SAMPLING AND ANALYSIS PLAN

Former Ken Foster Farm
Ironwood Homes - Wetland
SW Murdock Road, Sherwood, Oregon
ESCI No. 4750

March 22, 2011

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SAMPLING AND ANALYSIS PLAN

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1.0 INTRODUCTION

In October, November 2010, and January 2011, Martin S. Burck Associates, Inc (MSBA) conducted soil and sediment, surface water, and groundwater sampling at the Former Foster Farms wetland area referenced above. This sampling and analysis plan summarizes the findings of these sampling events. The site is located near Sherwood, Oregon within section 33, Township 22 South, Range 1 West as shown on Figure 1 (Appendix A). The site is located along the northeast base of Parrett Mountain, and approximately one-quarter mile west of South Rock Creek. The subject property was classified as a wetland by Ms. Rita N. Mrcozek, Professional Wetland Scientist (PWS). The wetland and buffer zone (wetland) was previously owned by Ken Foster. During the mid 1980's, the farm land was subdividec and sold. It is currently zoned for exclusive residential use, and contains several tax lots, ranging in size from 0.9 to 10.4 acres. In 2004 the property, including the wetland area, was purchased by current owners Mr. and Mrs. Patrick Huske, of Ironwood Homes. The purpose of this work was to evaluate the presence of tannery waste deposited on the farm and wetland from the nearby Frontier Leather Company (FLC) operation.

1.1 Site Background

The following site history is based on the Oregon Department of Environmental Quality (DEQ) Site Assessment Program - Preliminary Assessment and Database Site Summary Report for the subject property. As reported by the DEQ, the subject property received tannery wastes from FLC located nearby to the north (Figure 1). DEQ completed a Federal Preliminary Assessment (PA) for the Former Ken Foster Farm site (ESCI #2516) in September 2005. Based on the PA, it was determined that tannery waste from FLC (ESCI #116) was applied to the former Ken Foster Farm, including the Ironwood Homes properties. The tannery waste reportedly may contain metals, semi-volatile organic compounds (SVOCs), phthalates, polynuclear aromatic hydrocarbons (PAHs), petroleum constituents, chlorinated solvents, chlorinated benzene, and pesticides (fungicides/bacteriacides, DDT, chlordane, lindane).
In 2005, Creekside Environmental performed a limited Environmental Site Investigation on behalf of Ironwood Homes that included sampling of soil, sediment, and shallow (near surface) groundwater. Soil, groundwater, and sediment samples were analyzed for total chromium (Cr), trivalent Cr (Cr(III)), hexavalent Cr (Cr(VI)), lead, mercury, and manganese. Elevated concentrations of total Cr (primarily Cr(III)) and lead were measured. Subsequent evaluation of laboratory procedures showed that improper sample digestion procedures were used resulting in oxidation of Cr from a trivalent state to a hexavalent state resulting in elevated Cr(VI) concentrations. Follow-up analyses resulted in low, or non-detect Cr(VI) results from the Ironwood Homes property that are consistent with FLC, and indicated that Cr(VI) was not a contaminant of concern at either site.

However, lead, Cr, and mercury were detected at concentrations exceeding the reported applicable DEQ risk-based cleanup levels and site specific ecological screening levels. A subsequent cleanup agreement was reached with the DEQ that applies to Ironwood Homes lots 1-4, north of the wetland. The cleanup work was performed and DEQ recorded a decision of no further action (NFA) in July 2008.

2.0 PROJECT OBJECTIVE

Samples were collected to characterize the magnitude and extent of tannery waste in the wetland sediment, surrounding buffer zone soils, and shallow groundwater and surface water at the wetland. Near surface soil and sediment samples were collected initially and analyzed to evaluate the lateral extent followed by subsurface soil and sediment samples to characterize the vertical extent. Based on soil and sediment data and anticipated surface water drainage, MSBA also collected groundwater and surface water samples based on the soil and sediment analytical results and topography.

3.0 SAMPLING PLAN

This section is intended to document the procedural and sampling strategy implemented at the site by MSBA between October 2010 and January 2011.
3.1 Wetland and Buffer Zone Stratigraphy

A surrounding buffer zone slopes downward primarily from the north and south toward the wetland area. The low lying wetland area extends offsite to the east. The buffer zone consisted of a grassy hillside with oak trees and ash trees, and blackberry bushes. The soil typically consisted of a brown silty loam with gravels and cobbles. At several locations, basalt bedrock out crops and/or boulders were observed. Photographs depicting the pond/wetland area and buffer zone have been included as Photographs 1 and 2 (Appendix B).

The wetland area consisted of a very irregular surface composed of mounds of sod and vegetation. Most of the wetland area was covered in tall grasses. Ponded water was present near the center of the site and had a maximum depth of approximately one foot in October 2010 and 5 feet in January 2011. The wetland stratigraphy consisted of: 1) a mat of organic material of approximately 1 to 8 inches at the surface, 2) A slightly plastic dark brown to black loam of approximately 8 to 15 inches thick was observed beneath the organic mat; 3) A very plastic dark gray to dark brown silty clay was observed to approximately 30 inches below surface grade (bsg), the maximum depth explored. Apparent tannery waste was observed beneath the organic surface layer to a depth of up to 20 inches bsg at numerous locations within the wetland. The apparent waste was observed as angular white/grey clasts less than or equal to one-half inch, small white flecks, and blue/gray silty clay. These observed materials generally corresponded with areas of high Cr concentrations.

3.2 Near Surface Sampling

This section presents near surface soil and sediment sampling procedures for samples collected by MSBA between October 2010 and January 2011.

3.2.1 Near Surface Sample Locations

MSBA established a grid pattern over the entire subject property with a 60 foot spacing (Figure 2). Near surface samples were collected at each intersecting grid line and at interior locations as warranted to provide adequate delineation. Additional sample locations were also selected based on preliminary screening and analytical results. A total of 61 soil and sediment sample locations were selected. A summary of the near surface soil and sediment sample results is presented in section 6.2.

