



***Vapor Intrusion Assessment
Lebanon Areawide Groundwater Project
Lebanon, Oregon***



***Prepared for
Oregon Department of
Environmental Quality***



***August 23, 2010
5645-04/Task 3***



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CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	2
1.1 Purpose	2
1.2 Scope of Work	2
1.3 Limitations	3
2.0 BACKGROUND	3
2.1 Site Location and Description	3
2.2 Geology and Hydrogeology	3
2.3 Previous Environmental Activities and Data	4
3.0 VAPOR INTRUSION ASSESSMENT	6
3.1 Water Level Data	6
3.2 Extent of cVOC Contamination	7
3.3 Risk Screening	8
4.0 CONCLUSIONS	9
5.0 RECOMMENDATIONS	10
6.0 REFERENCES	10

TABLES

- 1 Shallow Groundwater Elevations
- 2 Maximum Recent and Historical Shallow Groundwater cVOC Detections
- 3 Maximum Historical Soil Gas cVOC Detections

FIGURES

- 1 Site Location Map
- 2 Study Area Vicinity Plan
- 3 Area-Wide Shallow Aquifer Groundwater Contour Map – June 2009
- 4 Shallow Aquifer PCE and TCE Contamination
- 5 Lebanon Zoning and Sewer Conveyance
- 6 Proposed Soil Gas Monitoring Locations

VAPOR INTRUSION ASSESSMENT LEBANON AREAWIDE GROUNDWATER PROJECT LEBANON, OREGON

EXECUTIVE SUMMARY

This report presents the results of a vapor intrusion assessment based on groundwater data collected through April 2010 in the Lebanon Area Groundwater study area in Lebanon, Oregon (Figure 1). The site vicinity of Lebanon and the Lebanon Areawide Groundwater study area are shown on Figure 2. The purpose of this assessment is to review available groundwater data to evaluate potential risks and hazards to human health from chlorinated volatile organic compounds (cVOCs) in groundwater via the vapor intrusion pathway. Please refer to the main body of this report for additional discussions.

- Historically, shallow groundwater cVOC concentrations in the Lebanon area have exceeded Oregon Department of Environmental Quality Risk-Based Concentrations for occupational and residential vapor intrusion into buildings by orders of magnitude.
- There are multiple potential sources of cVOCs investigated within the assessment area, including three sites currently undergoing interim remedial action, that may be contributing to the risk of cVOC vapor intrusion into buildings and also possibly volatilization to outdoor air.
- Shallow groundwater depths within the assessment area average approximately 10 feet below ground surface, making volatilization from groundwater to the surface a potentially complete pathway.
- The assessment area contains residential and occupational structures, representing potentially complete exposure pathway from cVOCs in the vadose zone into buildings.
- This assessment recommends performing a screening-level soil gas sampling round at a minimum of 15 locations in Lebanon near known and potential source areas to determine if additional monitoring, delineation, or risk assessment is necessary.

1.0 INTRODUCTION

This report presents the results of a vapor intrusion assessment based on groundwater and vapor data collected through April 2010 in the Lebanon Areawide Groundwater study area in Lebanon, Oregon (Figure 1). Data evaluated includes existing data collected from the Lebanon Area Groundwater Project, Johannsen Cleaners, NuWay II Cleaners, Poly Clean, and other potential source area sites. This assessment has been prepared for the Oregon Department of Environmental Quality (DEQ) under Task 3 of Task Order 59-08-32.

1.1 Purpose

The purpose of this assessment is to identify areas within the Lebanon Areawide Groundwater study area that may pose an unacceptable risk to human health from chlorinated volatile organic compounds (cVOCs) in groundwater via the vapor intrusion pathway, warranting the need for additional vapor intrusion assessment.

1.2 Scope of Work

To assess for potential vapor intrusion risks, we reviewed and evaluated available data in general accordance with DEQ's guidance, *Risk-Based Decision Making for the Remediation of Contaminated Sites* (DEQ, 2003). Specifically, our scope of work consisted of:

- Reviewing groundwater data from the Johannsen Cleaners site, Lebanon Areawide Groundwater Project, NuWay II Cleaners site, and Poly Clean site;
- Reviewing investigation data from the Alley's Garage, Kwik Cleaners, Oregon National Guard Armory, Union Cleaners I, and Union Cleaners II;
- Delineating the magnitude and extent of groundwater contamination (tetrachloroethene [PCE] and trichloroethene [TCE]) within the study area;
- Evaluating the Lebanon Areawide Groundwater study area for the vapor intrusion risk pathway;
- Recommending future actions to further assess and/or address any identified risks; and
- Preparing this Vapor Intrusion Assessment report.

1.3 Limitations

Work performed by Hart Crowser for this project and the preparation of this report was conducted in accordance with generally accepted professional practices in the same or similar localities, related to the nature of the work accomplished at the time our services were performed. This report is for specific application to the referenced project and for the exclusive use of the Oregon DEQ. No other warranty, express or implied, is made.

2.0 BACKGROUND

This section presents a brief description of the site, its history, and previous environmental activities performed at the site.

2.1 Site Location and Description

The City of Lebanon is located in Linn County, Oregon, southeast of Albany, along Oregon State Highway 22 (Figure 1). The site vicinity of Lebanon and the Lebanon Areawide Groundwater Investigation study area are shown on Figure 2. The population of Lebanon is approximately 14,400. The City of Lebanon provides water service to most of its residents. The Santiam Canal (an off-shoot of the Santiam River, which flows northward along the east side of town) serves as the source of the municipal water supply. Many area residents also have their own groundwater wells. Most of these wells are completed in the deeper, regional alluvial aquifer. A few residential wells draw water from shallow alluvial water-bearing zones. Many of the area residents use the municipal supply for drinking water and other domestic purposes, while using their groundwater wells for lawn irrigation and other non-potable uses. Some residents have chosen not to use the city water at all and rely solely on groundwater wells for their domestic water supply.

