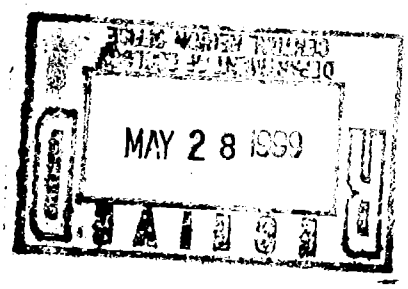

COMPLIANCE MONITORING PLAN

FOR

NEW CITY CLEANERS
RICHLAND, WASHINGTON

Submitted to

Washington State Department of Ecology

Prepared for

Copeland, Landye, Bennett and Wolf, LLP

May 25, 1999

Prepared by

EMCON
West 7106 Will D. Alton Lane, Suite 102
Spokane, Washington 99224

Project 40358-016.004(10)

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1 INTRODUCTION

The purpose of this compliance monitoring plan is to provide procedures to be followed to monitor groundwater concentrations and document natural attenuation of contaminants at the New City Cleaners Site, in Richland, Washington. This compliance monitoring plan was prepared consistent with the requirements of Enforcement Order No. DE 96TC-C180 between Paul and Bettie Haverluk, dba New City Cleaners, and the Washington State Department of Ecology (Ecology). This plan was also prepared in accordance with the Model Toxics Control Act (MTCA)[1] regulation (MTCA; WAC 173-340-410, -720, and -820).

This plan has been organized into seven sections as described below:

- **Introduction.** Overview of the site hydrogeology and monitoring objectives and rationale are provided in this section.
- **Confirmational Monitoring.** This section discusses compliance criteria, monitoring well installation, groundwater monitoring, sampling and analysis, and schedules for confirmational monitoring.
- **Data Evaluation.** Data validation and evaluation procedures are discussed in this section.
- **Reporting.** This section discusses the types and frequency of reports to be submitted to Ecology and the procedures that will be used to abandon the groundwater monitoring wells, after confirmational monitoring has been completed.

Attached to the plan is a Sampling and Analysis Plan (Appendix A). The Sampling and Analysis Plan describes procedures for sampling and monitoring activities, and identifies quality assurance procedures to be implemented during sampling activities and laboratory analyses.

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1 Chapter 173-340 WAC, "The Model Toxics Control Act Cleanup Regulation; Method A Cleanup Levels." Amended January 1996.

1.1 Overview of Site Hydrogeology

Four hydrostratigraphic units have been identified at the site: unsaturated fill and silty sand, upper silt aquitard, gravelly sand aquifer, and lower sand aquitard.

Groundwater elevations in monitoring wells installed in the gravelly sand aquifer appear to fluctuate at least 1 foot seasonally. Groundwater flow directions in the gravelly sand aquifer were based on monthly groundwater elevations measured in the four on-site and two off-site monitoring wells during May to November 1997. The groundwater elevation map for November 1997 (Figure 2) indicates a general northeasterly groundwater flow direction during periods of both seasonally high and seasonally low groundwater elevations. Based on these elevations, the average horizontal hydraulic gradient for the site is 0.0033 ft/ft. Based on the horizontal hydraulic conductivity and gradient data, the average horizontal groundwater velocity in the gravelly sand aquifer is 0.3 feet per day.

Unsaturated Fill and Silty Sand. The fill and silty sand units comprise the majority of the unsaturated soil beneath the site. Portions of excavated backfill may be saturated below 8 feet below ground surface (bgs).

Upper Silt Aquitard. The upper silt aquitard is a low permeability layer that partially confines underlying aquifer. The upper silt aquitard is saturated below 8 feet bgs. Downward vertical migration of surficial contaminant releases (former drum rack, dumpster, etc.) and surface precipitation is impeded by the aquitard. Limited quantities of groundwater exist, and groundwater flow velocities are expected to be low (less than 0.1 feet per day).

Gravelly Sand Aquifer. The gravelly sand aquifer is partially confined by the overlying aquitard. The majority of groundwater beneath the site occurs in the aquifer. The aquifer likely is hydraulically connected to the Columbia River, and is the same aquifer used for domestic water supply at the Wellsian Way well field.

Lower Silt Aquitard. The lower silt aquitard forms an impermeable base to the overlying aquifer, impeding downward vertical flow from the aquifer. The lower silt aquitard was not encountered during previous investigations, but reportedly is regionally extensive (Huntingdon, 1993).

1.2 Groundwater Monitoring Objectives and Rationale

Monitoring locations and types of analyses were selected to monitor the effectiveness of the interim cleanup actions (soil excavation) at meeting the groundwater cleanup standards for the site and to document natural attenuation of groundwater contaminants. New monitoring wells MW-3R and MW-5 will be installed to replace existing wells

MW-3 and MW-1, respectively (Figure 1), which will be abandoned prior to the excavation phase of the remedial action. Well MW-3R will be installed in the same location as existing well MW-3. Well MW-5 will be installed in the southwest corner of the property, approximately 25 feet southwest of existing well MW-1. Well MW-5 will be located hydraulically upgradient of the site. Groundwater will be monitored for volatile organic compounds (VOCs).

2 CONFIRMATIONAL MONITORING

The objective of confirmational monitoring is to monitor groundwater concentrations and document natural attenuation of VOC concentrations in groundwater. This section contains the procedures used to monitor groundwater concentrations.

2.1 Well Installation

As part of the confirmational monitoring program, new monitoring wells (MW-3R and MW-5) will be installed (Figure 1). The 2-inch-diameter wells will be screened across the water table, in accordance with WAC 173-360. Ecology will be notified seven days in advance of the well installation activities at the site. Detailed procedures for residuals management and well installation are presented in the Sampling and Analysis Plan (Appendix A).

