB-MW4B	X	X	X			X	X	
	Groundwater	14-113	X	X	X	X	X	X	X	
	Groundwater	14-210	X	X	X		X	X	X	
	Surface Water	NL-04	X		X	X	X			
	Sediment	NL-04			X		X			

Table 4-1. Summary of 2014 Field Activities by Site and Location (continued)

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
SWMU 62, New Housing Fuel Leak, Sandy Cove Housing	Groundwater	03-155	X	X	X			X	X	
	Groundwater	03-619	X	X	X			X	X	
	Groundwater	HMW-146-1		X						
	Groundwater	MW-107-1	NC	X	NC			NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Groundwater	MW-134-10		X						
	Groundwater	MW-134-11	X	X	X			X	X	
	Groundwater	MW-146-1	X	X	X			X	X	
	Groundwater	MW-187-1	X	X	X			X	X	
SWMU 62, New Housing Fuel Leak, Eagle Bay Housing	Groundwater	03-101		X						
	Groundwater	03-102		X						
	Groundwater	03-103		X						
	Groundwater	03-109		X						
	Groundwater	03-898		X						
	Groundwater	AMW-704	X	X	X			X	X	
	Groundwater	MW-15		X						
	Groundwater	HMW-303-3		X						
	Groundwater	HMW-303-4		X						
	Groundwater	HMW-303-11		X						
	Groundwater	MW-303-7	X	X	X			X	X	
	Groundwater	MW-303-8		X						
	Groundwater	MW-303-12		X						
	Groundwater	RW-303-4		X						
	Groundwater	RW-303-13	X	X	X			X	X	
	Groundwater	RW-303-14		X						

Table 4-1. Summary of 2014 Field Activities by Site and Location (continued)

Site Name	Sample Matrix	Location Cross Reference	Water Quality Parameters[1]	Water Level/ Product Thickness	Chemical Analysis	TAH/ TAqH[2]	Shoreline Visual Inspection[3]	Methane	NAPs	Comments
SWMU 62, New Housing Fuel Leak, Eagle Bay Housing (continued)	Groundwater	RW-303-15		X						
	Groundwater	RW-303-16	NC	X	NC			NC	NC	Product thickness ≥0.02 feet. No sample collected.
	Surface Water	NL-09	X		X	X	X			
	Sediment	NL-09			X		X			
Tanker Shed, UST 42494	Groundwater	04-175	X	X	X			X	X	
	Groundwater	04-290	X	X	X			X	X	
	Groundwater	04-301		X						
	Groundwater	04-302		X						
	Groundwater	04-306	X	X	X			X	X	
	Groundwater	04-312		X						
	Groundwater	04-313		X						
	Groundwater	04-601	X	X	X			X	X	
	Groundwater	TS-03		X						

Notes:
[1] Water quality parameters include pH, specific conductance, salinity, temperature, turbidity, dissolved oxygen, and oxidation-reduction potential with a Horiba U-22 or equivalent.
[2] Collected at surface water protection monitoring locations.
[3] Visual inspection of adjacent shoreline and surface water conducted for visible petroleum seeps or sheens.

Table 4-2. Environmental Quantities and Laboratory Analytical Methods for Groundwater, Surface Water and Sediment Samples by Location for Petroleum-Release and Non-Landfill CERCLA Sites

Site Name	Monitoring Type	Location	Sample Matrix	QA/QC Samples	GRO (AK 101)	BTEX (8260C)	Benzene (8260C)	DRO (AK 102)	Total Lead (6020A)	Dissolved Lead (6020A)	VOCs[1] (8260C)	PAHs (8270D SIM)	NAPs Alkalinity (SM2320B)	NAPs Sulfate (300.0)	NAPs Methane (RSK175)
Area 303/GCI Compound	MNA	03-107	GW		1	1			1	1			1	1	1
	MNA/SWP	03-012	GW	MS/MSD (GRO/PAHs/NAPs)	1	1		1				1	1	1	1
	MNA	04-211	GW		1								1	1	1
	MNA	03-104	GW					1					1	1	1
	MNA	03-778	GW					1					1	1	1
	MNA	03-502	GW		1				1	1			1	1	1
	MNA	MW-303-28	GW		1				1	1			1	1	1
	MNA	MW-303-30	GW	Duplicate GRO (MW-303-130)	2	1			1	1		1[2]	1	1	1
	MNA	MW-303-31	GW		1	1			1	1		1[2]	1	1	1
	MNA	MW-303-32	GW			1		1					1	1	1
	MNA	MW-303-33	GW	MS/MSD (GRO)	1	1		1					1	1	1
	MNA/SWP	MW-303-37	GW		1	1		1				1	1	1	1
	MNA	MW-303-38	GW		1	1			1	1		1[2]	1	1	1
	MNA	MW-303-39	GW		1	1			1	1		1[2]	1	1	1
	MNA	MW-303-40	GW		1	1			1	1		1[2]	1	1	1
	MNA	MW-303-41	GW		1	1			1	1		1[2]	1	1	1
	MNA	MW-303-42	GW		1	1							1	1	1
	MNA	MW-303-43	GW		1								1	1	1
	MNA	MW-303-44	GW		1								1	1	1
	MNA	MRP-MW2	GW	Duplicate BTEX (MRP-MW12) & MS/MSD (T/D Pb)	1	2			1	1			1	1	1
	MNA	MRP-MW3	GW		1	1		1	1	1			1	1	1
	MNA	04-100	GW	Duplicate (04-110)	1								2	2	2
	MNA	04-202	GW		1								1	1	1
	MNA	04-204	GW		1								1	1	1
	MNA	04-210	GW		1								1	1	1
	MNA	04-213	GW		1								1	1	1
	MNA	04-701	GW		1								1	1	1
Former Power Plant, Building T-1451	MNA	01-118	GW	Duplicate DRO (01-128)				2					1	1	1
	MNA	01-150	GW					1					1	1	1
	MNA	MW-1451-1	GW					1					1	1	1
	MNA/SWP	MW-1451-2	GW	Duplicate NAPs (MW-1451-12)		1		1				1	2	2	2
	MNA/SWP	MW-1451-3	GW			1		1				1	1	1	1
	MNA/SWP	MW-1451-4	GW			1		1				1	1	1	1
	MNA	MW-1451-5	GW					1					1	1	1
	MNA	MW-1451-6	GW					1					1	1	1
	MNA	MW-1451-7	GW					1					1	1	1
	MNA	MW-1451-8	GW					1					1	1	1
	MNA	MW-1451-9	GW					1					1	1	1
	MNA/BKG	E-701	GW	MS/MSD (NAPs)									1	1	1

Table 4-2. Environmental Quantities and Laboratory Analytical Methods for Groundwater, Surface Water and Sediment Samples by Location for Petroleum-Release and Non-Landfill CERCLA Sites (continued)

Site Name	Monitoring Type	Location	Sample Matrix	QA/QC Samples	GRO (AK 101)	BTEX (8260C)	Benzene (8260C)	DRO (AK 102)	Total Lead (6020A)	Dissolved Lead (6020A)	VOCs[1] (8260C)	PAHs (8270D SIM)	NAPs Alkalinity (SM2320B)	NAPs Sulfate (300.0)	NAPs Methane (RSK175)
Former Power Plant, Building T-1451 (continued)	SWP	NL-08	SW	Duplicate DRO (NL-18) & MS/MSD (PAHs)		1		2				1			
	SWP	NL-08	SD	MS/MSD (DRO & PAHs)				1				1[3]			
Housing Area (Arctic Acres)	MNA	03-416	GW					1					1	1	1
	MNA	03-420	GW					1					1	1	1
	MNA	03-421	GW					1					1	1	1
	MNA	03-890	GW					1					1	1	1
NMCB Building T-1416 Expanded Area	MNA	02-461	GW	Duplicate GRO (02-471)	2								1	1	1
	MNA/SWP	02-818	GW		1								1	1	1
	MNA	E-201	GW		1								1	1	1
	MNA/SWP	NMCB-07	GW		1								1	1	1
	MNA/SWP	NMCB-09	GW		1								1	1	1
	MNA/SWP	NMBC-10	GW		1								1	1	1
	MNA/SWP	NMCB-11	GW		1								1	1	1
ROICC Contractor's Area	MNA	08-200	GW	Duplicate NAPs (08-210)			1						2	2	2
	MNA	08-202	GW				1						1	1	1
SA 79, Main Road Pipeline, South End	MNA/SWP	02-230	GW					1					1	1	1
	MNA	601	GW					1					1	1	1
	MNA	MRP-MW8	GW	Duplicate DRO (MRP-MW18)				2					1	1	1
SA 80, Steam Plant 4, USTs 27089 and 27090	MNA	04-158	GW					1					1	1	1
	MNA	04-159	GW					1					1	1	1
	MNA	04-173	GW					1					1	1	1
	MNA	SP4-3	GW					1					1	1	1
South of Runway 18-36 Area	MNA/SWP	02-231	GW	Duplicate BTEX and PAHs (02-241)		2		1				2	1	1	1
	MNA/SWP	02-232	GW	Duplicate NAPs (02-242) & MS/MSD (BTEX)		1						1	2	2	2
	MNA/SWP	AS-1	GW	Duplicate NAPs (AS-11)		1						1	2	2	2
	NR	NSWSD-2S	SD					1							
	NR	NSWSD-4S	SD					1							
	NR	NSWSD-5S	SD					1							
SWMU 14, Old Pesticide Storage and Disposal Area	MNA	MW-14-5	GW	Duplicate T/D Pb (MW-14-15)	1			1	2	2			1	1	1
SWMU 17, Power Plant No. 3 Area	Compliance	05-735	GW								1		1	1	1
SWMU 55, Public Transportation Dept. Waste Storage Area	Compliance/ MNA	55-145	GW	Duplicate VOCs (55-155) & MS/MSD VOCs							2				

Table 4-2. Environmental Quantities and Laboratory Analytical Methods for Groundwater, Surface Water and Sediment Samples by Location for Petroleum-Release and Non-Landfill CERCLA Sites (continued)

Site Name	Monitoring Type	Location	Sample Matrix	QA/QC Samples	GRO (AK 101)	BTEX (8260C)	Benzene (8260C)	DRO (AK 102)	Total Lead (6020A)	Dissolved Lead (6020A)	VOCs[1] (8260C)	PAHs (8270D SIM)	NAPs Alkalinity (SM2320B)	NAPs Sulfate (300.0)	NAPs Methane (RSK175)
SWMU 60, Tank Farm A	MNA/SWP	LC5A	GW			1						1	1	1	1
	MNA/SWP	650	GW			1		1				1	1	1	1
	MNA/SWP	651	GW			1		1				1	1	1	1
	MNA/SWP	652	GW			1		1				1	1	1	1
	MNA/SWP	653	GW			1		1				1	1	1	1
	NR/SWP	852	SW	Duplicate PAHs (862) & MS/MSD BTEX and GRO		1		1				2			
	NR/SWP	852	SD	Duplicate 862				2				2[3]			
SWMU 61, Tank Farm B	MNA/SWP	14-113	GW		1	1						1	1	1	1
	MNA/SWP	14-210	GW	MS/MSD (BTEX)	1	1							1	1	1
	MNA	TFB-MW4B	GW		1	1							1	1	1
	NR/SWP	NL-04	SW	MS/MSD (GRO)	1	1						1			
	NR/SWP	NL-04	SD	Duplicate NL-14 MS/MSD (GRO, BTEX)	2	2									
SWMU 62, New Housing Fuel Leak, Sandy Cove Housing	MNA	03-155	GW					1					1	1	1
	MNA	03-619	GW	MS/MSD (DRO & NAPs)				1					1	1	1
	MNA	MW-107-1	GW					1					1	1	1
	MNA	MW-134-11	GW					1					1	1	1
	MNA	MW-146-1	GW					1					1	1	1
	MNA	MW-187-1	GW					1					1	1	1
SWMU 62, New Housing Fuel Leak, Eagle Bay Housing	MNA/SWP	AMW-704	GW					1					1	1	1
	MNA	MW-303-7	GW					1					1	1	1
	MNA/SWP	RW-303-13	GW	MS/MSD (DRO & NAPs)				1					1	1	1
	MNA/SWP	RW-303-16	GW					1					1	1	1
	SWP	NL-09	SW	Duplicate GRO & BTEX (NL-19)	2	2		1				1			
	SWP	NL-09	SD		1	1		1				1[3]			
Tanker Shed, UST 42494	MNA	04-175	GW					1					1	1	1
	MNA	04-290	GW	Duplicate DRO (04-300)				2					1	1	1
	MNA	04-306	GW					1					1	1	1
	MNA/SWP	04-601	GW	MS/MSD (DRO & NAPs)				1					1	1	1
Totals					**43**	**38**	**2**	**63**	**13**	**13**	**3**	**41**	**91**	**91**	**91**

Notes:
[1] PCE, TCE, and daughter products: 1,1-dichloroethene; cis-1,2-dichloroethene; trans-1,-2-dichloroethene; and vinyl chloride
[2] Analyzed for dibenz(a,h)anthracene only.
[3] Analyzed for 2-methylnaphthlalene and phenanthrene only.

Table 4-3. Environmental Quantities and Laboratory Analytical Methods for Groundwater, Surface Water and Sediment Samples by Location for Landfill Sites

				Water Analysis												Sediment Analysis		
										Water Quality Parameters								
Site	Matrix	Location	QA/QC Samples	Dissolved PP Metals (6020A/ 7470A Hg)[1]	Total PP Metals (6020A/ 7470A Hg)[1]	Total and Dissolved Aluminum (6020A)	Total and Dissolved Arsenic (6020A)	Total and Dissolved Barium (6020A)	VOCs[2] (8260C)	Alkalinity (SM 2320B)	Chemical Oxygen Demand (SM 5220C)	Sulfate (300.0)	Total Dissolved Solids (SM 2540C)	Total Kjeldahl Nitrogen (ASTM D1426-93B)	Ammonia Nitrogen (SM 4500G)	PCB Aroclors (8082A Low Level)	Metals[3] (6020A)	SVOCs (8270D[4])
SWMU 11, Palisades Landfill	SD	101S	MS/MSD (All)													1	1	
	SD	102S	Duplicate 112S													2	2	
	SD	103S	103													1	1	
SWMU 13, Metals Landfill	GW	MW13-1					1	1		1	1	1	1	1	1			
	GW	MW13-2					1	1		1	1	1	1	1	1			
	GW	MW13-3					1	1		1	1	1	1	1	1			
	GW	MW13-4					1	1		1	1	1	1	1	1			
	GW	MW13-5	MS/MSD				3	3		3	3	3	3	3	3			
	GW	MW-603					1	1		1	1	1	1	1	1			
	GW	MW-604					1	1		1	1	1	1	1	1			
	GW	MW-605	Duplicate MW-615				2	2		2	2	2	2	2	2			
SWMUs 18/19, White Alice Landfill	GW	21-4		1	1			1		1	1	1	1	1	1			
	GW	21.3		1	1			1		1	1	1	1	1	1			
	GW	WASW01		1	1			1		1	1	1	1	1	1			
	GW	WASW02		1	1			1		1	1	1	1	1	1			
	GW	WASW03		1	1			1		1	1	1	1	1	1			

Table 4-3. Environmental Quantities and Laboratory Analytical Methods for Groundwater, Surface Water and Sediment Samples by Location for Landfill Sites (continued)

				Water Analysis												Sediment Analysis		
										Water Quality Parameters								
Site	**Matrix**	**Location**	**QA/QC Samples**	**Dissolved PP Metals (6020A/ 7470A Hg)[1]**	**Total PP Metals (6020A/ 7470A Hg)[1]**	**Total and Dissolved Aluminum (6020A)**	**Total and Dissolved Arsenic (6020A)**	**Total and Dissolved Barium (6020A)**	**VOCs[2] (8260C)**	**Alkalinity (SM 2320B)**	**Chemical Oxygen Demand (SM 5220C)**	**Sulfate (300.0)**	**Total Dissolved Solids (SM 2540C)**	**Total Kjeldahl Nitrogen (ASTM D1426-93B)**	**Ammonia Nitrogen (SM 4500G)**	**PCB Aroclors (8082A Low Level)**	**Metals[3] (6020A)**	**SVOCs (8270D[4])**
SWMU 25, Roberts Landfill	GW	A-2	Duplicate A-12	2	2	4			2	1	1	1	1	1	1			
	GW	A-3		1	1	2			1	1	1	1	1	1	1			
	GW	A-5		1	1	2			1	1	1	1	1	1	1			
	GW	B-1	MS/MSD (PP Metals/ Aluminum/ VOCs)	1	1	2			1	1	1	1	1	1	1			
	SW	RLSW01		NC	NC	NC			NC	NC	NC	NC	NC	NC	NC			
	SW	RLSW02		NC	NC	NC			NC	NC	NC	NC	NC	NC	NC			
	SW	RLSW03	Duplicate RLSW13	1	1	2			1	2	2	2	2	2	2			
	SW	RLSW04	MS/MSD (All WQPs)	1	1	2			1	1	1	1	1	1	1			
	SW	RLSW05	RLSW05	1	1	2			1	1	1	1	1	1	1			
	SW	NL-11	NL-11	1	1	2				1	1	1	1	1	1			
	SW	NL-12	NL-12	1	1	2				1	1	1	1	1	1			
	SW	NL-14	NL-14	1	1	2				1	1	1	1	1	1			
Totals				**11**	**11**	**22**			**8**	**11**	**11**	**11**	**11**	**11**	**11**	**4**	**4**	**4**

Notes:
[1] The 13 priority pollutants (PP; antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc).
[2] Analytes of particular interest include BTEX and the ethenes (1,1-dichloroethene; cis-1,2-dichloroethene; trans-1,2-dichloroethene; tetrachloroethene; and trichloroethene). Additional VOCs will be reported by the laboratory.
[3] Antimony, arsenic, and nickel
[4] PAHs (8270D SIM) and bis(2-ethylhexyl)phthalate (8270D Low Level)
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4.1.2 Natural Attenuation Parameters Assessment

Reduction of dissolved petroleum concentrations in groundwater through natural attenuation has been demonstrated with data collected from previous sampling efforts. Biodegradation of petroleum hydrocarbons varies depending on the type of hydrocarbon. Gasoline, aviation gasoline (avgas), and jet fuel no. 5 (JP-5) were the most extensively used hydrocarbons on Adak Island. Gasoline and avgas are composed primarily of relatively volatile hydrocarbons containing 4 to 12 carbon atoms, including the BTEX compounds. JP-5 is a kerosene-based fuel composed primarily of relatively low-volatility hydrocarbons containing 11 to 13 carbon atoms and relatively insignificant (less than 1 percent by weight mass fraction) BTEX content.

The biodegradation of BTEX compounds to form the final end product of carbon dioxide is a generally well understood process. The efficiency of biodegradation is primarily a function of the availability of the various electron acceptors that may be used in the reactions as well as the presence of the appropriate microorganisms and enzymes. Oxygen is by far the most favorable electron acceptor, and BTEX degradation is relatively fast and efficient in aerobic groundwater. When DO is depleted within a contaminant plume, nitrate is the next most favorable electron acceptor, followed by manganese, ferric iron, sulfate, and carbon dioxide. All these anaerobic biodegradation processes are slower than aerobic processes; benzene degradation is particularly slow when carbon dioxide is the only available electron acceptor. Manganese is not usually considered an important electron acceptor because it generally is not abundant in aquifer sediments. The biodegradation of the various longer chained hydrocarbons that make up JP-5 is a less understood process, although aerobic degradation generally remains more rapid than anaerobic degradation (USGS 2005).

A universal indicator of hydrocarbon biodegradation is an accumulation of the end product carbon dioxide. An indication of aerobic hydrocarbon degradation is depletion of DO within a plume. An indication of hydrocarbon degradation linked to nitrate reduction is the depletion of nitrate (relative to upgradient concentrations) and a possible accumulation of nitrite, although nitrite generally is short-lived in shallow groundwater and was not analyzed in this study. An indication of hydrocarbon degradation linked to iron (II) reduction is the accumulation of ferrous iron. Ferrous iron is the soluble by-product of iron (II) reduction, and the oxidized ferric iron that serves as electron acceptors is primarily in a non-soluble state associated with aquifer sediments. An indication of hydrocarbon degradation linked to sulfate reduction is the depletion of sulfate and a possible accumulation of sulfide compound, although sulfide is also generally short-lived in shallow ground water and was not analyzed for this study. Lastly, an indication of hydrocarbon degradation linked to carbon dioxide reduction is the accumulation of methane. That process, referred to as methanogenesis, is relatively inefficient and generally

does not result in an observable depletion of carbon dioxide because it is being produced by the more efficient degradation processes (USGS 2005).

Groundwater samples were collected for assessment of NAPs during the 2014 monitoring event at wells at MNA sites for the 5-year review as prescribed by the CMP, Revision 6 (Navy 2014a). The samples were tested in the field for DO, ferrous iron, and carbon dioxide and were submitted for laboratory analyses for dissolved methane, alkalinity, and sulfate. During 2014 monitoring, the most consistent geochemical indicators for petroleum degradation observed at contaminated wells were anaerobic conditions (DO concentrations less than 1 milligram per liter [mg/L]); decreased sulfate concentrations; and increased ferrous iron, carbon dioxide, and methane concentrations compared to uncontaminated groundwater. Relatively high measurements of specific conductance were observed in contaminant plumes, but they are not a unique indicator of biodegradation (USGS 2005).

For all sites where MNA is the selected remedy, natural attenuation was found to be occurring at some degree in the groundwater. An in-depth discussion of the observance of natural attenuation at individual sites is presented in their respective site discussions in Sections 7 through 25.

Evidence for hydrocarbon degradation in groundwater was evaluated by comparing the concentrations of various electron acceptors and end products in “background” groundwater (located upgradient or in nearby uncontaminated areas) to concentrations of the same compounds within and downgradient from a hydrocarbon plume. Background groundwater (well E-701) in the downtown area was observed to be generally aerobic (DO concentrations ranging 5 to 11 mg/L), with relatively low specific conductance (0.108 to 0.238 milliSiemens per centimeter [mS/cm]), essentially no ferrous iron (less than 0.01 mg/L) or methane (less than 0.0038 mg/L), relatively little sulfate (2.52 to 3.1 mg/L), and low alkalinity (about 18.9 mg/L as calcium carbonate).

One contradictory circumstance for evaluating the indicators of hydrocarbon degradation is that they also are indicative of microbial transformation of non-petroleum organic compounds that may be naturally abundant in certain settings. In a wetland area where the water table is at or near the land surface, for example, the microbial degradation of abundant, naturally occurring organic matter in saturated surface soils results in a geochemical signature that may be indistinguishable from the signature resulting from petroleum hydrocarbon degradation (USGS 2005). Wetlands were specifically observed at SWMU 61, Tank Farm B where wetland methanogenesis may be occurring.

4.1.3 Visual Inspections

Visual inspections were performed at each monitoring well gauged and at each surface water and sediment sampling location. Information was recorded on the Monitoring Well and Sampling Visual Inspection Checklists that are presented in Appendix A. As appropriate, the visual inspections at surface water and sediment sampling locations were conducted at low tide along marine shorelines in accordance with the CMP, Revision 6 (Navy 2014a). Appendix E of this report includes a summary of wells found in need of repair. Appendix K of this report includes the applicable tide charts.

Visual inspections were also performed along shorelines downgradient to eight sites: Area 303/GCI Compound (East Canal); Former Power Plant, Building T-1451 (East Canal); NMCB Building T-1416 Expanded Area; SA 79, Main Road Pipeline; South of Runway 18-36 Area; SWMU 60, Tank Farm A; SWMU 61, Tank Farm B; and SWMU 62, New Housing Fuel Leak Area (East Canal).

Visual inspections were performed at 12 surface water and 10 sediment sampling locations in water bodies on or downgradient of the following sites: Former Power Plant, Building T-1451 (East Canal); South of Runway 18-36 Area (South Sweeper Creek); SWMU 11, Palisades Landfill (Kuluk Bay); SWMU 25, Roberts Landfill (Mitt Lake and Mitt Creek); SWMU 60, Tank Farm A (South Sweeper Creek); SWMU 61, Tank Farm B (North Sweeper Creek); and SWMU 62, New Housing Fuel Leak Area (East Canal).

Locations of the shoreline, surface water samples, and sediment samples visual inspections are presented in Table 4-4 and on sample location figures in specified site sections. Continuous stretches of shorelines were inspected downgradient of the specified sites to detect potential migration of petroleum compounds from contaminated groundwater to adjacent surface water bodies.

Visual petroleum seeps along the shoreline, odor and sheens on surface waters or sediments were recorded on the Seep and Shoreline Visual Inspection Checklists presented in Appendix A and are summarized in Table 4-4. Visual inspection information from surface water and sediment sample locations was recorded on the Surface Water Sampling and Sediment Sampling Visual Inspection Checklists also included in Table 4-4 and Appendix A.

East Canal

A portion of East Canal was inspected from north of the SWMU 62, New Housing Fuel Leak Area product recovery trench (which is also downgradient of Area 303/GCI Compound monitoring well 03-012) downstream to the southern-most point of the canal at the exit culverts

that flow into West Canal. This stretch of shoreline encompasses three sites: Area 303/GCI Compound; SWMU 62, New Housing Fuel Leak Area; and Former Power Plant, Building T-1451. Two petroleum seeps were observed in East Canal at the SWMU 62, New Housing Fuel Leak Area free product recovery trench at boom 8 and further downstream near the Former Power Plant, Building T-1451 at boom 11 (Figures 7-1, 8-1, and 24-2). Water levels in East Canal were uncharacteristically high due to irregular canal pump operation, which affected inspection observations.

The largest petroleum seep affects approximately 130 feet of shoreline and is located downgradient of the SWMU 62, New Housing Fuel Leak Area free product recovery trench in Eagle Bay Housing. Booms 2, 3, and 8 are maintained monthly at this location. This seep is characterized by oily shoreline sediments and soils, pooled product which collects behind the booms, sheen on surface water, strong petroleum odors, iron staining along the shoreline and in the water, and stressed vegetation where the petroleum flows to the ground surface, all of which were noted (except for pooled product) during the 2014 shoreline inspection. This area was inundated during the 2014 inspection due to the elevated water levels in East Canal. Periodic free product recovery is currently ongoing in several upgradient wells at the SWMU 62, New Housing Fuel Leak, Eagle Bay Housing site.

The other smaller seep is located further south downgradient of Former Power Plant, Building T-1451 and is located where boom 11 is being maintained. This seep affects approximately 25 feet of the shoreline of East Canal. Black-stained oily sediments, petroleum odor, sheen, oily sediments, and stressed vegetation were observed at this seep during the 2014 inspection.

In general, booms are effective in preventing the migration of sheen to downgradient surface waters; however, irregular operation of the East Canal pumps and subsequent elevated water levels in East Canal are allowing sheen to escape from the booms making them less effective. This is described in further detail in the Remedial Action Summary Report, Free Product Recovery (Navy 2014c).

Remedial activities were performed at a former seep location at boom 9 in July 2012 as part of the Navy's Petroleum Sites Program (Navy 2013d). Activities included removal of petroleum-impacted soils along and upgradient of the shoreline and replacement with amended clean fill. Since these activities have taken place, the flow of the petroleum seep at this location has ceased. During the shoreline inspection in 2014, no evidence of petroleum contamination was observed.

Table 4-4. 2014 Shoreline Surface Water Sample and Sediment Sample Visual Inspection Results

Site	Water Body	Shoreline Location	Observation[1]			Comments
			Seep	Odor	Sheen or Discolor	
Area 303/GCI Compound	East Canal	From boom 8 to northern end of that section of East Canal	No	No	Yes	Water level in East Canal has been elevated due to infrequent operation of dike pumps, causing petroleum sheen to move from boom 8 into upstream marshy areas. Area was heavily vegetated and marshy.
Former Power Plant, Building T-1451	Eastern shoreline of East Canal	From boom 9 to south end of East Canal at Crossover Canal	Yes	Yes	Yes	No visible petroleum was observed at remediated shoreline at boom 9. Petroleum seep at boom 11 is located 200 feet south of boom 9 and extends approximately 25 feet along the shoreline. Petroleum odor, stressed vegetation, sheen on surface water, and oily sediments were observed at the seep.
		Approximately 50 feet downstream of boom 11	No	Yes	No	Surface water/sediment sample NL-08 was collected downgradient of boom 11. Light petroleum odor noted from water.
NMCB Building T-1416 Expanded Area	Sweeper Cove	Downgradient and between wells 02-451 and 02-479	No	Yes	No	Slight petroleum odor noted on shoreline south of well NMCB-07.
SA 79, Main Road Pipeline	Sweeper Cove	From well 02-230 to mouth of South Sweeper Creek	No	No	No	No contamination observed.
South of Runway 18-36 Area	Eastern shoreline of South Sweeper Creek	Between surface water locations NSWSD-07 and NSWSD-08	Yes	Yes	Yes	Four areas of oil-stained sediment (most being 1 ft by 1 ft) were observed along shoreline downgradient of site, the largest being 4 ft by 4 ft in area. Light to moderate petroleum odor was observed at these locations and sheen was observed when sediments were disturbed.