Following the sample collection, AKS Engineering and Forestry, of Sherwood, Oregon, surveyed and prepared a sample location map.
3.2.2 Near Surface Sampling Equipment

The following equipment was utilized to perform the near-surface soil and sediment sampling:

- Stainless steel 3.25 inch hand augers
- Polyethylene hand trowels
- Polyethylene sampling trays
- Laboratory provided 4 ounce and 8 ounce glass jars with teflon-lined lids
- Plastic garbage bags
- Plastic sheeting (6 mm)
- 5-gallon buckets with lids
- Bentonite (chips, powder, and granular)

3.2.3 Near Surface Sampling Procedures

Surface soil and sediment samples were collected at 61 locations within the wetland (wetland and buffer zone) at the locations shown on Figure 2 (Appendix A). The surface soil and sediment samples were collected to define the magnitude and lateral extent of tannery waste. The following surface soil and sediment sample collection procedures were performed:

1) Overburden vegetation and organic material was scraped aside to expose the surface soil and sediment. Vegetation was generally encountered in the buffer zone and organic material in the wetland.

2) After removing the surface material, a 3.25 inch diameter hand auger was advanced between 5 and 18 inches bsg into the soil or sediment. The auger and sample was removed and placed in a clean, decontaminated, plastic sampling tray. A photograph depicting the typical sampling conditions is included as Photograph 3 (Appendix B).

3) The auger, with sample and sampling tray were immediately taken to a decontaminated sample preparation table. The sample preparation station and equipment decontamination area layout is illustrated on Figure 3 (Appendix A).

4) MSBA logged the soil and sediment and documented any observations as described in section 5.1.

5) The selected sample interval was determined based on the visual signs of suspect tannery waste material such as animal remains, lime, angular white/grey clasts, and soil with bluish/grey coloration. Intervals containing these materials were preferentially collected and preserved for analysis. If no suspected material was observed, a general representative sample was collected and preserved for analysis.

6) The selected sample interval was then homogenized in the field by mixing with the polyethylene hand trowel in a separate decontaminated polyethylene sampling a tray.
7) A representative portion of the preferential or general sample was placed directly into clean wide-mouth, laboratory-provided glass jars with minimal head space.

8) The sample locations were backfilled with hydrated bentonite in general accordance with applicable WRD regulations and standards.

The sampler donned disposable nitrile gloves prior to and during the entire sample collection process which were discarded after each sample collection event.

3.2.4 Near Surface Sample Containers Preservation and Shipment

Surface soil and sediment samples were collected using a hand auger and placed into clean wide-mouth, laboratory-provided glass 4 ounce or 8 ounce jars sealed with teflon lined lids leaving as little head space as possible. No preservative was added to the sample containers. The samples were placed in plastic bags and set in ice chests with a combination of chemical ice packs and cube ice for thermal preservation. When possible, the samples were delivered directly to the lab from the field. Otherwise samples were maintained in the ice chests and delivered to the laboratory via courier service at the earliest possible time.

3.3 Sub-Surface Sampling

This section presents sub-surface sampling procedures for soil and sediment samples collected by MSBA between October 2010 and November 2010.

3.3.1 Sub-Surface Sample Locations

Most samples were located on the grid described in section 3.2.1. The exact sample locations were adjusted in the field based on accessibility, site conditions, and the perimeter of the wetland boundary. Subsurface soil and sediment samples were collected at 14 locations within the subject property at the locations shown on Figure 2 (Appendix A). The sample locations were selected based on the near surface soil and sediment sample total Cr results. A summary of the sub-surface soil and sediment sample results is presented in section 6.4.
3.3.2 Sub-Surface Sampling Equipment

The following equipment was utilized to perform the subsurface soil and sediment sampling:

- Stainless steel 2 inch by 6 inch split core samplers with polyethylene retaining sleeves
- Laboratory provided 4 ounce and 8 ounce glass jars with teflon-lined lids
- Stainless steel 3.25 inch hand augers
- Polyethylene sampling trays
- Plastic garbage bags
- Plastic sheeting (6 mm)
- 4 inch diameter solid schedule 40 Polyvinyl Chloride (PVC) casing
- Peristaltic pump with silicone and polyethylene tubing
- 2 inch diameter disposable bailer
- 5-gallon buckets with lids
- Cellophane
- Bentonite (chips, powder, and granular)

3.3.3 Subsurface Sampling Procedures

Subsurface soil and sediment samples were collected at 14 locations within the wetland at the locations shown on Figure 2 (Appendix A). The subsurface samples were collected to define the vertical extent of apparent tannery waste and Cr at concentrations exceeding anticipated background levels. Due to the presence of shallow bedrock and/or cobbles, MSBA was unable to reach the desired depth of approximately 30 inches bsg at several locations. Samples were collected at these locations from the approximate depth of sampler refusal.

Subsurface soil or sediment samples were collected through open hand auger borings using a 2 inch by 6 inch stainless steel core sampler with a 2 inch diameter polyethylene retaining sleeve. The core sampler was used to minimize the potential for cross-contamination from the near surface soil and sediment. The following subsurface soil and sediment sample collection procedures were performed:

1) To avoid interference from ponded surface water present at several sample locations ranging from 1 to 26 inches deep, MSBA advanced a decontaminated 4 inch diameter solid schedule 40 PVC casing to an approximate depth of 20 inches bsg;

2) Surface water was removed from inside the 4 inch casing using a disposable bailer and/or a peristaltic pump;

3) Immediately after the surface water was removed, a 3.25 inch diameter hand auger was advanced to a depth of approximately 24 inches bsg;
4) A decontaminated core sampler with a 2 inch diameter polyethylene retaining sleeve was gently lowered and advanced through the bottom of the hand auger boring to a maximum depth of approximately 30 inches hsg using an impact, slide hammer. To prevent residual water in the bottom of the sample hole from entering the core sampler as it was lowered to the appropriate depth, the open end of the core sampler was wrapped in cellophane. The cellophane was pushed through as the sampler was advanced.