2.2 Compliance Levels

Groundwater cleanup levels are based on MTCA Method A groundwater cleanup levels (WAC 173-340-720).

- The groundwater cleanup level for tetrachloroethene (PCE) is 0.005 milligrams per liter (mg/L).
- The groundwater cleanup level for trichloroethene (TCE) is 0.005 mg/L.

2.3 Sampling, Analysis, and Schedule

Sample Collection. Ecology will be notified seven days in advance of any sample collection or work activity at the site. Groundwater samples will be collected from on-site wells MW-2 through MW-5 and off-site wells MW-D, and MW-E (Figure 2) by using low flow sampling techniques. The well will be purged at a low flow rate by using a peristaltic pump fitted with disposable polyethylene tubing. Purging will continue until field parameters have stabilized. Groundwater samples will then be collected with new disposable bailers. The groundwater levels will be measured before each sampling event.

Sample Analysis. All groundwater samples collected will be submitted to a State of Washington accredited laboratory. During each sampling event, the groundwater samples will be analyzed for VOCs.

Sampling and Analysis Procedures. Detailed procedures for groundwater sampling, sample handling, residuals management, sample analysis, and quality assurance are presented in the Sampling and Analysis Plan (Appendix A).

Schedule. Groundwater sampling will begin within 90 days following the completion of the interim cleanup actions and will continue for at least five years. Sampling will occur quarterly for the first two years. The data will be reviewed after the first two years. If groundwater quality data indicates that contaminant levels are below cleanup levels or that the groundwater concentrations are decreasing, upon review and approval by Ecology, the groundwater sampling will be continued on a semiannual basis for an additional three years. If, at the end of the two-year period, groundwater quality data indicate that contaminant levels are above cleanup levels and are not decreasing, the groundwater sampling frequency and the need, if any, for further actions will be discussed with Ecology.

The data will also be reviewed after the first five years. If groundwater contaminant levels are below cleanup levels, upon review and approval by Ecology, the groundwater sampling will be discontinued and the monitoring well will be abandoned. If, after five years, the groundwater contaminant levels are shown to be above the cleanup levels, the groundwater sampling frequency and the need, if any, for further actions will be discussed with Ecology.

2.4 Well Abandonment

If, after the five-year period, groundwater quality data indicates that VOC concentrations are below cleanup levels, following approval by Ecology, the wells will be abandoned per WAC 160-560. If, after the five-year period, groundwater quality data indicates VOC concentrations above the cleanup levels, the groundwater sampling frequency and the need, if any, for further actions will be discussed. Detailed procedures for well abandonment are presented in the Sampling and Analysis Plan (Appendix A).

3 DATA EVALUATION

3.1 Data Validation

All chemistry data will be validated according to United States Environmental Protection Agency (USEPA) data validation guidelines (USEPA, 1994a and 1994b). Data validation will include evaluation of holding times, method blank results, surrogate recovery results, field and laboratory duplicate results, completeness, detection limits, laboratory control sample results, and chain-of-custody forms. A detailed description of the data validation procedures is provided in the Sampling and Analysis Plan (Appendix A). After the data has been validated, it will be entered into the project database with any assigned data qualifiers.

3.2 Data Evaluation

3.2.1 Practical Quantitation Limits

WAC 173-340-707(2) states that if the Practical Quantitation Limit (PQL) for any constituent is above the corresponding cleanup level, the cleanup level will be considered to be attained if the constituent is undetected at the PQL or detected below the PQL. The cleanup levels for VOCs are above the PQLs.

3.2.2 Groundwater Chemistry Data Review

Confirmational Monitoring Data. Groundwater chemistry data will be reviewed after it is validated. The data will be evaluated for indications of natural attenuation of VOC concentrations in groundwater. Groundwater elevation data will be entered into the project database for use in the routine reports, the two year review, and the five year review.

3.2.3 Two Year Site Review

Groundwater elevation and chemistry data will be evaluated after the first two years of sampling. Groundwater VOC data will be evaluated using time-trend plots and data comparison to the cleanup levels. Time-trend plots will be prepared and trends will be identified by visual observation. If necessary, statistical analysis will be performed per WAC 173-340-720(8) and Ecology (1992, 1993, and 1995) using MTCA*Stat* to identify the trends in groundwater VOC concentrations. The time-trend plots will be used to evaluate long-term trends in the wells and to put the comparisons to cleanup levels in context.

The evaluation will be reviewed. If concentrations exceed cleanup levels and are not decreasing, the groundwater sampling frequency and the need, if any, for further actions will be discussed with Ecology. If concentrations are below cleanup levels or are decreasing, upon review and approval by Ecology, the sampling frequency will be reduced to semiannual.

3.2.4 Five Year Site Review

Groundwater elevation and chemistry data will be evaluated after the first five years of sampling. Groundwater VOC data will be evaluated using time-trend plots, data comparison to cleanup levels, and, if appropriate, statistical analysis using MTCA*Stat.* Time-trend plots will be prepared and trends will be identified by visual observation. The time-trend plots will be used to evaluate long-term trends in the compliance wells and to put the comparisons to cleanup levels and statistical analyses, if performed, in context.

The evaluation will be reviewed. If concentrations exceed cleanup levels and are not decreasing, the groundwater sampling frequency and the need, if any, for further actions will be discussed with Ecology. If concentrations are below cleanup levels, upon review and approval by Ecology, the sampling will be discontinued and the wells will be abandoned.