Table 4-4. 2014 Shoreline Surface Water Sample and Sediment Sample Visual Inspection Results (continued)

Site	Water Body	Shoreline Location	Observation[1]			Comments
			Seep	Odor	Sheen or Discolor	
South of Runway 18-36 Area (continued)	Eastern shoreline of South Sweeper Creek	Between surface water locations NSWSD-07 and NSWSD-08	No	Yes	Yes	Sediment sample NSWSD-2. Black-stained sediments with moderate petroleum odor observed at sampling location. Sheen observed on and beneath the surface.
			No	Yes	Yes	Sediment sample NSWSD-4. Sheen observed ½-inch below the surface with moderate petroleum odor.
			No	Yes	Yes	Sediment sample NSWSD-5. Black sediment and moderate sheen noted when sediment was disturbed. Heavy petroleum odor noted.
SWMU 11, Palisades Landfill	Kuluk Bay	Unnamed stream flowing through landfill	No	No	No	Sediment sample 101S. No contamination observed.
		Unnamed stream flowing through landfill	No	No	No	Sediment sample 102S. No contamination observed.
		Marine shoreline at stream outfall	No	No	No	Sediment sample 103S. No contamination observed.
SWMU 18/19, White Alice Landfill	Unnamed surface water adjacent to landfill	Unnamed surface water near landfill	No	No	No	Surface water sample WASW01. No contamination observed.
		Unnamed surface water near landfill	No	No	No	Surface water sample WASW02. No contamination observed.
		Unnamed surface water near landfill	No	No	No	Surface water sample WASW01. No contamination observed.
SWMU 25, Roberts Landfill	Mitt Creek	North landfill swale	No	No	No	Surface water sample RLSW01. No contamination observed.
	Mitt Creek	West landfill swale	No	No	No	Surface water sample RLSW02. No contamination observed, location was dry.
	Mitt Creek	Unnamed perennial stream flowing down from west side of landfill into Mitt Creek	No	No	No	Surface water sample RLSW03. No contamination observed.

Table 4-4. 2014 Shoreline Surface Water Sample and Sediment Sample Visual Inspection Results (continued)

Site	Water Body	Shoreline Location	Observation[1]			Comments
			Seep	Odor	Sheen or Discolor	
SWMU 25, Roberts Landfill (continued)	Mitt Creek	Mitt Creek downstream of landfill	No	No	No	Surface water sample RLSW04. No contamination observed. Trout observed in stream.
	Mitt Lake	Unnamed perennial stream flowing down from south side of landfill into Mitt Lake	No	No	No	Surface water sample RLSW05. No contamination observed.
	Mitt Creek	Confluence of unnamed perennial stream and Mitt Creek	No	No	No	Surface water sample NL-11 downstream of RLSW03. No contamination observed.
	Mitt Creek	Mitt Creek just below the confluence of unnamed perennial stream	No	No	No	Surface water sample NL-12 downstream of RLSW03, RLSW04, and NL-11. No contamination observed.
	Ditch in Adak Fuel Farm	North side of landfill	Yes	No	Yes	Surface water sample NL-14. Groundwater seep located at northern toe of landfill with brilliant blue, green, and white crystalline formations at seep emergence. Blue-green milky substance minimally seeping from upgradient hillside 4 ft above pooled water in ditch at sample location and diluting to a milky white to milky brown color. Water in the ditch was not flowing. Seep area is approximately 50 ft by 4 ft in area on hillside. Evidence of stressed vegetation noted.
SWMU 60, Tank Farm A	Western shoreline of South Sweeper Creek	Downgradient of well LC5A from mouth of South Sweeper Creek to top of lagoon	Yes	Yes	Yes	Petroleum seep was observed north and adjacent to the culvert in Sweeper Creek Lagoon (boom 10) approximately 15 ft by 5 ft in size. Oily, black sediment; moderate to heavy petroleum odor; and sheen observed at seep. A second area approximately 3 ft by 4 ft of sheen was observed inside the northern end of boom 10.

Table 4-4. 2014 Shoreline Surface Water Sample and Sediment Sample Visual Inspection Results (continued)

Site	Water Body	Shoreline Location	Observation[1]			Comments
			Seep	Odor	Sheen or Discolor	
SWMU 60, Tank Farm A (continued)	Western shoreline of South Sweeper Creek	Downgradient of well LC5A from mouth of South Sweeper Creek to top of lagoon	Yes	Yes	Yes	Surface water/sediment sample 852. Moderate odor of petroleum and sheen was observed on surface water. Black sediment noted with sheen and moderate petroleum odor when disturbed.
SWMU 61, Tank Farm B	Western shoreline of North Sweeper Creek	Between surface water sample location NL-04 and confluence of unnamed creek	No	No	No	No contamination observed. Extensive wetland observed.
			No	No	No	Surface water/sediment sample NL-04 collected downgradient of well 14-113. No contamination, sheen, or odor observed in surface water or in sediment.
SWMU 62, New Housing Fuel Leak Area	East Canal	Between SWMU 62 free product recovery trench boom locations 8 and 9	Yes	Yes	Yes	Petroleum seep observed along shoreline at boom 8 adjacent to product recovery trench approximately 3 ft by 130 ft in length. Sheen, black oily sediments, iron staining, stressed vegetation, and light petroleum odors observed. East Canal water level was uncharacteristically high due to irregular pump operation.
			Yes	Yes	Yes	Surface water/sediment sample NL-09 collected downgradient of boom 8. Light petroleum odor and sheen observed at sample location.

Note:
[1] Seep, odor, sheen or discolor was noted for petroleum or other potential site-related contaminants.

Two surface water/sediment samples were collected downgradient of the petroleum seeps in East Canal for analysis of petroleum hydrocarbons to determine the effectiveness of the booms. One sample was collected downgradient of SWMU 62, New Housing Fuel Leak Area boom location 8 (NL-09). The other sample was collected downgradient of Former Power Plant, Building T-1451 boom location 11 (NL-08). DRO was detected in surface water and sediment collected from location NL-08 at a concentration that exceeded endpoint criteria. No other contaminants of concern were detected above endpoint criteria in surface water or sediment collected from NL-08.

South Sweeper Creek

A shoreline inspection was performed from the mouth of South Sweeper Creek along the western shoreline upstream to the top of Sweeper Creek lagoon. One petroleum seep is located in South Sweeper Creek on the western shoreline of the lagoon downgradient of SWMU 60, Tank Farm A, well LC5A. The area of shoreline affected by the seep is approximately 15 feet by 5 feet in area and located north and adjacent to the culvert. This seep is characterized by oily sediments, sheen on surface water, and moderate petroleum odors which were noted during the shoreline inspection performed in 2014. A second area with sheen approximately 4 feet by 3 feet in area was observed inside the north end of boom 10. Boom 10 is maintained at this location to prevent migration of sheen to downgradient surface waters (Figure 22-1).

A surface water/sediment sample was collected at the seep at location 852 and analyzed for petroleum hydrocarbons to determine if natural recovery is progressing. DRO concentrations in surface water at this location were below endpoint criteria for the third consecutive sampling event. However, DRO concentrations in sediment remained above endpoint criteria at 1,100 milligrams per kilogram (mg/kg) but which were down compared to 10,000 mg/kg observed in 2012 and 2,000 mg/kg in 2013. Periodic free product recovery has been performed in wells 652 and 653 onsite at SWMU 60, Tank Farm A.

In addition, a shoreline inspection was performed on the opposite (eastern) shoreline of South Sweeper Creek from the mouth of the creek upstream to the old pipeline trestle across South Sweeper Creek. Oily sediments have been historically observed on the eastern shoreline of South Sweeper Creek downgradient from the South of Runway 18-36 product recovery trench. These oily sediments are approximately a quarter to a half inch below ground surface (bgs) and are not associated with an active petroleum seep. Oil-sorbent boom 6 is being maintained monthly in South Sweeper Creek to control migration of sheen

from this site and from SWMU 60, Tank Farm A to Sweeper Cove (see the Remedial Action Summary Report, Free Product Recovery [Navy 2014c] for more details).

During the shoreline inspection, numerous small (1-foot square) areas of oil sheen on sediment were observed. The largest was a 4 by 4-foot area observed just south (downstream) of the Moffett Road Bridge. Moderate petroleum odor and black-stained sediment just beneath the soil surface which released sheen when disturbed were also observed at these locations. Oily sediments, petroleum sheen, and odor were observed along the shoreline adjacent to South of Runway 18-36 Area during sediment sampling at locations NSWSD-2, NSWSD-4, and NSWSD-05 at approximately a quarter to a half inch below the sediment surface. DRO concentrations in all three of these sediment samples exceeded endpoint criteria in 2014.

Sweeper Cove

No visual evidence of petroleum contamination was observed during the Sweeper Cove shoreline inspection at the NMCB Building T-1416 Expanded Area downgradient of well NMCB-07, although a slight petroleum odor was noted. Periodic product recovery is being performed at this site (see Appendix J).

A shoreline inspection of Sweeper Cove was performed at site SA 79, Main Road Pipeline from well 02-230 north to the mouth of South Sweeper Creek. This inspection was performed because groundwater has historically exceeded endpoint criteria in surface water protection wells 02-230 and MRP-MW8. No evidence of petroleum contamination was observed during the inspection.

North Sweeper Creek

A shoreline inspection of North Sweeper Creek was performed downgradient of site SWMU 61, Tank Farm B between monitoring well 14-113 and the confluence with an unnamed stream approximately 100 feet to the north. No visual evidence of petroleum contamination was observed during the inspection or during sampling at location NL-04. No surface water exceeded endpoint criteria. No target analytes were detected in the sediment collected at NL-04, although the GRO detection limits were elevated due to the high moisture content of the sample.

Kuluk Bay

Three sediment samples (101S through 103S) were collected from Palisades Creek and its outfall at SWMU 11, Palisades Landfill. The stream flows through the landfill and into Kuluk Bay (Figure 15-1). Sample 103S was collected at the outfall of the stream in the marine sediments of Kuluk Bay. No visible contamination was observed at any of these sample locations. A shoreline inspection was not required for this site. The sum of polychlorinated biphenyl (PCB) Aroclors, antimony, arsenic, and nickel exceeded endpoint criteria in sediment sample 102S.

Mitt Lake/Mitt Creek

Five surface water samples were collected from Mitt Creek and unnamed perennial streams flowing from SWMU 25, Roberts Landfill into Mitt Creek and Mitt Lake. No visible contamination was observed at any of the sample locations. Aluminum and copper exceeded endpoint criteria in sample RLSW03 collected at the base of the southeastern side of the landfill. Copper also exceeded endpoint criteria in NL-04 (collected downstream of RLSW03 just before the confluence with Mitt Creek) and in RLSW05 (collected upstream of Mitt Lake) and in sample NL-11 (collected downstream of RLSW03).

A groundwater seep (NL-14) was observed and sampled outside of the northern toe of SWMU 25, Roberts Landfill in the Adak Fuels Facility (Figure 20-1). The seep is approximately 30 feet by 4 feet in area and was observed to be minimally flowing from the hillside 4 feet into a roadside ditch. The seep is characterized by blue, green, and white crystallization with areas of black discoloring. A concentrated blue-green tinted milky substance was observed seeping into the surface water of the ditch at the sample location NL-14 and diluting to a milky white to milky brown color. Water in the ditch was ponded but not flowing during the sampling. The surface water collected at this location exceeded endpoint criteria for aluminum, cadmium, and copper.

Shoreline, surface water, and sediment sample visual inspections are also discussed for individual sites in Sections 7 through 25.

4.1.4 Environmental Sampling

Groundwater samples were collected from 91 monitoring wells during the sampling event. Surface water was collected from 14 locations, and sediment samples were collected from 10 locations. All samples were collected in accordance with the CMP, Revision 6 (Navy 2014a).

The purpose of monitoring at each well location is specified in Table 2-5. Groundwater samples were collected using low-flow sampling methods as outlined in NAVFAC SOP I-C-5 (Low-Flow Groundwater Purging and Sampling) and Stand-Alone Specific Instruction #4 (Low-Flow Groundwater Sampling from Shallow Wells). Well purging and sampling were conducted using a low-flow peristaltic pump. Wells were considered adequately purged when field parameters (pH, ORP, specific conductance, turbidity, DO, temperature, and salinity) stabilized or when a minimum of three well casing volumes had been removed. During the 2014 field event, each well stabilized or three well casings were removed, with one exception. Well 14-210 at SWMU 61, Tank Farm B was purged dry. Per the SAP, samples were collected after 3 hours. The 2014 analytical results from this well are consistent with past analytical results and appear to be unaffected by the lack of stabilization and limited purging volume.

An interface probe was used to monitor the presence or absence of free product at each well sampling location before the sample collection activities were initiated. Product thickness and depth-to-groundwater were measured relative to a surveyed mark on the top of the well casing. If free product was measured at a thickness greater than or equal to 0.02 feet in a monitoring well scheduled for groundwater sampling, no sample was collected. Such deviations were documented on Sampling Deviation Forms (Appendix B). During the 2014 LTM field event, free product was observed in eight monitoring wells slated for sampling that equaled or exceeded 0.02 feet in thickness; therefore, samples were not collected from these wells. Free product was removed from monitoring wells if measured at greater than 0.5 feet in a 2-inch diameter well or greater than 0.1 feet in a 4-inch diameter (or larger) well. During the 2014 LTM event, 0.50 feet of product was observed in Former Power Plant, Building T-1451 well MW-1451-7 (2-inch well diameter) from which 0.1 gallons (380 milliliters) of product was recovered and managed per the Waste Management Plan (Navy 2014e). Deviations from planned sampling and field activities are discussed in greater detail in Section 5.

4.1.5 Sample Preservation and Volume Requirements

To maintain the integrity of the samples from the time they were collected until the analyses were completed, the samples were preserved by chemical addition, cooling, or both at the time of collection. This process served to prevent or retard the degradation or modification of chemicals in samples. The sample container type and volume required for each analysis are specified in the CMP, Revision 6 (Navy 2014a).

4.1.6 Sample Custody and Holding Time Requirements

All samples submitted to the laboratory were labeled as specified in NAVFAC SOP III-E (Record Keeping, Sample Labeling and Chain-of-Custody Procedures). Sample custody was documented by recording the sample handling history from the time a sample was collected, through all transfers of custody, until it was received at the analytical laboratory, as specified in NAVFAC SOP III-E. After collection, identification, and preservation, the samples were maintained following the specified custody procedures through delivery to and analysis by the contract laboratory. Internal laboratory records then documented the custody of the sample through final disposition.

To ensure the samples collected during site investigations were traceable from the time they were collected until their derived data were used in the final report, the following sample handling and custody procedures were used:

- Sampling information was recorded in field logbooks and field data forms. This information included identifying information, such as project name, sample identification names, sample location, date, time, name of samplers, and field observations.
- Samples were collected per applicable Navy SOPs and Stand-Alone Specific Instructions presented in CMP, Revision 6 (Navy 2014a). Containers were batched together with documentation to indicate their integrity. Field personnel were responsible for the care and custody of the samples collected until they were properly shipped to the laboratory.

The information recorded on the sample label included the following, as appropriate: project name, field sample name, sample location, date, time, chemical analysis, preservation, sampler's initials, and media.

Samples were packaged according to U.S. Department of Transportation sample requirements for shipment and then dispatched to the laboratory for analysis with a chain-of-custody record accompanying each shipment. Field personnel kept a duplicate copy of the chain-of-custody record. Each individual sample container or group of sample containers were secured with a custody seal and placed in a cooler. Empty space within the cooler was filled with bubble pack or other material to prevent shifting or breakage during shipment. Sufficient "gel ice" was added to maintain required temperatures, accounting for expected shipping and transfer times. Chain-of-custody forms were enclosed in each cooler, which was then secured with custody seals and tape. The sampler or designated sample packager

initialed and dated the seals. Because airline inspectors may break the cooler seals, sample containers (or groups of sample containers) were individually wrapped and sealed to maintain the security of the samples. All samples shipped to a laboratory were shipped by the most expeditious means (e.g., the next off-island flight). Preservation, shipping, and holding times were coordinated with flights to meet the method-specific requirements.

Upon receipt at the primary laboratory, ALS Environmental in Kelso, Washington, cooler temperatures were within the acceptance range of 2ºC to 6ºC or slightly lower. Some temperatures were below 2°C; however, data quality is not adversely impacted by temperatures below 2°C. A few sample containers did freeze and break due to low temperatures or movement during shipping, but sufficient unbroken containers were available to perform the required analyses (extra sample containers were provided to the laboratory in case of breakage during shipping). Thus, no required sample analyses were lost due to breakage or compromised due to temperature exceedance.

Upon receipt at the laboratory located in Kelso, Washington, headspace (i.e., air bubbles greater than 6 millimeters in diameter) was observed in a few VOC vials containing aliquots for analyses of BTEX and/or other VOCs, GRO, or methane. (No air bubbles were observed at the time of collection or shipment preparation prior to leaving the site; thus, it is inferred that they developed during shipping.) Sufficient headspace-free containers were available for analysis, and the laboratory documented that no vials containing headspace were used for sample analysis. In accordance with the CMP, Revision 6 (Navy 2014a), the primary laboratory, ALS Environmental in Kelso, Washington, shipped methane aliquots to their facility located in Simi Valley, California but retained all other sample aliquots at the Kelso, Washington facility.

Samples were prepared and analyzed within holding times, with an exception for analysis of total dissolved solids (TDS) for seven samples and one field duplicate sample and BTEX for one matrix spike/matrix spike duplicate (MS/MSD). In the case of TDS, the 7-day holding time was inadvertently exceeded by one day due to a laboratory error for samples collected at Metals Landfill wells MW13-1, MW13-3, MW13-4, MW13-5, MW-603, MW-604, and MW-605. TDS is a WQP and not identified as a target analyte of concern per the CMP, Revision 6 (Navy 2014a). Thus, the slight holding time exceedance is not a significant concern. The third-party validation firm applied qualifiers to the sample results on the basis of the holding time exceedance. In the case of the MS/MSD for BTEX collected at SA 79, Main Road Pipeline well 02-232, the parent (unspiked) sample was analyzed within the holding time. Due to an inadvertent laboratory error, the MS/MSD analysis was performed

outside of the holding time. Accuracy and precision criteria were met for the MS/MSD. The reported result for the parent (unspiked) sample is not impacted by the holding time exceedance for the MS/MSD; thus, no qualifiers were deemed necessary during data validation. All other samples were prepared and analyzed within holding times.

4.2 ANALYTICAL METHODS

The laboratory analyses were performed in accordance with methods identified in the CMP, Revision 6 (Navy 2014a). Routine procedures used for measuring precision and accuracy include analyses of quality control (QC) samples including field duplicate samples, MS/MSD sets, and trip blanks. Laboratory QC checks were the responsibility of the contracted laboratory. Environmental and QC samples collected during the field program were sent to ALS Environmental in Kelso, Washington and Simi Valley, California for quantitative analyses. A summary of chemical analyses used by sample location is presented in Tables 4-2 and 4-3.

To achieve compliance sampling requirements at some sites, TAH and TAqH calculations were performed as specified in the CMP, Revision 6 (Navy 2014a). Calculation of TAH included the analysis of BTEX by EPA Method 8260C and summing the results. When one or more compounds were detected, TAH was calculated by summing the detections (the number zero was used for undetected compounds). When no detections for BTEX were reported, TAH was calculated by summing the detection limits. Calculation of TAqH included analysis of 16 PAHs by EPA Method 8270D Selected Ion Monitoring (SIM) and BTEX by EPA Method 8260C. The sum of these results was used to calculate the TAqH results reported. When one or more compounds were detected, TAqH was calculated by summing the detections (the number zero was used for undetected compounds). When no detections for individual compounds were reported, TAqH was calculated by summing the detection limits.

4.3 INVESTIGATION-DERIVED WASTE

IDW generated during the field investigation (e.g., equipment-decontamination fluids, well purge water, and miscellaneous wastes) was handled according to the Final Waste Management Plan (Navy 2014e). Approximately 30 gallons of non-regulated purge water (from non-CERCLA sites) was filtered through a granulated activated carbon filter and was sampled (sample IDW-PETRO-2014) for petroleum site contaminants of concern. Similarly, approximately 40 gallons of purge water from CERCLA sites was filtered through a granulated activated carbon filter and sampled (sample IDW-CERCLA-2014) for toxicity characteristic leaching procedure (TCLP) compounds and CERCLA site contaminants of concern. All IDW purge water was stored in properly labeled 55-gallon drums within

secondary containment at the storage bunker as per the Final Waste Management Plan (Navy 2014e), pending analysis and disposal.

Analytical results from samples IDW-PETRO-2014 and IDW-CERCLA-2014 (included in Appendix F) showed that all contaminants of concern were below hazardous waste criteria and endpoint criteria (where groundwater is not a drinking water source OR using 10 times the ADEC cleanup levels for groundwater as a drinking water source). The purge water was then discharged to the ground at CERCLA/petroleum site SWMU 17, Power Plant No. 3 Area as per the Final Waste Management Plan (Navy 2014e).

5 DEVIATIONS

Based on the requirements of the CMP, Revision 6 (Navy 2014a), the following deviations occurred during the 2014 monitoring event. Sampling Deviation Forms and Field Change Request Forms are provided in Appendix B.

Because the presence of free product in the well was equal to or greater than 0.02 feet in thickness, the following ten monitoring wells were not sampled as scheduled:

- Area 303/GCI Compound, well 04-202
- Former Power Plant, Building T-1451, wells MW-1451-1 and MW-1451-7
- Housing Area (Arctic Acres), well 03-890
- NMCB Building T-1416 Expanded Area, wells NMCB-07, NMCB-10, and NMCB-11
- SWMU 60, Tank Farm A, well 653
- SWMU 62, New Housing Fuel Leak, wells MW-107-1 and RW-303-16

One sample could not be collected because the sampling location was dry. This occurred at SWMU 25 Roberts Landfill, surface water sample location RLSW01.

The field duplicates for three laboratory analyses (sulfate, methane, and alkalinity) and three field test kit parameters (carbon dioxide, dissolved oxygen, and ferrous iron) scheduled to be collected at Former Power Plant, Building T-1451 well MW-1451-2 and South of Runway 18-36 Area well 02-232 were instead collected at Area 303/ GCI Compound wells MRP-MW2 and MW-303-37.

One Field Change Request was submitted to amend the revised CMP Appendix A tables (Navy 2014a), which was approved by the Navy. The Field Change Request stated that three laboratory analyses (sulfate, methane, and alkalinity) and three field test kit parameters (carbon dioxide, dissolved oxygen, and ferrous iron) would be performed at well 55-145 at SWMU 55, Public Works Transportation Department Waste Storage Area in order to evaluate natural attenuation.

6 DATA QUALITY ASSESSMENT

The quality of laboratory and field data is discussed in this section. Data quality goals are specified in the CMP, Revision 6 (Navy 2014a). Evaluation of compliance with data quality goals was accomplished by assessing the precision, accuracy, representativeness, completeness, and the comparability of the data. Data quality goals were met for the 2014 monitoring event and are discussed in the following subsections.

6.1 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance (QA) and QC activities were implemented throughout the planning, implementation, assessment, and reporting processes to ensure that environmental data of known and acceptable quality were provided to meet the requirements and objectives of the CMP. These activities are defined as follows:

- QA – An integrated system of management activities involving planning, implementation, assessment, reporting, and improvement to ensure that an item, process, or service is of the type and quality needed. This system includes development of plans, training of personnel, implementation of applicable procedures, documentation of field and analytical processes, and assessment of final products by independent objective sources.
- QC – An overall system of technical activities that measures the performance of a process, item, or service against defined standards to verify that performance meets the stated requirements. This system includes performance of field surveillances, collection of field and laboratory QC samples, and review of field and laboratory data.

6.1.1 Quality Assurance

The following QA activities were performed to ensure project requirements were met:

- Current and applicable plans and procedures were available and used by field personnel.
- Project personnel received adequate indoctrination and training on procedures and protocols for sample collection, sample custody, sample shipment, laboratory analysis, data review, and final reporting.

- All activities, findings, and results were documented, defensible, and consistent with the data quality requirements.
- Changes to contractual or CMP requirements followed project procedures, with significant changes to be noted in the final document, and with appropriate justification and assessment of the potential or real impacts on the results.

Level 4, third-party validation was performed by Laboratory Data Consultants in Carlsbad, California on the analytical data packages associated with LTM samples generated by the laboratory. The validation was performed to verify that data quality was acceptable. Data validation reports, including qualified sample results, are presented in Appendix F. The requirement for an additional Laboratory Data Review Checklist was waived by ADEC for LTM data for this project.

For waste characterization samples, the data generated by the laboratory was reviewed by Laboratory Data Consultants. A Laboratory Data Review Checklist was completed and is provided in Appendix F.

6.1.2 Quality Control

The following QC activities were performed to ensure data were usable and defensible for the intended use:

- Field surveillances were performed to ensure monitoring was performed in accordance with the plans.
- Field QC samples including trip blanks, field duplicates, and MS/MSDs were collected at the appropriate frequency to ensure field procedures were properly performed and to determine field and laboratory conditions that could influence data quality.
- Laboratory QC samples were analyzed at the appropriate frequency to determine impact on analytical data quality.
- Review of field and laboratory documentation was performed to verify correctness and completeness of records.
- Review of field and laboratory documentation was performed to verify activities were performed in accordance with the plans.

6.1.3 Field Quality Control Samples

Field QC samples are necessary for evaluating data quality. The three types of QC samples analyzed for this project were field duplicates, trip blanks, and MS/MSDs. Each field duplicate and MS/MSD was collected in the field at the same time the environmental sample was collected. The analytical laboratory provided the trip blanks.

For every 20 samples taken, one duplicate sample was collected and submitted for laboratory analysis. The duplicate samples were intended to be identical to the original sample and are used to gain field precision information on homogeneity, handling, shipping, storage, preparation, and analysis. Duplicate sampling was used to identify possible field and laboratory variations or errors. Each duplicate sample was collected at the same time and location as the corresponding environmental sample.

For every 20 samples taken, one MS/MSD triple-volume sample was collected and submitted to the laboratory. The MS/MSD samples were used to evaluate analysis bias or interferences that may have occurred due to the sample matrix.

Trip blanks were prepared by the laboratory with analyte-free water and accompanied groundwater and surface water sample aliquots designated for volatile constituents during storage and shipment back to the laboratory. Sediment trip blanks were prepared with methanol and accompanied sediment samples for volatile constituents during storage and shipment back to the laboratory. One trip blank accompanied each cooler containing samples submitted for GRO, VOC, and BTEX analyses. Trip blanks are used to assess possible sources of erroneous contamination from packing, shipping, and storage.

The CMP, Revision 6 (Navy 2014a) specifies that field duplicates and MS/MSDs be collected at a rate of one for every 20 environmental samples (5 percent). Field duplicate and MS/MSD samples were collected for every analytical parameter at a rate equal to or greater than one for every 20 environmental samples (greater than 5 percent), which met the specified objective of 5 percent. All field duplicate and MS/MSD samples that were collected were analyzed as requested.

6.2 PRECISION

Precision is a measure of the agreement among replicate, duplicate, or collocated sample measurements of the same analyte. The closer the numerical values of the measurement are to each other, the more precise the measurement. Precision examines the spread of data about the mean. The spread shows how different the individual reported values are from the average

reported value. Precision is a measure of the magnitude of errors and is expressed as relative percent difference (RPD). Therefore, the lower the RPD value, the more precise the data.

RPD is calculated as follows:

$$RPD = \frac{(SR - DS)}{[(SR + DS) / 2]} \times 100$$

Where: SR – sample result
DS – duplicate sample result

The project objective for precision was to meet requirements specified in the CMP and analytical methods. Precision was evaluated during third-party data validation by examining results for field duplicate sets, MS/MSD sets, sample/matrix duplicate results, and laboratory control sample/laboratory control sample duplicate sets.

Precision was assessed during the independent data validation. Data validation reports are provided in Appendix F. The overall precision of the data for this project was determined to have met the acceptance criteria.

The RPD values for environmental samples and field duplicate samples are also used to evaluate the precision of the field sampling program. In this case, the RPD values were calculated for those analyte pairs (primary sample and duplicate) for which results were detected. If one or both of the analyte pair results were qualified as not detected (U), then an RPD was not calculable for that particular analyte.