5) The core sampler including soil or sediment was extracted and immediately placed in a clean, decontaminated, polyethylene sampling tray;

6) The core sampler and tray were taken to a decontaminated sample preparation table (Figure 3, Appendix A) (Photograph 4, Appendix B);

7) To avoid potential for cross-contamination from surface water or sloughing in the bottom of the sample hole, MSBA scraped away any loose material and up to a minimum of 1-2 inches of sediment or soil from each end of the sampler;

8) The remaining sample interval was then preserved by placing polyethylene end caps over each end of the plastic retaining sleeves;

9) Following sample collection, the casing was removed if present and the holes were backfilled with hydrated bentonite chips in general accordance with applicable WRD regulations and standards.

The sampler donned disposable nitrile gloves prior to and during the entire sampling process which were discarded after collecting each sample.

3.3.4 Sample Containers Preservation and Shipment

Subsurface soil or sediment samples were collected using a 2 inch by 6 inch core sampler with a 2 inch diameter polyethylene retaining sleeve. All sample collection equipment and containers were decontaminated prior to sampling. Following sample collection, 1 to 2 inches of loose, potential slough material was removed from each end of the polyethylene sleeve and discarded. The remaining soil was sealed in the polyethylene retaining sleeve with 2 inch diameter polyethylene caps, differentiating between the bottom and top of the sample with blue and orange caps. The blue caps were labeled with ‘B’, to represent the bottom of the sampling interval and orange caps were used to represent the top. When sampler refusal due to bedrock or cobbles was encountered, samples were collected using a hand auger and placed into clean wide-mouth, laboratory-provided glass 4 ounce or 8 ounce jars with teflon lined lids leaving as little head space as possible. No preservative was added to the sample containers. The samples were placed in plastic bags and set in ice chests with a combination of chemical ice packs and cube ice for thermal preservation. When possible, the samples were delivered directly to the lab from the field. Otherwise samples were maintained in the ice chests and delivered to the laboratory via courier service at the earliest possible time.
3.4 Surface Water Sampling

This section presents surface water sampling procedures for samples collected by MSBA in November 2010.

3.4.1 Surface Water Sample Locations

Surface water sample locations were selected based on the near surface soil and sediment with the highest total Cr concentrations. MSBA also selected locations that could be reached with a telescoping extension rod from dry ground to minimize disturbance of the standing water during sample collection.

3.4.2 Surface Water Sampling Equipment

The following equipment was utilized to perform the surface water sampling:

- Peristaltic pump with silicone and polyethylene tubing
- 4 inch diameter schedule 40 PVC casing
- Hand operated pump
- Silica filter sand
- Bentonite (chips, powder, and granular)
- 1 inch diameter schedule 40 PVC casing with 0.10 inch slotted screen
- 5-gallon buckets with lids
- Telescoping extension rod
- Zip ties

3.4.3 Surface Water Sampling Procedures

The following surface water sample collection procedures were conducted:

1) Dedicated polyethylene tubing was attached to the end of a decontaminated telescoping extension rod with a maximum reach of approximately 15 feet. The tubing was connected to a peristaltic pump with a 0.45 micron field filter at the discharge end.

2) The intake end of the tubing was placed 12 feet from the sampler in the undisturbed surface water at the desired sample location. MSBA did not enter the area and had not disturbed the surface water in this area for approximately 13 days. The intake tubing was lowered through the water and a sample was collected from approximately 4 inches above ground surface.

3) A minimum of three tubing volumes were purged prior to sample collection.

The sampler donned disposable nitrile gloves prior to and during the entire sampling process which were discarded after collecting each sample.
3.4.4 Sample Containers Preservation and Shipment

Surface water samples were collected using a peristaltic pump and transferred into laboratory provided glass and polyethylene containers with or without preservative, as necessary for the specific analyses. The samples were placed in plastic bags and set in ice chests with a combination of chemical ice packs and cube ice for thermal preservation. When possible, the samples were delivered directly to the lab from the field. Otherwise samples were maintained in the ice chests and delivered to the laboratory via courier service at the earliest possible time.

3.5 Shallow Groundwater Sampling

This section presents shallow groundwater sampling procedures for samples collected by MSBA in November 2010.

3.5.1 Shallow Groundwater Sample Locations

A total of three groundwater sample locations were selected based on the results of the soil and sediment sampling and surface topography at the locations shown of Figure 2 (Appendix A). Groundwater sample location GW-1, was selected based on the relatively higher than expected total Cr concentrations detected in nearby sediment samples (S-1, E-6). In addition, this sample was also selected as the likely downgradient location at the edge of the subject property. Groundwater sample boring GW-2, was selected based on the elevated Cr concentrations detected in near surface samples and the downgradient location relative to the detected concentrations near groundwater sample boring GW-3. Groundwater sample boring GW-3 was selected based on the highest detected concentrations of total Cr in shallow sediment samples at this general location. A summary of the groundwater sample results is presented in section 6.5.

3.5.2 Shallow Groundwater Sampling Equipment

The following equipment was utilized to perform the shallow groundwater sampling:

- Peristaltic pump with silicone and polyethylene tubing
- 4 inch diameter schedule 40 PVC casing
- Hand operated pump
- Silica filter sand
- Bentonite (chips, powder, and granular)
- 1 inch diameter schedule 40 PVC casing with 0.10 slotted screen
- 5-gallon buckets with lids
- Telescoping extension rod
- Zip ties
3.5.3 Shallow Groundwater Sampling Procedures

Shallow groundwater samples were collected from temporary wells at three locations within the wetland (Figure 2, Appendix A). The temporary well screens were installed between approximately 18 and 24 inches bsg. The upper screen depth of 18 inches is below the highly organic layer and was intended to help seal off and prevent/minimize surface water incursion. The following temporary well installation and sampling procedures were performed:

1) To avoid interference from ponded surface water present at several sample locations ranging from 19.5 to 32 inches deep at the time and locations the samples were collected, MSBA advanced a decontaminated solid 4 inch diameter schedule 40 PVC casing to an approximate depth of 18 inches bsg.

2) Surface water was removed from inside the 4 inch casing using a disposable bailer and/or a hand-operated pump.

3) Immediately after the surface water was removed, a 3.25 inch diameter hand auger was advanced to a depth of approximately 24 inches bsg.