4 REPORTING

Compliance monitoring data will be submitted to Ecology throughout the monitoring program. Data will be submitted in the following reports:

- **Routine Data Reports.** Routine data reports will be prepared following each sampling event. The reports will be submitted to Ecology by the 30th day of the month following the quarter in which the sampling was conducted. The data report will include the laboratory report, a data validation memo, updated groundwater chemistry tables, updated groundwater elevation tables, and a potentiometric surface map.

- **Two-year Review Report.** A report will be submitted to Ecology summarizing the two-year review of the compliance monitoring data. The report will be submitted to Ecology by the 30th day of the month following the second year of monitoring. The report will include the laboratory report and data validation memo for the latest monitoring event, updated groundwater elevation tables, updated groundwater chemistry tables, time-trend plots, statistical analysis of the data, a potentiometric surface map for the latest monitoring event, and a comparison of the data to cleanup levels.

- **Five-year Review Report.** A report will be submitted to Ecology summarizing the five-year review of the compliance monitoring data. The report will be submitted to Ecology by the 30th day of the month following the fifth year of monitoring. The report will include the laboratory report and data validation memo for the latest monitoring event, updated groundwater elevation tables, updated groundwater chemistry tables, a potentiometric surface map for the latest monitoring event, time-trend plots, a comparison of the data to cleanup levels, and statistical analysis of the data.

LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

REFERENCES

Ecology. 1992. *Statistical Guidance for Ecology Site Managers.* Publication No. 92-54. August.

Ecology. 1993. *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below PQL Values (Censored Data Sets).* August.

Ecology. 1995. *Guidance on Sampling and Data Analysis Methods.* Publication No. 94-49. January.

U.S. Environmental Protection Agency. 1994a. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* USEPA Office of Solid Waste and Emergency Response.

U.S. Environmental Protection Agency. 1994b. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* USEPA Office of Solid Waste and Emergency Response.