The field duplicate results for the groundwater and surface water samples are provided in Appendix G, Table G-1; the field duplicate results for sediment samples are provided in Appendix G, Table G-2. The RPD values for detected analytes are also summarized in these tables and compared to the criterion of 50 percent specified in the CMP, Revision 6 (Navy 2014a). As shown in Tables G-1 and G-2 of Appendix G, the RPD values for eight paired data points for the field duplicate sets were greater than the criteria. In all cases, the RPD values greater than the 50 percent criterion were attributed with one of the following explanations: 1) sediment samples, which typically exhibit higher RPD values due to its heterogeneous nature, 2) sample results below or near the quantitation limit, which have relatively similar concentrations although RPD values are higher than 50 percent, and 3) results from 50-fold dilutions, which can yield higher RPD values because of the 50-fold multiplication factor. For the remaining 177 paired data points summarized in the two tables, no RPD exceedances were observed. Assessment of the field duplicate results indicates that the overall field sampling program has met the requirement for precision.

6.3 ACCURACY

Accuracy is a measure of bias in a measurement system that indicates a random or systematic error of an analytical method. Examples of bias include contamination and errors made in sample collection, preservation, handling, or analysis. Accuracy is also assessed by the collection of trip blanks and by the use of known and unknown QC samples. The more closely the value of the measurement agrees with the true value, the more accurate the measurement. Accuracy is expressed as the percent recovery (PR) of an analyte such as a surrogate, blank spike (or laboratory control sample), or matrix spike. Surrogate, blank spike, and matrix spike recoveries are calculated by the laboratory and reported on standard forms for comparison. The closer the value is to 100 percent, the more accurate the data.

Accuracy for QC samples such as matrix spikes is often measured as PR, which is calculated as follows:

$$PR = \frac{SSR - SR}{SAA} \times 100$$

Where: SSR – spike sample result
SR – sample (unspiked) result
SAA – spike amount added

The project objective for accuracy is to meet requirements specified in the CMP, Revision 6 (Navy 2014a) and analytical methods.

Accuracy was evaluated during third-party data validation by examining PR for matrix spikes, laboratory control samples, and surrogate compounds as well as by reviewing sample receipt conditions and items such as results for trip and method blanks. A small percentage of the 2014 analytical results were qualified as “estimated” or “not detected” because of exceedances of accuracy criteria, such as recoveries outside the specified criteria, or trace contamination observed in the trip and method blanks; however, the overall effect on the accuracy goals for the entire sampling event was negligible. The overall accuracy of the data for this project was determined to have met the acceptance criteria specified in the CMP, Revision 6 (Navy 2014a) and analytical methods.

6.4 COMPLETENESS

Completeness is a comparison of the number of valid measurements obtained relative to the total number of measurements planned. The closer the numbers, the more complete the measurement process.

Analytical completeness is a comparison of the number of valid (usable) measurements obtained relative to the total number of planned measurements. During 2014, data for samples that were collected and submitted for laboratory analysis were validated by a third-party validation firm. One sample and one field duplicate were analyzed more than once for 16 PAHs. In these cases, the validation firm selected a preferable result for each analyte and rejected the less preferable result. A usable result for each analyte was obtained for each sample. Therefore, analytical completeness for the project was 100 percent.

Overall completeness can be influenced by factors such as ability to collect a valid sample or environmental conditions (e.g., presence or absence of free product). During the 2014 monitoring event, 10 wells were not sampled because of the presence of floating free product. The CMP specifies that groundwater samples shall not be collected from wells where free product is observed on the groundwater surface at a thickness of 0.02 feet or greater. A second factor impacting overall completeness was identified for surface water. At one surface water location, RLSW01 at SWMU 25, Roberts Landfill no sample was collected because the location was dry.

Overall completeness for the 2014 groundwater sampling program for each analytical method per site is summarized in Appendix G, Table G-3 for groundwater sites (non-landfill) and Table G-4 for landfill sites. Completeness for some parameters for some sites was less than 100 percent. However, usable information (i.e., whether free product in a well was present or absent) was obtained at the 10 locations that were not sampled. Thus, completeness did not significantly impact data quality.

Per the data validation reports (Appendix F), the 2014 data met the quality goals established in the CMP, Revision 6 (Navy 2014a). These data (as qualified) are usable for monitoring purposes.

6.5 COMPARABILITY

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. The comparability goal is achieved by following SOPs to collect and analyze representative samples, report analytical results in appropriate and consistent units and maintain consistent quantitation limits. The goal is also achieved by maintaining consistency in sampling conditions, sampling procedures, sample preservation and analytical methods. Complete documentation of field data collection supports the assessment of comparability. Historical comparability is achieved through consistent use of methods and documentation procedures throughout the LTM program.

Planned sample collection and handling techniques were consistently used to maintain comparable representativeness of all collected samples. Consistent sampling procedures, preservation technique, and analytical methods were used to the maximum extent practicable. Samples were generally collected in the same proximity (within a few feet) as historic samples at the same location.

Laboratory-reported analytical results were provided in appropriate and consistent units with the appropriate method detection limit and quantitation limit. The detection limits provided by the laboratory met the goal to be less than the specified endpoint criteria, with a few exceptions. The exceptions were the GRO detection limits for the sediment samples collected at locations NL-04 at SWMU 61, Tank Farm B and NL-09 at SWMU 62, New Housing Fuel Leak, which are greater than the endpoint criteria due to high water content in the samples, and mercury detection limits for the surface water samples collected at locations RLSW02, RLSW03, RLSW04, RLSW05, NL-11, NL-12, and NL-14 at SWMU 25, Roberts Landfill.

6.6 REPRESENTATIVENESS

Representativeness is a qualitative parameter that expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point or an environmental condition. The design and rationale of the sampling program, which ensured that environmental conditions were sufficiently represented, included the purpose of sampling, selection of sampling locations, number of samples to be collected, ambient conditions for sample collection, frequencies and timing of sampling, and sampling techniques. Sampling locations were selected to represent the range of environmental conditions observed. An adequate number of samples were collected during the 2014 LTM field event.

While performing Level 4 validations, representativeness was evaluated, in part, by examining the sample receipt documentation (indicating conditions of samples upon receipt at the laboratory) and chain-of-custody forms (in order to determine whether the sample analyses were performed within the specified holding time). No significant receipt issues were identified during data validation. With the exception of analysis of TDS for seven samples and one field duplicate, and BTEX for one MS/MSD as discussed in Section 4.1.6, all samples were analyzed within the applicable holding times. As indicated in the validation reports provided in Appendix F, all data were found to be acceptable, as qualified, and the quality goals for representativeness were considered to be met.

7 AREA 303/GCI COMPOUND, UST GCI-1

This section presents the results of groundwater monitoring performed at the Area 303/GCI Compound, UST GCI-1 site during 2014. In 2014, Area 303 was combined with another established MNA site, GCI Compound. Six monitoring wells from SWMU 62, New Housing Fuel Leak Area were also included in this new combined area (Figure 7-1). A mixed DRO and GRO contaminant plume underlies the majority of the site and overlaps the SWMU 62, New Housing Fuel Leak Area, Sandy Cove Housing DRO/GRO plume to the north and the SWMU 62, New Housing Fuel Leak Area, Eagle Bay DRO/GRO plume to the south. The GRO plume underlying the GCI Compound is part of the Area 303 plume occupying its central portion.

The remedy selected for the Area 303 site is MNA, ICs, and free-product recovery pursuant to a groundwater investigation performed in 2013 and according to the Final Technical Memorandum for the Long-Term Monitoring Program for Area 303 (Navy 2012a). The remedy specified for the GCI Compound portion of the site in the OU A ROD is free product recovery (Navy et al. 2000). MNA with ICs was selected by the Navy and ADEC as the post-free product recovery remedy for this site (Navy and ADEC 2005). To comply with requirements specified for this remedy, the Navy conducts periodic groundwater sampling and water level/product thickness monitoring as specified in the CMP, Revision 6 (Navy 2014a). Groundwater samples are collected from these wells to evaluate groundwater quality relative to Alaska groundwater cleanup levels (18 AAC 75.345) to verify that natural attenuation is occurring and to monitor for surface water protection.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Site photographs are presented in Appendix I.

7.1 FIELD MEASUREMENTS

Depth-to-water and product thickness measurements were collected at 30 monitoring wells on September 10, 2014. Table 7-1 provides the measured depths-to-water, calculated groundwater elevations, and if present, product thicknesses. Figure 7-1 shows the location of the monitoring wells relative to potential source areas at Area 303/GCI Compound such as

fuel lines, the site topography, the interpreted potentiometric surface and groundwater flow direction, and the downgradient surface water body (East Canal of the airport ditch system). A discontinuous perched aquifer was previously identified in the location of the former UST GCI-1 (Navy 2004), and two wells measured in 2014 (MW-303-40 and MW-303-41) are representative of this shallow water table. The water level data indicate that the direction of groundwater flow is to the west, toward East Canal.

Twenty-six monitoring wells were sampled between September 11 and 16, 2014. Monitoring well 04-202 was not sampled because 0.02 feet or greater of free product was present. Eight wells (03-104, 03-502, MRP-MW2, MW-303-37, MW-303-41, MW-303-42, MW-303-44, and 04-701) did not stabilize, which required three casing volumes of groundwater be removed from each well prior to sampling per CMP, Revision 6 (Navy 2014a). Field measurements were recorded on field forms and logbooks during monitoring well sampling activities (Appendix A). Table 7-1 lists the final field measurements recorded at each monitoring well prior to sample collection.

Periodic free product recovery activities were performed at this site from October 2013 through September 2014. During this time period, no free product was recovered (see Appendix J). Free product recovery operation and maintenance activities are summarized in the Remedial Action Summary Report, Free Product Recovery (Navy 2014c).

The northeastern shoreline of East Canal was inspected from the north end of East Canal south to boom 8 (Figure 7-1). This shoreline is directly downgradient of surface water protection wells 03-012 and MW-303-37 and is heavily vegetated and marshy with minimal water. One petroleum shoreline seep is located in East Canal downgradient of the SWMU 62, New Housing Fuel Leak Area recovery trench. Sorbent booms (boom locations 2, 3, and 8), which are maintained monthly, have been placed at and downstream of the seep to prevent the downstream migration of sheen. A light petroleum sheen was observed in several pools along the heavily vegetated areas lining the shoreline. This sheen is due to the canal being flooded from excessive rains and the intermittent operation of the canal pumps.

Table 7-1. 2014 Field Measurements for Area 303/GCI Compound

	Physical Measurements				Water Quality Parameters						
Well Location	Casing Elevation (ft MLLW)	Depth-to-Water[1] (ft BTOC)	Groundwater Surface Elevation (ft MLLW)	Measured Product Thickness (ft)	pH (SU)	Specific Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (°C)	Salinity (%)	ORP (mV)
03-107	31.30	27.12	4.18	0	6.92	0.287	2	0.00	6.96	0.01	-26
03-012	9.27	7.43	1.84	0	6.23	0.134	0	6.51	9.66	0.01	221
04-211	28.45	23.48	4.97	0	6.13	0.386	3	0.00	6.30	0.00	-51
03-104	25.13	19.26	5.87	0	6.04	0.226	3	0.00	8.86	0.00	-38
03-778	25.30	19.33	5.97	0	6.41	0.291	17	0.00	7.15	0.00	-99
03-502	28.04	24.14	3.90	0	6.74	0.285	0	0.00	10.77	0.01	23
MW-303-28	32.83	27.91	4.92	0	6.09	0.861	1	0.00	8.01	0.00	-10
MW-303-30	31.20	27.14	4.06	0	6.63	0.264	2	0.00	7.47	0.01	28
MW-303-31	31.82	27.19	4.63	0	5.83	0.436	20	0.00	6.93	0.00	12
MW-303-32	29.16	23.89	5.27	0	6.79	0.398	0	0.00	8.09	0.02	-27
MW-303-33	27.18	21.85	5.33	0	6.75	0.339	6	0.00	7.54	0.02	-37
MW-303-37	16.23	12.70	3.53	0	6.08	0.144	0	6.37	7.54	0.01	221
MW-303-38	27.68	24.88	2.80	0	5.96	0.429	5	0.00	6.71	0.00	15
MW-303-39	23.43	20.98	2.45	0	6.59	0.287	3	0.00	7.60	0.01	24
MW-303-40	17.68	6.89	10.79	0	5.96	0.404	0	0.00	10.23	0.00	86
MW-303-41	30.73	20.40	10.33	0	6.17	0.511	72	5.59	9.26	0.00	18
MW-303-42	30.73	28.32	2.41	0	6.29	0.870	52	0.00	8.18	0.00	-39
MW-303-43	32.50	28.37	4.13	0	5.64	0.451	1	0.00	9.20	0.00	119
MW-303-44	32.91	28.92	3.99	0	5.93	0.486	113	2.50	7.65	0.00	84
MRP-MW2	26.99	18.89	8.10	0	5.89	0.358	25	0.00	7.37	0.00	-27
MRP-MW3	27.25	7.31	19.94	0	6.19	0.290	0	0.00	10.41	0.00	-67

Table 7-1. 2014 Field Measurements for Area 303/GCI Compound (continued)

	Physical Measurements				Water Quality Parameters						
Well Location	**Casing Elevation (ft MLLW)**	**Depth-to-Water[1] (ft BTOC)**	**Groundwater Surface Elevation (ft MLLW)**	**Measured Product Thickness (ft)**	**pH (SU)**	**Specific Conductance (mS/cm)**	**Turbidity (NTU)**	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**	**Salinity (%)**	**ORP (mV)**
RW-102-4	25.28	18.95	6.33	0	NP	NP	NP	NP	NP	NP	NP
04-100	32.80	27.84	4.96	0	6.96	0.278	2	0.00	6.23	0.01	3
04-201	30.61	25.40	5.21	0	NP	NP	NP	NP	NP	NP	NP
04-202	30.90	25.63	5.27	0.02	FP	FP	FP	FP	FP	FP	FP
04-203	31.13	26.06	5.07	0	NP	NP	NP	NP	NP	NP	NP
04-204	30.82	25.48	5.34	0	6.76	0.317	2	0.00	7.31	0.01	16
04-210	29.22	24.44	4.78	0	6.20	0.208	5	0.00	7.94	0.00	-49
04-213	28.70	23.53	5.17	0	6.92	0.249	4	0.00	6.14	0.01	-1
04-701	18.19	13.80	4.39	0	6.10	0.262	0	0.00	9.42	0.00	25

Notes:
[1]Corrected if presence of product in the well.
FP – free product, unable to be sampled
NP – not planned to be measured
The reported casing elevation is the surveyed elevation residing in the Naval Installation Restoration Information Solution (NIRIS) database.
The last groundwater parameter measurement prior to sample collection is reported.

7.2 TARGET ANALYTE RESULTS

The groundwater samples collected from 23 of the 26 monitoring wells were analyzed for GRO. In addition, samples from eleven wells were analyzed for total and dissolved lead; samples from two wells were analyzed for benzene; samples from twelve wells were analyzed for BTEX; samples from six wells were analyzed for dibenz(a,h)anthracene; and samples from eight wells were analyzed for DRO. Finally, samples from two surface water protection wells (03-012 and MW-303-37) were analyzed for BTEX and PAHs for the calculation of TAH and TAqH. All groundwater samples were also analyzed for natural attenuation parameters (NAPs), which are discussed in Section 7.3.

Table 7-2 presents groundwater results for the 2014 sampling event. Figure 7-2 shows the sampling locations and the analytical results that exceed the applicable endpoint criteria. The analytical results obtained for these locations are summarized in Appendix C-1. Laboratory reports presenting the 2014 results are provided in Appendix F.

GRO was detected above the endpoint criteria of 2,200 µg/L in groundwater collected from 13 of 23 wells sampled, ranging from 2,500 µg/L (at well 03-502) to 31,000 µg/L (at well MRP-MW3). Benzene was detected above the endpoint criteria of 5 µg/L in four wells: 03-107 (5.5 µg/L), MW-303-32 (5.5 µg/L), MW-303-38 (7.6 µg/L), and MRP-MW2 (94 µg/L). Ethylbenzene was detected above the endpoint criteria of 700 µg/L in wells MRP-MW2 (750 µg/L) and MRP-MW3 (1,900 µg/L). Total xylenes were also detected above the endpoint criteria of 10,000 µg/L at well MRP-MW3 (11,500 µg/L). Toluene and dibenz(a,h)anthracene did not exceed endpoint criteria in any well sampled for these target analytes.

Total and dissolved lead were detected above the endpoint criteria of 15 µg/L in groundwater from four wells: 03-107 (26.6 µg/L and 30.2 µg/L, respectively), MW-303-28 (97.8 µg/L and 96.9 µg/L, respectively), MW-303-30 (88.9 µg/L and 88.7 µg/L, respectively) and MRP-MW3 (at 40.3 µg/L and 38.9 µg/L, respectively).

TAH and TAqH were calculated for samples collected from two surface water protection wells 03-012 and MW-303-37. TAH and TAqH were detected above their respective endpoint criteria of 10 µg/L and 15 µg/L, respectively, in well MW-303-37 at concentrations of 514 µg/L and 515 µg/L, respectively. TAH and TAqH did not exceed endpoint criteria in surface water protection well 03-012, which is located in closest proximity upgradient of East Canal (Figure 7-1).

DRO was detected above the endpoint criteria of 1,500 µg/L in groundwater collected from four wells: 03-104 (12,000 µg/L), 03-778 (1,700 µg/L), MRP-MW2 (3,800 µg/L) and MRP-MW3 (12,000 µg/L).

Table 7-2. Analytical Results for Petroleum-Related Chemicals at Area 303/GCI Compound

Well Location	Year	DRO (µg/L)	GRO (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	Dibenz(a,h) anthracene (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)
03-107	2013	NP	**6,100 Y**	2.8 D	NP	NP	NP	NP	NP	NP	14.7	14.8
Plume Source Area	2014	NP	**9,200 Y**	**5.5**	NP	NP	NP	NP	NP	NP	**26.6**	**30.2**
03-012	2013	16 J	100 U	0.50 U	0.50 U	0.50 U	NP	NP	2.5 U	0.08	NP	NP
Surf. Water Protection	2014	20 J	100 U	0.50 U	0.50 U	0.50 U	1.0 U	NP	2.5 U	0.03 J	NP	NP
04-211	2013	NP	**3,000 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Plume Source Area	2014	NP	**3,500 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
03-104	2006	**FP**	**FP**	**FP**	**FP**	**FP**	**FP**	NP	NP	NP	NP	NP
Plume Area	2007	**9,000 Y**	200 H	0.50 U	0.73	2.4	17	NP	NP	NP	NP	NP
	2008	**4,800 Y**	340 H	0.50 U	1.9 U	5.6	48	NP	NP	NP	NP	NP
	2009	**5,200 Y**	240 Y	0.050 J	1.2	3.7	37	NP	NP	NP	NP	NP
	2010	**5,600 Y**	190 H	0.50 U	0.83	5.2	31	NP	NP	NP	NP	NP
	2011	**9,600 Y**	270 H	0.50 U	0.94	4.3	38	NP	NP	NP	NP	NP
	2012	**4,900 Y**	200 H	0.50 U	0.82 U	4	38	NP	NP	NP	NP	NP
	2013	**5,500 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	**12,000 YJ**	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
03-778	2006	**1,800**	150	1.0 U	1.0 U	12	7.5 J	NP	NP	NP	NP	NP
Upgradient Plume	2007	**2,100 Y**	160 H	0.50 U	0.73	13	8.5	NP	NP	NP	NP	NP
Edge	2008	1,500 Y	170 H	0.090 J	0.77 U	13	8.2	NP	NP	NP	NP	NP
	2009	860 Y	130 Y	0.50 U	0.68	9.2	6.8	NP	NP	NP	NP	NP
	2010	**2,400 Y**	170 H	0.11 J	0.97	9.5	11	NP	NP	NP	NP	NP
	2011	1,500 Y	170 H	0.090 J	0.50 U	9.5	12	NP	NP	NP	NP	NP
	2012	**1,600 Y**	120 HJ	0.080 J	0.95	9.1	13	NP	NP	NP	NP	NP
	2013	**1,700 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	**1,700 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
03-502	2006	**8,200**	**8,200**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Plume Area	2007	**6,400 Z**	**6,700 DY**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2008	**4,800 Z**	**5,300 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2009	1,300 Y	**3,600 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2010	1,200 Y	1,500 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2011	1,400 Y	**3,200 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2012	1,300 L	**3,400 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2013	NP	**3,300 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	NP	**2,500 Y**	NP	NP	NP	NP	NP	NP	NP	3.01	2.93
Endpoint Criteria[3]		1,500	2,200	5	1,000	700	10,000	0.12	10	15	15	15

Table 7-2. Analytical Results for Petroleum-Related Chemicals at Area 303/GCI Compound (continued)

Well Location	Year	DRO (µg/L)	GRO (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	Dibenz(a,h) anthracene (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)
MW-303-28	2013	NP	**FP**	NP	NP	NP	NP	NP	NP	NP	**FP**	**FP**
Plume Source Area	2014	NP	**8,400 DY**	NP	NP	NP	NP	NP	NP	NP	**97.8**	**96.9**
MW-303-30	2013	NP	**16,000 DY**	1.4 JD	330 D	**1,100 D**	NP	0.019 U	NP	NP	**29.1**	**29**
Plume Source Area	2014	NP	**12,000 DY**	1.0 JD	230 D	1,000 D	2,070 D	0.019 U	NP	NP	**88.9**	**88.7**
MW-303-31	2013	NP	810 Y	0.15 J	0.50 U	0.50 U	NP	0.020 U	NP	NP	3.08	2.97
Plume Source Area	2014	NP	250 Y	0.50 U	0.50 U	0.15 J	1.0 U	0.019 U	NP	NP	0.660	0.627
MW-303-32	2013	**2,100 L**	1,900 Y	4.6 D	NP	NP	NP	NP	NP	NP	NP	NP
Plume Source Area	2014	1,400 L	NP	**5.5 D**	0.78 JD	52 D	323 D	NP	NP	NP	NP	NP
MW-303-33	2013	NP	70 J	0.10 J	NP	NP	NP	NP	NP	NP	NP	NP
Plume Source Area	2014	320 Y	150 Y	0.16 J	0.13 J	0.10 J	1.5	NP	NP	NP	NP	NP
MW-303-37	2013	300 L	690 Y	0.070 J	22	49	NP	NP	**138 J**	**139 JX**	NP	NP
Surface Water Protection	2014	450 L	1,600 Y	0.17 J	74 D	180 D	260 D	NP	**514 JD**	**515 JD**	NP	NP
MW-303-38	2013	NP	**4,400 Y**	**6.0**	3.8	0.77	NP	0.021 U	NP	NP	**18.3**	**17.7**
Plume Source Area	2014	NP	**5,200 DY**	**7.6 J**	8.8 J	1.3 J	0.79 J	0.020 U	NP	NP	1.27	1.16
MW-303-39	2013	NP	1,100 Y	0.50 UJ	0.070 J	2.6 J	NP	0.020 U	NP	NP	7.03	8.07
Plume Edge	2014	NP	1,200 Y	0.50 U	0.50 U	2.6	3.0	0.019 U	NP	NP	1.36	1.64
MW-303-40	2013	NP	550 Y	0.50 U	0.060 J	1.5	NP	0.020 U	NP	NP	2.40	2.43
Plume Edge	2014	NP	300 Y	0.50 U	0.50 U	0.29 J	0.34 J	0.020 U	NP	NP	1.85	1.76
MW-303-41	2013	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Plume Edge	2014	NP	94 J	0.50 U	0.15 J	0.10 J	0.32 J	0.020 U	NP	NP	0.020 U	0.020 U
MW-303-42	2013	NP	**18,000 DY**	0.92	NP	NP	NP	NP	NP	NP	NP	NP
Plume Source Area	2014	NP	**20,000 DY**	1.4 JD	NP	NP	NP	NP	NP	NP	NP	NP
MW-303-43	2013	NP	**3,500 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Plume Source Area	2014	NP	**4,500 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
MW-303-44	2013	NP	**3,800 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Plume Source Area	2014	NP	2,200 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
Endpoint Criteria[3]		1,500	2,200	5	1,000	700	10,000	0.12	10	15	15	15

Table 7-2. Analytical Results for Petroleum-Related Chemicals at Area 303/GCI Compound (continued)

Well Location	Year	DRO (µg/L)	GRO (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	Dibenz(a,h) anthracene (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)
MRP-MW2 Plume Source Area	2006	840	**3,100**	**39**	1.8	94	730	NP	NP	NP	NP	NP
	2007	770 Z	**8,400 DY**	**67 D**	3.7 D	320 D	1,501 D	NP	NP	NP	NP	NP
	2008	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2009	650 Y	**4,700 Z**	**75 D**	4.6 D	230 D	1,313 D	NP	NP	NP	NP	NP
	2010	910 Z	**2,300 Y**	**43**	1.9	120 D	620 D	NP	NP	NP	NP	NP
	2011	**1,600 L**	**4,800 Y**	**29 D**	1.7 JD	210 D	861 JD	NP	NP	NP	NP	NP
	2012	890	**2,900 Y**	**35 J**	6.9 J	130 DJ	658 DJ	NP	NP	NP	NP	NP
	2013	1,300 L	**5,900 Y**	**94 D**	6.1 D	310 D	NP	NP	NP	NP	1.93	1.74
	2014	**3,800 L**	**15,000 DY**	**94 D**	31 D	**750 JD**	4,450 JD	NP	NP	NP	8.04	7.80
MRP-MW3 Plume Area	2006	**1,800**	**38,000**	2.4 J	730	**2,500**	**13,100**	NP	NP	NP	NP	NP
	2007	**6,300 Z**	**38,000 DY**	3.2 JD	680 D	**1,500 D**	8,400 D	NP	NP	NP	NP	NP
	2008	**FP**	**FP**	**FP**	**FP**	**FP**	**FP**	NP	NP	NP	NP	NP
	2009	**2,700 Y**	**40,000 DY**	**5.5 D**	610 D	**2,100 D**	**11,400 D**	NP	NP	NP	NP	NP
	2010	**FP**	**FP**	**FP**	**FP**	**FP**	**FP**	NP	NP	NP	NP	NP
	2011	1,200 L	**34,000 DY**	2.5 U	270 D	**1,900 D**	**10,800 D**	NP	NP	NP	NP	NP
	2012	**2,600 L**	**31,000 DY**	0.80 JD	230 DJ	**1,900 DJ**	**11,400 DJ**	NP	NP	NP	NP	NP
	2013	**4,600 L**	**60,000 DY**	1.6 JD	280 D	**2,200 D**	**12,600 D**	NP	NP	NP	NP	NP
	2014	**12,000 L**	**31,000 DY**	1.5 JD	140 D	**1,900 D**	**11,500 D**	NP	NP	NP	**40.3**	**38.9**
04-100 Downgradient	2004	NP	**5,300 J**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2005	NP	**4,420 J**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2006	NP	**5,200 J**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2007	NP	**4,400 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2008	NP	**4,000 Z**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2009	NP	**4,400 Z**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2010	NP	**3,100 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2011	NP	**2,900 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2012	NP	**3,800 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2013	NP	**2,900 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	NP	**3,800 DY**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Endpoint Criteria[3]		1,500	**2,200**	5	1,000	700	10,000	0.12	10	15	15	15

Table 7-2. Analytical Results for Petroleum-Related Chemicals at Area 303/GCI Compound (continued)

Well Location	Year	DRO (µg/L)	GRO (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	Dibenz(a,h) anthracene (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)
04-202	2002	NP	**5,100**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Plume Source Area	2005	NP	**FP**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2006	NP	**FP**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2007	NP	**FP**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2008	NP	**4,400 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2009	NP	**5,200 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2010	NP	**3,300 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2011	NP	**FP**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2012	NP	**3,400 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2013	NP	**4,100 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	NP	**FP**	NP	NP	NP	NP	NP	NP	NP	NP	NP
04-204	2006	NP	230	NP	NP	NP	NP	NP	NP	NP	NP	NP
Upgradient	2007	NP	380 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2008	NP	230 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2009	NP	250 Z	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2010	NP	300 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2011	NP	410 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2012	NP	200 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2013	NP	490 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	NP	400 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
04-210	2002	NP	**5,000**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Downgradient	2005	NP	**4,580 J**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2006	NP	**6,400**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2007	NP	**8,300 DY**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2008	NP	**6,100 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2009	NP	**6,800 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2010	NP	**4,800 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2011	NP	**4,700 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2012	NP	**6,300 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2013	NP	**5,500 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	NP	**3,900 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
Endpoint Criteria[3]		1,500	**2,200**	5	1,000	700	10,000	0.12	10	15	15	15

Table 7-2. Analytical Results for Petroleum-Related Chemicals at Area 303/GCI Compound (continued)

Well Location	Year	DRO (µg/L)	GRO (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)	Dibenz(a,h) anthracene (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)	Total Lead (µg/L)	Dissolved Lead (µg/L)
04-213 Plume	2006	NP	**3,800 J**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2007	NP	**5,900 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2008	NP	**6,900 Z**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2009	NP	**4,400 Z**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2010	NP	**3,300 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2011	NP	**4,000 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2012	NP	**3,900 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2013	NP	**3,200 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	NP	**2,800 Y**	NP	NP	NP	NP	NP	NP	NP	NP	NP
04-701 Downgradient, Plume Edge	2004	NP	199	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2005	NP	547	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2006	NP	420 J	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2008	NP	700 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2010	NP	230 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2012	NP	100 Y	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2013	NP	100 U	NP	NP	NP	NP	NP	NP	NP	NP	NP
	2014	NP	100 U	NP	NP	NP	NP	NP	NP	NP	NP	NP
Endpoint Criteria[3]		1,500	2,200	5	1,000	700	10,000	0.12	10	15	15	15

Notes:
[1]TAH results were calculated by summing the detected concentrations of BTEX when one or more were detected, by summing the quantitation limits when one or more were detected, and by summing the quantitation limits when none were detected.
[2]TAqH results were calculated by summing the detections of BTEX and 16 PAHs when one or more were detected and by summing the quantitation limits when none were detected.
[3]The TAH and TAqH endpoint criteria are based on ADEC water quality standards as specified in 18 AAC 70.
NP - not planned
FP - free product, unable to be sampled
Bold indicates reported concentration is greater than the endpoint criteria or water quality standard.