4) Water was purged from the boring using the decontaminated hand-operated pump.

5) A thin layer of silica sand (approximately one-half inch) was placed in the bottom of the borehole to prevent contact between the casing and the sediment.

6) A 1-inch diameter PVC well casing with a 6-inch length of 0.10 inch slotted screen at the bottom was installed in the open borehole. The annular space adjacent to the well screen was filled with silica filter sand to just above the top of the screen. The annular space above the sand was filled with bentonite forming a seal in general accordance with applicable WRD regulations and standards for temporary wells. A photograph depicting the typical completed temporary well is included as Photograph 5 (Appendix B).

7) Dedicated polyethylene tubing was placed in the temporary well and a peristaltic pump was used to purge a minimum of three well volumes.

8) After purging, groundwater sample collection was initiated when the water level in the well had recharged to within 85 percent of the initial static water level. If the desired recharge was not achieved within a period of 60 minutes, the sample collection was initiated and the deficient water level was recorded. The samples were collected through a 0.45 micron field filter placed on the discharge end of the sample tubing. Due to the slow recharge, several recharge cycles were required to achieve the required sample volumes.

9) Following sample collection, the casing, temporary well, and filter sand were removed and the boring was abandoned with bentonite in general accordance with applicable WRD regulations and standards.
The sampler donnec disposable nitrile gloves prior to and during the entire sampling process which were discarded after collecting each sample.

3.5.4 Sample Containers Preservation and Shipment

Groundwater samples were collected using a peristaltic pump and transferred into laboratory provided glass and polyethylene containers, as necessary for the required analytes. Preservatives were present in some of the glass water sample containers as necessary; the remaining sampling containers were un-preserved. The samples were placed in plastic bags and set in ice chests with a combination of chemical ice packs and cube ice for thermal preservation. When possible, the samples were delivered directly to the lab from the field. Otherwise samples were maintained in the ice chests and delivered to the laboratory via courier service at the earliest possible time.

3.6 Sample Nomenclature

The following section presents a summary of the nomenclature used when labeling soil, sediment, groundwater, and surface water samples.

- Near-Surface Soil and Sediment Samples
  Examples: (0,0), (N-1), and (N-1, W-1)

Near surface soil and sediment samples were named based on the sampling grid coordinate location from which they were collected. Sample names with only coordinates represent the initial near-surface soil and sediment samples.

- Subsurface Soil and Sediment Samples
  Examples: (N-1 B), (N-1, E-2 B), and (S-1, E-1 B)

Subsurface soil and sediment samples include ‘B’ in the sample name after each sampling grid coordinate location from which they are collected.

- High-Grade Soil and Sediment Samples
  Examples: (0-0 (HG-2)), (N-2, W-2 B (HG)), and (S-1, W-3 B (HG))

High-grade soil and sediment samples include ‘(HG)’ in the sample name after each sampling grid coordinate location from which they were collected. High grade samples were collected to further assess total Cr concentrations in ‘suspect material’. Note: Sample Stockpile (HG) was collected near the engineered soil cell stockpile located outside of the wetland and buffer zone area that was derived from the previous Ironwood cleanup on adjacent lots.
• Duplicate Soil and Sediment Samples
  
  Examples: (S-1, E-6 (3)), (W-1 (2)), and (W-1 B (3))
  
  Duplicate soil and sediment samples include ‘(2)’, ‘(3)’, and ‘(4)’ in the sample name following each sampling grid coordinate location from which they were collected. Duplicate samples were generally collected to assess the homogeneity of total Cr concentrations at sample locations and at various depth intervals.

• Groundwater Samples
  
  Examples: (GW-1), (GW-2), and (GW-3)
  
  Groundwater samples were labeled GW-1 through GW-3.

• Surface Water Samples
  
  Examples: Surface H20 and Surface H20 2
  
  Surface water samples were labeled Surface H20 and Surface H20 2.
  
  For reference while reviewing sample data, a summary of the following information is also included in Appendix E.

4.0 DECONTAMINATION PROCEDURES

The following section describes the general decontamination procedures that were utilized when personnel and equipment entered and exited the site.

4.1 Decontamination Area

Prior to entering the wetland area for sampling, MSBA constructed a decontamination area located near the northeast portion of the site, within the buffer zone. A split rail fence is present south of the decontamination area, representing the approximate outside boundary of the wetland buffer zone. A small opening in the fence was used as an entry and exit point for personnel and equipment. The adjacent property located on lot 3 was designated as a support zone for vehicle parking and equipment transport. The decontamination area acted as a contamination reduction corridor (CRC). All equipment and personnel that entered the wetland (exclusion zone) used the CRC as an entry and exit point. The decontamination area consisted of an equipment decontamination area, a personnel decontamination area, a sampling table, and an equipment staging area. The ground surface beneath the personnel decontamination, equipment decontamination, and sampling table
areas where water splashing might occur were covered with a nylon tarp overlain by an absorbent canvas cloth tarp adhered to the ground with stakes. The entry and exit point and equipment staging area were covered with 6 mm plastic or nylon tarps. A figure illustrating the decontamination area layout is presented on Figure 3 (Appendix A). A photograph depicting the general layout of the personnel decontamination area is presented as Photograph 6 (Appendix B).

4.2 Equipment Decontamination Procedures

Non-disposable equipment used to collect soil and sediment, groundwater, and surface water samples such as: core samplers, hand augers, polyethylene sampling trays, auger and sampler extensions, bailers, water level indicators, etc., were decontaminated prior to each use. Strict decontamination procedures were utilized to help eliminate the potential for cross-contamination between samples and sample locations. The equipment decontamination procedure consisted of a four stage process as described below. The decontamination area layout is presented on Figure 3 (Appendix A).

All non-disposable sampling equipment was subject to the following equipment decontamination procedures which were strictly adhered to.

1) When no longer in use, all equipment to be decontaminated was placed on cloth and nylon tarps adjacent to decontamination bucket #1 (DB1) (Figure 3, Appendix A). DB1 consisted of clean tap water, TSP or Alconox, dish soap, and a dedicated nylon brush.