FIGURES

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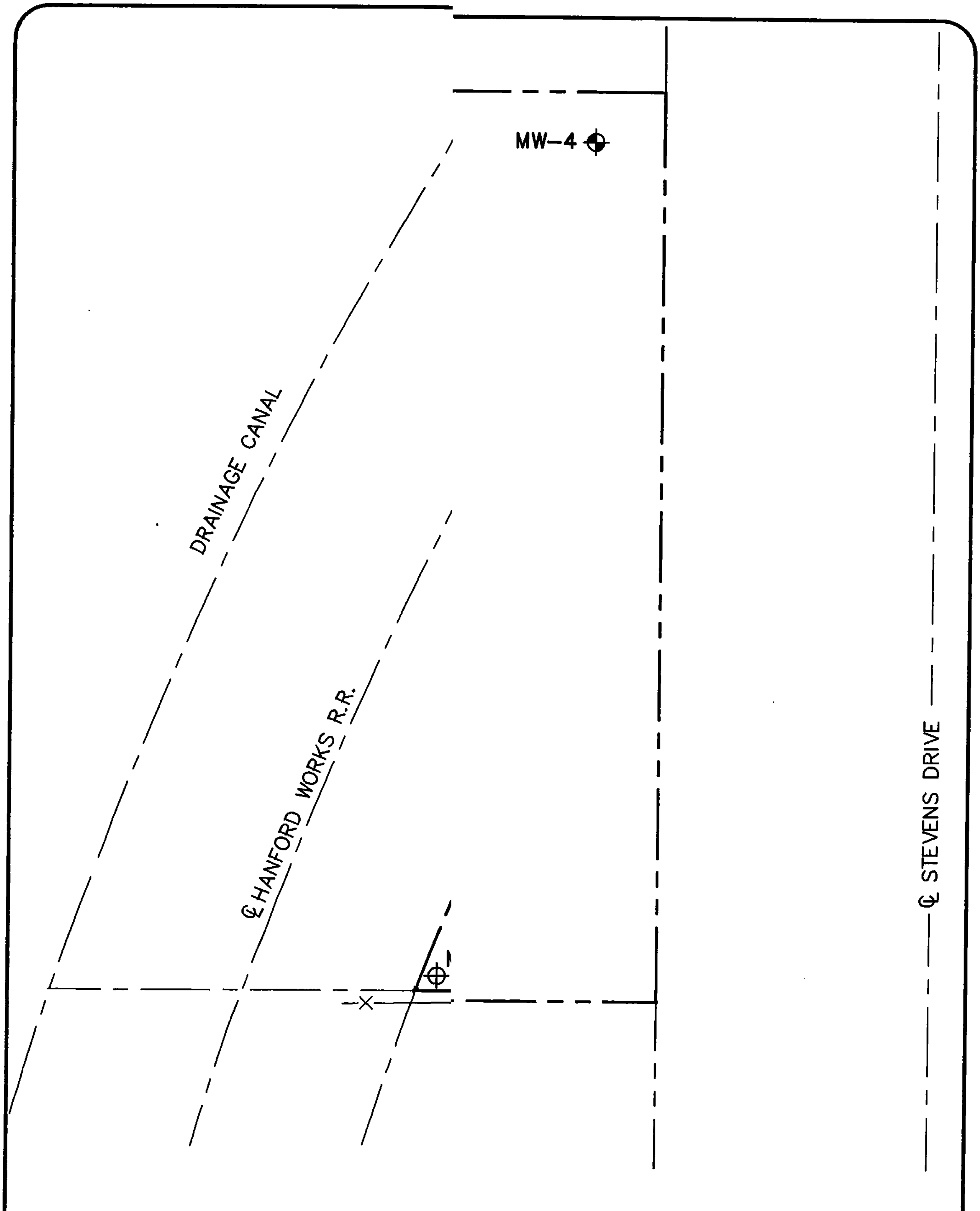
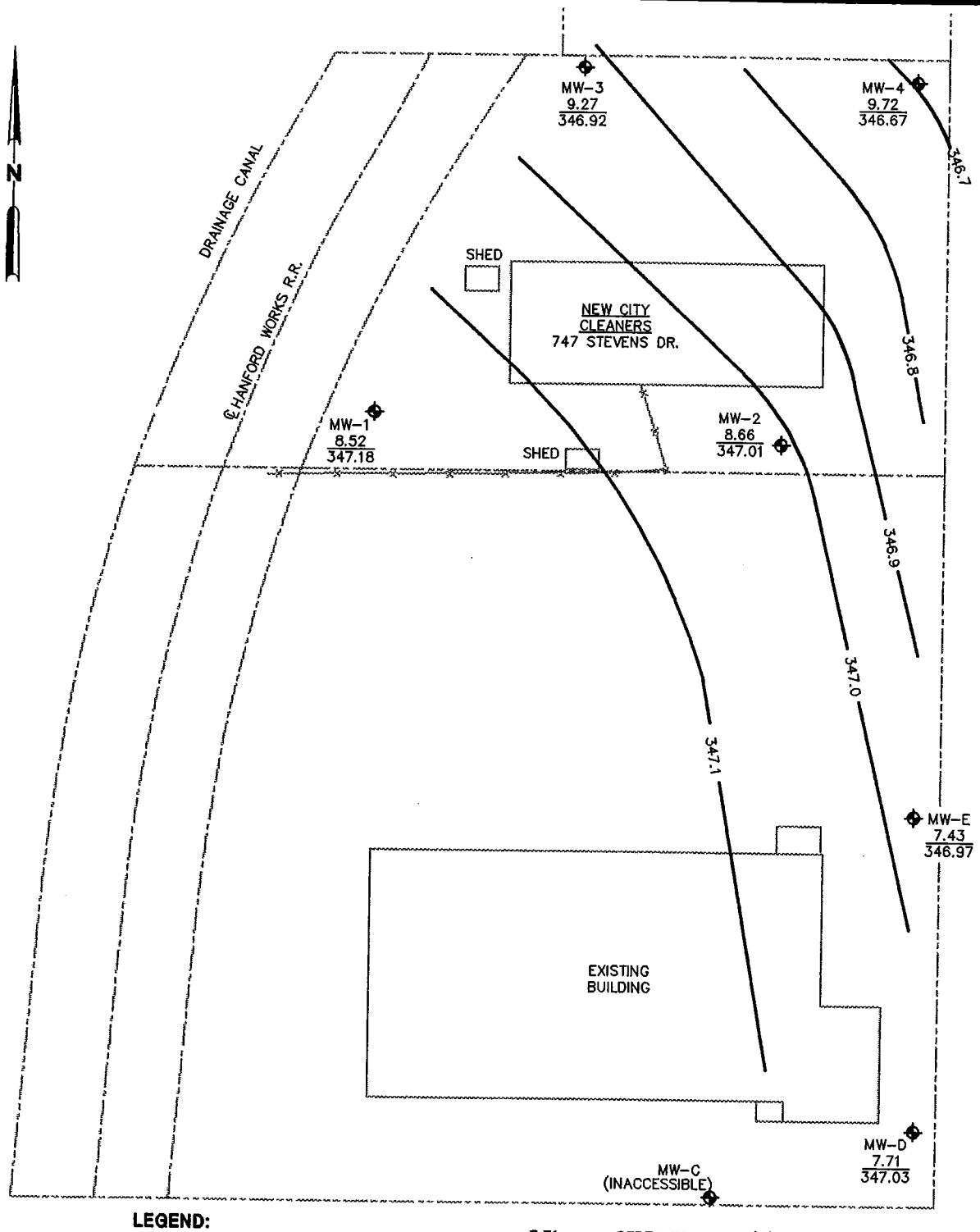


EMCON

FIGURE 1
NEW CITY CLEANERS
747 STEVENS DRIVE
RICHLAND, WASHINGTON

SITE MAP



LEGEND:

MW-1 ⊕ MONITORING WELLS

—346.9— GROUNDWATER CONTOUR LINE AND ELEVATION

——— PROPERTY LINE

FENCE

7.71 / 347.03 DEPTH TO WATER (ft) / GROUNDWATER ELEVATION (ft)

0 50 100

SCALE (ft)

EMCON

DATE 5/98
DWN
APP KK
REV
PROJECT NO.
40358-016.004

FIGURE 2
NEW CITY CLEANERS
747 STEVENS DRIVE
RICHLAND, WASHINGTON
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(NOVEMBER, 1997)

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APPENDIX A

SAMPLING AND ANALYSIS PLAN

SAMPLING AND ANALYSIS PLAN

FOR

NEW CITY CLEANERS, RICHLAND, WASHINGTON

Prepared for

Washington State Department of Ecology

May 25, 1999

Prepared by

EMCON
West 7106 Will D. Alton Lane, Suite 102
Spokane, Washington 99224

Project 40358-016.004 (10)

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End of Plan

Tables

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1 INTRODUCTION

The purposes of this Sampling and Analysis Plan are to (1) specify procedures for field sampling and monitoring activities described in the Compliance Monitoring for the New City Cleaners site, in Richland, Washington, (2) identify quality assurance (QA) procedures to be implemented during sampling activities and laboratory analyses, and (3) meet the requirements of the Model Toxics Control Act (MTCA)[1] for sampling and analysis plans (WAC 173-340-820).