7.3 MONITORED NATURAL ATTENUATION

The CMP, Revision 6 (Navy 2014a) required collection of NAPs at Area 303/GCI Compound wells during the 2014 monitoring event. Both laboratory analytical and field test kit results are presented in Table 7-3. The occurrence of aerobic digestion is evidenced by the elevated CO_2 concentrations in plume wells (ranging up to 80 mg/L) compared to the background well E-701 (29 mg/L) which is located south of the Former Power Plant area. The current onsite anaerobic conditions are shown by the depleted DO concentrations (0.00 mg/L) compared to the background concentration of 6.5 mg/L. The alkalinity concentrations are also higher in site wells (up to 138 mg/L) than background (27 mg/L).

Sulfate concentrations (less than 0.20 mg/L) for several wells within the contaminant plume are depleted compared to background (3.1 mg/L), indicating sulfate reduction is occurring at the site. Onsite ferrous iron concentrations (up to 37.5 mg/L) are elevated in wells within the contaminant plume compared to background (0 mg/L), indicating the occurrence of iron (II) reduction. Finally, methanogenesis is observed at Area 303/GCI Compound, as demonstrated by elevated methane concentrations in plume wells. Methane was not detected in the background well (1.3 U µg/L), while plume wells had concentrations up to 3,700 µg/L.

Water quality parameters, presented in Table 7-1, collected during the 2014 LTM event support evidence of continued natural attenuation as shown by the reducing environment (low or negative ORP) and depleted oxygen (0.00 mg/L) at certain areas within the plume.

These combined data indicate that anaerobic biodegradation of petroleum hydrocarbons is likely occurring by iron (II) reduction; sulfate reduction; and methanogenesis, which followed aerobic natural attenuation, as shown by elevated carbon dioxide levels and depleted oxygen levels. A more in-depth discussion of natural attenuation is presented in Section 4.1.2.

Table 7-3. 2014 Analytical and Field Measurement Data for NAPs for Area 303/GCI Compound

		Laboratory-Reported Results			Field Test Kit Results		
Well Location	**Monitoring Purpose**	**Alkalinity SM 2320B (mg/L)**	**Sulfate 300.0 (mg/L)**	**Dissolved Methane RSK175 (µg/L)**	**Carbon Dioxide[1] (mg/L)**	**Ferrous Iron[2] (mg/L)**	**Dissolved Oxygen[3] (mg/L)**
03-107	MNA	65	0.08 J	350	55	25	0.1
03-012	MNA	27 U	3.2	1.3 U	18	0	6
04-211	MNA	138	0.09 J	1.500	28	12.5	0.1
03-104	MNA	115	0.18 J	410	13	35	0.05
03-778	MNA	88	0.35	670	14	37.5	0
03-502	MNA	64	0.14 J	2,700	60	30	0
MW-303-28	MNA	121	0.25	65	12	25	0.3
MW-303-30	MNA	70	0.20 U	91	40	20	0
MW-303-31	MNA	54	2.7	180	13	2	1
MW-303-32	MNA	80	3.3	2,800	80	35	0
MW-303-33	MNA	74	0.08 J	2,300	42	25	1
MW-303-37	MNA	24 U	4.1	11	20	0	6
MW-303-38	MNA	52	1.2	220	15	4	0.8
MW-303-39	MNA	73	0.43	1,100	37	20	0.2
MW-303-40	MNA	41	4.5	14	22	2	0.6
MW-303-41	MNA	49	1.2	950	14	10	5
MW-303-42	MNA	115	2.7	27	12	30	0.3
MW-303-43	MNA	61	7.0	0.88 J	13	1	0.6
MW-303-44	MNA	63	8.4	0.56 J	14	2	2.5
MRP-MW2	MNA	72	0.35	3,700	14	35	0.1
MRP-MW3	MNA	141	3.9	210	13	30	0.05
04-100	MNA	70	0.28	1,200	32	20	0.4
04-202	MNA	FP	FP	FP	FP	FP	FP
04-204	MNA	91	1.1	1,200	50	10	0.8
04-210	MNA	49	0.20 U	2,000	12	35	0.05
04-213	MNA	62	0.87	970	40	15	0.3
04-701	MNA	53	2.4	91	14	17.5	0.4

Notes:
FP - free product, unable to be sampled
[1] Field test kit, CHEMetrics K-1910 and K-1920
[2] Field test kit, CHEMetrics K-6210
[3] Field test kit, CHEMetrics K-7501 and K-7512

7.4 TREND EVALUATION

Statistical trend evaluations for target analyte concentrations in groundwater were not conducted for a majority of the Area 303/GCI Compound wells in 2014 since a minimum number of four data points is required in accordance with the CMP, Revision 6 (Navy 2014a). Some wells that were formerly within GCI Compound and SWMU 62 sites did meet criteria for a trend evaluation to be performed.

Trend evaluation was conducted only for analytes that exceeded the endpoint criteria within the last two sampling events and had a minimum of four data points. Sen's slopes were calculated only for wells with decreasing trends. The results of the Mann-Kendall and Sen's trend evaluations are presented in Table 7-4. Worksheets and graphs are provided in Appendix H.

The following are the results of the statistical evaluation:

- Well 03-104: The DRO concentration exhibits an increasing trend at the 80 percent confidence interval.
- Well 03-778: The DRO concentration exhibits no trend at either the 80 or 95 percent confidence intervals.
- Well 03-502: The GRO concentration exhibits a decreasing trend at the 80 and 95 percent confidence intervals. The Sen's evaluation also indicates a statistically significant decreasing trend, with a median slope of -630.
- Well MRP-MW2: The GRO and ethylbenzene concentrations exhibit an increasing trend at the 80 percent confidence interval. The DRO concentration exhibits an increasing trend at the 95 percent confidence interval. The benzene concentration exhibits no trend at either the 80 or 95 percent confidence intervals. The coefficient of variation indicates the concentration is stable.
- Well MRP-MW3: The GRO, ethylbenzene, and total xylenes concentrations exhibit no trend at either the 80 or 95 percent confidence intervals. The coefficients of variation indicate the concentrations are stable. The DRO concentration exhibits an increasing trend at the 80 percent confidence interval.
- Well 04-100: The GRO concentration exhibits a decreasing trend at the 80 and 95 percent confidence intervals. The Sen's evaluation also indicates a statistically significant decreasing trend, with a median slope of -145.
- Well 04-210: The GRO concentration exhibits a decreasing trend at the 80 percent confidence interval. However, the Sen's evaluation does not indicate a statistically significant decreasing trend.
- Well 04-213: The GRO concentration exhibits a decreasing trend at both the 80 and 95 percent confidence interval. The Sen's evaluation also indicates a statistically significant decreasing trend, with a median slope of -360.

7.5 CONCLUSIONS

This section presents the conclusions based on a review of groundwater monitoring performed at the Area 303/GCI Compound site in 2014. The conclusions are as follows:

- Groundwater Flow: The potentiometric surface interprets groundwater flow direction at the site to the west, toward East Canal.
- MNA: The groundwater parameters obtained during 2014 provide evidence that natural attenuation of petroleum hydrocarbons continues to occur at the site.
- Free Product: Free product was detected in one well (04-202, 0.02 feet) at this site in 2014. Free product recovery efforts were conducted at select site wells from October 2013 through September 2014, however there was no product recovered from any of the wells (Appendix J).
- Well 03-107: GRO, benzene, total lead, and dissolved lead exceeded endpoint criteria in this surface water protection well. DRO, toluene, ethylbenzene, TAH, and TAqH did not exceed endpoint criteria in this well. This well is located southwest and downgradient of the site near East Canal.
- Well 03-012: Groundwater did not exceed endpoint criteria for the parameters analyzed. The well is located in the southwestern portion of the mixed contaminant Area 303/GCI Compound plume and was also monitored for free product.
- Well 04-211: GRO exceeded endpoint criteria in this well. This well is located within the center of the mixed contaminant Area 303/GCI Compound plume that consists primarily of GRO, and was also monitored for free product.
- Well 03-104: GRO exceeded endpoint criteria in this well. No other parameters were planned for sampling. This well is located in the northern extent of the Area 303/GCI Compound plume.
- Well 03-778: GRO exceeded endpoint criteria in this well. No other parameters were planned for sampling. This well is located in the very northern extent of the Area 303/GCI Compound plume.
- Well 03-502: GRO exceeded endpoint criteria in this well. Total and dissolved lead concentrations were detected below the endpoint criteria. This well is located in the southern portion of the Area 303/GCI Compound plume.

- Well MRP-MW2: Concentrations of GRO and benzene have exceeded endpoint criteria in this well since 2006. DRO was detected above the endpoint criteria in 2014 after being detected below the endpoint criteria during the previous two sampling events and ethylbenzene exceeded endpoint criteria for the first time (Table 7-2). Statistical analysis (Table 7-4) shows that GRO and ethylbenzene concentrations exhibit an increasing trend at the 80 percent confidence interval. The DRO concentration exhibits an increasing trend at the 95 percent confidence interval. The benzene concentration exhibits no trend. Toluene and xylene compounds have not exceeded endpoint criteria since 2006 (eight sampling events, Table 7-2). Total and dissolved lead did not exceed endpoint criteria for the second consecutive sampling event (Table 7-2). MRP-MW2 is also monitored for free product. This well is nested with MRP-MW3 and located within the northern portion of the mixed contaminant Area 303/GCI Compound plume. Well MRP-MW2 is the deeper well with groundwater at a depth of 18.89 feet. Well MRP-MW3 (discussed below) is completed within the shallow perched aquifer (depth-to-water = 7.31 feet).
- Well MRP-MW3: Concentrations of DRO, GRO, ethylbenzene, total xylenes, total lead, and dissolved lead exceeded endpoint criteria in this well in 2014. Statistical analysis shows that the concentrations of these compounds are stable with the exception of DRO concentration, which exhibits an increasing trend at the 80 percent confidence interval (Table 7-4). Benzene and toluene were below the endpoint criteria for the fourth consecutive event.
- Well MW-303-28: GRO, total lead, and dissolved lead exceeded endpoint criteria. This well was not sampled during the previous sampling event due to the presence of free product. This well is located within the southern portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-30: DRO, total lead, and dissolved lead concentrations exceeded endpoint criteria. Benzene, toluene, ethylbenzene, total xylenes, and dibenz(a,h)anthracene were below endpoint criteria. This well is located within the southwestern portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-31: GRO, benzene, toluene, ethylbenzene, total xylenes, dibenz(a,h)anthracene, total lead, and dissolved lead did not exceed endpoint criteria. This well is located downgradient (west) of the mixed contaminant Area 303/GCI Compound plume.

- Well MW-303-32: Groundwater exceeded the benzene endpoint criteria but DRO, toluene, ethylbenzene, and total xylenes did not. This well is located within the northern portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-33: Groundwater did not exceed endpoint criteria for any of the parameters analyzed. This well is located within the northern portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-37: TAH and TAqH exceeded the endpoint criteria in this surface water protection well. DRO, GRO, benzene, toluene, ethylbenzene, and total xylenes did not exceed endpoint criteria. This well is located upgradient of East Canal within the southwestern corner of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-38: GRO and benzene concentrations exceeded endpoint criteria for the second consecutive sampling event while toluene, ethylbenzene, total xylenes, dibenz(a,h)anthracene, total lead, and dissolved lead were below endpoint criteria. This well is located within the southwestern portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-39: Groundwater in this well did not exceed endpoint criteria for any of the parameters analyzed. This well is located within the southern portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-40: Groundwater in this well did not exceed endpoint criteria for any of the parameters analyzed. This well is located downgradient (west) the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-41: Groundwater in this well did not exceed endpoint criteria for any of the parameters analyzed. It is located in the central portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-42: GRO exceeded endpoint criteria in this well. Benzene was below endpoint criteria. This well is located in the eastern portion of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-43: GRO exceeded endpoint criteria in this well for the second consecutive sampling event. This well is located near the eastern extent of the mixed contaminant Area 303/GCI Compound plume.
- Well MW-303-44: GRO did not exceed endpoint criteria after exceeding this criteria the last sampling event. This well is located near the southeastern extent of the mixed contaminant Area 303/GCI Compound plume.

- Well 04-100: This well is located within the northern portion of the Area 303/GCI Compound contaminant plume. The GRO concentration in 2014 exceeded the endpoint criteria. Mann-Kendall trend and Sen's evaluation performed on the GRO data collected between 2004 and 2014 indicates the concentration is decreasing, with a statistical significance, with a 95 percent confidence interval.
- Well 04-202: This well is located within the northern portion of the Area 303/GCI Compound contaminant plume. This well was not sampled due to the presence of free product (0.02 feet).
- Well 04-204: This well is located on the central upgradient edge of the contaminant plume. GRO has been detected at concentrations below the endpoint criteria in this upgradient well since 2006, when sampling began at this well (nine consecutive events).
- Well 04-210: This well is a downgradient well located within the western portion of the contaminant plume. GRO has been detected at concentrations above the endpoint criteria since 2002. The trend evaluation performed on GRO data from 2002 to 2014 indicates a decreasing trend at the 80 percent confidence interval. However, the Sen's evaluation does not indicate a statistically significant decreasing trend.
- Well 04-213: This well is located within the central portion of the contaminant plume. GRO has been detected above the endpoint criteria since 2006, when sampling began at this well. The Mann-Kendall and Sen's trend evaluations performed on the GRO data indicate a statistically significant decreasing concentration trend at the 95 percent confidence interval.
- Well 04-701: GRO has been detected below the endpoint criteria in this downgradient well since 2006, when sampling began. This well is located downgradient to the west of the mixed contaminant plume.
- A shoreline inspection was performed on the northern portion of the section of East Canal downgradient of Area 303/GCI Compound and SWMU 62, New Housing Fuel Leak Area (Eagle Bay Housing). A large petroleum seep has previously been identified in East Canal that is associated with SWMU 62 and is managed by three booms placed in East Canal. There was light petroleum sheen observed in pools along heavily vegetated areas along the shoreline most likely due to the canal being flooded from excessive rains and the intermittent operation of the canal pumps.

7.6 RECOMMENDATIONS

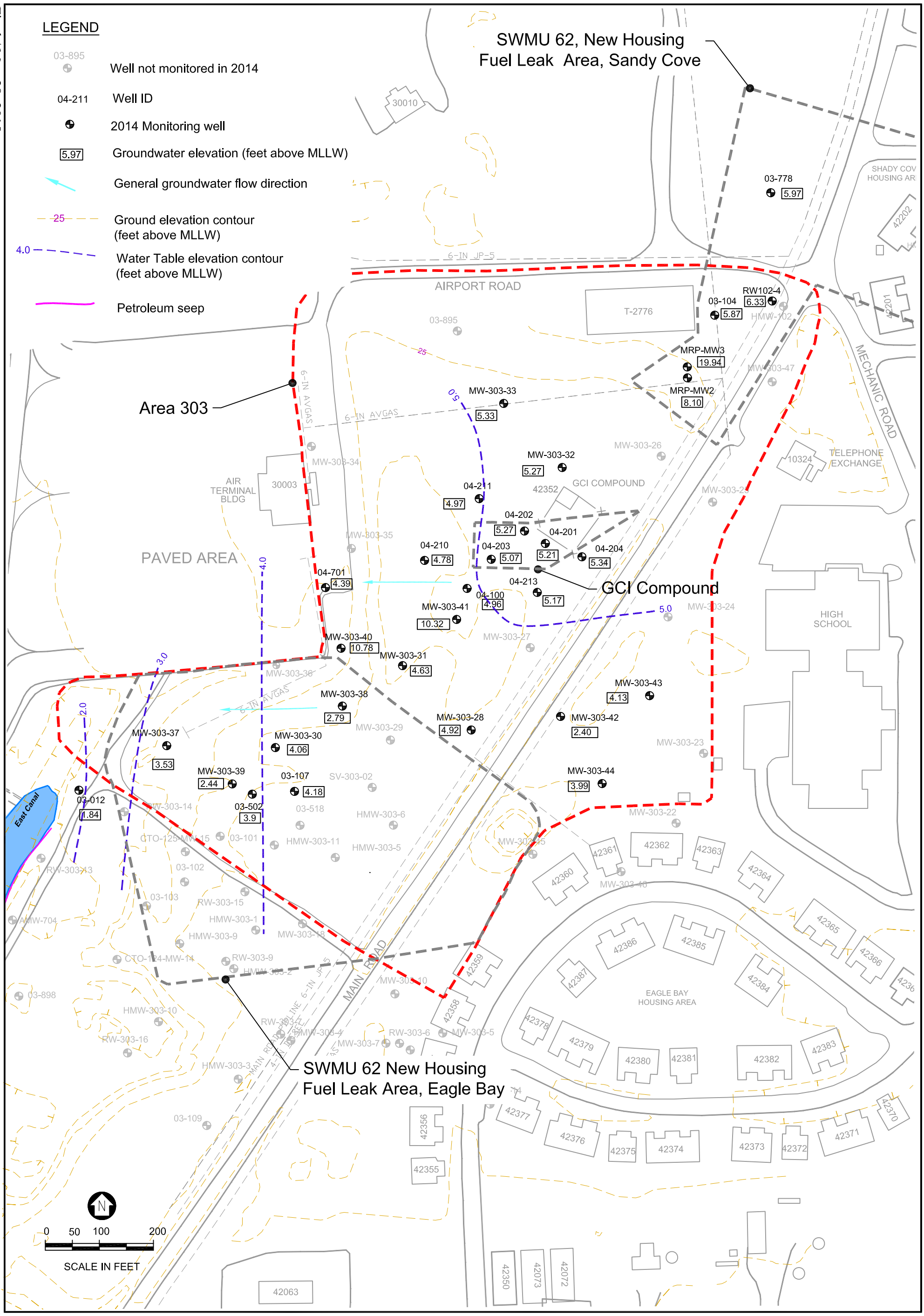
To streamline the monitoring program, it is recommended that sampling from the following wells be discontinued: 03-502, 04-100, 04-202, MW-303-32, MW-303-39, MW-303-40, and MW-303-41. These wells do not significantly add to definition of the groundwater plume extent. The wells should continue to be monitored for water level and free product.

To better define the downgradient extent of the groundwater plume, it is recommended that wells 03-103 and 03-518 be added to the monitoring program for analysis of DRO, GRO, and BTEX. In addition, the analyte GRO should be added for well AMW-704.

Table 7-4. Concentration Trend Evaluation for Area 303/GCI Compound

Well	Target Analyte	Exceeds Endpoint Criteria	Highest Concentration Last Two Sampling Periods (µg/L)	Endpoint Criteria[1] (µg/L)	Sampling Periods (n)	Mann-Kendall Statistic (S)	Mann-Kendall Trend: Trend at 80% C.I.	Mann-Kendall Trend: Trend at 95% C.I.	Concentration Stability[2]	Sen's Slope: Median Slope	Sen's Slope: Statistically Significant Trend	Sen's Slope: 2-Tailed Test at 80% C.I.: Lower Limit	Sen's Slope: 2-Tailed Test at 80% C.I.: Upper Limit
03-104	DRO	Yes	12,000 YJ	1,500	8	8	Increasing	No Trend	NA	NC	NC	NC	NC
03-778	DRO	Yes	1,700 Y	1,500	9	0	No Trend	No Trend	Stable	NC	NC	NC	NC
03-502	GRO	Yes	3,300 Y	2,200	9	-24	Decreasing	Decreasing	NA	-630	Yes	-875	-233
MRP-MW2	GRO	Yes	15,000 DY	2,200	8	8	Increasing	No Trend	NA	NC	NC	NC	NC
	Benzene	Yes	94 D	5	8	7	No Trend	No Trend	Stable	NC	NC	NC	NC
	Ethylbenzene	Yes	750 JD	700	8	10	Increasing	No Trend	NA	NC	NC	NC	NC
	DRO	Yes	3,800 L	1,500	8	16	Increasing	Increasing	NA	NC	NC	NC	NC
MRP-MW3	GRO	Yes	60,000 DY	2,200	7	-5	No Trend	No Trend	Stable	NC	NC	NC	NC
	Ethylbenzene	Yes	2,200 D	700	7	-2	No Trend	No Trend	Stable	NC	NC	NC	NC
	Total Xylenes	Yes	12,600 D	10,000	7	4	No Trend	No Trend	Stable	NC	NC	NC	NC
	DRO	Yes	12,000 L	1,500	7	7	Increasing	No Trend	NA	NC	NC	NC	NC
04-100	GRO	Yes	3,800 DY	2,200	10	-28	Decreasing	Decreasing	NA	-145	Yes	-250	-33
04-210	GRO	Yes	5,500 Y	2,200	10	-13	Decreasing	No Trend	NA	-167	No	-400	44
04-213	GRO	Yes	3,200 Y	2,200	9	-20	Decreasing	Decreasing	NA	-360	Yes	-475	-125

Notes:
[1] Endpoint criteria are established from ADEC cleanup levels for groundwater used as a drinking water source.
[2] Concentration stability is determined from the coefficient of variation when no trend exists at the 80% confidence interval (C.I.).
Sen's Slope is calculated for target analytes with decreasing concentration trends only.



U.S. NAVY	SEALASKA	Figure 7-1 Area 303/GCI Compound Potentiometric Surface	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

P:\PRODUCTION\FIG\ADAK\TO 05\2014 GW\PREVIOUS LTM MAPS & DATA\FIG 7-1 R3.DWG
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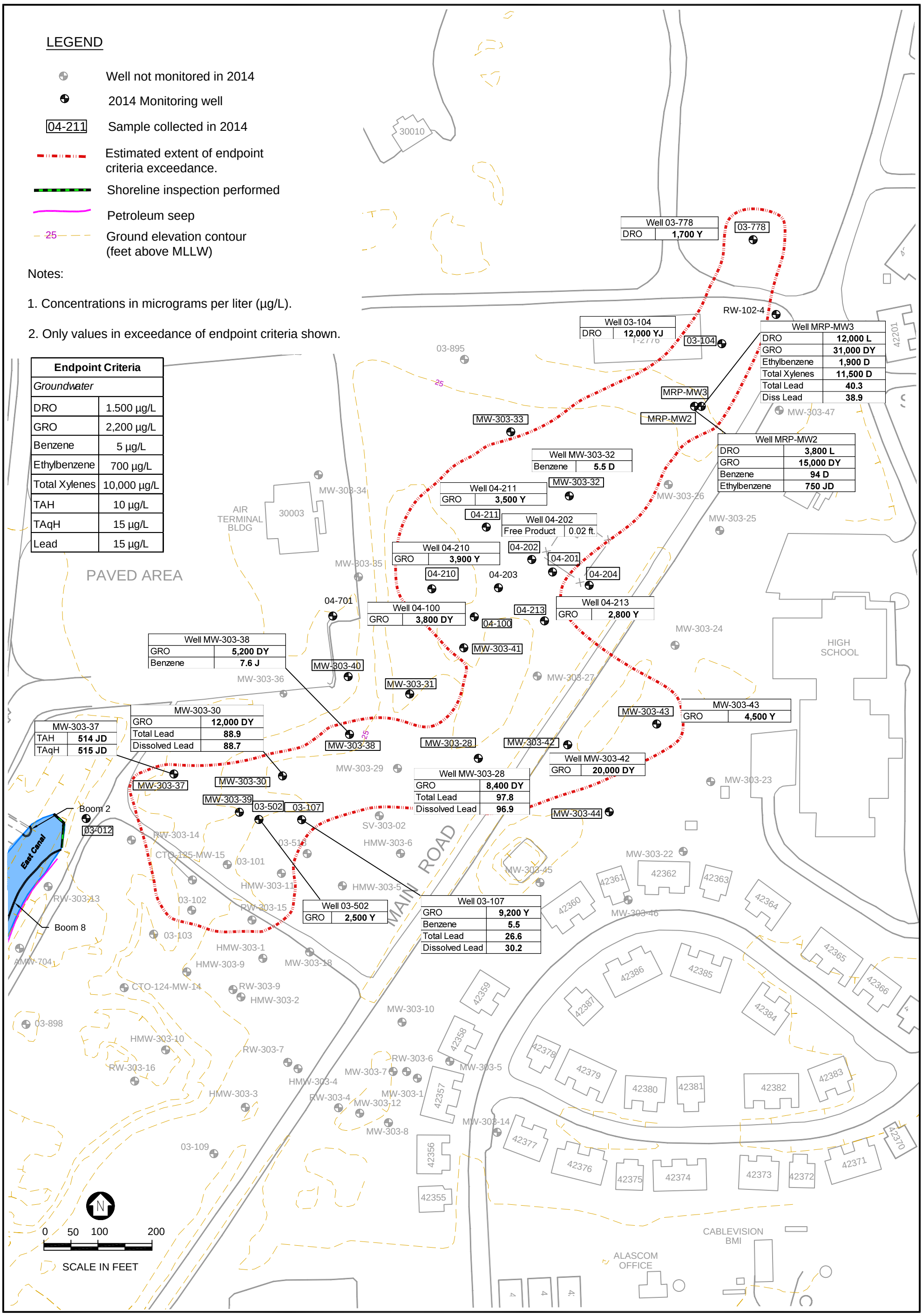


U.S. NAVY	SEALASKA	Figure 7-2 Area 303/GCI Compound Sampling Locations	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

P:\SEALASKA\ADAK\TO 05\2014 GW \FIG 7-2.DWG
FEB 26, 2015

8 FORMER POWER PLANT, BUILDING T-1451

This section presents the results of groundwater monitoring performed at the Former Power Plant, Building T-1451 site during 2014. MNA is the remedy selected for this site (Navy, ADEC, and EPA 2000). To comply with requirements specified for this remedy, the Navy conducts periodic groundwater sampling and water level/product thickness monitoring. In 2012, nine additional monitoring wells were installed to better characterize groundwater at the site. Groundwater samples are collected from these wells to evaluate groundwater quality relative to Alaska groundwater cleanup levels (18 AAC 75.345), to verify that natural attenuation is occurring, and to monitor for surface water protection.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Site photographs are presented in Appendix I.

8.1 FIELD MEASUREMENTS

Depth-to-water and product thickness measurements were collected at twelve monitoring wells on September 9, 2014. Table 8-1 provides the measured depths-to-water, calculated groundwater elevations and, if present, product thicknesses. Figure 8-1 shows the location of the monitoring wells relative to potential source areas at the Former Power Plant site, the site topography, the interpreted potentiometric surface and groundwater flow direction, and the downgradient surface water body (East Canal of the airport ditch system). The water level data indicate that the direction of groundwater flow is to the west, toward East Canal.

Ten monitoring wells and one surface water location were sampled between September 9 and 10, 2014. All wells stabilized prior to sampling. Field measurements were recorded on the field forms and logbooks during monitoring well sampling activities (Appendix A). Table 8-1 lists the final field measurements recorded at each monitoring well prior to sample collection.

Free product was observed in two wells MW-1451-1 (0.26 feet) and MW-1451-7 (0.87 feet) during the 2014 LTM event. Samples were not collected from these wells as planned because product thickness was greater than or equal to 0.02 feet.