2) Equipment was placed in DB1 and scrubbed thoroughly removing all sediment, soil, and loose material using a dedicated brush. After all visible material was removed, the equipment was transferred to decontamination bucket #2 (DB2), which consisted of a clean tap water and a dedicated nylon brush.

3) Equipment in DB2 was scrubbed again using a brush removing any excess soap and TSP as an initial rinse. The equipment was then transferred to decontamination bucket #3 (DB3), which also consisted of clean tapwater and a dedicated nylon brush.

4) Equipment in DB3 was scrubbed using a dedicated brush as a secondary rinse. Following the secondary rinse, the equipment was held over bucket DB3 and rinsed with a sprayer that contained de-ionized (DI) or distilled water.

5) Following the final rinse with DI or distilled water, the equipment was placed on a clean canvas covered tarp pending reuse. If time permitted, the clean equipment was allowed to air-dry.

Disposable nitrile gloves were worn during the decontamination process to eliminate any risk of contact with contaminants. Following the decontamination process, gloves and all other disposables were placed in garbage bags within covered garbage cans, pending disposal.
4.2.1 Equipment Blanks

Equipment blanks were collected during each sampling event to verify that decontamination procedures were sufficient to prevent cross-contamination between sample locations. The utilized equipment was rinsed with DI or distilled water and the water was collected and submitted for laboratory analysis of total Cr. The equipment blank results are discussed in section 6.7.

4.3 Personnel Decontamination Procedures

All MSBA personnel entering the exclusion zone (wetland area) were required to complete a pre-entry safety meeting describing associated risks and necessary safety precautions. In addition, personnel were required to review and sign the Site Health and Safety Plan (HASP) prior to entering the site. The HASP is included in Appendix C. All personnel entering the site were required to wear rubber boots and Tyvek outerwear or rubber hip or chest waders. To protect personnel and prevent any contaminated material from leaving the site, all personnel entering the site were required to undergo decontamination procedures when leaving the wetland area (the exclusion zone) (Figure 3, Appendix A).

The following personnel decontamination procedures were strictly followed:

1) Prior to exiting the site, personnel was required step into personnel decontamination station 1 (PD1), which consisted of clean tap water, TSP or Alconox, dish soap, and a dedicated nylon brush. Tyvek clothing were removed and discarded prior to entering PD1. The boots, hip waders, or chest waders were then scrubbed thoroughly with the brush in PD1 until all visible sediment, soil, or material were removed.

2) Following the completion of PD1, personnel stepped directly into personnel decontamination station 2 (PD2), which consisted of clean tap water and a dedicated nylon brush. The boots were then scrubbed to remove excess dish soap and TSP.

3) Following the completion of PD2, personnel stepped directly into personnel decontamination station 3 (PD3), which consisted of clean tap water and a dedicated nylon brush. The boots were once again scrubbed as a secondary rinse. While remaining in PD3, the boots were lifted above the clean tap water and rinsed with a pressure sprayer that contained DI or distilled water.

4) Following the completion of the final DI or distilled water rinse, personnel stepped directly onto an area of plastic sheeting staked to the ground leading directly to the adjacent property (support zone).
4.4 Investigation Derived Waste Disposal

Investigation derived waste such as soil and sediment cuttings, purge water, and decontamination water were stored in steel 55-gallon drums pending disposal. All other related waste including but not limited to sampling gloves, wooden stakes, soil and sediment cuttings, purge water, decontamination water, and other miscellaneous disposable items and materials were placed in heavy-duty garbage bags within covered garbage cans pending disposal. Sample results were submitted to WasteXpress of Portland, Oregon, for disposal validation. Approximately twelve drums were picked up and disposed by WasteXpress. The disposal receipts for this waste are included as Appendix D.

5.0 DOCUMENTING AND REPORTING

All sampling activities were recorded in field notes during each site activity. The field notes were intended to document the vital project and sample information. In addition to daily field notes, various field sampling and data collection documentation forms were completed during the sampling process including the following:

1) Daily time sheets;
2) Groundwater purge and sample data sheets;
3) Temporary well logs;
4) Chain of custody forms;

Examples of these forms are included in Appendix C.

5.1 Field Notes

Field notes were recorded during each site activity to document the vital project and sample information. At a minimum the following information was recorded in the daily field notes:

1) Names of employees/subcontractors present;
2) Arrival and departure times of employees/subcontractors;
3) Daily scope of work;
4) All relevant sampling data and information including but not limited to:
   a) Sample name;
   b) Sampler type and diameter;
   c) MSBA staff;
   d) General area description;
c) Sample time;
f) Surface water depth;
g) Groundwater depth;
h) Description of borehole stratigraphy;
i) Misc observations;
j) Sample interval;
k) Ect...

5.2 Sample Labeling and Chain of Custody Procedures

A label was affixed to each sample container designating the sample name, and other critical information including: project name, location, date, time, and sampler name. After receiving the samples, the laboratory assigned a unique number to each discrete sample for reference and verification.

A completed chain of custody (COC) record accompanied all samples submitted for laboratory analysis. The COC documents the formal possession throughout the life of the samples including collection, storage, transport, and receipt by the laboratory(s). Information recorded on the COC includes the following:

- Project name
- Sample name
- Date and time of sampling
- Sample matrix (i.e. soil, water, air)
- Analyses to be performed
- Names of sampling personnel and transfer of custody acknowledgment spaces

6.0 SAMPLE ANALYTICAL RESULTS

The following section discusses the analytes of concern, results for the soil and sediment, groundwater, and surface water samples, and data validation procedures.