The sampling and analysis plan is organized into four sections:

- **Introduction.** This section provides an overview of the Sampling and Analysis Plan.
- **Field Sampling Plan.** This section identifies the sampling locations and presents the procedures to be used during field sampling activities. Included are procedures for: groundwater sample collection; sample labeling, shipping and chain-of-custody; monitoring well installation and sampling; decontamination; residuals management; and monitoring well abandonment.
- **Quality Assurance Project Plan.** This section identifies the QA procedures for field activities and laboratory analyses.
- **Field Forms.** Forms and an equipment list to be used during field activities are provided in this section.

[1] Chapter 173-340 WAC, "The Model Toxics Control Act Cleanup Regulation; Method A Cleanup Levels." Amended January 1996.

2 FIELD SAMPLING PLAN

2.1 Overview

The objectives of the field compliance monitoring activities will be to provide data of sufficient quality and quantity to monitor the natural attenuation of contaminant concentrations in the groundwater. Field compliance monitoring activities will include measuring groundwater levels and collecting groundwater samples.

2.2 Sample Locations, Frequency, and Analyses

2.2.1 Soil Samples

The installation of monitoring wells MW-3R and MW-5 will consist of drilling two soil borings to a depth of approximately 32 feet below ground surface (bgs). Both wells will be advanced in the clean backfill placed following the excavation activities associated with the remedial action. MW-3R will be installed in the same location as former well MW-3. MW-5 will be installed in the southwest corner of the site, as shown on Figure 1 of the Compliance Monitoring Plan. Soil samples will not be collected during the well installation activities.

2.2.2 Groundwater Samples

Groundwater samples will be collected from on-site monitoring wells MW-2, MW-3R, MW-4, MW-5 and off-site wells MW-D and MW-E. The well locations are shown on Figure 2 of the Compliance Monitoring Plan. Samples will be collected quarterly for the first two years. If groundwater concentrations are below cleanup levels or concentrations are decreasing, upon review and approval by the Washington State Department of Ecology (Ecology), the sampling frequency will be reduced to semiannual for an additional three years. If groundwater concentrations are above cleanup levels and are not decreasing, the groundwater sampling frequency and the need, if any, for further actions will be discussed with Ecology. After five years of sampling, the groundwater sampling will be discontinued if the concentrations are below cleanup levels and the wells will be abandoned following review and approval by Ecology (see Section 2.5). If

the concentrations are above cleanup levels, the groundwater sampling frequency and the need, if any, for further actions will be discussed with Ecology.

All groundwater samples will be submitted to a State of Washington accredited laboratory for analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method 8021B (USEPA, 1996). Dissolved oxygen, conductivity, temperature, and pH will be measured with field probes. The objectives for laboratory and field analyses are presented on Tables 1 and 4, respectively. The laboratory deliverables requirements and the data validation parameters are presented on Tables 2 and 3, respectively.

2.3 Sample Designation

Groundwater samples will be labeled with the monitoring well designation and a date suffix. The date suffix will include the month and year. For example, MW-5-0699 would represent the water sample collected from MW-5 in June 1999. Duplicate samples will be labeled similar to groundwater samples but with a fictitious well number (e.g., MW-6-0699). Trip blanks will be identified as such with a date suffix (e.g., TB1-0699). Extra samples collected for laboratory duplicate and matrix spike and matrix spike duplicate (MS/MSD) analyses will be identified with the same designation as the sample.

2.4 Drilling Procedures

2.4.1 Drilling Procedures

Two soil borings will be drilled for the purpose of installing groundwater monitoring wells MW-3R and MW-5. All drilling will be performed in accordance with WAC 173-160, *Minimum Standards for Construction and Maintenance of Wells.* Prior to drilling, the drilling locations will be checked for the presence of underground utilities and structures. The soil boring locations may be moved due to underground utilities or underground structures. The field geologist may approve minor relocations and will notify the project manager before drilling commences. Major relocations from the original boring location will require approval by the project manager, the qualified environmental engineer, and Ecology before drilling commences.

The soil borings will be drilled with an auger drilling rig equipped with 4¼-inch inside diameter hollow-stem-auger flights. All downhole drilling equipment will be decontaminated prior to use as described in Section 2.8. If the addition of water to the borings is necessary to control heaving conditions, only potable water will be used. All

residual soil and water collected during drilling will be handled and disposed of following the procedures described in Section 2.6.

2.4.2 Monitoring Well Installation

The soil borings will be completed with monitoring wells MW-3R and MW-5. The wells will be constructed of 2-inch I.D. flush-threaded Schedule 40 PVC, including a threaded end cap. The wells will be constructed using screen up to 15 feet long with machined 0.010-inch slots, and will be screened across the water table. The depth of the screened interval will be decided by the field geologist. A filter pack of Colorado Silica™ 20-40 sand will be placed from approximately 6 inches below, to approximately 36 inches above the screen. A hydrated bentonite chip seal will be placed above the sand pack to within 1.5 feet bgs. An flush-mounted monument will be cemented in-place. The wellhead will be sealed with a water-tight well cap.

After installation, the wells will be surged and developed to remove accumulated sediment and improve the flow of formation water to the well screen. A stainless steel bailer will be lowered with new rope to surge and develop the well. The bailer will be decontaminated prior to use in accordance with Section 2.8. Field parameters including pH, conductivity, dissolved oxygen, and temperature will be collected. A minimum of 20 well casing volumes of groundwater will be purged until the turbidity of the development water is greatly reduced or the field parameters stabilize. Management of development water is discussed in Section 2.6.