Table 8-1. 2014 Field Measurements for Former Power Plant, Building T-1451

	Physical Measurements				Water Quality Parameters						
Well Location	**Casing Elevation (ft MLLW)**	**Depth-to-Water[1] (ft BTOC)**	**Groundwater Surface Elevation (ft MLLW)**	**Measured Product Thickness (ft)**	**pH (SU)**	**Specific Conductance (mS/cm)**	**Turbidity (NTU)**	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**	**Salinity (%)**	**ORP (mV)**
Groundwater Samples											
01-118	19.68	15.94	3.74	0	7.03	0.701	8	0.00	7.97	0.03	-84
01-150	22.68	19.24	3.44	0	6.76	0.472	3	0.00	10.26	0.02	-27
MW-1451-1	6.56	6.46	0.11	0.26	FP	FP	FP	FP	FP	FP	FP
MW-1451-2	6.24	5.90	0.34	0	7.05	0.540	4	0.00	9.91	0.03	-88
MW-1451-3	5.09	5.26	-0.17	0	7.02	0.379	3	0.00	8.99	0.02	3
MW-1451-4	5.99	6.07	-0.08	0	6.51	0.229	0	1.60	7.34	0.01	210
MW-1451-5	7.50	6.24	1.26	0	6.43	0.191	8	0.00	9.29	0.01	36
MW-1451-6	6.15	4.25	1.90	0	6.17	0.742	0	0.00	10.75	0.00	-62
MW-1451-7	7.33	6.04	1.29	0.87	FP	FP	FP	FP	FP	FP	FP
MW-1451-8	8.07	6.23	1.84	0	6.54	0.277	16	0.00	9.56	0.01	-14
MW-1451-9	9.91	8.11	1.80	0	6.20	0.283	5	0.00	9.31	0.01	28
E-701	21.26	17.89	3.37	0	6.25	0.617	0	6.59	8.29	0.00	128
Surface Water Sample											
NL-08	NA	NA	NA	NA	6.30	0.845	31	7.27	10.91	0.00	-45

Notes:

[1]Corrected if presence of product in the well.
FP – free product, unable to be sampled
The reported casing elevation is the surveyed elevation residing in the NIRIS database.
The last groundwater parameter measurement prior to sample collection is reported.

At well MW-1451-7, 0.60 gallons (2.27 liters) of product was recovered during the LTM event and managed per the Waste Management Plan (Navy 2014e). Periodic free product recovery activities were performed at this site from October 2013 through September 2014. Approximately 8.68 gallons of free product were recovered from wells MW-1451-1, MW-1451-6, and MW-1451-7, during this time period (see Appendix J). Free product recovery operation and maintenance activities are summarized in the Remedial Action Summary Report, Free Product Recovery (Navy 2014c).

The eastern shoreline of East Canal was inspected from boom 9 to the southern-most point of the canal at the exit culvert (Crossover Canal) that flows into West Canal (Figure 8-2). One petroleum shoreline seep is located in East Canal approximately 75 feet downgradient of boom 9 where boom 11 is being maintained. This seep affects approximately 25 feet of the shoreline of East Canal. Black-stained oily sediments, stained rocks, light petroleum odor, and sheen were observed at this seep during the 2014 inspection. In general, booms are effective in preventing the migration of sheen to downgradient surface waters.

Remedial activities were performed at a former seep location south of boom 9 in July 2012 as part of the Navy's Petroleum Sites Program. Activities included removal of petroleum-impacted soils and replacement of some shoreline and upgradient soil with amended clean fill. Since these activities have taken place, the flow of the petroleum seep has ceased.

One surface water sample and one sediment sample (NL-08) were collected downgradient of the southern-most boom (boom 12) to determine the effectiveness of sorbent booms (Figure 8-2). Petroleum odor was noted during surface water and sediment sampling. Results of shoreline inspections are summarized in Section 4.1.3.

8.2 TARGET ANALYTE RESULTS

The groundwater samples collected from nine monitoring wells (01-118, 01-150, MW-1451-2, MW-1451-3, MW-1451-4, MW-1451-5, MW-1451-6, MW-1451-8, and MW-1451-9) were analyzed for DRO. Well E-701 is considered the background well for NAPs and was not tested for contaminants. The groundwater samples collected from monitoring wells MW-1451-2, MW-1451-3, and MW-1451-4 were also analyzed for BTEX and PAHs for the calculation of TAH and TAqH. The monitoring wells are located within or along the edge of a dissolved petroleum plume and downgradient of the former petroleum-release area but upgradient (east) from East Canal.

At location NL-08, surface water was analyzed for DRO, BTEX, and PAHs for the calculation of TAH and TAqH. Sediment was analyzed for DRO and PAHs. Because no

risk-based endpoint criteria have been established for East Canal, DRO results were compared to the criteria established for South Sweeper Creek, which may or may not reflect risks associated with East Canal.

Table 8-2 presents groundwater results for the 2004 through 2014 events. Tables 8-3 and 8-4 present the surface water and sediment analytical results, respectively. Figure 8-2 shows the locations of the sampling locations and the analytical results that exceed the applicable endpoint criteria. Laboratory reports presenting the 2014 results are provided in Appendix F. Wells MW-1451-1 through MW-1451-9 were newly installed in 2012; therefore, historical data is not extensive. Wells MW-1451-1 and MW-1451-7 were not sampled due to the presence of product in the well (0.26 feet and 0.87 feet, respectively).

DRO was detected above the endpoint criteria of 1,500 µg/L in groundwater collected from seven of the nine wells sampled, ranging from 1,700 µg/L (well 01-150) to 5,800µg/L (well MW-1451-6). For the second consecutive sampling event, TAqH exceeded the endpoint criteria of 15 µg/L in groundwater collected from well MW-1451-2 (29 µg/L). The remaining TAqH concentrations were below the endpoint criteria. TAH was below the endpoint criteria of 15 µg/L in all three wells for which it was calculated.

The concentration of DRO exceeded endpoint criteria (250 µg/L) in the surface water sample collected at location NL-08 at 310 µg/L. TAH and TAqH were detected in the surface water sample below endpoint criteria (10 µg/L and 15 µg/L, respectively).

The concentration of DRO in sediment at location NL-08 exceeded endpoint criteria (90.6 mg/kg) at 990 mg/kg. Phenanthrene and 2-methylnaphthalene were detected in the sediment sample collected at location NL-08 below endpoint criteria (both 0.225 mg/L).

Table 8-2. Analytical Results for Petroleum-Related Chemicals at Former Power Plant, Building T-1451

Well Location	Year	DRO (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)
01-118	2004	**7,080**	NP	NP
Plume Source Area	2005	**11,200 J**	NP	NP
	2006	**8,700**	NP	NP
	2007	**7,000 Y**	NP	NP
	2008	**9,300 Y**	NP	NP
	2009	**8,700 Y**	NP	NP
	2010	**7,100 Y**	NP	NP
	2011	**10,000 Y**	NP	NP
	2012	**9,400 YJ**	NP	NP
	2013	**12,000 Y**	NP	NP
	2014	**4,800 Y**	NP	NP
01-150	2004	394	NP	NP
Downgradient	2005	927 J	NP	NP
	2006	1,400	NP	NP
	2007	1,100 Y	NP	NP
	2008	**3,400 Y**	NP	NP
	2009	1,100 Y	NP	NP
	2010	1,300 Y	NP	NP
	2011	1,400 Y	NP	NP
	2012	1,300 YJ	NP	NP
	2013	1,400 Y	NP	NP
	2014	**1,700 Y**	NP	NP
MW-1451-1	2013	**5,600 Y**	NP	NP
Plume Source Area	2014	**FP**	NP	NP
MW-1451-2	2013	**6,200 Y**	6.6 J	**20 JDX**
Plume Source Area	2014	**4,700 Y**	6.2 J	**29 JDX**
MW-1451-3	2013	1,300 Y	2.5 UJ	0.03 X
Plume Edge	2014	1,100 Y	0.08 J	0.29 JX
MW-1451-4	2013	160 Y	2.5 UJ	0.05
Plume Edge	2014	360 Y	2.5 U	0.05 J
MW-1451-5	2013	**3,700 Y**	NP	NP
Plume Source Area	2014	**2,400 Y**	NP	NP
MW-1451-6	2013	**5,600 Y**	NP	NP
Plume Source Area	2014	**5,800 Y**	NP	NP
MW-1451-7	2013	**FP**	NP	NP
Plume Source Area	2014	**FP**	NP	NP
MW-1451-8	2013	**2,600 Y**	NP	NP
Plume Source Area	2014	**3,600 Y**	NP	NP
MW-1451-9	2013	**FP**	NP	NP
Plume Source Area	2014	**3,800 Y**	NP	NP
Endpoint Criteria[3]		1,500	10	15

Notes:
[1] TAH results were calculated by summing the detected concentrations of BTEX when one or more were detected and by summing the quantitation limits when none were detected.
[2] TAqH results were calculated by summing the detections of BTEX and 16 PAHs when one or more were detected and by summing the quantitation limits when none were detected.
[3] The TAH and TAqH endpoint criteria are based on ADEC water quality standards as specified in 18 AAC 70.
NP - not planned
FP - free product, unable to be sampled
Bold indicates reported concentration is greater than the endpoint criteria or water quality standard.

Table 8-3. Analytical Results for Surface Water at Former Power Plant, Building T-1451

Location	Year	DRO (µg/L)	Indeno(1,2,3-cd)pyrene (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)
NL-08	2010	240 Y	0.020 U	6.2 J	6.2 J
	2011	130 Y	0.020 U	7.4 J	7.5 J
	2012	160 YJ	0.020 U	3.4 J	3.4 J
	2013	240 Y	0.020 U	1.1 J	1.1 J
	2014	**310 Y**	0.020 U	8.9 J	9.1 J
Endpoint Criteria[3,4]		250	0.28	10	15

Notes:
[1] TAH results were calculated by summing the detected concentrations of BTEX when one or more were detected and by summing the quantitation limits when none were detected.
[2] TAqH were calculated by summing the detections of BTEX and 16 PAHs when one or more were detected and by summing the quantitation limits when none were detected.
[3] The TAH and TAqH endpoint criteria are based on ADEC water quality standards as specified in 18 AAC 70.
[4] Endpoint criteria for East Canal have not been established, so endpoints for South Sweeper Creek were used.
Bold indicates reported concentration is greater than the endpoint criteria or water quality standard.

Table 8-4. Analytical Results for Sediment at Former Power Plant, Building T-1451

Location	Year	DRO (mg/kg)	2-Methylnaphthalene (mg/kg)	Phenanthrene (mg/kg)
NL-08	2010	51 Y	0.0031 U	0.0031 U
	2011	**420 DY**	0.0040 U	0.029
	2012	**170 DY**	0.0050 U	0.0030 J
	2013	84 DY	0.0032 U	0.0027 J
	2014	**990 DY**	0.0019 J	0.026
Endpoint Criteria[1]		90.6	0.0202	0.225

Notes:
[1] Endpoint criteria for East Canal have not been established so endpoints for South Sweeper Creek were used.
Bold indicates reported concentration is greater than the endpoint criteria.

8.3 MONITORED NATURAL ATTENUATION

The CMP, Revision 6 (Navy 2014a), required the collection of NAPs at Former Power Plant, Building T-1451 during the 2014 monitoring event. Table 8-5 presents the analytical results for the NAPs that were collected in 2014. NAPs data from well E-701 was used to represent background conditions in the following natural attenuation discussion. Evidence of aerobic digestion is seen by the elevated CO_2 concentrations in plume wells (up to 99 mg/L) compared to the background well E-701 (29 mg/L) and the current onsite anaerobic conditions are shown by the depleted DO concentrations (0.0 mg/L) compared to the background concentration of 6.5 mg/L. The alkalinity concentrations are also higher in site plume wells (up to 247 mg/L) than background (not detected).

Sulfate concentrations for nearly half of the wells within the contaminant plume are elevated compared to background (3.1 mg/L), indicating sulfate reduction is occurring in some areas at the site. Onsite ferrous iron concentrations in plume wells (up to 40 mg/L) are elevated compared to background (0 mg/L), indicating the occurrence of iron (II) reduction.

Finally, strong evidence of methanogenesis is observed at the Former Power Plant, Building T-1451 site, as demonstrated by elevated methane concentrations in plume wells up to 9,600 µg/L, compared to background concentrations in which methane was not detected in the background well (1.3 U mg/L).

Water quality parameters presented in Table 8-1 support evidence of continued natural attenuation as shown by the reducing environment (low or negative ORP) and depleted oxygen (0.00 mg/L) at certain areas within the plume.

These combined data indicate that anaerobic biodegradation of petroleum hydrocarbon is likely occurring by iron (II) reduction; sulfate reduction; and methanogenesis, which followed aerobic natural attenuation, as shown by elevated carbon dioxide levels and depleted oxygen levels. A more in-depth discussion of natural attenuation is presented in Section 4.1.2.

Table 8-5. 2014 Analytical and Field Measurement Data for NAPs for Former Power Plant, Building T-1451

		Laboratory-Reported Results			Field Test Kit Results		
Well Location	**Monitoring Purpose**	**Alkalinity SM 2320B (mg/L)**	**Sulfate 300.0 (mg/L)**	**Dissolved Methane RSK175 (µg/L)**	**Carbon Dioxide[1] (mg/L)**	**Ferrous Iron[2] (mg/L)**	**Dissolved Oxygen[3] (mg/L)**
01-118	MNA	247	0.23	3,500	99	40	0.1
01-150	MNA	191	0.21	9,600	65	20	0.3
MW-1451-1	MNA	FP	FP	FP	FP	FP	FP
MW-1451-2	MNA	121	32	6,100	40	40	0
MW-1451-3	MNA	122	5.8	1,300	20	3	1
MW-1451-4	MNA	64	6.9	8.1	11.5	0	3
MW-1451-5	MNA	49	2.8	540	27	15	0.6
MW-1451-6	MNA	42	0.20 U	3,700	14	35	0.05
MW-1451-7	MNA	FP	FP	FP	FP	FP	FP
MW-1451-8	MNA	65	1.2	430	55	15	0.05
MW-1451-9	MNA	79	3.6	350	70	15	0.2
E-701	Background	27 U	3.1	1.3 U	29	0	6.5

Notes:
FP – free product, unable to be sampled
[1] Field test kit, CHEMetrics K-1910 and K-1920
[2] Field test kit, CHEMetrics K-6210
[3] Field test kit, CHEMetrics K-7501 and K-7512

8.4 TREND EVALUATION

Statistical trend evaluations were conducted for target analyte concentrations in groundwater in accordance with the CMP, Revision 6 (Navy 2014a). Trend evaluation was conducted only for analytes that exceeded the endpoint criteria within the last two sampling events and had a minimum of four data points (two wells). Sen's slopes were calculated only for wells with decreasing trends. Results of the statistical evaluations are summarized in Table 8-6. Worksheets and graphs are provided in Appendix H.

The following are the results of the statistical evaluation:

- Well 01-118: DRO in this well exhibits no trend at either the 80 or 95 percent confidence interval. The coefficient of variation indicates the concentration is stable.
- Well 01-150: The DRO concentration exhibits an increasing trend at the 80 percent confidence interval.

8.5 CONCLUSIONS

This section presents the conclusions based on a review of groundwater monitoring performed at the Former Power Plant, Building T-1451 site in 2014. The conclusions are as follows:

- Groundwater Flow: Based on the water levels measured in 2014, the groundwater flow direction at the site is to the west, toward East Canal.
- MNA: The groundwater parameters obtained during 2014 provide evidence that natural attenuation of petroleum hydrocarbons continues to occur at the site.
- Free Product: Free product was detected in two wells at this site in 2014, which were consequently not sampled. Product was measured in well MW-1451-1 at a thickness of 0.26 feet and in well MW-1451-7 at a thickness of 0.87 feet (0.60 gallons [2.27 liter] of product recovered). Periodic free product recovery performed from October 2013 through September 2014 recovered 8.68 gallons of product from three wells at this site.
- Well 01-118: The DRO concentration has remained above the endpoint criteria established for groundwater used as a drinking water source (1,500 µg/L) for the last 11 monitoring events. The Mann-Kendall trend evaluation performed on the DRO data collected between 2004 and 2014 indicates that the concentration is stable with no statistically significant trend (Table 8-6).

- Well 01-150: The DRO concentration exceeded endpoint criteria in 2014 after not exceeding endpoint criteria for the last five years. Statistical analysis performed on the DRO concentration exhibits an increasing trend at the 80 percent confidence interval.
- Well MW-1451-2: The DRO and TAqH concentrations exceeded their respective endpoint criteria.
- Wells MW-1451-3 and MW-1451-4: Groundwater concentrations were below endpoint criteria for DRO, TAH, and TAqH.
- Wells MW-1451-5, MW-1451-6, MW-1451-8, and MW-1451-9: The DRO concentrations exceeded the endpoint criteria.
- A shoreline inspection was conducted downgradient of this site on the eastern bank of East Canal, between the former location of well 01-151 and the southern-most end of the canal. During the shoreline inspection in 2014, 25 feet of intermittent seeps along the east side of the canal near boom 11 were observed. There were petroleum stained rocks, sediments, and vegetation along boom 11. There was also a presence of surface sheen. In general, booms 11 and 12 are effective in preventing the migration of sheen to downgradient surface waters. No evidence of petroleum contamination was observed in the former seep location at boom 9.
- Sampling location NL-08: Surface water and sediment samples were collected downgradient of the southern-most boom (boom 12) in East Canal to determine whether the installed booms were effectively preventing the migration of petroleum contamination. The surface water and sediment samples collected from this location exceeded DRO endpoint criteria in 2014. No active petroleum seep was observed at this sampling location, but light petroleum odor was noted from the water.

8.6 RECOMMENDATIONS

DRO and TAqH concentrations exceeded endpoint criteria in site groundwater and DRO exceeded endpoint criteria in surface water and sediment collected from East Canal. Indeno(1,2,3-cd)pyrene has not been observed in surface water above detection limits or endpoint criteria for five consecutive years. Additionally, 2-methylnaphthalene and phenanthrene have also not been observed in sediment above endpoint criteria for five consecutive years. Therefore, it is recommended that sampling for these three parameters be discontinued.

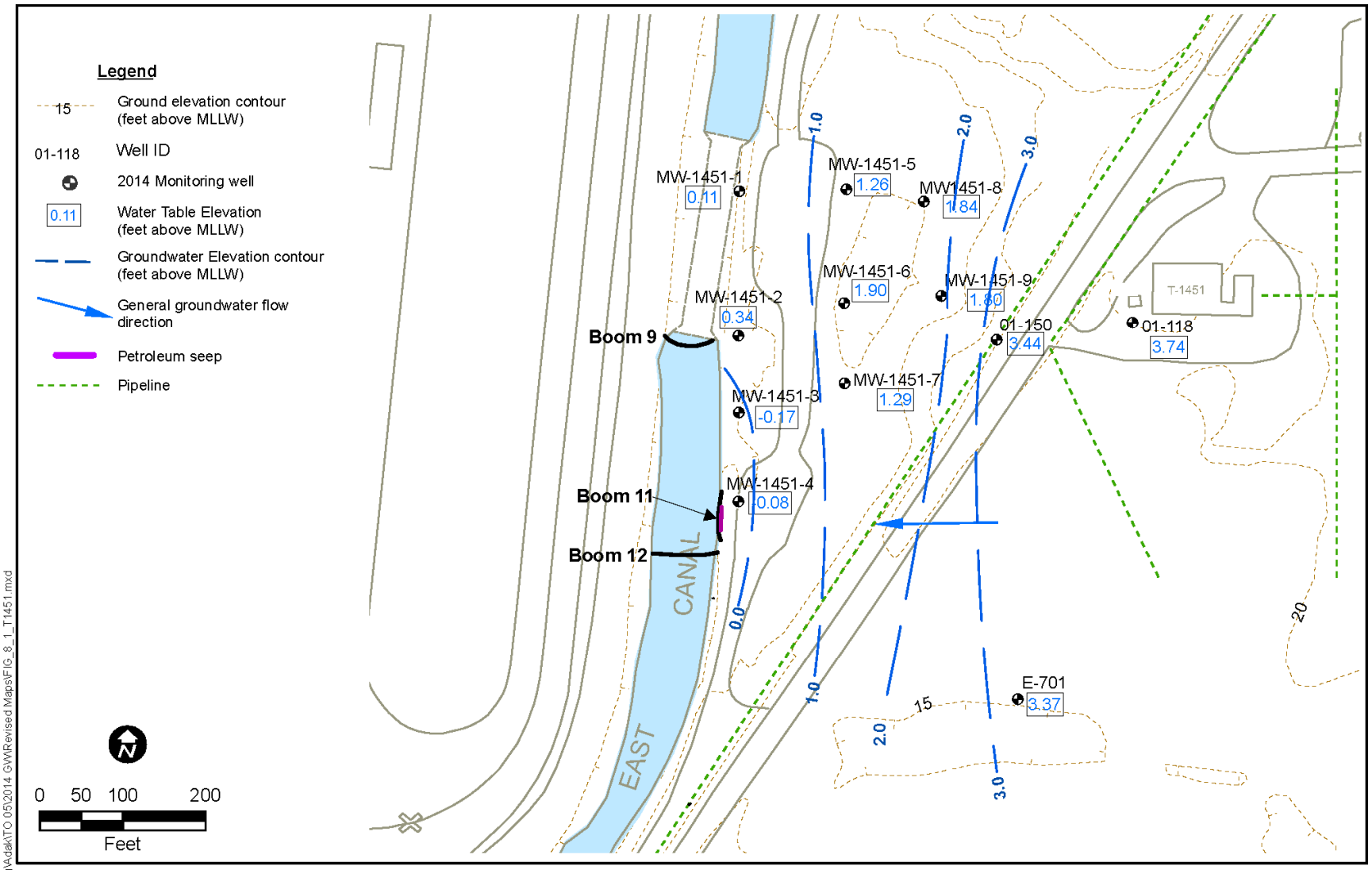
Free product was observed in two onsite wells, up to 0.87 feet thick. Because of this, the shoreline downgradient of the remediated area should also continue to be monitored and boom 11 and 12 maintained. However, NAPs monitoring indicates that natural attenuation is

occurring initially by aerobic digestion shown by elevated CO_2 and depleted DO concentrations, followed by anaerobic means via iron (II) reduction, sulfate reduction, and methanogenesis in groundwater. For these reasons, all other monitoring of groundwater, surface water, and sediment should continue as prescribed to monitor the effectiveness of the remedy. It is further recommended that annual sampling be conducted until at least three sampling data points have been obtained at the newly installed wells so that it can be determined if endpoint criteria have been met.

Table 8-6. Concentration Trend Evaluation for Former Power Plant, Building T-1451

							Mann-Kendall Trend			Sen's Slope			
												2-Tailed Test at 80% C.I.	
Well	**Target Analyte**	**Exceeds Endpoint Criteria**	**Highest Concentration Last Two Sampling Periods (µg/L)**	**Endpoint Criteria[1] (µg/L)**	**Sampling Periods (n)**	**Mann-Kendall Statistic (S)**	**Trend at 80% C.I.**	**Trend at 95% C.I.**	**Concentration Stability[2]**	**Median Slope**	**Statistically Significant Trend**	**Lower Limit**	**Upper Limit**
01-118	DRO	Yes	12,000 Y	1,500	10	0	No Trend	No Trend	Stable	NC	NC	NC	NC
01-150	DRO	Yes	1,700 Y	1,500	10	18	Increasing	No Trend	NA	NC	NC	NC	NC

Notes:
[1] Endpoint criteria are established from ADEC cleanup levels for groundwater used as a drinking water source.
[2] Concentration stability is determined from the coefficient of variation when no trend exists at the 80% confidence interval (C.I.).
Sen's Slope is calculated for target analytes with decreasing concentration trends only.



U.S. NAVY	SEALASKA	Figure 8-1 Former Power Plant, Building T-1451 Potentiometric Surface	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

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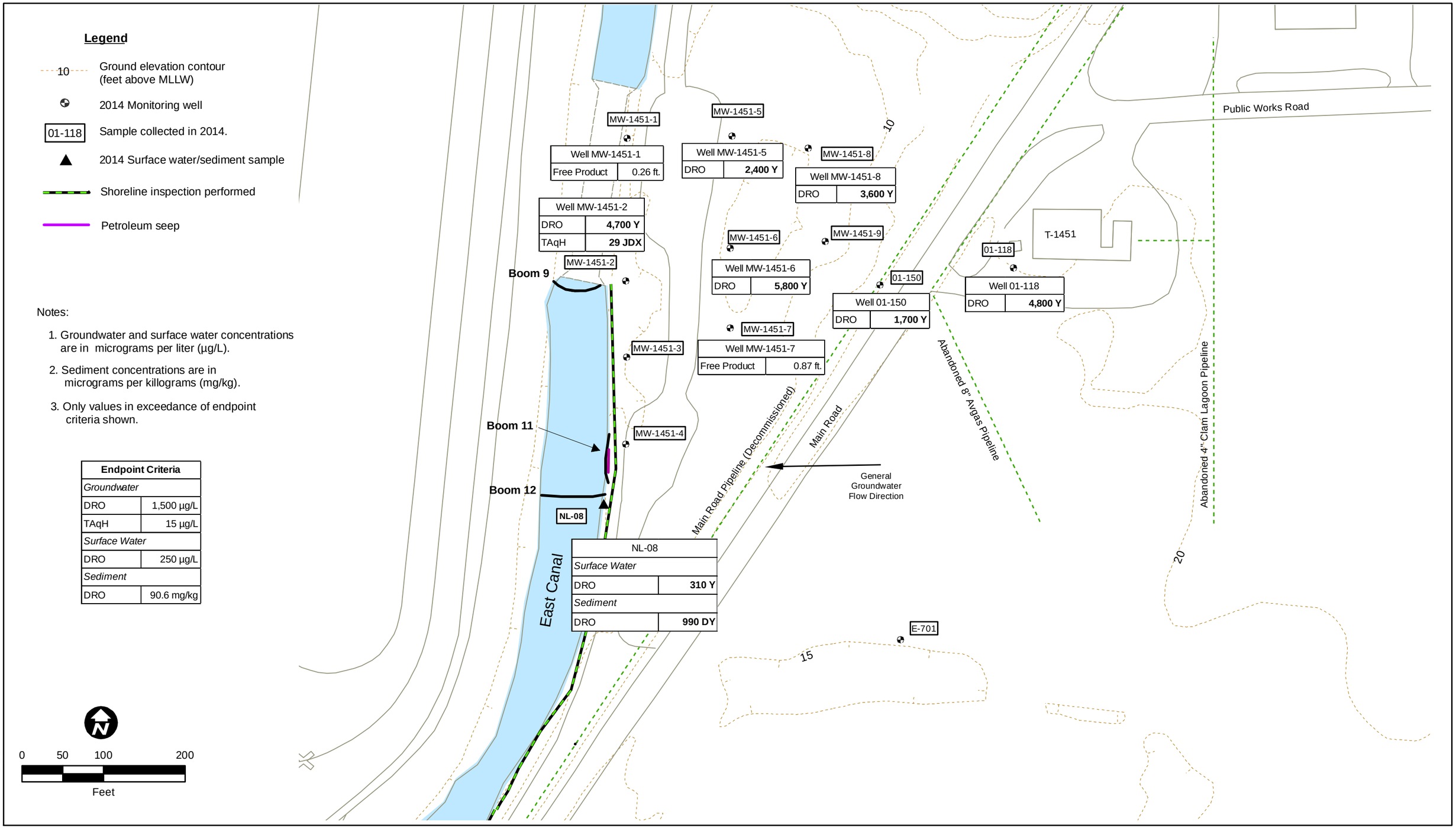

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U.S. NAVY	SEALASKA	Figure 8-2 Former Power Plant, Building T-1451 Sample Locations	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

9 HOUSING AREA (ARCTIC ACRES)

This section presents the results of groundwater monitoring performed at the Housing Area (Arctic Acres) site during August 2014. MNA is the remedy selected for this site (Navy, ADEC, and EPA 2000). To comply with requirements specified for this remedy, the Navy conducts periodic groundwater sampling and water level/product thickness monitoring. Groundwater samples are collected from these wells to evaluate groundwater quality relative to Alaska groundwater cleanup levels (18 AAC 75.345) and to verify that natural attenuation is occurring.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Site photographs are presented in Appendix I.

9.1 FIELD MEASUREMENTS

Monitoring wells were gauged on August 28, 2014. Depth-to-water and product thickness measurements were collected at four wells in 2014. Table 9-1 provides the measured depth-to-water, the calculated groundwater elevations and, if present, the product thickness. Figure 9-1 shows the locations of the wells relative to potential source areas at the Housing Area (Arctic Acres), site topography, and the approximate groundwater flow direction. The historic water level data indicate that the direction of groundwater flow in the main aquifer beneath the site is to the northeast, toward Kuluk Bay. Groundwater elevations collected in 2014 were compared with historical data and are consistent with this interpretation. Previous monitoring has shown that a water table high (divide) occurs just west of well 03-421, with the groundwater southwest of the divide flowing to the southwest toward East Canal. This divide may migrate east and west seasonally.

Free product was observed in one well, 03-890 (0.02 feet) during the 2014 LTM event. Samples were not collected from this well as planned because product thickness was greater than or equal to 0.02 feet.