6.1 Analytes of Concern and Analyses Performed

As discussed in section 1.1, the previous investigation conducted by Creekside Environmental at Ironwood homes development (lots 1-4), established that Cr, lead and mercury were the primary analytes of concern. MSBA used total Cr as an ‘indicator’ constituent for the wetland
characterization, following the precedent set in the DEQ-approved Interim Remedial Action Measures (IRAM) Work Plan, 2008. Based on the total Cr results, MSBA also performed follow-up analysis of mercury and lead. Additional select samples were also analyzed for Cr(VI), TCLP metals, additional metals, select anions, and various conventional chemistry parameters. Sediment, soil, surface water, shallow groundwater samples with the highest total Cr concentrations were selectively submitted for additional analyses required for disposal such as Volatile Organic Compounds (VOCs), PAHs, and several additional metals. Copies of all laboratory analytical reports are included in Appendix F. The soil, sediment, surface water, and shallow groundwater sample locations and selected analytical results are illustrated on Figures 4 and 5. The following analyses were performed:

**Sediment and Soil:**

- Total Metals: Cr, mercury, lead, antimony, arsenic, barium, cadmium, copper, manganese, nickel, selenium, silver, and zinc using EPA Method 6020 (ICPMS). The results for these analyses are presented in Table 1 (Appendix E).

- Total hexavalent Cr using EPA Method 7196A and 7199. Total Cr(III) by calculation based on total Cr and total Cr(VI). The results for these analyses are presented in Tables 1 and 2 (Appendix E).

- TCLP Metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver using EPA Method 6020 (ICPMS). The results for these analyses are presented in Table 3 (Appendix E).

- Full List of VOCs using EPA Method 8260B. The results for these analyses are presented in Table 4 (Appendix E).

- Full List of PAHs using EPA Method 8270D. The results for these analyses are presented in Table 5 (Appendix E).

- Anions: chloride, sulfate, nitrite as nitrogen, and nitrate as nitrogen using EPA Method 300.0/9056A. The results for these analyses are presented in Table 6 (Appendix E).

- Conventional chemistry parameter: Soil pH and temperature using EPA Method 9045D. The results for these analyses are presented in Table 7 (Appendix E).

**Surface Water and Shallow Groundwater:**

- Total Metals: Cr, lead, and mercury using EPA Method 6020 (ICPMS). The results for these analyses are presented in Table 8, (Appendix E)

- Dissolved Metals: Cr, lead, mercury, arsenic, barium, cadmium, selenium, and silver using EPA Method 6020 (ICPMS) and Cr(VI) using EPA Method 7196A. The results for these analyses are presented in Table 8 (Appendix E).
• Conventional Chemistry Parameters: pH and temperature using EPA Method 150.1 and oxidation reduction potential using Method ORP. The results for these analyses are presented in Table 9 (Appendix E).

• Full List of VOCs using EPA Method 8260. The results for these analyses are presented in Table 10 (Appendix E).

• Full list of PAHs using EPA Method 8270D. The results for these analyses are presented in Table 11 (Appendix E).

• Anions: Chloride, sulfate, nitrate as nitrogen, and nitrite as nitrogen using Method 300.0/9056A. The results for these analyses are presented in Table 12 (Appendix E).

6.2 Near Surface Soil and Sediment Sample Analytical Results

A total of 75 near surface soil and sediment samples were submitted to Apex Labs (Apex), of Tigard, Oregon, for analysis of total Cr. Of the 75 samples, 9 were selected for follow-up analysis of mercury and lead. One or more samples were also analyzed for the following: Cr(VI), Cr(III), additional metals, several metals using TCLP, VOCs, PAHs, select anions, and conventional chemistry parameters.

• Total Cr was detected in all of the soil samples at concentrations ranging from 23.9 ppm (N-3,W-2) to 98,600 ppm (W-1) (Table 1, Appendix E). As illustrated on Figure 2 (Appendix A), the highest concentrations appear to be located near the northwest side of the wetland.

• Total mercury was detected in 11 of the 15 soil samples analyzed for mercury at concentrations ranging from 1.89 ppm (S-1,E-3) to 350 ppm (S-1,E-2) (Table 1, Appendix E).

• Total lead was detected in all of the 15 soil samples analyzed for lead at concentrations ranging from 13.4 ppm (S-1,E-3) to 660 ppm (S-1,W-1) (Table 1, Appendix E).

• Additional total metals were detected at the following maximum concentrations: barium (95.1 ppm), copper (128 ppm), manganese (332), nickel (8.83 ppm), and zinc (315 ppm). Additional metals antimony, arsenic, cadmium, selenium, and silver were not detected above the method reporting limits, some of which were raised due to dilution necessary for analysis (Table 1, Appendix E).

• Cr analyzed using TCLP was detected at a concentration of 0.264 ppm. Additional metals analyzed using TCLP were not detected above the method reporting limits, which were raised due to dilution necessary for analysis (Table 3, Appendix E).
• Based on the location of the highest detected concentration of total Cr, sample W-1(3) was exclusively analyzed for the full list of VOCs using EPA method 8260B. VOCs were not detected above the method reporting limits, some of which were raised due to dilution necessary for analysis (Table 4, Appendix E).

• Based on the location of the highest detected concentration of total Cr, sample W-1(3) was exclusively analyzed for the full list of PAHs using EPA method 8270D. PAHs were not detected above the method reporting limits, some of which were raised due to dilution necessary for analysis (Table 5, Appendix E).

• Chloride, nitrate, and nitrite were not detected above the method reporting limits. Sulfate was detected at a concentration of 585 (W-1 (3)) (Table 6, Appendix E).

• pH was measured at 7.35 at a temperature of 22.3 degrees Celsius (Table 7, Appendix E).

The near surface soil and sediment sample analytical results for total Cr, mercury, and lead are shown on Figure 4 (Appendix A) and all laboratory results are summarized in Tables 1 through 7 (Appendix E). Copies of the laboratory analytical results are presented in Appendix F.

6.3 General Data Validation Results

All final laboratory reports were submitted to Analytical Quality Associates, Inc. (AQA) of Albuquerque, New Mexico for a Level II data validation. The analytical data were evaluated in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Review, dated October 2004, and the applicable methods. No sample data was rejected as a result of the data validation (with the exception of the nitrate results for sediment sample W-1 (3)).