2.4.3 Groundwater Sampling

To collect a groundwater sample, polyethylene tubing will be lowered to a point approximately 2 feet below the water level in the well. Groundwater will then be slowly extracted by using a peristaltic pump. After purging is complete, a groundwater sample will be collected by placing the sample in the appropriate groundwater sample containers as described below.

Groundwater samples will be collected using the following procedures:

1. The groundwater level in the well will be measured before the sampling event. Water levels will be measured to the nearest 0.01 foot from the tops of the well casings by using an electric well probe. Water depths will be recorded on a Field Sampling Data Form (Figure 3) and will include date and time.

2. The monitoring well will be purged with a peristaltic pump fitted with high density polyethylene tubing and silicone tubing at the pump head. The tubing intake will be placed approximately two feet below the water table in each well.

3. The well will be purged at a low flow rate (1 liter per minute or less) to minimize water level drawdown and the amount of suspended solids generated. Management of purge water is discussed in Section 2.6.

4. Water levels in the well, discharge rates, and field parameters (dissolved oxygen, pH, conductivity, and temperature) will be measured and recorded on the Field Sampling Data Form as frequently as possible during purging.

5. The well will be purged until specific conductance and dissolved oxygen measurements are stable (±10 percent) for three consecutive readings. Measurements will be recorded to the following standards: dissolved oxygen to 0.05 milligrams per liter (mg/L); pH to ±0.01 units; specific conductance to ±1 µS/cm (measured specific conductance ≤99 µS/cm), to ±10 µS/cm (99 µS/cm < specific conductance <1,000 µS/cm), or to ±100 µS/cm (measured specific conductance >1,000 µS/cm); and temperature to ±0.5°C. The pH/conductivity meter and the dissolved oxygen meter will be calibrated at the beginning of each sampling day.

6. After parameter stabilization, groundwater samples will be collected with new disposable bailers and transferred into a container prepared by the analytical laboratory for the given parameters. Duplicate samples will be collected by alternately filling the sample and duplicate sample bottles. If samples are to be split with Ecology, the procedures outlined in Section 2.7 will be followed.

7. Decontamination procedures are described in Section 2.8. The sampler(s) will wear clean or new nitrile, vinyl, or neoprene gloves and new pump tubing will be used.

8. Samples will be labeled, handled, and shipped using the procedures described in Section 2.10. Sample custody will be maintained until delivery to the analytical laboratory. All sampling field activity and data will be recorded on a Field Sampling Data Form.

2.5 Well Abandonment

The wells will be abandoned per the requirements of WAC 173-160-560. The surface security casing will be removed, and the well casing will be filled with bentonite chips or bentonite grout. If grout is used, it will be pumped to the base of the well casing through a tremie pipe to displace water in the casing from the bottom up. Bentonite chips placed above the water table will be hydrated with water. If possible, the upper piece of well casing will be removed at the end of abandonment. The upper 2 feet of the well or hole will be sealed with concrete or gravel, depending on the surrounding surficial material.

2.6 Residuals Management

All drill cuttings, development water, purge water, and used decontamination solutions will be handled appropriately. A composite soil sample will be collected from the drill cuttings for disposal purposes. Residuals will be managed in accordance with all applicable local, state, and federal requirements. Used disposable clothing and equipment will be handled as solid waste. Appropriate personal protective clothing will be worn during residuals transfers because of potential skin contact and splash hazards. The following residuals management procedures will be used:

- The drill cuttings generated during well installation will be placed in 55-gallon drums pending off-site disposal.
- All water generated during well development, sampling, and decontamination activities will be placed in 55-gallon drums pending off-site disposal.
- Drums will be labeled with the date when filled, the sampling location from which the contents were collected, and a description of the contents (including approximate quantity).
- The drill cuttings will be transported to an approved disposal facility.
- All water wastes will be transported to an approved disposal facility.
- A record of all generated residuals stored in drums will be maintained to expedite characterization and disposal upon completion of field activities.
- Disposable clothing and equipment will be placed in plastic bags and disposed of as solid waste.

2.7 Guidelines for Splitting Samples

If requested by Ecology, the qualified environmental engineer will provide for the collection of split or replicate groundwater samples. The following sample splitting procedures will be followed:

- Samples will be collected as described in Section 2.4.
- If the well produces sufficient water for collecting a split sample, then either Ecology (or Ecology's representative) or the qualified environmental engineer will collect a split sample in conjunction with the sample collected by the qualified environmental engineer, alternately filling like bottles. The qualified environmental engineer will record the number and type of bottles collected by

Ecology, Ecology's sample designation, and the analyses to be performed on the split sample.

- If the well produces insufficient water for collecting a split sample, then the well will be allowed to recover after the qualified environmental engineer collects a sample, and either Ecology (or Ecology's representative) or the qualified environmental engineer will then collect the split sample.

- Under no circumstances will sample splitting compromise the sampling being performed by the qualified environmental engineer.

2.8 Decontamination Procedures

A decontamination area will be established for cleaning the drilling rig. All downhole drilling equipment and the working area of the drill rig will be steam-cleaned or hot water pressure-washed before beginning drilling.