2.2 Geology and Hydrogeology

The geology beneath the study area consists of surficial alluvium generally including unsaturated clay and silt, with variable amounts of sand and gravel. A second unit below the surficial alluvium consists of an alluvium water-bearing zone containing sand and/or gravel with varying amounts of clay and silt. This second unit is the most consistent unit encountered in the study area in terms of composition and thickness. Groundwater wells designated as "Shallow" are completed in this unit.

A third unit consisting of primarily clay and silt with variable amounts of sand and occasional secondary gravel is located directly beneath the second unit and represents the most laterally extensive confining or semi-confining layer beneath the study area. Locally, this unit includes isolated interbeds of water-bearing sand occurring primarily as thin intermittent layers. Beneath portions of the study area, the sand interbeds are of sufficient thickness and continuity to have been considered as separate aquifers. Groundwater wells designated as “Intermediate” are completed within the water-bearing zones of this third unit.

The bottom unit is an older alluvium water-bearing zone, consisting of sand and gravel with variable amounts of secondary silt and clay. Upper portions consist of silty sand in some locations. Groundwater wells designated as “Deep” are completed within this unit. Most of the residential domestic wells within the study area are completed in the “Deep” regional alluvial aquifer.

2.3 Previous Environmental Activities and Data

In the late 1980s, PCE and related breakdown products were detected in one of the City of Lebanon’s irrigation wells in Century Park during an investigation of the feasibility of expanding the municipal water supply system. The Oregon Department of Human Resources-Health Division conducted a number of sampling events to investigate the presence of PCE in the Century Park well and other wells in the vicinity (PRC, 1993). From 1994 through 2009, groundwater monitoring was completed by the DEQ from selected domestic and monitoring wells throughout the Lebanon Area Groundwater study area (Hart Crowser, 2009).

Additional investigations were performed at specific sites of potential interest from 1995 through 2008 to improve understanding of shallow cVOC sources and contaminant distribution. The Alley’s Garage preliminary assessment (PA) included three push probe locations analyzing both soil and groundwater (DEQ, 1995). No cVOCs were detected in any samples. A 2005 investigation of the National Guard Armory by the EPA included 17 push probe locations and also did not detect any cVOCs (E&E, 2006). Expanded PAs were conducted by DEQ during 1996 at the Kwik Clean, Union Cleaners I, and Union Cleaners II. The Kwik Clean PA found low levels of PCE in groundwater (PRC, 1996a). The Union Cleaners I expanded PA included 8 push probe sampling locations and found high cVOC concentrations, ranging up to 2,400 µg/L of PCE in groundwater (PRC, 1996b). The Union Cleaners II expanded PA included 5 push probe locations and found relatively low concentrations of PCE and related dechlorination products in groundwater around the building. However, additional Union Cleaners II investigations were conducted during 2008 and

found much higher cVOC concentrations in both groundwater, soil, and soil gas directly under the building (B-B&A, 2008).

Removal actions have been performed at three former dry cleaner sites within the Lebanon Areawide plume. These include the DEQ-managed NuWay II and Johannsen sites and Safeway-managed Poly Clean site. Cleanup and/or monitoring activities continue to be performed for each of these sites.

A Groundwater Beneficial Use Survey was conducted in October 2000, and included a door-to-door canvas of selected known or suspected domestic well users located within the Lebanon Area Contamination project site area (Hart Crowser, 2000b). An additional Groundwater Beneficial Use Survey was conducted in spring 2008 to expand the survey area, identify additional well users within the survey area, and to update the Lebanon Area Groundwater Contamination GIS database with current information (Hart Crowser, 2008).

In spring 2007, the United States Environmental Protection Agency (EPA) conducted an Expanded Site Inspection (ESI) of the Lebanon Groundwater Contamination site, which included sampling of 29 monitoring wells and 26 domestic wells (EPA, 2007). Because of the extensive cVOC contamination in groundwater and based on the spring 2007 EPA ESI results, the DEQ created a Lebanon Area Groundwater Contamination Geographical Information Systems (GIS) database that includes county tax lot information (including names and addresses), previous groundwater sampling data, domestic well locations, risk screening levels, and the location of water mains that could be accessed for city water hook-ups.

Currently bottled water is being provided to six residents that were identified as having PCE and TCE concentrations exceeding federal maximum contaminant levels (MCLs) for drinking water. Additionally, one residence that was discovered to have elevated levels of PCE and TCE in its well water during EPA's 2007 sampling event was connected to city water by the DEQ in November 2007. Additional city water hookups are planned for 2010.

The Oregon Public Health Division's Environmental Health Assessment Program (EHAP) completed a Health Consultation for the Lebanon Areawide study area in January 2009 (EHAP, 2009). The Health Consultation concluded that as long as residents with PCE and TCE well contamination above MCLs are using alternate water supplies (such as bottled water) the contamination should not pose a public health hazard via the inhalation and ingestion from tap water pathway. However, the EHAP stated groundwater contamination via vapor intrusion into buildings pathway may pose a health risk and should be further assessed. This vapor intrusion assessment addresses this concern.