Although only one result was rejected, several data qualifiers were also assigned to the soil, sediment, and water sample results for additional analyses. These qualifiers cited laboratory quality control, hold times, and preservation. Each individual data validation report is included in Appendix G. The data qualifiers, if present, were included as footnotes on each applicable data table in Appendix E. Based on the data validation results, with the exception of nitrate, all sample data should be considered valid and may be relied upon.
6.3.1 Cr(VI) Results

MSBA initially selected 5 near surface samples (N-1), (N-1, E-2), (S-1, E-3), (S-1, W-2), and (W-1) for follow-up Cr(VI) analysis by Apex using EPA method 7196A. This method was previously used during the FLC and Ironwood investigations and resulted in reporting limits ranging from 0.24 and 0.26 parts per million (ppm) with a maximum detected concentration of 2.14 ppm at the adjacent Ironwood properties. Cr(VI) was not detected in four of the five near surface samples analyzed by Apex, however, the method reporting limits were significantly elevated due to sample dilution necessary for analysis and ranged from 55.1 ppm to 233 ppm. Cr(VI) was exclusively detected in sample S-1, W-2 at a concentration of 67.6 ppm. The required dilution and significantly elevated reporting limits were attributed by the laboratory to matrix interference from potential constituents such as manganese, molybdenum, vanadium, and mercury. It has also been shown that soil and sediment samples with a high moisture content, such as the saturated sediment samples collected from within the wetland, can result in raised reporting limits. The results of these analyses are presented in Table 1 and Table 2.

Due to the potential interferences and high reporting limits, MSBA directed Apex to transfer the sample extracts to Weck Laboratories, Inc. (Weck), in City of Industry, California, for follow-up analysis of Cr(VI) using EPA method 7199. EPA method 7199 uses Ion Chromatography (IC) to separate Cr(VI) from interfering substances and is generally considered more accurate than the colorimetric EPA method 7196. Methods 7199 and 7196 both use the alkaline digestion procedure SW846 3060. During preparation for shipment, it was discovered that Apex had prematurely disposed of the sample extracts and the remaining soil or sediment samples had exceeded the EPA recommended hold time. MSBA determined that the data obtained from the out of hold samples would still provide useful screening data. Therefore, samples (S-1, E-3), (S-1, W-2), and (W-1), which exceeded the recommended hold time, were submitted for follow-up analysis by Weck using EPA method 7199. The total Cr concentration of these samples was also analyzed to evaluate any potential changes that might be associated with the hold time discrepancy. The total Cr concentrations for the out of hold samples were consistent with the initial Apex results. However, the results by Weck indicated that sample W-1 contained Cr(VI) at a concentration of 2,800 ppm. The Weck results for samples S-1, E-3 and S-1, W-2 were within the general range of variability compared to the initial Apex results. Due to the potential exceedingly high Cr(VI) concentration detected in sample W-2 by Weck, additional investigation and analysis was required.

Based on the additional Cr(VI) results, MSBA re-sampled a total of eight surface sample locations (N-1), (N-1, W-1), (N-2, W-2), (N-3, E-1), (S-1, W-1), (S-1, W-2), (S-2, W-1), and (W-1) for Cr(VI) and within hours shipped the samples overnight to the lab for an expedited analysis using EPA method 7199; total Cr was also analyzed. Previous analytical data from Ironwood (Creekside 2007) was rejected because the laboratory did not apply a recommended step in Method 3060A suggested for suppressing oxidation of samples with high Cr(III). This recommended step was performed during the recent analysis of all wetland sediment and soil samples under both the 7196 and 7199 methods.
Based on a recommendation by AQA (Section 6.2), which noted a potential for oxidation of Cr(III) to Cr(VI) during several procedural steps involved in the sample digestion process, and the anomalously high Cr(VI) concentrations detected by Weck, MSBA determined that additional analysis for Cr(VI) was warranted. Therefore, MSBA prepared the following additional extraction and analysis procedures to be implemented during the re-analysis of previously analyzed samples:

1) Complete analysis as soon as possible after the digestion, no more than 24 hours.

2) Test duplicate without spiking and spike separately. Method 3060A requires both soluble and insoluble pre-digestion matrix spikes when variability is suspected; perform both. Re-digestion and re-analysis of the entire batch is required per the method when the matrix spike fails.

3) When adding 5M nitric acid, add very slowly with constant stirring.

4) While adding buffering agent such as magnesium chloride, the precipitate must be rinsed extremely well.

5) While heating the sample digestate, verify and document that boiling did not occur.

Three representative samples (S-1, W-1), (S-2, W-1), and (W-1) from the re-sampled locations were selected for re-analysis and analyzed a second time by both Weck Labs and CH2M Hill (CH2M), of Corvallis, Oregon. These results are presented in Table 2 for comparison.

6.3.1.1 Cr(VI) Conclusion

After reviewing all available Cr(VI) data, MSBA has concluded that Cr(VI) is likely present at concentrations ranging from 5.75 to 67.6 ppm (Table 2, Appendix E). Cr(VI) was not detected at significant concentrations at the source site, FLC, and the adjacent Ironwood Homes properties during the previous investigations. Based on the Apex and CH2M data, Cr(VI) concentrations ranged from 5.75 ppm to 67.6 ppm. However, Weck Cr(VI) results ranged from 6.3 ppm to 2,800 ppm. Based on all available data, MSBA has determined that the Weck data is not reliable and that high Cr(VI) concentrations may have been caused by improper laboratory procedures resulting in the oxidation of Cr(III) to Cr(VI). These conclusions are based on the following:

1) When additional digestion/analysis precautions were requested, Cr(VI) concentrations detected by Weck for sample W-1 R decreased from 2,100 ppm to 6.3 ppm;

2) Previous investigations at the former Foster Farms property did not detect Cr(VI) in soil or sediment above concentrations of 2.14 ppm;

3) Data from Apex and CH2M Hill appears to be more consistent with previous investigation data in terms of concentrations and the ratio of Cr(III) to Cr(VI);
4) Cr(VI) was not known or suspected to have been used in the tanning process at the source site, FLC;

5) The significantly high Cr(VI) concentrations detected by Weck did not correspond to the high Cr(III) concentrations on a sample per sample basis;

6) The potential natural oxidation of Cr(III) to Cr(VI) is unlikely to form the elevated concentrations of Cr(VI) detected by Weck 6; and

7) Elevated concentrations of total Cr increase potential for oxidation of Cr(III) to Cr(VI) during laboratory digestion, especially if any procedures are performed improperly 6. The conclusion by AQA regarding the Cr(VI) results, as well as responses from the laboratory, if available, have been included as Attachment G.