Table 9-1. 2014 Field Measurements for Housing Area (Arctic Acres)

	Physical Measurements				Water Quality Parameters						
Well Location	**Casing Elevation (ft MLLW)**	**Depth-to-Water[1] (ft BTOC)**	**Groundwater Surface Elevation (ft MLLW)**	**Measured Product Thickness (ft)**	**pH (SU)**	**Specific Conductance (mS/cm)**	**Turbidity (NTU)**	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**	**Salinity (%)**	**ORP (mV)**
03-416	26.40	19.65	6.75	0	6.44	0.31	0	0.00	8.18	0.01	-36
03-420	29.76	22.79	6.97	0	6.20	0.278	0	0.00	8.74	0.01	3
03-421	29.81	22.71	7.10	0	6.39	0.418	0	0.00	8.06	0.02	-27
03-890	30.54	23.63	6.93	0.02	FP	FP	FP	FP	FP	FP	FP

Notes:
[1]Corrected if presence of product in the well.
FP – free product, unable to be sampled
The reported casing elevation is the surveyed elevation residing in the NIRIS database.
The last groundwater parameter measurement prior to sample collection is reported.

Groundwater sampling was performed at three scheduled monitoring wells, which did not have product present, on August 28 and 29, 2014. Field measurements were recorded on the field forms and logbooks during monitoring well sampling activities (Appendix A). Table 9-1 lists the final field measurements recorded at the monitoring wells prior to sample collection. A review of the sampling data reported for this site indicates that prior to sample collection all groundwater parameters stabilized in all wells.

9.2 TARGET ANALYTE RESULTS

Groundwater samples were collected from the Housing Area (Arctic Acres) in 2014 from three monitoring wells, 03-416, 03-420, and 03-421, which were all analyzed for DRO. Table 9-2 presents the analytical results for the 2001 through 2014 events for all site monitoring wells. The accumulated analytical results obtained for these locations are also summarized in Appendix C-1. Laboratory reports presenting the 2014 results are provided in Appendix F. Figure 9-1 shows the locations of the site wells and analytical results that exceed the applicable endpoint criteria.

DRO was detected above the endpoint criterion of 1,500 µg/L in the samples from wells 03-420 (3,400 µg/L) and 03-421 (2,400µg/L).

9.3 MONITORED NATURAL ATTENUATION

NAPs were collected at this site in 2014 to determine if natural attenuation was occurring in groundwater and to support the 5-year review process. Both laboratory analytical and field test kit results are presented in Table 9-3. The 2014 data indicated that biodegradation of petroleum hydrocarbons is likely occurring by iron (II) reduction; sulfate reduction; and methanogenesis, as shown by elevated ferrous iron concentration, depleted sulfates, and elevated methane concentrations in comparison to background conditions. Water quality parameters presented in Table 9-1 collected during the 2014 LTM event support evidence of continued natural attenuation as shown by the reducing environment (low or negative ORP) and depleted oxygen (0.00 mg/L) within the plume. A more in-depth discussion of natural attenuation is presented in Section 4.1.2.

Table 9-2. Analytical Results for Petroleum-Related Chemicals for Housing Area (Arctic Acres)

Well Location	Year	DRO (µg/L)
03-416	2001	**3,450**
Downgradient	2003	790
	2004	1,160
	2005	NP
	2006	**1,500**
	2007	NP
	2008	1,400 Y
	2009	NP
	2010	1,300 Y
	2011	NP
	2012	NP
	2013	**1,600 Y**
	2014	1,200 Y
03-420	2001	**12,300**
Plume Source Area	2002	**4,900**
	2003	**4,900**
	2004	**5,450**
	2005	**5,650 J**
	2006	**3,800**
	2007	**2,400 Y**
	2008	**3,300 Y**
	2009	**2,200 Y**
	2010	NP
	2011	**4,300 Y**
	2012	NP
	2013	**3,300 Y**
	2014	**3,400 Y**
03-421	2001	**81,300 J**
Plume Source Area	2002	**3,500**
	2006	**FP**
	2007	**FP**
	2008	**FP**
	2009	**15,000 Y**
	2010	**3,800 Y**
	2011	**19,000 Y**
	2012	NP
	2013	**3,000 Y**
	2014	**2,400 Y**
03-890	2001	**90,600 J**
Plume Source Area	2002	**16,000**
	2006	**FP**
	2007	**FP**
	2008	**FP**
	2009	**44,000 YJ**
	2010	**10,000 Y**
	2011	**13,000 Y**
	2012	NP
	2013	**11,000 Y**
	2014	**FP**
Endpoint Criteria		1,500

Notes:
NP - not planned **FP** – free product, unable to be sampled
Bold indicates reported concentration is greater than the endpoint criteria.

Table 9-3. Analytical and Field Measurement Data for NAPs for Housing Area (Arctic Acres)

		Laboratory-Reported Results			Field Test Kit Results		
Well Location	**Monitoring Purpose**	**Alkalinity SM 2320B (mg/L)**	**Sulfate 300.0 (mg/L)**	**Dissolved Methane RSK175 (µg/L)**	**Carbon Dioxide[1] (mg/L)**	**Ferrous Iron[2] (mg/L)**	**Dissolved Oxygen[3] (mg/L)**
03-416	MNA	79	0.65	1,500	36	30	1.0
03-420	MNA	84	1.9	300	35	20	1.0
03-421	MNA	128	1.8	320	50	40	1.0
03-890	MNA	FP	FP	FP	FP	FP	FP

Notes:
FP – free product, unable to be sampled
[1] Field test kit, CHEMetrics K-1910 and K-1920
[2] Field test kit, CHEMetrics K-6210
[3] Field test kit, CHEMetrics K-7501 and K-7512

9.4 TREND EVALUATION

Statistical trend evaluations were conducted for target analyte concentrations in groundwater in accordance with the CMP, Revision 6 (Navy 2014a). Trend evaluation was conducted only for analytes that exceeded the endpoint criteria within the last two sampling events and had a minimum of four data points. The Sen's evaluation was conducted only for wells with decreasing trends. The results of the Mann-Kendall and Sen's trend evaluations are presented in Table 9-4. Worksheets and graphs are provided in Appendix H.

Based on the statistical evaluation:

- Well 03-416: The DRO concentration exhibits no trend at either the 80 or 95 percent confidence intervals, with the coefficient of variation indicating the data is stable.
- Well 03-420: The DRO concentration exhibits a decreasing trend at the 80 percent confidence interval. The Sen's evaluation has a statistically significant downward trend with a median slope of -291.
- Well 03-421: The DRO concentration exhibits a decreasing trend at the 80 percent confidence interval. However, the Sen's evaluation does not indicate a statistically significant downward trend.

9.5 CONCLUSIONS

This section presents the conclusions based on a review of groundwater monitoring results performed at the Housing Area (Arctic Acres) site in 2014. The conclusions are as follows:

- Groundwater Flow: The groundwater flow direction at the site was interpreted to be to the northeast in 2014, with historical data showing a water table high (divide)

occuring in the vicinity of well 03-421, with the groundwater southwest of there flowing to the southwest.

- MNA: The groundwater parameters obtained during 2014 support evidence that natural attenuation of petroleum hydrocarbons continues to occur at the site.
- Free Product: Free product was detected in one well (03-890 at 0.02 feet) at this site in 2014, which was consequently not sampled.
- Well 03-416: The DRO concentration did not exceed endpoint criterion in 2014. The trend analysis performed indicates that the concentration is stable with no statistically significant trend.
- Well 03-420: The DRO concentration has been above the endpoint criterion in this well since sampling began in 2001. The Mann-Kendall and Sen's trend evaluation indicate that the DRO concentration has a statistically significant decreasing trend at the 80 percent confidence level.
- Well 03-421: The DRO concentration has been above the endpoint criterion or free product has been observed in this well since sampling began in 2001. The trend evaluation exhibits a decreasing trend, however, does not indicate a statistically significant downward trend.

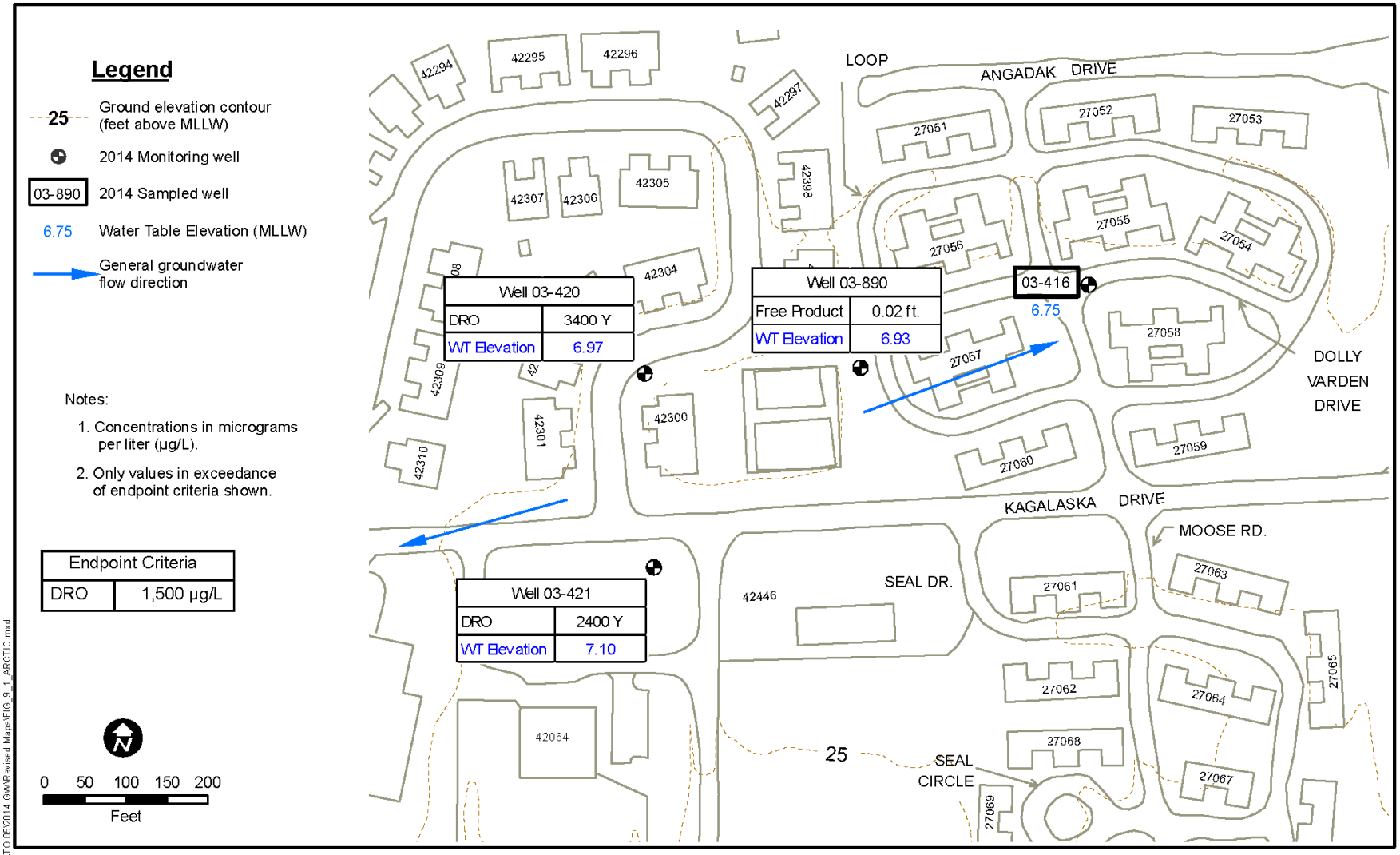
9.6 RECOMMENDATIONS

Because DRO concentrations remain above the endpoint criterion or free product was present in groundwater collected from site wells, monitoring should continue as prescribed.

Table 9-4. Concentration Trend Evaluation for Housing Area (Arctic Acres)

							Mann-Kendall Trend			Sen's Slope			
												2-Tailed Test at 80% C.I.	
Well	**Target Analyte**	**Exceeds Endpoint Criteria**	**Highest Concentration Last Two Sampling Periods (µg/L)**	**Endpoint Criteria[1] (µg/L)**	**Sampling Periods (n)**	**Mann-Kendall Statistic (S)**	**Trend at 80% C.I.**	**Trend at 95% C.I.**	**Concentration Stability[2]**	**Median Slope**	**Statistically Significant Trend**	**Lower Limit**	**Upper Limit**
03-416	DRO	No	1,600 Y	1,500	8	0	No Trend	No Trend	Stable	NC	NC	NC	NC
03-420	DRO	Yes	3,400 Y	1,500	10	-16	Decreasing	No Trend	NA	-291	Yes	-533	-150
03-421	DRO	Yes	3,000 Y	1,500	7	-11	Decreasing	No Trend	NA	-1875[3]	No	-11200[3]	2000[3]

Notes:
[1] Endpoint criteria are established from Alaska cleanup levels for groundwater used as a drinking water source.
[2] Concentration stability is determined from the coefficient of variation when no trend exists at the 80% confidence interval.
[3] Data from 2009 to 2014 used for the Sen's slope analysis for this well, since the analysis requires that there cannot be more than two years between consecutive sampling events.
NC – not calculated



U.S. NAVY	SEALASKA	Figure 9-1 Housing Area (Arctic Acres) Sample Locations	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

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10 NMCB BUILDING T-1416 EXPANDED AREA

This section presents the results of groundwater monitoring performed at the NMCB Building T-1416 Expanded Area (henceforth referred as NMCB) during 2014. The remedy specified for this site in the OU A ROD (Navy, ADEC, and EPA 2000) is interim free product recovery followed by determination of further remedies using the focused feasibility study process. In 2006, the Final Decision Document for the NMCB site selected the preferred remedies of ICs, free product recovery, and MNA for the site (Navy 2006b). During the contract year 2007/2008, the site met the endpoint criteria for free product recovery of less than a rolling average of 5 gallons per month for 6 months. Monthly free product activities ceased for this site but were restarted in June 2010 to meet surface water protection goals. Annual groundwater monitoring is conducted as part of the prescribed long-term monitoring. Groundwater samples are collected to evaluate groundwater quality relative to specified endpoint criteria in order to verify that natural attenuation is occurring and to monitor for surface water protection.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Groundwater at NMCB is not considered to be a potential future water source due to the potential for salt water intrusion, as per Alaska regulations (18 AAC 75.345[b][2]). The endpoint criteria are set at 10 times the 18 AAC 75.345[b][2] Table C groundwater cleanup levels. Site photographs are presented in Appendix I.

10.1 FIELD MEASUREMENTS

Depth-to-water and product thickness measurements were collected at 24 monitoring wells on August 26, 2014. Field measurements were recorded in the field forms and logbooks during monitoring well sampling activities (Appendix A). Table 10-1 provides the measured depths-to-water, the calculated groundwater elevations and, if present, the product thicknesses. Depth-to-water and groundwater elevations have been corrected for the presence of free product in those wells with detectable thickness (Appendix D-1). Figure 10-1 shows the locations of wells at the site, the site topography, the interpreted groundwater flow direction, and the downgradient surface water body (Sweeper Cove).

Table 10-1. 2014 Field Measurements for NMCB Building T-1416 Expanded Area

	Physical Measurements				Water Quality Parameters						
Well Location	Casing Elevation (ft MLLW)	Depth-to-Water[1] (ft BTOC)	Groundwater Surface Elevation (ft MLLW)	Measured Product Thickness (ft)	pH (SU)	Specific Conductance (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (°C)	Salinity (%)	ORP (mV)
02-300	11.99	9.41	2.58	0.12	NP	NP	NP	NP	NP	NP	NP
02-301	14.87	12.02	2.85	0	NP	NP	NP	NP	NP	NP	NP
02-451	10.99	8.33	2.66	0	NP	NP	NP	NP	NP	NP	NP
02-452	11.94	9.00	2.94	0	NP	NP	NP	NP	NP	NP	NP
02-453	11.68	8.84	2.84	0.02	NP	NP	NP	NP	NP	NP	NP
02-455	14.08	11.42	2.66	0	NP	NP	NP	NP	NP	NP	NP
02-461	9.41	6.49	2.92	0	6.12	0.990	5	0.00	9.15	0	-71
02-463	12.58	9.54	3.04	0	NP	NP	NP	NP	NP	NP	NP
02-478	10.24	7.58	2.66	0	NP	NP	NP	NP	NP	NP	NP
02-479	16.25	9.96	6.29	0	NP	NP	NP	NP	NP	NP	NP
02-497	9.15	6.54	2.61	0	NP	NP	NP	NP	NP	NP	NP
02-815	16.35	13.42	2.93	0.03	NP	NP	NP	NP	NP	NP	NP
02-816	12.86	10.12	2.74	0	NP	NP	NP	NP	NP	NP	NP
02-817	12.49	9.74	2.75	0	NP	NP	NP	NP	NP	NP	NP
02-818	11.55	8.70	2.85	0	6.24	0.664	0	0.00	10.50	0	-94
02-819	10.03	7.15	2.88	0	NP	NP	NP	NP	NP	NP	NP
E-201	15.54	12.91	2.63	0	6.15	0.688	0	0.00	8.25	0	-75
NMCB-04	14.49	11.50	2.99	0	NP	NP	NP	NP	NP	NP	NP
NMCB-07	11.85	7.35	4.50	0.18	FP	FP	FP	FP	FP	FP	FP
NMCB-08	8.52	6.15	2.37	1.02	NP	NP	NP	NP	NP	NP	NP
NMCB-09	11.96	9.27	2.69	0	6.51	0.940	11	0.00	8.64	0	-124
NMCB-10	12.95	10.23	2.72	0.03	FP	FP	FP	FP	FP	FP	FP
NMCB-11	12.05	8.98	3.07	0.03	FP	FP	FP	FP	FP	FP	FP
NMCB-12	16.27	13.64	2.63	0	NP	NP	NP	NP	NP	NP	NP

Notes:
[1]Corrected if presence of product in the well.
FP – free product, unable to be sampled
NP – not planned
The reported casing elevation is the surveyed elevation residing in the NIRIS database. The last groundwater parameter measurement prior to sample collection is reported.

The historic water level data indicate that a groundwater high, or divide, occurs in the main aquifer beneath the site parallel to Seawall Road. The groundwater south of Seawall Road flows south toward Sweeper Cove. North of Seawall Road, the groundwater flows to the northwest, toward East Canal. Groundwater elevations collected in 2014 were compared with historical data and are consistent with this interpretation. The wells along the Sweeper Cove shoreline are influenced by tidal fluctuations.

A total of four groundwater samples were collected from onsite wells on August 27, 2014. Three wells were not sampled due to the presence of free product. A review of the sampling data reported for this site indicates that groundwater parameters stabilized at all monitoring wells. Table 10-1 lists the final water quality parameters measurements recorded at each monitoring well prior to sample collection.

Measurable free product was detected in seven wells: 02-300 (0.12 feet), 02-453 (0.02 feet), 02-815 (0.03 feet), NMCB-07 (0.18 feet), NMCB-08 (1.02 feet), NMCB-10 (0.03 feet), and NMCB-11 (0.03 feet). Sampling was not performed at wells NMCB-07, NMCB-10, and NMCB-11 as planned per the CMP since product thickness equaled or exceeded 0.02 feet. At well NMCB-08, 0.12 gallons (0.47 liters) of product was recovered during the LTM event and managed per the Final Waste Management Plan (Navy 2014e). Periodic product recovery activities were performed at this site from October 2013 through September 2014. Approximately 1.40 gallons of free product were removed from site wells during this time period (see Appendix J). Product recovery activities are described in further detail in the Remedial Action Summary Report, Free Product Recovery (Navy 2014c).

An inspection was conducted along the shoreline of Sweeper Cove between wells 02-451 and 02-479 (Figure 10-1). No evidence of petroleum contamination was observed along the shoreline, although a slight petroleum odor was noted south of well NMCB-07. Results of shoreline inspections are summarized in Section 4.1.3.

10.2 TARGET ANALYTE RESULTS

Four groundwater samples were collected and analyzed for GRO. Figure 10-1 shows the locations of the wells sampled and the location of the wells containing free product. None of the wells sampled exceeded endpoint criteria for GRO (13,000 µg/L). Table 10-2 presents the groundwater analytical results since 2006 for seven site monitoring wells. The historical analytical results obtained for these locations are summarized in Appendix C-1. Laboratory reports presenting the 2014 results are provided in Appendix F.

Table 10-2. Analytical Results for Petroleum-Related Chemicals at NMCB

Well Location	Year	GRO (µg/L)
02-461	2006	9,900
Plume Source Area	2007	**14,000 DY**
	2008	8,600 Y
	2009	10,000 DY
	2010	9,500 DY
	2011	**14,000 DY**
	2012	7,800 Y
	2013	7,000 Y
	2014	7,600 Y
02-818	2006	**FP**
Plume Edge	2007	9,600 DY
	2008	9,700 Z
	2009	9,100 DY
	2010	**FP**
	2011	9,700 DY
	2012	**FP**
	2013	6,900 Y
	2014	6,200 YJ
E-201	2006	**14,000**
Plume Edge	2007	13,000 DY
	2008	9,400 DY
	2009	11,000 DY
	2010	13,000 DY
	2011	**17,000 DY**
	2012	9,900 Y
	2013	7,900 Y
	2014	9,500 Y
NMCB-07	2006	**FP**
Plume Source Area	2007[2]	**17,000 DY**
	2008	**FP**
	2009	**FP**
	2010	**FP**
	2011	**FP**
	2012	**FP**
	2013	**FP**
	2014	**FP**
NMCB-09	2006	470
Surface Water Protection Well	2007	330 Y
	2008	580 H
	2009	430 Y
	2010	360 Y
	2011	360 H
	2012	NP
	2013	210 Y
	2014	460 Y

Table 10-2. Analytical Results for Petroleum-Related Chemicals at NMCB (continued)

Well Location	Year	GRO (µg/L)
NMCB-10	2006	4,700
Plume Source Area	2007	4,600 DY
	2008	3,400 Y
	2009	**FP**
	2010	**FP**
	2011	4,300 Y
	2012	**FP**
	2013	**FP**
	2014	**FP**
NMCB-11	2006	25 U
Surface Water Protection Well	2007	27 J
	2008	17 J
	2009	18 J
	2010	19 J
	2011	19 J
	2012	100 U
	2013	**FP**
	2014	**FP**
Endpoint Criteria[1]		13,000

Notes:
[1] The endpoint criteria are 10 times the ADEC cleanup levels for groundwater as a drinking water source and as specified in 18 AAC 75.345[b][1], Table C.
[2] Indicates well had 0.02 feet or greater of product that was bailed off prior to sampling; results are potentially elevated due to presence of free product.
Bold indicates reported concentration is greater than the endpoint criteria.
FP - free product, unable to be sampled
NP – not planned

10.3 MONITORED NATURAL ATTENUATION

NAPs were collected at this site in 2014 to determine if natural attenuation was occurring in groundwater and to support the 5-year review process. Both laboratory analytical and field test kit results are presented in Table 10-3. The 2014 data indicated that biodegradation of petroleum hydrocarbons is likely occurring by iron (II) reduction; sulfate reduction; and methanogenesis, as shown by elevated ferrous iron concentration, depleted sulfates, and elevated methane concentrations in comparison to background conditions. Water quality parameters presented in Table 10-1 collected during 2014 support evidence of continued natural attenuation as shown by the reducing environment (low or negative ORP) and depleted oxygen (0.00 mg/L) within the plume. A more in-depth discussion of natural attenuation is presented in Section 4.1.2.

Table 10-3. 2014 Analytical and Field Measurement Data for NAPs for NMCB

		Laboratory-Reported Results			Field Test Kit Results		
Well Location	**Monitoring Purpose**	**Alkalinity SM 2320B (mg/L)**	**Sulfate 300.0 (mg/L)**	**Dissolved Methane RSK175 (µg/L)**	**Carbon Dioxide[1] (mg/L)**	**Ferrous Iron[2] (mg/L)**	**Dissolved Oxygen[3] (mg/L)**
02-461	MNA	263	15	4.2	60	25	0.8
02-818	MNA	89	0.12 J	76	23	10	3.0
E-201	MNA	57	2.6	17	40	25	0.05
NMCB-07	MNA	FP	FP	FP	FP	FP	FP
NMCB-09	MNA	172	1.3	1,200	50	40	0.1
NMCB-10	MNA	FP	FP	FP	FP	FP	FP
NMCB-11	MNA	FP	FP	FP	FP	FP	FP

Notes:
FP - free product, unable to be sampled
[1] Field test kit, CHEMetrics K-1910 and K-1920
[2] Field test kit, CHEMetrics K-6210
[3] Field test kit, CHEMetrics K-7501 and K-7512

10.4 TREND EVALUATION

Statistical trend evaluations were conducted for target analyte concentrations in groundwater in accordance with the CMP, Revision 6 (Navy 2014a). Trend evaluation was conducted only for analytes that exceeded the endpoint criteria within the last three sampling events and had a minimum of four data points. Because groundwater contaminant concentrations in all wells have been below endpoint criteria for at least the last three consecutive years, trend evaluations were not performed at this site in 2014.

10.5 CONCLUSIONS

This section presents the conclusions based on a review of analytical results obtained for groundwater monitoring conducted at the NMCB site during 2014. The conclusions are as follows:

- Groundwater Flow: The interpreted groundwater flow direction in September 2014 is south toward Sweeper Cove and northwest toward East Canal north of Seawall Road.
- MNA: The groundwater parameters obtained during the 2014 LTM event provide evidence that natural attenuation of petroleum hydrocarbons continues to occur at the site.
- Free Product: Measurable free product was detected in seven site wells: 02-300 (0.12 feet), 02-453 (0.02 feet), 02-815 (0.03 feet), NMCB-07 (0.18 feet), NMCB-08 (1.02 feet), NMCB-10 (0.03 feet), and NMCB-11 (0.03 feet). Periodic free product recovery from October 2013 through September 2014 recovered 1.40 gallons of product from the site.

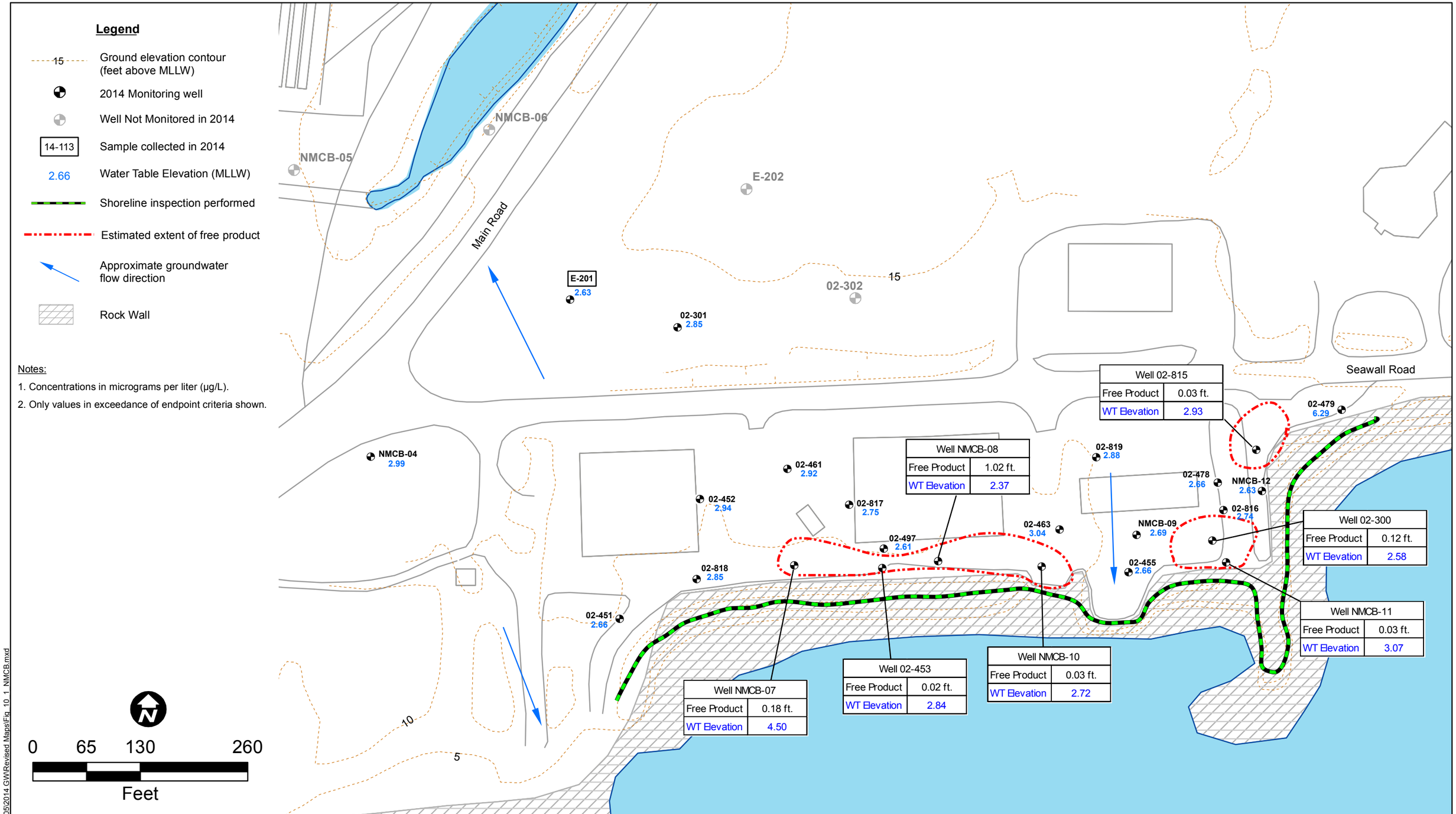
- Well 02-461: This well is located on the upgradient side of the site. GRO was detected at a concentration above the endpoint criteria in 2007 and 2011, however the concentration has dropped below endpoint criteria for the last three consecutive events.
- Well 02-818: This well is located on the western edge of the site. The GRO concentration in 2014 was below the endpoint criteria for the second consecutive year. Free product has been detected in this well during the LTM events at a thickness greater than or equal to 0.02 feet three times since sampling commenced in 2006.
- Well E-201: This well is located downgradient, northwest of the site. GRO was detected at a concentration above the endpoint criteria of 13,000 µg/L in 2011 but has been below the endpoint criteria the last three sampling events.
- Well NMCB-07: This well is located within the contaminant plume. The well was not sampled due to the presence of free product measuring 0.18 feet in thickness.
- Well NMCB-09: This well is a surface water protection well located between two areas of free product. GRO has not exceeded endpoint criteria in this well since 2006.
- Well NMCB-10: This well is located within the contaminant plume. The well was not sampled due to the presence of free product measuring 0.03 feet in thickness. This was the third consecutive year that free product was measured in the well.
- Well NMCB-11: This well is located within the contaminant plume. The well was not sampled due to the presence of free product measuring 0.03 feet in thickness. This was the second consecutive observance of free product greater than or equal to 0.02 feet since sampling began in 2006. Prior to 2013, the well exhibited generally non-detectable concentrations of GRO.
- The shoreline inspection of Sweeper Cove between wells 02-451 and 02-479 did not reveal any groundwater seeps, sheen, or discoloration that indicated petroleum contamination, however a light petroleum odor was noted in one area.