3.0 VAPOR INTRUSION ASSESSMENT

This vapor intrusion assessment reviewed groundwater elevation data, the current and historical extent of groundwater cVOC contamination, and screening of these data to assess for current potential risk to human health via vapor intrusion. The data presented in individual site investigation reports and the June 2009 Monitoring Report, Lebanon Areawide Groundwater Investigation (Hart Crowser, 2009) was used as the basis for recent data in this assessment. The 2009 Monitoring Report compiled data from area investigations and recent domestic and irrigation well data to assess the nature and extent of cVOC groundwater contamination. Additional historical data for the Alley's Garage, Kwik Clean, Oregon National Guard Armory, Union Cleaners I, and Union Cleaners II were provided from their respective PA or ESI reports. Groundwater contouring and PCE concentration maps were prepared and are discussed in the sections below.

3.1 Water Level Data

Table 1 presents shallow groundwater monitoring well water elevations from the Lebanon Areawide wells, Johannsen Cleaners wells, NuWay II Cleaners wells, and Poly Clean wells. It includes the most recent comprehensive rounds of measurements, previous measurements, and well completion depths. The groundwater level data for June 2009 are shown and contoured for the shallow aquifer on Figure 3. Only shallow groundwater levels were assessed as cVOCs in deeper groundwater wouldn't pose a vapor intrusion risk because of the overlying shallow groundwater.

Shallow groundwater depths within the assessment area average approximately 10 feet below ground surface. Based on the data presented in Table 1, depth to groundwater in area wide investigation wells ranged between 3.6 and 10.8 feet below the top well casing (feet TOC) and averaged 7.0 feet TOC. Near the Johannsen Cleaners site, depth to groundwater ranged between 8.8 and 10.0 feet TOC and averaged 7.0 feet TOC. Near the NuWay II Cleaners site, depth to groundwater ranged between 8.42 and 13.5 feet TOC and averaged 9.9 feet TOC. Near the Poly Clean site, depth to groundwater ranged between 8.5 and 12.2 feet TOC and averaged 10.7 feet TOC. In general, the TOC in these investigation wells was within 0.5 foot of ground surface.

In general, shallow groundwater flow direction appears to be toward the north-northwest (Figure 3) with localized variances. Investigations performed at the Johannsen, NuWay II, and Poly Clean sites suggest that subsurface sewer, municipal water, or other subsurface conveyance may have a localized effect on shallow groundwater elevations and gradients. These effects include both

localized depressions due to groundwater preferentially migrating along conveyance backfill or mounding due to sewer or municipal line leakage. The areawide shallow aquifer horizontal groundwater gradient based on the June 2009 water level data was approximately 0.002 ft/ft.

Based on the measured depth to groundwater, any cVOC contamination present in groundwater could potentially migrate to the surface and pose a vapor intrusion risk. While the Johannsen and NuWay II sites have undergone groundwater remediation, cVOC that previously volatilized from groundwater may still be present in soil and present an on-going risk for vapor intrusion.

3.2 Extent of Shallow cVOC Contamination

Shallow groundwater quality in Lebanon is sampled periodically from monitoring wells and analyzed for cVOCs as part of the Johannsen, NuWay II, and Poly Clean sites. Broader water quality is monitored through the Lebanon Areawide network of monitoring wells; however, the extent of this monitoring network is limited and shallow monitoring well coverage in some areas is insufficient to delineate the magnitude and extent of contamination. In addition to groundwater as a source of cVOC contamination in unsaturated soil, releases may directly impact the vadose zone and more directly contribute to exposure risk. Sites investigated as potential sources for the PCE and TCE contamination are shown on Figure 4.

The 2009 groundwater cVOC analytical data from the Areawide Investigation and other sites were used to prepare a shallow groundwater plume map (Figure 4). The comprehensive data set used to prepare Figure 4 is presented in the June 2009 Monitoring Report, Lebanon Areawide Groundwater Investigation, dated August 21, 2009 (Hart Crowser, 2009). Due to the lack of current shallow monitoring well data in some areas, historical PCE water quality data collected from push probes are also included for previously investigated areas. These data are presented as PCE contours on Figure 4. As TCE contamination is generally associated with the PCE plume, monitoring wells with detectable TCE concentrations are identified on Figure 4.

As shown on Figure 4, PCE and/or TCE was detected during 2009 in several shallow monitoring wells in the vicinity of the Johannsen Cleaners, NuWay II Cleaners, and Poly Clean sites. Historically, PCE and/or TCE concentrations have been observed to extend approximately 70 feet northeast of the Johannsen Cleaners site, approximately 500 feet north of the NuWay II Cleaners site, and approximately 500 feet northwest of the Poly Clean site. Based on 2009 shallow monitoring well data, it appears that PCE and TCE are limited to the general vicinity of these three areas. The presence of TCE in the shallow aquifer is likely

from degradation of PCE. The Johannsen Cleaners, NuWay II Cleaners, and Poly Clean sites are currently being addressed as individual investigation and remediation projects.

Historical investigations of the Union Cleaners I, Union Cleaners II, and Kwik Clean sites have detected various cVOCs of interest. As part of the Poly Clean investigation, well PCW-13 cmt was installed on the J&D Auto Repair property and contains low levels of cVOCs near the base of the shallow aquifer. The Unions Cleaners I PA found PCE in groundwater up to 2,400 µg/L adjacent to a commercial building in 1996, with concentrations attenuating quickly with distance. The Union II expanded site investigation conducted during 2008 found much higher concentrations of cVOCs in soil and groundwater directly under the building compared to the lot surrounding the former dry cleaner. Soil gas was collected as part of this investigation and revealed cVOC concentrations several orders of magnitude above applicable RBCs and well above levels indicative of groundwater being the source of soil gas cVOCs (Table 3). The Kwik Clean expanded PA detected only low concentrations of PCE in groundwater in 1996, ranging up to 19 µg/L.