The following decontamination procedures will be used for well development equipment:

- Tap water rinse
- Hexane rinse (if equipment is visibly oily)
- Tap water rinse
- Non-phosphatic detergent (Liquinox) and tap water wash
- Tap water rinse
- Dilute nitric acid rinse (pH <2) if split-spoon sampler or sampling spoons are visibly rusty
- Distilled water rinse

The electronic well probe will be rinsed with distilled water between uses. Decontamination of personnel involved in sampling activities will be accomplished as described in the Health and Safety Plan to be prepared by the qualified environmental engineer.

2.9 Sampling Procedure Alterations

Deviations from the general sampling procedures presented here will be brought to the attention of the project manager, and a Sample Alteration Checklist will be filled out (Figure 4).

2.10 Sample Labeling, Shipping, and Chain-of-Custody

2.10.1 Sample Labeling

Sample container labels will be completed immediately before or immediately after sample collection. Container labels will include the following information:

- Project name and number
- Sample number
- Name or initials of collector
- Date and time of collection
- Analyses requested

2.10.2 Sample Shipping

Water and soil samples will be shipped to a State of Washington accredited laboratory as follows:

- Sample containers will be transported in a sealed, iced cooler.
- In each shipping container, glass bottles will be separated by a shock-absorbing and absorbent material to prevent breakage and leakage.
- Ice or "blue ice," sealed in separate plastic bags, will be placed into each shipping container with the samples.
- All sample shipments will be accompanied by a Chain-of-Custody/Laboratory Analysis Request Form (Figure 5). The completed form will be sealed in a plastic bag and taped to the inside lid of the shipping container.
- Signed and dated chain-of-custody seals will be placed on all shipping containers.

- The analytical laboratory's name and address and the sampling company's name and office (return) address will be placed on each shipping container prior to shipping.

2.10.3 Chain-of-Custody

Once a sample is collected, it will remain in the custody of the sampler or other company personnel until shipment to the laboratory. Upon transfer of sample containers to subsequent custodians, a Chain-of-Custody/Laboratory Analysis Request Form will be signed by the persons transferring custody of the sample container. A signed and dated chain-of-custody seal will be placed on each shipping container prior to shipping. Upon receipt of the samples at the laboratory, the shipping container seal will be broken, and the condition of the samples will be recorded by the receiver. Chain-of-custody records will be included in the analytical report prepared by the laboratory.

3 QUALITY ASSURANCE PROJECT PLAN

3.1 Quality Assurance Objectives

The overall quality assurance (QA) objective for measurement data is to ensure providing data of known and acceptable quality. All measurements will be made to yield accurate and precise results representative of the media and conditions measured. Chemical analyses will be performed in accordance with the requirements of WAC 173-340-830. All sample results will be calculated and reported in the units presented in Tables 1 and 4 to allow comparison of the sample data with regulatory criteria and federal, state, and local databases. QA objectives for precision, accuracy, and completeness have been established for each measurement variable, where possible (Tables 1 and 4).

3.2 Analytical Procedures

Analytical methods and references for the analyses are summarized in Tables 1 and 4. The laboratory will use USEPA. Data reporting requirements for all analyses are presented in Section 3.3.

Routine analysis of environmental samples will be performed using procedures based on the following methods:

- USEPA Method 8021B: VOCs by Hall/PID (USEPA, 1996)

Field measurements of pH, conductivity, temperature, and dissolved oxygen will be performed according to instrument manufacturer's instructions, and to USEPA (1983) methods, where applicable.

3.3 Data Reduction, Validation, and Reporting

The laboratory performing sample analyses will be required to submit summary data and QA information to permit independent and conclusive determination of data quality. The determination of data quality will be performed using the following as guidelines for data review: USEPA Contract Laboratory Program National Functional Guidelines for

Inorganic Data Review (USEPA, 1994a) and USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 1994b).

Laboratory deliverable requirements for analyses will include the information outlined below and in Table 2.

- A cover letter for each sample batch will include a summary of any quality control, sample, shipment, or analytical problems, and will document all internal decisions. Problems will be outlined and final solutions documented. A copy of the signed chain-of-custody form for each batch of samples will be included in the narrative packet.

- Sample concentrations will be reported on standard data sheets in proper units and to the appropriate number of significant figures. For undetected values, the lower limit of detection for each compound will be reported separately for each sample. Dates of sample extraction or preparation and analysis must be included.

- A method blank summary will be included.

- Surrogate percent recovery will be calculated and reported.

- Laboratory control sample (LCS) results.

- Matrix spike/matrix spike duplicate (MS/MSD) percent recoveries, spike level, and relative percent difference will be included.

- Laboratory duplicate results.

All laboratory deliverables will be reviewed for data validation of chemical analyses. The main items for review are described in Table 3.

3.4 Data Assessment Procedures

Accuracy, precision, completeness, representativeness, and comparability are terms used to describe the quality of analytical data. Accuracy is a measure of the bias in a measurement system and is determined by comparing a measurement with an accepted reference or true value. Precision is a measure of the reproducibility of analyses under a given set of conditions and is determined by measuring the scatter of a group of measurements made at the same specified conditions around their average. Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that could be expected to be obtained under "normal" conditions. Representativeness expresses the degree to which sampling data accurately and precisely

represent selected characteristics. Comparability is an expression of the confidence with which one data set can be compared to another.