10.6 RECOMMENDATIONS

At wells NMCB-09, 02-461, and E-201, GRO concentrations have not exceeded endpoint criteria nor has free product been observed for at least the last three years; therefore, it is recommended that monitoring be discontinued at these locations.

Because product has not been observed in well 02-301 since 2006, it is recommended that water-level measurements be discontinued at this location.

Because free product was continued to be observed in several onsite wells, it is recommended that all other monitoring at this site continue biennially as prescribed.



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U.S. NAVY	SEALASKA	Figure 10-1 NMCB Building T-1416 Expanded Area Sample Locations	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

11 ROICC CONTRACTOR'S AREA, UST ROICC-7

This section presents the results of groundwater monitoring performed at the ROICC Contractor's Area, UST ROICC-7 site during 2014. Limited groundwater monitoring was the remedy selected for this site (Navy, ADEC, and EPA 2000); however, monitoring results obtained between 1999 and 2003 identified benzene concentrations in groundwater above the determined endpoint criteria. Therefore, the remedy was changed to MNA in response to a recommendation in the subsequent 5-year review. Groundwater samples are collected from these wells to evaluate groundwater quality relative to Alaska groundwater cleanup levels (18 AAC 75.345) and to verify that natural attenuation is occurring.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Site photographs are presented in Appendix I.

11.1 FIELD MEASUREMENTS

Depth-to-water and product thickness measurements were collected at two wells on August 29, 2014. Table 11-1 provides the measured depths-to-water and the calculated groundwater elevations. Figure 11-1 shows the locations of the wells at ROICC Contractor's Area, the site topography and the approximate groundwater flow direction. The historic water level data indicate that the groundwater beneath the site flows to the southeast. Groundwater elevations collected in 2014 were compared with historical data and are consistent with this interpretation. Free product was not observed in any of the wells in 2014.

Groundwater sampling was performed at the two scheduled monitoring wells on August 29 and 30, 2014. Field measurements were recorded on the field forms and logbooks during monitoring well sampling activities (Appendix A). Table 11-1 lists the final field measurements recorded at the monitoring wells prior to sample collection. A review of the sampling data reported for this site indicates that prior to sample collection all groundwater parameters stabilized in all wells.

Table 11-1. 2014 Field Measurements for ROICC Contractor's Area, UST ROICC-7

	Physical Measurements				Water Quality Parameters						
Well Location	**Casing Elevation (ft MLLW)**	**Depth-to-Water (ft BTOC)**	**Groundwater Surface Elevation (ft MLLW)**	**Measured Product Thickness (ft)**	**pH (SU)**	**Specific Conductance (mS/cm)**	**Turbidity (NTU)**	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**	**Salinity (%)**	**ORP (mV)**
08-200	14.87	3.74	11.13	0	6.60	1.92	0	0.00	10.13	0.10	-87
08-202	13.86	2.51	11.35	0	7.24	1.00	11	0.00	8.48	0.08	-96

Notes:
The reported casing elevation is the surveyed elevation residing in the NIRIS database.
The last groundwater parameter measurement prior to sample collection is reported.

11.2 TARGET ANALYTE RESULTS

Groundwater samples were collected from wells 08-200 and 08-202 and analyzed for benzene. Table 11-2 presents the historical analytical results for the two site monitoring wells. The historical analytical results obtained for these locations are also summarized in Appendix C-1. Laboratory reports presenting the 2014 results are provided in Appendix F. Figure 11-1 shows the locations of the site wells and the analytical results that exceed the applicable endpoint criteria.

Benzene was detected above the endpoint criteria (5 µg/L) in the 2014 samples collected from wells 08-200 and 08-202 at concentrations of 260 µg/L and 9.3 µg/L, respectively.

Table 11-2. Analytical Results for Petroleum-Related Chemicals for ROICC Contractor's Area, UST ROICC-7

Well Location	Year	Benzene (µg/L)
08-200 Plume Source	2003	**390**
	2004	**288J**
	2005	**233 J**
	2006	**250**
	2007	**300 D**
	2008	**320 D**
	2009	**310 D**
	2010	**310 JD**
	2012	**280 D**
	2013	**260 JD**
	2014	**280 D**
08-202 Onsite	2003	**24**
	2004	**16**
	2005	**14.6**
	2006	**13 J**
	2007	**14**
	2008	**16**
	2009	**12**
	2010	**12**
	2012	**9.6**
	2013	**9.3**
	2014	**9.9**
Endpoint Criteria		5

Note:
Bold indicates reported concentration is greater than the endpoint criteria.

11.3 MONITORED NATURAL ATTENUATION

NAPs were collected at this site in 2014 to determine whether natural attenuation was occurring in groundwater and to support the 5-year review process. Both laboratory

analytical and field test kit results are presented in Table 11-3. The 2014 data indicated that biodegradation of petroleum hydrocarbons is likely occurring by iron (II) reduction; sulfate reduction; and methanogenesis as shown by elevated ferrous iron concentration, depleted sulfates, and elevated methane concentrations in comparison to background conditions. Elevated CO_2 concentrations (ranging up to 330 mg/L) also show evidence of aerobic digestion. Water quality parameters presented in Table 11-1 collected during 2014 support evidence of continued natural attenuation as shown by the reducing environment (negative ORP) and depleted dissolved oxygen levels (0.0 mg/L) within the plume. A more in-depth discussion of natural attenuation is presented in Section 4.1.2.

Table 11-3. Analytical and Field Measurement Data for NAPs for ROICC Contractor's Area, UST ROICC-7

		Laboratory-Reported Results			Field Test Kit Results		
Well Location	**Monitoring Purpose**	**Alkalinity SM 2320B (mg/L)**	**Sulfate 300.0 (mg/L)**	**Dissolved Methane RSK175 (µg/L)**	**Carbon Dioxide[1] (mg/L)**	**Ferrous Iron[2] (mg/L)**	**Dissolved Oxygen[3] (mg/L)**
08-200	MNA	371	0.19 J	9,900	330	50	1.00
08-202	MNA	228	0.20 U	11,000	200	100	0.05

Notes:
[1] Field test kit, CHEMetrics K-1910 and K-1920
[2] Field test kit, CHEMetrics K-6210
[3] Field test kit, CHEMetrics K-7501 and K-7512

11.4 TREND EVALUATION

Statistical trend evaluations were conducted for target analyte concentrations in groundwater in accordance with the CMP, Revision 6 (Navy 2014a). Trend evaluation was conducted only for analytes that exceeded the endpoint criteria within the last two sampling events and had a minimum of four data points. Sen's evaluations were performed on decreasing trends only. The results of the trend evaluation performed for this site are presented in Table 11-4. Worksheets and graphs are provided in Appendix H.

The following are the results of the statistical evaluation:

- Well 08-200: The benzene concentration exhibits no trend at the 80 and 95 percent confidence intervals. The coefficient of variation indicates the concentration is stable.
- Well 08-202: The benzene concentration exhibits a decreasing trend at both the 80 and 95 percent confidence intervals. The Sen's evaluation also indicates a statistically significant downward trend, with a median slope of -0.83.

11.5 CONCLUSIONS

This section presents the conclusions based on a review of groundwater monitoring results performed at the ROICC Contractor's Area site in 2014. The conclusions are as follows:

- Groundwater Flow: The groundwater flow direction in 2014 at the site is interpreted to be to the southeast.
- MNA: The groundwater parameters obtained during 2014 support evidence that natural attenuation of petroleum hydrocarbons continues to occur at the site.
- Free Product: No free product was detected in the two wells monitored at this site in 2014.
- Well 08-200: This well is located within the contaminant plume. Benzene has been detected above the endpoint criteria since sampling began in 2003. The trend evaluation performed on the benzene data collected between 2003 and 2014 shows a stable benzene concentration with no trend at both the 80 and 95 percent confidence intervals.
- Well 08-202: This well is located within the contaminant plume on the upgradient edge. Benzene has been detected above the endpoint criteria since sampling began in 2003. The statistical evaluation performed on the benzene data collected between 2003 and 2014 shows a decreasing trend at the 95 percent confidence interval. The Sen's evaluation verifies that benzene is decreasing with statistical significance in this well.

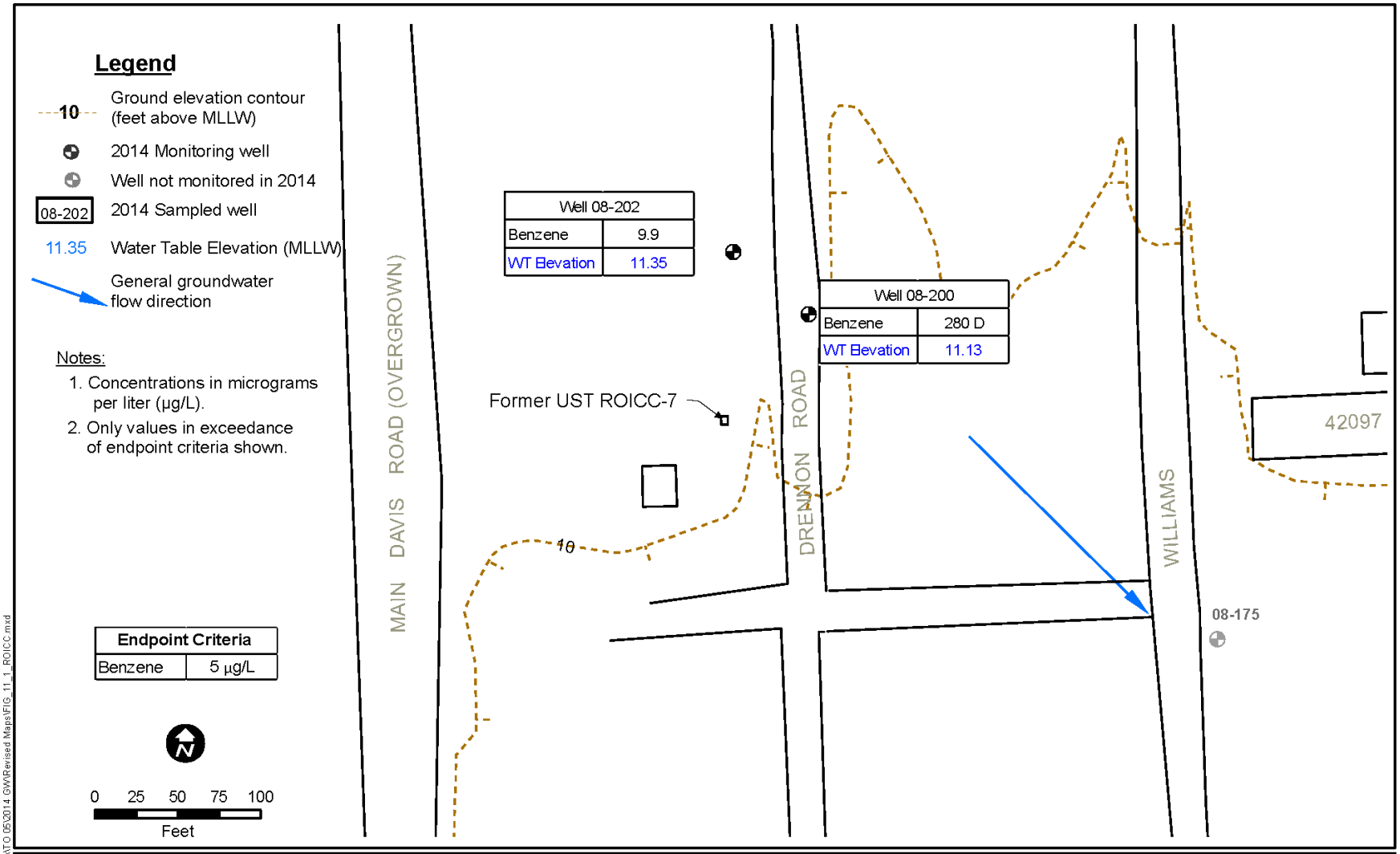
11.6 RECOMMENDATIONS

Because the benzene concentration remains above the endpoint criteria in monitoring wells 08-200 and 08-202, but exhibits stable or decreasing trends, monitoring at the site is recommended to continue as prescribed.

Table 11-4. Concentration Trend Evaluation for ROICC Contractor's Area, UST ROICC-7

							Mann-Kendall Trend			Sen's Slope			
												2-Tailed Test at 80% C.I.	
Well	**Target Analyte**	**Exceeds Endpoint Criteria**	**Highest Concentration Last Two Sampling Periods (µg/L)**	**Endpoint Criteria[1] (µg/L)**	**Sampling Periods (n)**	**Mann-Kendall Statistic (S)**	**Trend at 80% C.I.**	**Trend at 95% C.I.**	**Concentration Stability[2]**	**Median Slope**	**Statistically Significant Trend**	**Lower Limit**	**Upper Limit**
08-200	Benzene	Yes	280 D	5	10	3	No Trend	No Trend	Stable	NC	NC	NC	NC
08-202	Benzene	Yes	9.9	5	10	-31	Decreasing	Decreasing	NA	-0.83	Yes	-1	-0.68

Notes:
[1] Endpoint criteria are established from ADEC cleanup levels for groundwater used as a drinking water source.
[2] Concentration stability is determined from the coefficient of variation when no trend exists at the 80% confidence interval (C.I.).
Sen's Slope is calculated for target analytes with decreasing concentration trends only.



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U.S. NAVY	SEALASKA	Figure 11-1 ROICC Contractor's Area UST ROICC-7 Sample Locations	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

12 SA 79, MAIN ROAD PIPELINE, SOUTH END

This section presents the results of groundwater monitoring performed at SA 79, Main Road Pipeline, South End during 2014. Limited groundwater monitoring is the OU A ROD-specified remedy for the south end of the site (Navy, ADEC, and EPA 2000). The north end of the site achieved endpoint criteria and received closure from ADEC in 2004; however, the south end did not achieve limited groundwater monitoring endpoint criteria and was reverted to a natural attenuation evaluation. To comply with requirements specified for these remedies, the Navy conducts periodic groundwater sampling and water level/product thickness monitoring. Groundwater samples are collected from these wells to evaluate groundwater quality relative to ADEC groundwater cleanup levels (18 AAC 75.345), to determine whether natural attenuation is occurring at the south end of the site and to monitor for surface water protection.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Site photographs are presented in Appendix I.

12.1 FIELD MEASUREMENTS

Three monitoring wells at this site were gauged and sampled in 2014. Depth-to-water and product thickness measurements were collected at the wells on August 25, 2014 (Table 12-1). Well 02-230 was monitored for surface water protection purposes. Figure 12-1 shows the location of monitoring wells, land surface topography, and Sweeper Cove. Table 12-1 provides the measured depths-to-water and the calculated groundwater elevations. Based on the analysis of historical water level measurements and the hydrogeological setting of the site, the groundwater flow direction is to the east-southeast toward Sweeper Cove. Groundwater elevations collected in 2014 were compared with historical data and are consistent with this interpretation. Measurable free product was not observed in any of the wells in 2014.

Field measurements were recorded on field forms during monitoring well sampling activities (Appendix A). Table 12-1 lists the final field measurements recorded at each monitoring well prior to sample collection. A review of the sampling data reported for this site indicates that prior to sample collection groundwater parameters stabilized in all wells.

Table 12-1. 2014 Field Measurements for SA 79, Main Road Pipeline, South End

	Physical Parameters				Water Quality Parameters						
Well Location	**Casing Elevation (ft MLLW)**	**Depth-to-Water (ft BTOC)**	**Groundwater Surface Elevation (ft MLLW)**	**Measured Product Thickness (ft)**	**pH (SU)**	**Specific Conductance (mS/cm)**	**Turbidity (NTU)**	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**	**Salinity (%)**	**ORP (mV)**
02-230	13.69	11.73	1.96	0	6.67	0.729	0	0.00	11.69	0.00	-79
601	13.77	11.03	2.74	0	6.54	0.331	1	0.00	8.11	0.00	-30
MRP-MW8	12.72	10.01	2.71	0	6.07	0.899	16	0.00	8.08	0.00	-85

Notes:
The reported casing elevation is the surveyed elevation residing in the NIRIS database.
The last groundwater parameter measurement prior to sample collection is reported.

Because DRO concentrations in groundwater samples collected from wells 02-230 and MRP-MW8 have been greater than the endpoint criteria (1,500 µg/L) since 2001, a visual inspection of the Sweeper Cove shoreline from well MRP-MW8 to the mouth of South Sweeper Creek was conducted in 2014. The purpose of the inspection was to identify groundwater or petroleum seeps on the shoreline, or sheens on the surface water of Sweeper Cove. No seeps, sheens, odors, discolorations or evidence of contamination were observed during the shoreline inspection. Shoreline inspection and results are summarized in Section 4.1.3.

12.2 TARGET ANALYTE RESULTS

The groundwater samples collected from all wells were analyzed for DRO. Table 12-2 presents the analytical results. Figure 12-1 shows the locations of the wells sampled and the analytical results that exceed the applicable endpoint criteria. The historical analytical results obtained for these locations are summarized in Appendix C-1. Laboratory reports presenting the 2013 results are provided in Appendix F.

DRO was detected above the endpoint criteria (1,500 µg/L) in samples collected from all three wells: MRP-MW8 (3,400 µg/L), 601 (1,900 µg/L), and 02-230 (4,300 µg/L).

12.3 MONITORED NATURAL ATTENUATION

NAPs were collected at this site in 2014 to determine whether natural attenuation was occurring in groundwater and to support the 5-year review process. Both laboratory analytical and field test kit results are presented in Table 12-3. The 2014 data indicated that biodegradation of petroleum hydrocarbons is possibly occurring by aerobic digestion; iron (II) reduction; and weak evidence of methanogenesis as indicated by reduced dissolved oxygen levels, weakly elevated ferrous iron concentrations, and slightly elevated methane concentrations in comparison to background conditions. Water quality parameters collected during the 2014 LTM event, which are presented in Table 12-1, support evidence of continued natural attenuation as shown by the reducing environment (negative ORP) and depleted dissolved oxygen (0.00 mg/L) within the plume at the site. A more in-depth discussion of natural attenuation is presented in Section 4.1.2.

Table 12-2. Analytical Results for Petroleum-Related Chemicals for SA 79, Main Road Pipeline, South End

Well Location	Year	DRO (µg/L)
MRP-MW8 Plume Source Area	2001	**2,790**
	2002	**2,700**
	2003	**3,600**
	2004	**3,890**
	2005	**3,700**
	2006	**4,300**
	2007	**4,700 Y**
	2008	**3,400 Y**
	2009	**3,000 Y**
	2010	**2,700 Y**
	2011	**3,700 Y**
	2012	**3,900 Y**
	2013	**3,600 Y**
	2014	**3,400 Y**
601 Plume Source Area	2011	**2,100 Y**
	2012	**1,800 Y**
	2013	**1,900 Y**
	2014	**1,900 Y**
02-230 Surface Water Protection Well	2001	**4,230**
	2002	**3,500**
	2003	**3,900**
	2004	**5,760**
	2005	**4,060 J**
	2006	**5,500**
	2007	**4,800 Y**
	2008	**5,000 Y**
	2009	**2,400 Y**
	2010	**4,000 Y**
	2011	**4,200 Y**
	2012	**3,200 Y**
	2013	**3,500 Y**
	2014	**4,300 Y**
Endpoint Criteria		1,500

Note:
Bold indicates reported concentration is greater than the endpoint criteria.

Table 12-3. 2014 Analytical and Field Measurement Data for NAPs for SA 79, Main Road Pipeline, South End

		Laboratory-Reported Results			Field Test Kit Results		
Well Location	**Monitoring Purpose**	**Alkalinity SM 2320B (mg/L)**	**Sulfate 300.0 (mg/L)**	**Dissolved Methane RSK175 (µg/L)**	**Carbon Dioxide[1] (mg/L)**	**Ferrous Iron[2] (mg/L)**	**Dissolved Oxygen[3] (mg/L)**
02-230	MNA	115	21	4.6	50	20	0.8
601	MNA	63	6.5	0.98 J	75	30	0.0
MRP-MW8	MNA	70	2.1	14	60	22.5	0.6

Notes:
[1] Field test kit, CHEMetrics K-1910 and K-1920
[2] Field test kit, CHEMetrics K-6210
[3] Field test kit, CHEMetrics K-7501 and K-7512

12.4 TREND EVALUATION

Statistical trend evaluations were conducted for target analyte concentrations in groundwater in accordance with the CMP, Revision 6 (Navy 2014a). Trend evaluation was conducted only for analytes that exceeded the endpoint criteria within the last two sampling events and had a minimum of four data points. The results for the trend evaluation performed for this site are summarized in Table 12-4. Worksheets and graphs are provided in Appendix H.

The following are the results of the statistical evaluation:

- Well MRP-MW8: The DRO concentration exhibits a decreasing trend at the 80 percent confidence interval. However, the Sen's evaluation does not indicate that this trend is statistically significant.
- Well 601: The DRO concentration is stable with no trend at either the 80 or 95 percent confidence interval.
- Well 02-230: The Mann-Kendall evaluation for the DRO concentration shows a decreasing trend at the 80 percent confidence interval. However, the Sen's evaluation does not indicate that this trend is statistically significant.

Table 12-4. Concentration Trend Evaluation for SA 79, Main Road Pipeline, South End

							Mann-Kendall Trend			Sen's Slope			
												2-Tailed Test at 80% C.I.	
Well	**Target Analyte**	**Exceeds Endpoint Criteria**	**Highest Concentration Last Two Sampling Periods (µg/L)**	**Endpoint Criteria[1] (µg/L)**	**Sampling Periods (n)**	**Mann-Kendall Statistic (S)**	**Trend at 80% C.I.**	**Trend at 95% C.I.**	**Concentration Stability[2]**	**Median Slope**	**Statistically Significant Trend**	**Lower Limit**	**Upper Limit**
MRP-MW8	DRO	Yes	3,600 Y	1,500	10	-11	Decreasing	No Trend	NA	13	No	-40	87
601	DRO	Yes	1,900 Y	1,500	4	-1	No Trend	No Trend	Stable	NC	NC	NC	NC
02-230	DRO	Yes	4,300 Y	1,500	10	-11	Decreasing	No Trend	NA	-43	No	-157	36

Notes:
[1] Endpoint criteria are established from ADEC cleanup levels for groundwater used as a drinking water source.
[2] Concentration stability is determined from the coefficient of variation when no trend exists at the 80% confidence interval (C.I.).
Sen's Slope is calculated for target analytes with decreasing concentration trends only.

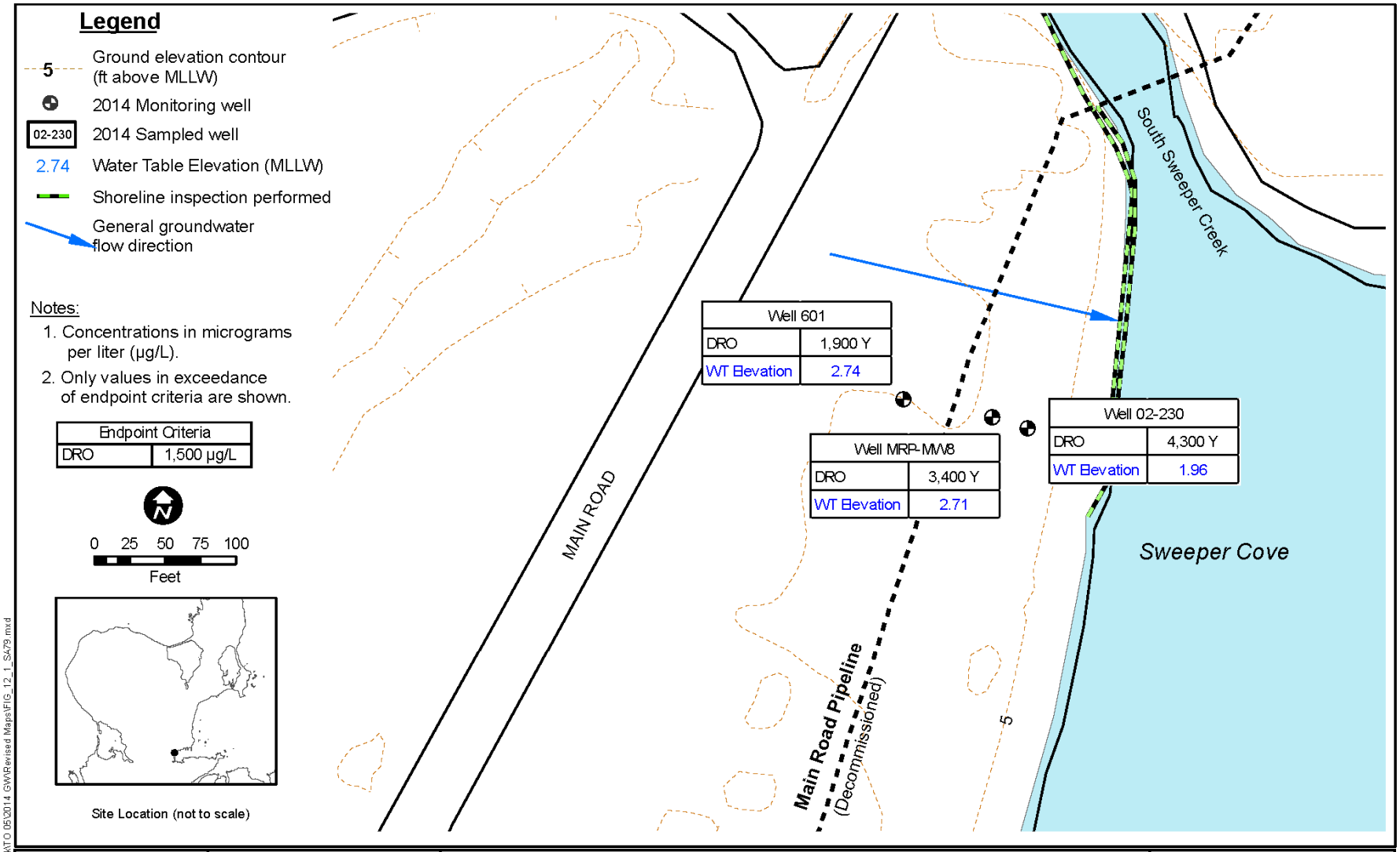
12.5 CONCLUSIONS

This section presents the conclusions based on groundwater monitoring conducted at the SA 79, Main Road Pipeline, South End site in 2014. The conclusions are as follows:

- Groundwater Flow: The groundwater flow direction is interpreted to be to the east toward Sweeper Cove.
- MNA: The groundwater parameters obtained during 2014 provide evidence that natural attenuation of petroleum hydrocarbons is possibly occurring at the site.
- Free Product: No measurable free product was detected in any site well.
- Well MRP-MW8: This well is located within the contaminant plume. DRO has been detected above the endpoint criteria since 2001. The trend evaluation performed on the DRO data collected between 2001 and 2014 exhibits a decreasing trend at the 80 percent confidence interval. However, the Sen's evaluation does not indicate that this trend is statistically significant.
- Well 601: This well is located within the contaminant plume. DRO has remained above the endpoint criteria since 2011 when sampling was initiated (four consecutive sampling events). The trend evaluation performed shows the DRO concentration is stable with no trend.
- Well 02-230: This well is located within the contaminant plume and closest to the shoreline. DRO has been detected above the endpoint criteria since 2001. The Mann-Kendall evaluation for the DRO concentration shows a decreasing trend at the 80 percent confidence interval. However, the Sen's evaluation does not indicate that this trend is statistically significant.
- A shoreline inspection in Sweeper Cove downgradient of the site revealed no observed evidence of petroleum contamination.