3.3 Risk Screening

Shallow groundwater cVOC concentration data through December 2009 were screened against DEQ's Risk-Based Concentrations (RBCs) for vapor intrusion and volatilization to outdoor air under both residential and occupational exposure scenarios (DEQ, 2009). A summary of recent groundwater cVOC concentrations (2009), previous maximum cVOC concentrations (prior to 2009), and potentially applicable RBCs are included in Table 2. Soil gas cVOC data collected in 2008 under the former Union Cleaners II building are presented in Table 3. Concentrations in bold indicate values exceeding one or more RBCs.

NuWay II, Johannsen, and Poly Clean are occupational use and are currently zoned as Central Business Commercial (CBC). For these properties, occupational RBCs are applicable (Figure 5). The CBC zoning is mixed-use though, as Lebanon zoning code grandfathered residential use of existing structures within the CBC zone. As a result, some properties adjacent to cVOC sources continue to be used for residential purposes. Due to the mixed-use nature of the study area, residential inhalation through vapor intrusion or volatilization to outdoor air was considered in addition to occupational exposure pathways.

Recent data indicate that cVOC concentrations in groundwater do not exceed any occupational RBCs for volatilization to indoor or outdoor air. In comparison to residential RBCs, recent data indicate that TCE exceeds residential vapor intrusion

RBCs at the Johannsen and Poly Clean sites and that VC exceeds residential vapor intrusion RBCs at the NuWay II and Johannsen sites.

Historically, PCE, TCE, and VC groundwater concentrations have exceeded one or more potentially applicable residential or occupational vapor intrusion and volatilization to outdoor air RBCs at the Johannsen, NuWay II, Johannsen, Poly Clean, Union Cleaners I, and Union Cleaners II sites.

4.0 CONCLUSIONS

Historical releases of cVOC have impacted soil and groundwater at various locations in Lebanon. The cVOC contamination has migrated with groundwater, expanding contamination across discrete sections of Lebanon. Due to the relatively shallow groundwater levels, sewer lines and utility conduits may provide preferential movement of cVOC-impacted groundwater, influencing distribution and potential areas of increased risk. Due to the volatility of cVOCs and the magnitude of observed groundwater concentrations, the dissolved-phase contaminants may have diffused into the vadose zone over time.

Risk-screening of recent groundwater data indicate that TCE and VC show potential for off-site residential RBC exceedances at the three remedial investigation sites (i.e., NuWay II, Johannsen, and Poly Clean). Groundwater concentrations at these three sites have historically exceeded occupational vapor intrusion RBCs. The age of the cVOC releases and observed migration with groundwater suggest the possibility that cVOCs from groundwater may have transferred enough mass to the vadose zone to present an on-going source of risk. While remediation of the groundwater eliminates further mass transfer, previously adsorbed cVOC mass may remain in vadose zone soils until natural attenuation or diffusion reduces soil gas cVOCs below applicable RBCs. The rate with which this occurs is variable and site-specific. Additionally, residual cVOCs may be present within vadose zone soils from the original releases, which may not be treated by groundwater remediation.

In addition to the above three sites currently known to have groundwater contamination above RBCs, historical investigations have identified the former Union Cleaners I and Union Cleaners II sites as potentially presenting unacceptable risk to current workers and off-site residents through vapor intrusion. Direct soil gas measurements under the former Union Cleaners II building suggest the possibility that soil is a source of cVOCs, rather than off-gassing of cVOCs from groundwater toward the surface. At the J&D Auto Repair property, cVOCs below vapor intrusion RBCs are present at 26 feet below ground surface. However, shallower data near the groundwater smear zone was

not available for this review, leaving a data gap to more accurately assess potential vapor intrusion risk at this site. Additionally, leaking sewer lines through which cVOCs may have been historically discharged could provide unknown point-sources of cVOCs in soil gas.

Other unidentified sources of cVOCs may also be present within the Lebanon Areawide plume. Deep aquifer water quality data collected during June 2009 suggests that additional shallow cVOC sources may be present within the study area (Hart Crowser, 2009). Due to the limited shallow monitoring well network, the nature and magnitude of any additional sources can not be confirmed. As a result, their potential contribution to vapor intrusion risk within Lebanon can not be assessed. Further investigation activities may be necessary to resolve this data gap.

5.0 RECOMMENDATIONS

The potential risks posed by cVOC inhalation from historical releases should be evaluated. To do this, a screening-level soil gas survey consisting of at least 15 sampling locations should be conducted in areas of potential interest to determine if further investigation and risk assessment is warranted. This preliminary survey should evaluate the potential for onsite occupational exposure, offsite residential exposure, and unknown but potential for exposure based on historical investigations.

Recommended sampling locations are presented on Figure 6. These locations are proposed to identify areas that may pose an on-going risk to human health. In addition to quantifying potential risk in the three current investigation areas, soil gas monitoring is proposed for areas generally near and downgradient of NuWay Cleaners I, Union Cleaners I, J&D Auto Repair, and sewer lines through which cVOCs may have been historically discharged. Confirmation and initial delineation sampling should be completed at the Union Cleaners II based on the one 2008 soil gas result.