The CH2M and Apex results both received several qualifiers during the data validation, most significantly, that the sample was not analyzed within 24 hours of digestion. However, method 3060A clearly states that Cr(VI) has been shown to be stable in alkaline digestates (pH 12) for up to 168 hours after the extraction from soil 4. MSBA has discussed this matter with several chemists from several laboratories and was unable to find an expert that would agree with the AQA interpretation of the analysis requirements (analyzing the sample within 24 hours of extraction). In addition, out of six labs contacted, only one routinely completes the analysis within 24 hours of extraction. Based on all available data, MSBA concludes that sample analysis for Cr(VI) within 24 hours of extraction is not required or preferable.

6.4 Subsurface Soil Sample Analytical Results

A total of 17 subsurface soil samples were submitted to Apex for analysis of total Cr. The subsurface sample analytical results for total Cr are shown on Figure 2 and are summarized in Table 1, Appendix E. Copies of the laboratory analytical reports are presented in Appendix F.

- Total Cr was detected in all of the 17 subsurface soil samples at concentrations ranging from 15.4 ppm (S-1,E-6 B) to 23,500 ppm (S-1,W-3 B(2)) (Table 1, Appendix E).

- Mercury was detected in 2 of the 6 subsurface soil samples analyzed for mercury at concentrations of 0.218 ppm (N-3,E-2 B) and 0.342 ppm (W-1 B(2)) (Table 1, Appendix E).

- Lead was detected all of the 11 subsurface soil samples analyzed for lead at concentrations ranging from 3.84 ppm (W-1 B(2)) to 9.68 ppm (N-3,E-2 B) (Table 1, Appendix E).
6.5 Shallow Groundwater Sample Analytical Results

A total of 3 groundwater samples were submitted to Apex for analysis of dissolved Cr. The 3 samples were also submitted for follow-up analysis of dissolved mercury and lead. Shallow groundwater samples submitted for total metals were field filtered, therefore, may more closely represent dissolved concentrations. One or more of the samples were also analyzed for the following: dissolved Cr(VI), arsenic, barium, cadmium, selenium, silver, VOCs, PAHs, select anions, and conventional chemistry parameters. The groundwater sample analytical results for total Cr, Cr(VI), mercury, and lead are shown on Figure 5 and all laboratory results are summarized in Tables 8 through 12. Copies of the laboratory analytical results are presented in Appendix F.

- Dissolved Cr was detected in all of the 3 groundwater samples at concentrations ranging from 2.40 parts per billion (ppb) (GW-1) to 11.8 ppb (GW-3) (Table 8, Appendix E).
- Dissolved Cr(VI) was not detected in any of the groundwater samples (Table 8, Appendix E).
- Dissolved lead was detected in 1 of the 3 groundwater samples at a concentration of 1.8 ppb (GW-1) (Table 8, Appendix E).
- Additional dissolved metals, arsenic, barium, cadmium, selenium, and silver, were not detected above their respective method reporting limits (Table 8, Appendix E).
- Samples submitted for total metals analysis were field filtered. Cr was detected at concentrations ranging from 11.2 ppb to 365 ppb. Lead and Mercury were detected at concentrations ranging from 0.294 ppb to 15.7 ppb (Table 8, Appendix E).

6.6 Surface Water Sample Analytical Results

A total of 2 surface water samples were submitted to Apex for analysis of total and dissolved Cr. Both samples were selected for follow-up analysis of mercury, lead, and conventional chemistry parameters. The surface water sample analytical results for total Cr, mercury, and lead are shown on Figure 5 (Appendix A) and all laboratory results are summarized in Tables 8 through 12 (Appendix E). Copies of the laboratory analytical results are presented in Appendix F.

- Dissolved Cr was detected in both of the surface water samples at concentrations ranging from 12.2 ppb (Surface H2O) to 17.1 ppb (Surface H2O 2)(Table 8, Appendix E).
- Dissolved Cr(VI) was not detected in either of the surface water samples (Table 8, Appendix E).
• Dissolved lead and mercury were not detected in either of the surface water samples (Table 8, Appendix E).

• Samples submitted for total metals analysis were field filtered. Cr was detected at concentrations ranging from 12.5 ppb to 18.5 ppb. Mercury and Lead were not detected (Table 8, Appendix E).

6.7 Equipment Blank Sample Results

A total of 20 equipment blank samples were submitted to Apex for analysis of total chromium. Chromium was not detected above commonly method reporting limit in 15 of the 20 samples. Chromium was detected in five of the samples at concentrations ranging from 2.56 ppb to 17.6 ppb. The sample analytical results for the equipment blanks are summarized on Table 13 (Appendix E) and copies of the laboratory analytical results are presented in Appendix F.
7.0 REMARKS AND SIGNATURES

The information/conclusions/recommendations/proposals contained in this Sampling Report were arrived at in accordance with currently accepted professional geologic and environmental practices at this time and location. No warranties are intended or implied. This report was prepared solely for those entities for which read and rely authorization has been specifically assigned by MSBA. MSBA is not responsible for the independent interpretations, conclusions, or actions of others derived from or based on the information presented herein.

Information and opinions presented in this report are based on the collection and review of data from limited and discrete portions of the site, subsurface, and surroundings. Martin S. Burck Associates, Inc. is not responsible for conditions at specific portions of the site that are not investigated; for conditions that are not reported or properly presented; and/or for future activities or investigations that may alter the current condition or understanding of the site.

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S:\Archive\Ironwood Homes\(2011 03 22) Ironwood Homes Wetland Sampling & Analysis Plan.pdf
8.0 REFERENCES

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Appendix A

Figures

Figure 1  Site Location Map
Figure 2  Site Map
Figure 3  Decontamination Area Layout
Figure 4  Soil and Sediment Sample Data Map
Figure 5  Surface Water and Groundwater Sample Data Map