12.6 RECOMMENDATIONS

Because of the observed exceedances of DRO above endpoint criteria in wells MRP-MW8, 02-230, and 601, it is recommended that monitoring at this site be continued as prescribed.



U.S. NAVY | SEALASKA

Figure 12-1
SA 79, Main Road Pipeline, South End Sample Locations

Task Order 05
Adak Island, AK
2014 Annual Groundwater and Landfill Monitoring Report

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13 SA 80, STEAM PLANT 4, USTS 27089 AND 27090

This section presents the results of groundwater monitoring performed at SA 80, Steam Plant 4, USTs 27089 and 27090 during 2014. The remedy specified for this site in the OU A ROD is free product recovery (Navy, ADEC, and EPA 2000). The Navy and ADEC have selected MNA with ICs as the post-free product recovery remedy for this site (Navy and ADEC 2005). To comply with requirements specified for these remedies, the Navy conducts annual groundwater sampling and water level/product thickness monitoring.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Site photographs are presented in Appendix I.

13.1 FIELD MEASUREMENTS

Depth-to-water and product thickness measurements were collected at seven monitoring wells on August 28, 2014. Table 13-1 presents the depth-to-water measurements (corrected for product thickness, if present), the calculated groundwater elevations and, if present, the product thicknesses. Figure 13-1 shows the location of the wells, the site topography and features, and the interpreted groundwater flow direction.

A shallow perched aquifer zone has been identified to occur in the area of the removed USTs (Navy 2004). Two wells monitored in 2014 (04-155 and 04-173) have shallow water levels that represent this perched zone. The historic water level data from the remaining wells that are representative of the regional aquifer indicate that the direction of groundwater flow is to the west-southwest, toward East Canal. Groundwater elevations collected in 2014 were compared with historical data and are consistent with this interpretation.

Sampling was conducted at four monitoring wells on August 29, 2014. Field measurements were recorded on the field forms and in the logbooks during monitoring well sampling activities (Appendix A). Table 13-1 lists the final field measurements recorded at each monitoring well prior to sample collection. A review of the sampling data reported for this site indicates that, prior to sample collection, groundwater parameters stabilized in all the wells sampled.

Table 13-1. 2014 Field Measurements for SA 80, Steam Plant 4

	Physical Measurements				Water Quality Parameters						
Well Location	**Casing Elevation (ft MLLW)**	**Depth-to-Water[1] (ft BTOC)**	**Groundwater Surface Elevation (ft MLLW)**	**Measured Product Thickness (ft)**	**pH (SU)**	**Specific Conductance (mS/cm)**	**Turbidity (NTU)**	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**	**Salinity (%)**	**ORP (mV)**
04-155	27.77	15.59	12.18	0.04	NP	NP	NP	NP	NP	NP	NP
04-157	28.18	19.82	8.36	0	NP	NP	NP	NP	NP	NP	NP
04-158	27.36	19.99	7.37	0	6.28	0.428	0	0.00	10.51	0.02	-19
04-159	29.86	23.28	6.58	0	6.43	0.942	7	0.00	8.36	0.00	-83
04-164	28.51	21.92	6.59	0	NP	NP	NP	NP	NP	NP	NP
04-173	27.46	14.81	12.65	0	6.25	0.703	10	0.00	7.94	0.00	-46
SP4-3	26.70	20.11	6.59	0	6.22	0.897	12	0.00	7.49	0.00	-41

Notes:
[1]Corrected if presence of product in the well.
NP – not planned
The reported casing elevation is the surveyed elevation residing in the NIRIS database.
The last groundwater parameter measurement prior to sample collection is reported.

Measurable free product was observed in one of the seven wells (0.04 feet in well 04-155). Because the product thickness was less than 0.5 feet, removal of free product from the well was not required during the LTM event. Periodic free product recovery activities were performed at this site during October 2013 through September 2014. A total of 1.28 gallons was recovered from site wells during this time period. The periodic free product recovery activities are summarized in Appendix J. Product recovery activities are described in further detail in the Remedial Action Summary Report, Free Product Recovery (Navy 2014c).

13.2 TARGET ANALYTE RESULTS

Groundwater samples were collected from wells 04-158, 04-159, 04-173, and SP4-3 in 2014 and analyzed for DRO. Table 13-2 presents the results of these analyses. Figure 13-1 shows the location of the wells and the analytical results that exceeded the endpoint criteria. The historical analytical results obtained for these locations are summarized in Appendix C-1. Laboratory reports presenting the 2014 results are provided in Appendix F.

DRO was detected above the endpoint criteria (1,500 µg/L) in samples collected from all four wells: 04-158 (8,700 µg/L), 04-159 (2,400 µg/L), 04-173 (2,800 µg/L) and SP4-3 (4,300 µg/L).

13.3 MONITORED NATURAL ATTENUATION

NAPs were collected at this site in 2014 to determine whether natural attenuation was occurring in groundwater and to support the 5-year review process. Both laboratory analytical and field test kit results are presented in Table 13-3. The 2014 data strongly indicated that biodegradation of petroleum hydrocarbons is likely occurring by iron (II) reduction; sulfate reduction; and methanogenesis, as shown by elevated ferrous iron concentrations, depleted sulfates, strongly elevated methane concentrations, and elevated carbon dioxide concentrations in comparison to background conditions. Water quality parameters presented in Table 13-1 collected during 2014 supports evidence of continued natural attenuation as shown by the reducing environment (negative ORP) and depleted dissolved oxygen (0.00 mg/L) within the plume at the site. A more in-depth discussion of natural attenuation is presented in Section 4.1.2.

Table 13-2. Analytical Results for Petroleum-Related Chemicals for SA 80, Steam Plant 4

Well Location	Year	DRO (µg/L)
04-158	2003	NP
Plume Source Area	2004	NP
	2005	**7,310 J**
	2006	**FP**
	2007	**FP**
	2008	**FP**
	2009	**FP**
	2010	**13,000 Y**
	2011	**FP**
	2012	**8,700 Y**
	2013	**7,500 Y**
	2014	**8,700 Y**
04-159	2003	NP
Plume Edge	2004	NP
	2005	1,410 J
	2006	**3,900**
	2007	**4,300 Y**
	2008	**9,800 Y**
	2009	**3,800 Y**
	2010	**4,000 Y**
	2011	**5,000 Y**
	2012	**3,200 Y**
	2013	**3,400 Y**
	2014	**2,400 Y**
04-173	2003	NP
Plume Source Area	2004	**2,560**
	2005	**FP**
	2006	**FP**
	2007	**FP**
	2008	**FP**
	2009	**FP**
	2010	**3,200 Y**
	2011	**FP**
	2012	**3,900 Y**
	2013	**3,100 Y**
	2014	**2,800 Y**
SP4-3	2003	**3,400**
Plume Edge	2004	**5,130**
	2005	**1,670**
	2006	**4,900**
	2007	800 Y
	2008	500 Y
	2009	NP
	2010	**5,700 Y**
	2011	NP
	2012	**3,500 Y**
	2013	**3,800 Y**
	2014	**4,300 Y**
Endpoint Criteria		1,500

Notes:
NP – not planned
FP – free product, unable to be sampled
Bold indicates reported concentration is greater than the endpoint criteria.

Table 13-3. 2014 Analytical and Field Measurement Data for NAPs for SA 80, Steam Plant 4

		Laboratory-Reported Results			Field Test Kit Results		
Well Location	**Monitoring Purpose**	**Alkalinity SM 2320B (mg/L)**	**Sulfate 300.0 (mg/L)**	**Dissolved Methane RSK175 (µg/L)**	**Carbon Dioxide[1] (mg/L)**	**Ferrous Iron[2] (mg/L)**	**Dissolved Oxygen[3] (mg/L)**
04-158	MNA	134	2.2	130	100	50	1.0
04-159	MNA	71	0.20 U	1,300	130	50	0.2
04-173	MNA	72	2.0	51	42	12.5	0.8
SP4-3	MNA	93	0.80	1,800	100	67.5	0.05

Notes:
[1] Field test kit, CHEMetrics K-1910 and K-1920
[2] Field test kit, CHEMetrics K-6210
[3] Field test kit, CHEMetrics K-7501 and K-7512

13.4 TREND EVALUATION

Statistical trend evaluations were conducted for target analyte concentrations in groundwater in accordance with the CMP, Revision 6 (Navy 2014a). Trend evaluation was conducted only for analytes that exceeded the endpoint criteria within the last two sampling events and had a minimum of four data points. Results of the trend evaluation performed for this site are summarized in Table 13-4. Worksheets and graphs are provided in Appendix H.

The following are the results of the statistical evaluation:

- Wells 04-158, 04-159, 04-173, and SP4-3: The DRO concentration is stable at all four wells with no trend at the 80 or 95 percent confidence intervals.

13.5 CONCLUSIONS

This section presents conclusions based on a review of groundwater monitoring performed at the SA 80, Steam Plant 4, USTs 27089 and 27090 sites in 2014. The conclusions are as follows:

- Groundwater Flow: Based on the field measurements in August 2014, the groundwater flow direction in the regional aquifer is interpreted to be west-southwest toward the East Canal.
- MNA: The groundwater parameters obtained during 2014 provide evidence that natural attenuation of petroleum hydrocarbons continues to occur at the site.
- Free Product: Free product was detected in well 04-155 (0.04 feet). Periodic free product recovery from October 2013 through September 2014 recovered 1.28 gallons of product from the site.

- Well 04-158: This well is located within the contaminant plume. DRO exceeded endpoint criteria in 2014. The statistical evaluation of data from the four events collected from 2005 to 2014 showed that the concentration is stable with no statistically significant trend.
- Well 04-159: This well is located within the contaminant plume. DRO continues to be detected above the endpoint criteria (since 2006). As indicated by statistical analysis of data collected between 2005 and 2014, the DRO concentration is stable with no statistically significant trend.
- Well 04-173: This well is located within the contaminant plume. In 2014, DRO exceeded endpoint criteria for the third consecutive year. As indicated by statistical analysis of the four events collected between 2004 and 2014, the concentration is stable with no statistically significant trend.
- Well SP4-3: This well is located within the contaminant plume. DRO was detected at concentrations above endpoint criteria in 2014 for the third consecutive year. As indicated by statistical analysis of data collected between 2003 and 2014, the DRO concentration is stable with no statistically significant trend.

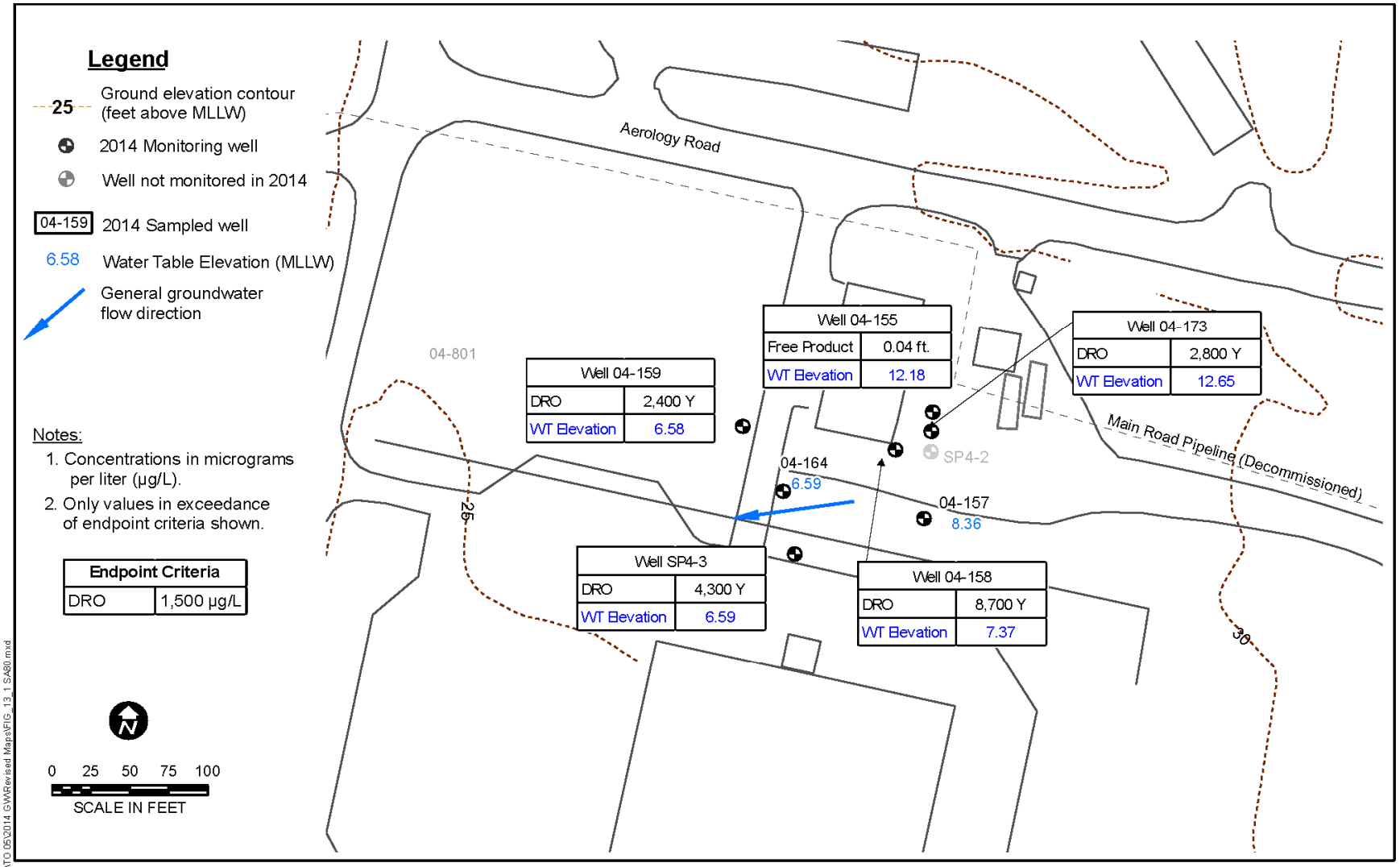
13.6 RECOMMENDATIONS

DRO continues to exceed endpoint criteria and is exhibiting stable concentrations in site wells. Measurable product continues to be observed in some site wells and periodic product recovery activities continue at the site. Additionally, there is strong evidence that MNA is occurring in groundwater at the site. It is therefore recommended that monitoring at this site continue as prescribed to allow for the remedy to decrease contaminant concentrations in groundwater.

Table 13-4. Concentration Trend Evaluation for SA 80, Steam Plant 4

							Mann-Kendall Trend			Sen's Slope			
												2-Tailed Test at 80% C.I.	
Well	Target Analyte	Exceeds Endpoint Criteria	Highest Concentration Last Two Sampling Periods (µg/L)	Endpoint Criteria[1] (µg/L)	Sampling Periods (n)	Mann-Kendall Statistic (S)	Trend at 80% C.I.	Trend at 95% C.I.	Concentration Stability[2]	Median Slope	Statistically Significant Trend	Lower Limit	Upper Limit
04-158	DRO	Yes	8,700 Y	1,500	5	1	No Trend	No Trend	Stable	NC	NC	NC	NC
04-159	DRO	Yes	3,400 Y	1,500	10	-7	No Trend	No Trend	Stable	NC	NC	NC	NC
04-173	DRO	Yes	3,100 Y	1,500	5	0	No Trend	No Trend	Stable	NC	NC	NC	NC
SP4-3	DRO	Yes	4,300 Y	1,500	10	3	No Trend	No Trend	Stable	NC	NC	NC	NC

Notes:
[1] Endpoint criteria are established from ADEC cleanup levels for groundwater used as a drinking water source.
[2] Concentration stability is determined from the coefficient of variation when no trend exists at the 80% confidence interval (C.I.).
Sen's Slope is calculated for target analytes with decreasing concentration trends only.



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U.S. NAVY	SEALASKA	Figure 13-1 SA 80, Steam Plant 4, USTs 27089 and 27090 Sample Locations	Task Order 05 Adak Island, AK 2014 Annual Groundwater and Landfill Monitoring Report

14 SOUTH OF RUNWAY 18-36 AREA

This section presents the results of groundwater monitoring performed at the South of Runway 18-36 Area site during 2014. The remedy specified for this site in the OU A ROD is Free Product Recovery (Navy, ADEC, and EPA 2000). ICs, product recovery, and MNA were established as remedies in the Final Decision Document for South of Runway 18-36 Area, August 2006 (Navy 2006a). In addition, natural recovery was selected for surface water and sediment in South Sweeper Creek at this site. The LTM program for this site was initially proposed in a technical memorandum in 2006 (Navy 2006c). Annual monitoring under the LTM program for 2014 includes groundwater sampling, water level/product thickness monitoring, and sediment sampling. The Final Decision Document for the South of Runway 18-36 (Navy 2006a) specifies that groundwater at this site is not reasonably expected to be a potential future source of drinking water. Groundwater samples are collected from these wells to evaluate groundwater quality relative to 10 times the ADEC Table C values (18 AAC 75.345) and to monitor for surface water protection and natural recovery.

The following sections present field and laboratory data resulting from monitoring activities conducted at this site including: field measurements with an interpretation of groundwater flow direction based on groundwater levels, a comparison of target analyte concentration data to endpoint criteria specified in Section 3, a discussion of natural attenuation conditions, evaluations of trends, conclusions based on the analyses, and recommendations for future monitoring activities at the site. Site photographs are presented in Appendix I.

14.1 FIELD MEASUREMENTS

Depth-to-water and product thickness measurements were collected at 12 monitoring wells on August 27, 2014. Table 14-1 provides the measured depths-to-water, the calculated groundwater elevations and, if present, the product thicknesses. Groundwater elevations have been corrected for the presence of free product in those wells with detectable thickness (Appendix D-1).

Figure 14-1 shows the location of the monitoring wells, the site topography, the interpreted groundwater flow direction, and the downgradient surface water bodies (South Sweeper Creek and Sweeper Cove).

Table 14-1. 2014 Field Measurements for South of Runway 18-36 Area

	Physical Measurements				Water Quality Parameters						
Well Location	**Casing Elevation (ft MLLW)**	**Depth-to-Water[1] (ft BTOC)**	**Groundwater Surface Elevation (ft MLLW)**	**Measured Product Thickness (ft)**	**pH (SU)**	**Specific Conductance (mS/cm)**	**Turbidity (NTU)**	**Dissolved Oxygen (mg/L)**	**Temperature (°C)**	**Salinity (%)**	**ORP (mV)**
Groundwater Samples											
02-231	16.59	13.85	2.74	0	6.42	0.530	0	0.00	10.37	0.03	-81
02-232	18.54	16.34	2.20	0	6.80	0.622	0	0.00	8.79	0.03	-109
18/36-02	19.86	17.01	2.85	0	NP	NP	NP	NP	NP	NP	NP
AS-1	12.10	13.12	-1.02	0	6.29	1.050	0	0.00	8.49	0	-126
E-213	13.73	9.78	3.95	0	NP	NP	NP	NP	NP	NP	NP
E-216	18.45	15.53	2.92	0.31	NP	NP	NP	NP	NP	NP	NP
E-217	18.12	15.10	3.02	0	NP	NP	NP	NP	NP	NP	NP
RW-18/36-03	16.25	13.25	3.00	0	NP	NP	NP	NP	NP	NP	NP
RW-18/36-04	16.29	13.56	2.73	0.03	NP	NP	NP	NP	NP	NP	NP
RW-18/36-05	11.39	8.30	3.09	0	NP	NP	NP	NP	NP	NP	NP
Z3-6	9.81	6.51	3.30	0	NP	NP	NP	NP	NP	NP	NP
Z4-2	14.92	11.66	3.26	0	NP	NP	NP	NP	NP	NP	NP

Notes:
[1]Corrected if presence of product in the well.
NP – not planned to be measured
The reported casing elevation is the surveyed elevation residing in the NIRIS database.
The last groundwater parameter measurement prior to sample collection is reported.

Historic groundwater elevation data indicate that the groundwater flows primarily west onto the site and then spreads radially to discharge into adjacent surface water bodies: north to Crossover Canal and West Canal, west to South Sweeper Creek, and southwest to Sweeper Cove. Groundwater elevations collected in 2014 were compared with historical data and are consistent with this interpretation.

Three monitoring wells and three sediment sampling locations were sampled between August 25 and 28, 2014. Surface water protection monitoring was performed at three well locations (02-231, 02-232, and AS-1). Field measurements were recorded in the field forms and logbooks during sampling activities (Appendix A). Table 14-1 lists the final field measurements recorded at each monitoring well prior to sample collection. A review of the sampling data reported for this site indicates that prior to sample collection all wells exhibited groundwater parameters that stabilized to within specified criteria.

Measurable free product was detected in two wells during the 2014 LTM field event: E-216 (0.31 feet) and RW 18/36-04 (0.03 feet). Because all product thicknesses were less than 0.5 feet, removal of free product from these wells was not required during the LTM event.

Visual inspection of the eastern South Sweeper Creek shoreline was conducted from the mouth of the creek upstream to the old pipeline trestle across South Sweeper Creek to identify evidence of visible petroleum contamination. During the shoreline inspection, numerous small (1-foot square) areas of oil sheen on sediment were observed. The largest was a 4 by 4-foot area observed just south (downstream) of the Moffett Road Bridge. Moderate petroleum odor and black-stained sediment just beneath the soil surface which released sheen when disturbed were also observed at these locations. Oily sediments, petroleum sheen, and odor were observed along the shoreline adjacent to South of Runway 18-36 Area during sediment sampling at locations NSWSD-2, NSWSD-4, and NSWSD-05 at approximately a quarter to a half inch below the sediment surface. DRO concentrations in all three of these sediment samples still exceeded endpoint criteria in 2014. Results of the visual shoreline inspections are summarized in Section 4.1.3.

14.2 TARGET ANALYTE RESULTS

The following sections describe the analytical results for each medium sampled in 2014. Figure 14-1 illustrates the location of the wells sampled, the sediment locations, and the analytical results above the endpoint criteria. The analytical results obtained for these locations from 2000 through 2014 are summarized in Appendix C-1. Laboratory reports presenting the 2014 results are provided in Appendix F.

14.2.1 Groundwater

Groundwater samples were collected from three wells: 02-231, 02-232, and AS-1. The samples from all wells were analyzed for BTEX and PAHs. In addition, the sample from well 02-231 was also analyzed for DRO. TAH and TAqH were then calculated from the BTEX and PAH results. Table 14-2 presents the analytical results. Figure 14-1 shows the locations of the wells and the analytical results of the data exceeding the endpoint criteria.

DRO and BTEX compounds were not detected above the endpoint criteria in any groundwater sample collected in 2014. TAH exceeded the ADEC water quality standard (10 µg/L) in the 2014 samples collected from wells 02-231 and AS-1 at concentrations of 194 µg/L and 70 µg/L, respectively. In addition, TAqH exceeded the ADEC water quality standard (15 µg/L) in wells 02-231 and AS-1 at concentrations of 285 µg/L and 141 µg/L, respectively. The TAH and TAqH standards were not exceeded in the samples from well 02-232.

14.2.2 Sediment

The sediment samples (NSWSD-2, NSWSD-4, and NSWSD-5) were analyzed for DRO. Table 14-3 presents the analytical results. Figure 14-1 shows the locations where sediment samples were collected and the analytical results in exceedance of the endpoint criteria.

DRO was detected in sediment samples NSWSD-2, NSWSD-4, and NSWSD-5 at concentrations ranging from 420 mg/kg to 9,900 mg/kg, which exceed the risk-based cleanup level of 90.6 mg/kg.

Table 14-2. Analytical Results for Petroleum-Related Chemicals in Groundwater at South of Runway 18-36 Area

Well Location	Year	DRO (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	TAH[1] (µg/L)	TAqH[2] (µg/L)
02-231 Plume Source Area; Surface Water Protection Well	2000	1,200	39	4.3	52	220	NP	NP
	2001	**23,800**	33.4	4.37	47.3	157	NP	NP
	2002	14,000	33	3.2	34	150	NP	NP
	2003	8,600	**110**	4.2	64	176	NP	NP
	2004	9,970	**67.4**	1.99	49.2	103	NP	NP
	2005	**17,800**	42 J	2.65 J	55.1 J	221	NP	NP
	2006	**20,000 J**	36	2.9	52	230	NP	NP
	2007	**18,000 J**	17	2.1	52	219 D	**290 JD**	**291 JD**
	2008	**18,000 JY**	24	2.4	52	208 D	**287 D**	**292 D**
	2009	6,700 Y	35	2.6	68	290 D	**395 D**	**532 D**
	2010	7,100 YJ	31	2.9	65	268 D	**367 D**	**532 JD**
	2011	5,100 Y	25	2.4	61	258 D	**346 D**	**470 D**
	2012	5,400 YJ	25 J	3.9 J	70 D	269 JD	**368 JD**	**491 JDX**
	2013	6,000 Y	21	2.3	60	177 D	**260 D**	**396 JDX**
	2014	5,100 Y	48	2.6	46	97.6	**194**	**285 JD**
02-232 Downgradient Plume Edge; Surface Water Protection Well	2000	160 UJ	0.2 U	0.3 U	0.46 J	0.4	NP	NP
	2001	1,780	0.2 U	0.5 U	0.5 U	0.2 UJ	NP	NP
	2002	2,800	NP	NP	NP	NP	NP	NP
	2003	1,100	NP	NP	NP	NP	NP	NP
	2004	1,870	NP	NP	NP	NP	NP	NP
	2005	2,320	NP	NP	NP	NP	NP	NP
	2006	2,000	1.0 U	1.0 U	1.0 U	3.0 U	NP	NP
	2007	1,300 Y	0.50 U	0.16 J	0.22 J	1.0 U	0.38 J	0.51 J
	2008	1,400 Y	0.50 U	0.50 U	0.21 J	0.12 J	0.33 J	1.8 J
	2009	1,500 Y	NP	NP	NP	NP	NP	NP
	2010	2,400 YJ	0.16 J	0.50 U	0.29 J	1.0 U	0.45 J	2.3 J
	2011	3,300 Y	NP	NP	NP	NP	NP	NP
	2012	NP	0.19 J	0.50 U	3.3	0.45 J	3.9 J	9.0 J
	2013	NP	0.14 J	0.50 U	0.090 J	1.0 U	0.23 J	3.5 JX
	2014	NP	0.12 J	0.070 J	0.10 J	1.0 U	0.29 J	2.0 JX
AS-1 Surface Water Protection Well	2006	**FP**	**FP**	**FP**	**FP**	**FP**	NP	NP
	2007	2,800 Y	12	0.42 J	35	39	**86 J**	**280 JD**
	2008	3,500 Y	10	0.55 U	19	21 J	**50 J**	**176 JD**
	2009	2,700 Y	10	0.50 U	34	36	**80**	**286 D**
	2010	1,500 YJ	4.0	0.50 U	15	12 J	**31 J**	**48 JD**
	2011	950 Y	2.6	0.14 J	0.26 J	0.11 J	3.1 J	7.3 J
	2012	NP	13	1.0 U	9.1	9.0 J	**31 J**	**89 JDX**
	2013	NP	17	0.090 J	1.7	3.7	**22 J**	**43 JDX**
	2014	NP	15	0.30 J	27	27 J	**70 J**	**141 JD**
Endpoint Criteria[3, 4]		15,000	50	10,000	7,000	100,000	10	15

Notes:
[1] TAH results were calculated by summing the detected concentrations of BTEX when one or more were detected and by summing the quantitation limits when none were detected.
[2] TAqH results were calculated by summing the detections of BTEX and 16 PAHs when one or more were detected and by summing the quantitation limits when none were detected.
[3] The TAH and TAqH endpoint criteria are based on ADEC water quality standards as specified in 18 AAC 70.
[4] The endpoint criteria are 10 times the ADEC cleanup levels for groundwater as a drinking water source and as specified in 18 AAC 75.345[b][1], Table C.
NP – not planned
FP – free product, unable to be sampled
Bold indicates reported concentration is greater than the endpoint criteria.