6.0 REFERENCES

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Table 1 - Shallow Groundwater Elevations
Lebanon Areawide Groundwater Project
Lebanon, Oregon

Well Identification	Total Well Depth (ft)	Date of Measurement	Top of Casing Elevation (ft)	Depth to Water (ft)	Groundwater Elevation (ft)
Areawide Monitoring Wells					
MW-1S	22	Oct-98	345.51	7.90	337.61
		Feb-00		5.42	340.09
		Nov-00		7.15	338.36
		Jun-09		7.52	337.99
MW-2S	30	Oct-98	342.14	8.28	333.86
		Feb-00		6.89	335.25
		Nov-00		7.84	334.30
		Jun-09		8.12	334.02
MW-3S	28	Oct-98	347.78	9.56	338.22
		Feb-00		9.16	338.62
		Nov-00		9.16	338.62
		Jun-09		9.46	338.32
MW-4S	30	Oct-98	342.47	7.73	334.74
		Feb-00		6.13	336.34
		Nov-00		7.15	335.32
		Jun-09		7.96	334.51
MW-5S	23	Oct-98	341.44	10.78	330.66
		Feb-00		8.22	333.22
		Nov-00		10.47	330.97
		Jun-09		10.02	331.42
MW-6S	24	Oct-98	344.53	6.35	338.18
		Feb-00		4.20	340.33
		Nov-00		5.37	339.16
		Jun-09		6.60	337.93
MW-7S	24	Oct-98	345.84	7.92	337.92
		Feb-00		4.44	341.40
		Nov-00		6.30	339.54
		Jun-09		6.61	339.23
MW-8S	23	Oct-98	341.72	7.12	334.60
		Feb-00		4.66	337.06
		Nov-00		6.25	335.47
		Jun-09		5.83	335.89
MW-9S	23	Oct-98	340.13	4.41	335.72
		Feb-00		3.60	336.53
		Nov-00		4.05	336.08
		Jun-09		4.12	336.01
MW-10S	25	Oct-98	342.41	7.02	335.39
		Feb-00		6.02	336.39
		Nov-00		6.68	335.73
		Jun-09		7.11	335.30

Please see notes on the last page.

**Table 1 - Shallow Groundwater Elevations
Lebanon Areawide Groundwater Project
Lebanon, Oregon**

Well Identification	Total Well Depth (ft)	Date of Measurement	Top of Casing Elevation (ft)	Depth to Water (ft)	Groundwater Elevation (ft)
Johannsen Cleaners Wells					
JCW-1	18	Oct-98	348.12	9.36	338.76
		Feb-00		7.61	340.51
		Nov-00		9.04	339.08
		Jun-09		8.58	339.54
JCW-2	18	Oct-98	348.07	9.02	339.05
		Feb-00		6.96	341.11
		Nov-00		9.18	338.89
		Jun-09		8.94	339.13
JCW-3	18	Oct-98	348.07	9.01	339.06
		Feb-00		7.01	341.06
		Nov-00		9.06	339.01
		Jun-09		8.99	339.08
MW-1	25	Oct-98	347.58	8.68	338.90
		Feb-00		7.13	340.45
		Nov-00		9.29	338.29
		Jun-09		9.40	338.18
MW-2	24	Oct-98	348.02	9.98	338.04
		Feb-00		7.63	340.39
		Nov-00		9.82	338.20
		Jun-09		9.50	338.52
MW-3	24	Oct-98	347.99	9.36	338.63
		Feb-00		7.23	340.76
		Nov-00		9.48	338.51
		Jun-09		9.32	338.67
MW-4	25	Oct-98	348.04	9.18	338.86
		Feb-00		7.21	340.83
		Nov-00		9.34	338.70
		Jun-09		9.23	338.81
MW-5	24	Oct-98	347.93	9.81	338.12
		Feb-00		7.44	340.49
		Nov-00		9.98	337.95
		Jun-09		9.59	338.34
NuWay II Cleaners Wells					
MWNII-1S	22	Feb-00	345.48	9.48	336.00
		Nov-00		12.88	332.60
		Jun-09		9.35	336.13
MWNII-2S*	20	Jun-09	344.73	9.00	335.83
MWNII-3S	22	Feb-00	345.91	10.28	335.63
		Nov-00		13.52	332.39
		Jun-09		10.28	335.63
MWNII-4S	22	Feb-00	345.35	10.58	334.77
		Nov-00		12.01	333.34
		Jun-09		9.71	335.64
MWNII-5S	23	Feb-00	345.25	9.81	335.44
		Nov-00		11.46	333.79
		Jun-09		9.40	335.85

Please see notes on the last page.

Table 1 - Shallow Groundwater Elevations
Lebanon Areawide Groundwater Project
Lebanon, Oregon

Well Identification	Total Well Depth (ft)	Date of Measurement	Top of Casing Elevation (ft)	Depth to Water (ft)	Groundwater Elevation (ft)
NuWay II Cleaners Wells (Cont.)					
MWNII-6S	20	Feb-00	345.34	9.15	336.19
		Nov-00		10.39	334.95
		Jun-09		9.79	335.55
MWNII-7S	23	Feb-00	346.06	8.49	337.57
		Nov-00		9.42	336.64
		Jun-09		9.00	337.06
MWNII-8S	20	Feb-00	345.62	10.04	335.58
		Nov-00		11.66	333.96
		Jun-09		9.98	335.64
MWNII-9S	19	Feb-00	345.33	9.71	335.62
		Nov-00		11.03	334.30
		Jun-09		9.70	335.63
MWNII-10S	20	Feb-00	345.47	8.75	336.72
		Nov-00		8.55	336.92
		Jun-09		8.42	337.05
MWNII-11S	20	Jun-09	344.64	8.80	335.84
MWNII-12S	20	Jun-09	344.29	9.03	335.26
MWNII-13S	20	Jun-09	345.45	9.63	335.82
MWNII-14S	20	Jun-09	345.24	9.20	336.04
MWNII-15S	20	Jun-09	345.29	9.34	335.95
MWNII-16S*	20	Jun-09	345.42	9.61	335.92
Poly Clean Wells					
PCW-1S	21	Oct-98	348.89	8.52	340.37
		Nov-00		11.08	337.81
		Jun-09		10.92	337.97
PCW-2S	21	Oct-98	348.95	11.88	337.07
		Nov-00		12.19	336.76
		Jun-09		11.95	337.00
PCW-3S	21	Oct-98	348.39	11.91	336.48
		Nov-00		9.41	338.98
		Jun-09		10.02	338.37
PCW-4S	21	Oct-98	348.75	11.31	337.44
		Nov-00		10.95	337.80
		Jun-09		11.00	337.75
PCW-5S	21	Oct-98	348.44	10.67	337.77
		Nov-00		10.15	338.29
		Jun-09		10.51	337.93
PCW-7S	19	Jun-09	347.96	10.00	337.96
PCW-8S	15	Jun-09	348.40	9.18	339.22
PCW-9 cmt	85.5 20-20.5**	Jun-09	348.36	9.59	338.77
PCW-10 cmt	85.5 20-20.5**	Jun-09	349.18	10.66	338.52
PCW-11 cmt	95.5 25-25.5**	Jun-09	347.86	11.45	336.41

Please see notes on the last page.

Table 1 - Shallow Groundwater Elevations
Lebanon Areawide Groundwater Project
Lebanon, Oregon

Well Identification	Total Well Depth (ft)	Date of Measurement	Top of Casing Elevation (ft)	Depth to Water (ft)	Groundwater Elevation (ft)
Poly Clean Wells (Cont.)					
PCW-12 cmt	90.5 20-20.5**	Jun-09	347.81	9.60	338.21
PCW-13 cmt	95.5 26-26.5**	Jun-09	346.97	11.30	335.67

Notes:

Shallow = Shallow water-bearing zone (Unit 2).

NA = Not Applicable.

* = Non-aqueous phase liquid (NAPL) in well.

** = Screened interval monitored in multiple-screened well.

Table 2 - Maximum Recent and Historical Shallow Groundwater cVOC Detections
Lebanon Areawide Groundwater Project
Lebanon, Oregon

Site Name	Maximum Detected cVOC Concentrations in µg/L																			
	PCE				TCE				TCA				cDCE				VC			
	Recent		Historical		Recent		Historical		Recent		Historical		Recent		Historical		Recent		Historical	
	Date	µg/L	Date	µg/L	Date	µg/L	Date	µg/L	Date	µg/L	Date	µg/L	Date	µg/L	Date	µg/L	Date	µg/L	Date	µg/L
Alley's Auto Probes	NA	NR	Jun-95	<5	NA	NR	Jun-95	<5	NA	NR	Jun-95	<5	NA	NR	Jun-95	<5	NA	NR	Jun-95	<10
J&D Auto Repair (PCW-13 cmt)	Jun-09	2.52	NA	NR	Jun-09	1.23	NA	NR	NA	NR	NA	NR	Jun-09	5.3	NA	NR	Jun-09	<0.5	NA	NR
Johannsen Investigation Wells	Dec-09	19.1	Mar-99	5,800	Dec-09	45.5	Aug-08	91	NA	NR	NA	NR	Dec-09	162	Mar-07	1,100	Dec-09	49.9	Aug-08	51
Kwik Clean Probes	NA	NR	May-96	19	NA	NR	May-96	<0.5	NA	NR	NA	NR	NA	NR	NA	NR	NA	NR	NA	NR
Lebanon Areawide Investigation Wells	Dec-09	<1.0	Mar-07	30	Dec-09	<1.0	Feb-00	5.66	Dec-09	<1.0	NA	<1.0	Dec-09	<1.0	Jun-94	5.1	Dec-09	<1.0	NA	NR
National Guard Armory Probes	NA	NR	Nov-05	ND	NA	NR	Nov-05	ND	NA	NR	Nov-05	ND	NA	NR	Nov-05	ND	NA	NR	Nov-05	ND
NuWay II Investigation Wells	Dec-09	<2.5	Mar-98	3,530	Dec-09	0.73	Mar-98	1,550	NA	NR	NA	NR	Dec-09	308	Mar-98	5,260	Dec-09	76	Feb-98	810
Poly Clean Investigation Wells	Jun-09	73	May-99	1,200	Jun-09	39	Jan-05	280	NA	NR	NA	NR	Jun-09	256	Feb-06	4,740	Jun-09	2.56	Feb-06	47
Union Cleaners I Probes	NA	NR	May-96	2,400	NA	NR	May-96	2.7	NA	NR	NA	NR	NA	NR	May-96	0.65	NA	NR	May-96	<1.0
Union Cleaners II Probes	NA	NR	Jul-08	384	NA	NR	Jul-08	142	NA	NR	Jul-08	<10	NA	NR	Jul-08	239	NA	NR	Jul-08	39.5
RBC - Residential Vapor Intrusion	95				9.9				1,200,000				>S				18			
RBC - Residential Volatilization to Outdoor Air	1,800				170				>S				>S				400			
RBC - Occupational Vapor Intrusion	1,400				150				>S				>S				910			
RBC - Occupational Volatilization to Outdoor Air	9,200				870				>S				>S				6,800			

Notes:
Recent data includes all results from 2009 monitoring events. Historical data are prior to 2009.
Positively detected analytes are highlighted.
Bold concentrations exceed one or more risk standards.
PCE = Tetrachloroethylene.
TCE = Trichloroethylene.
TCA = 1,1,1-Trichloroethane.
cDCE = cis-1,2-Dichloroethene.
cVOC = Chlorinated Volatile Organic Compound.
Oregon Department of Environmental Quality's DEQ Risk-Based Concentrations (RBCs) for Individual Chemicals, September 15, 2009.
< = Not detected at concentration above method reporting limit (MRL). MRLs are not reported for data from sampling events conducted by other prior to 5/97.
ND = Not detected; MRL not reported.
NR = Concentrations for analyte not presented in available reports.
NA = Not applicable.
J&D Auto Repair data collected as part of the Poly Clean Site work as well PCW-13 cmt screened from 26.0 to 26.5 feet below ground surface.
Lebanon Areawide Investigation Wells includes data from private wells having unknown completion depths.
Union Cleaners II data from Bergeson-Boese & Associates October 2, 2008 report.

Table 3 - Maximum Historical Soil Gas cVOC Detections
Lebanon Areawide Groundwater Project
Lebanon, Oregon

Site Name	Maximum Detected cVOC Concentrations in $\mu\text{g}/\text{m}^3$									
	PCE		TCE		TCA		cDCE		VC	
	Date	$\mu\text{g}/\text{m}^3$	Date	$\mu\text{g}/\text{m}^3$	Date	$\mu\text{g}/\text{m}^3$	Date	$\mu\text{g}/\text{m}^3$	Date	$\mu\text{g}/\text{m}^3$
Union Cleaners II	Jul-08	79,000	Jul-08	160,000	Jul-08	<5,000	Jul-08	490,000	Jul-08	79,000
RBC - Residential Vapor Intrusion	82		5.4		1,000,000		>Pv		33	
RBC - Occupational Vapor Intrusion	2,100		140		22,000,000		>Pv		2,800	

Notes:

Positively detected analytes are highlighted in yellow

Bold concentrations exceed one or more risk standards.

PCE = Tetrachloroethylene.

TCE = Trichloroethylene.

TCA = 1,1,1-Trichloroethane.

cDCE = cis-1,2-Dichloroethene.

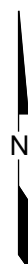
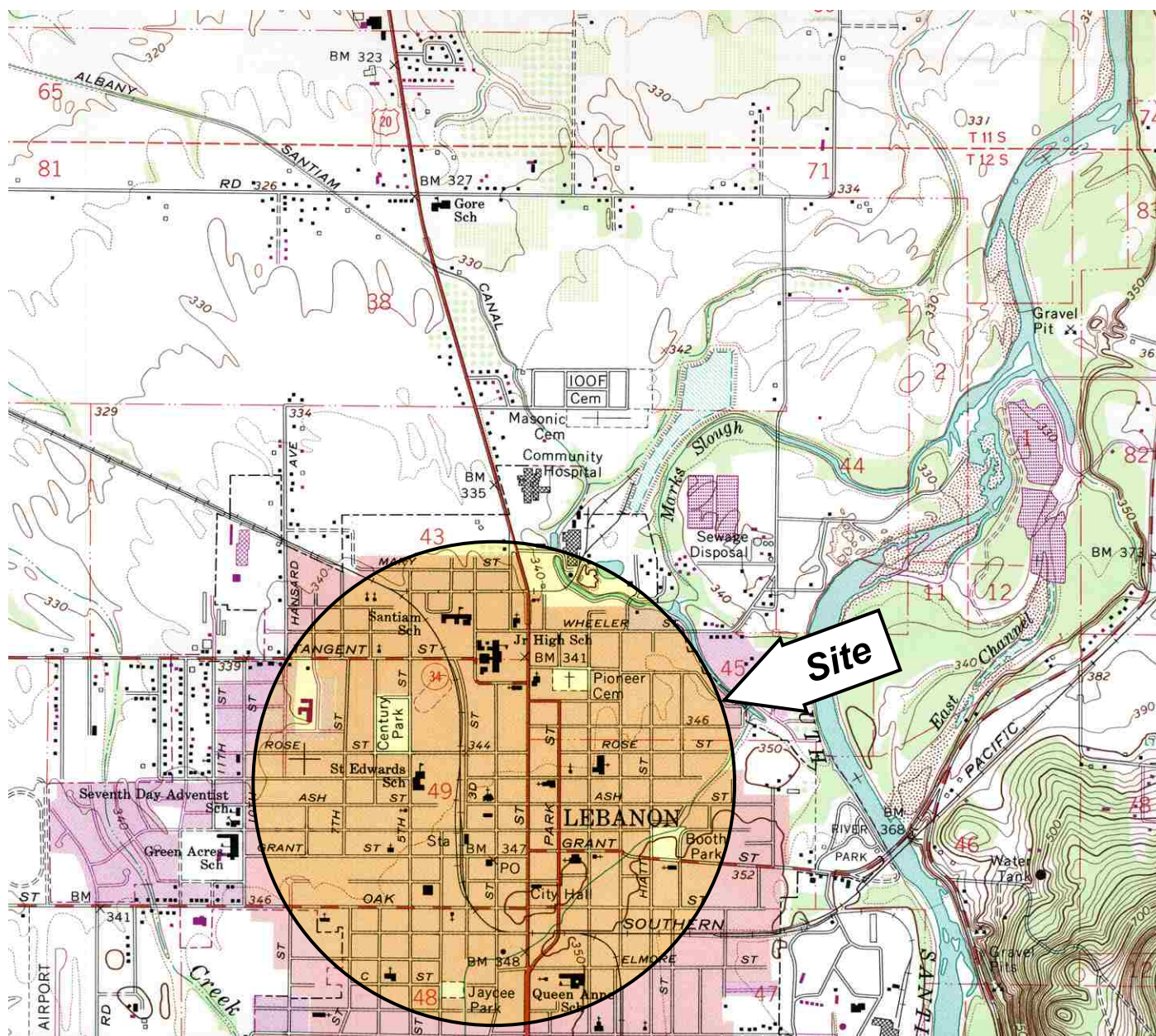
cVOC = Chlorinated Volatile Organic Compound.

Oregon Department of Environmental Quality's DEQ Risk-Based Concentrations (RBCs) for Individual Chemicals, September 15, 2009.

< = Not detected at concentration above method reporting limit (MRL).

>Pv = Air concentration exceeds the vapor pressure of pure product.

Union Cleaners II data from Bergeson-Boese & Associates October 2, 2008 report.



0 2,000 4,000
Scale in Feet

Lebanon Area Groundwater Investigation
Lebanon, Oregon

Site Location Map

5645-04/Task 3

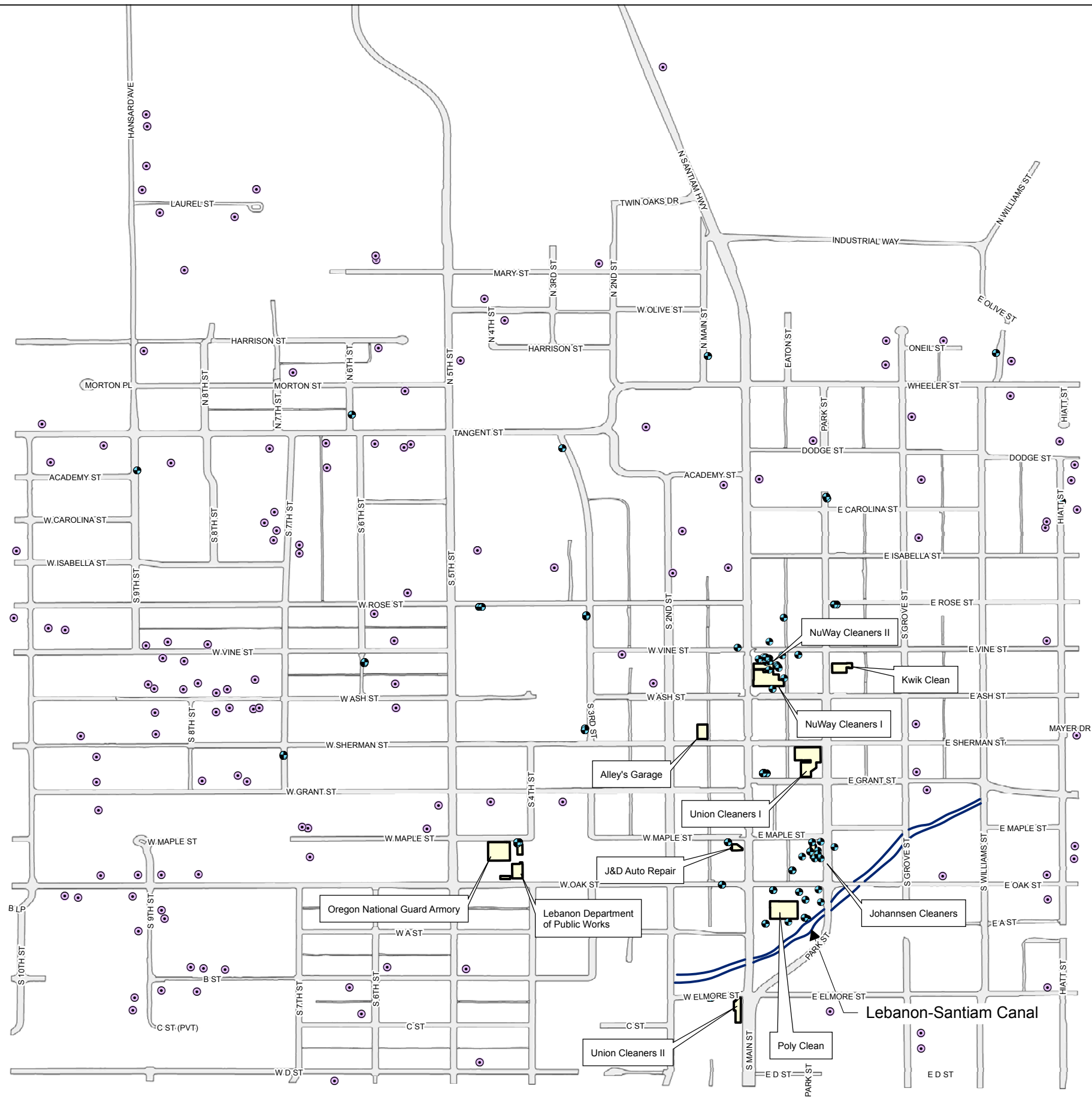
8/10

HARTCROWSER

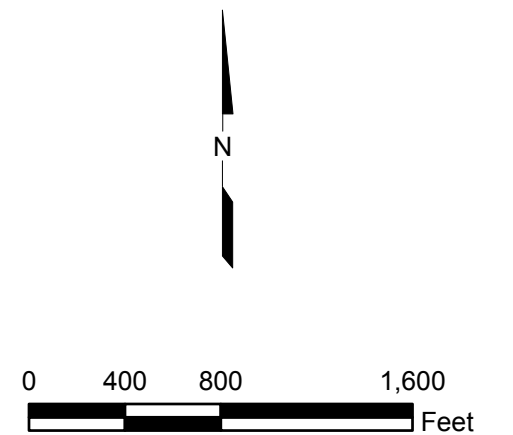
Figure

1

Source: Base map prepared from the USGS 7.5-minute quadrangle of Lebanon, Oregon, photorevised 1986.



- Monitoring Well Location
- Domestic Well Location



Lebanon Area Groundwater Investigation Lebanon, Oregon	
Study Area Vicinity Plan	
5645-04/Task 3	8/10
 HARTCROWSER	Figure 2