Routine procedures for measuring precision and accuracy include use of replicate analyses, standard reference materials (SRMs), matrix spikes, and procedural blanks. Replicate matrix spikes and method blanks will be analyzed by the selected laboratory. Additional spikes and replicate analyses may be implemented. The minimum frequencies are as follows:

- Replicate analysis
  - one replicate analysis will be conducted per sample batch
- Matrix Spike
  - one matrix spike or laboratory control sample will be analyzed per sample batch
- Method Blank
  - one preparation blank per matrix will be analyzed for each sample preparation batch.
- LCS or SRM
  - one LCS will be analyzed per sample batch

Quality of analytical data represented by precision and accuracy are calculated using the mean, standard deviation, and percent recoveries. The mean, $\overline{C}$, of a series of replicate measurements of concentration, C_i, for a given analyte will be calculated as:

$$\overline{C} = \frac{1}{n} \sum_{i=1}^{n} C_i$$

where:

n = Number of replicate measurements

The estimate of precision of a series of replicate measurements can be expressed as the relative standard deviation, RSD:

$$RSD = \frac{SD}{\overline{C}} \times 100\%$$

where:

SD = Standard deviation:

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (C_i - \overline{C})^2}{(n-1)}}$$

Alternatively, for data sets with a small number of points (e.g., duplicate measurements), the estimate of precision will be expressed as a relative percent difference (RPD):

$$RPD = \frac{C_1 - C_2}{\overline{C}} \times 100$$

where:

C_1 = First concentration value or recovery value measured for a variable

C_2 = Second concentration value or recovery value measured for a variable

Accuracy as measured by matrix spike or laboratory control sample results will be calculated as:

$$Recovery = \frac{\Delta C}{C_s} \times 100$$

where:

ΔC = The measured concentration increase due to spiking (relative to the unspiked portion)

C_s = The known concentration increase in the spike

Accuracy can also be measured by analysis of standard reference material (SRM) or regional reference material and will be determined by comparing the measured value with the 95 percent confidence interval established for each analyte.

Completeness will be measured for each set of data received by dividing the number of valid measurements actually obtained by the number of valid measurements that were planned.

3.5 Field Quality Assurance Samples

Field quality assurance (QA) will be maintained through compliance with the sampling plan, collection of field QA samples, and the documentation of sampling plan alterations. Field QA samples will consist of a duplicate sample. Duplicate samples will not be labeled as such but will be submitted blind to the laboratory. The duplicate sample will be submitted for the same analyses as the original sample.

One duplicate sample will be collected during each groundwater sampling event. Duplicate samples will not be labeled as such but will be submitted blind to the laboratory. Wells in which duplicate samples will be collected will be selected to represent the anticipated range of constituent concentrations found at the site. Duplicate samples will be submitted for the same analyses as the original sample.

One trip blank will be submitted to the laboratory during each groundwater sampling event. Trip blanks will be analyzed for VOCs.

3.6 Corrective Actions

Corrective actions consist of (1) handling of analytical or equipment malfunctions, (2) handling of nonconformance or noncompliance with the established QA requirements, and (3) alterations to sampling procedures or locations due to uncontrollable circumstances. During field operations and sampling procedures, the field team leader will be responsible for correcting equipment malfunctions. All corrective measures will be documented in the project file using a sampling alteration checklist (Figure 4).

The analytical laboratory must adhere to standard operating procedure guidelines and specifications. When instrument response, quality control sample (SRM or matrix spike duplicate) precision or accuracy, or blank analyses indicate exceedance of control limits, the cause of the exceedance of control limits must be determined and documented, and corrective actions must be initiated before continuing with sample analysis.

3.7 Data Validation Reports

A data validation report will be prepared for each sampling event. The handling and content of the data report are discussed in Section 3.8.

3.8 Data Management

Raw data generated in the field or received from the analytical laboratory will be validated, entered into a computerized database, and verified for consistency and correctness.

3.8.1 Field Data Management

Accurate documentation of field activities, (e.g., pH measurements, conductivity measurements, field notes) will be maintained using field log books, field data forms, correspondence records, and/or photographs. Entries will be made in sufficient detail to provide an accurate record of field activities without reliance on memory.

Field log entries will be dated and include a chronological description of task activities, names of individuals present, names of visitors, weather conditions, etc. All entries will be legibly entered in ink and initialed.

3.8.2 Analytical Data Management

Following validation, all analytical data will be entered into a computerized database. The data may require some manipulation, such as common unit conversions and extraction from support information. To accomplish these manipulations, data reduction and tabulation techniques will be applied to the data and documented. Several different tabular reports will be generated from the database. All analytical, locational, and tracking data will be stored in the database. Data reports for each type of analysis will be generated to product standard reports.

All data validation, document control, and locational and analytical information generated by this project will be entered, store, and generated by IBM/PC-compatible machines. Commercially available software products will be used. The volume of digital data anticipated on this project may be accommodated on a single PC work station. Project data backups will be made on a periodic basis. Access to the database will be limited to the data manager and other authorized project personnel.

3.8.3 Sample Management

The sample management system forms the foundation of all other analytical data collection, verification, and validation tasks. Analytical data cannot be considered valid unless all proper sample management steps have been carried out. These include:

- Sample documented on a Field Sampling Data Form or in a field log book
- Chain-of-Custody requirements met
- All sample-related documents filed
- Use of unique sample identification numbers

Data that do not pass the validation process either will be assigned data qualifiers to restrict or modify usage, or will be rejected for use. Modifications to the use of data will be documented in data validation reports.

4 STANDARD FIELD FORMS AND EQUIPMENT LIST

Standard field forms used to record monitoring and sampling data are:

- Boring Log (Figure 1)
- Soil Descriptions (Figure 2)
- Field Sampling Data Form (Figure 3)
- Sampling Alteration Checklist (Figure 4)
- Chain of Custody Form (Figure 5)

A blank copy of each form is presented in this section. Equipment that may be used during field activities are presented in Table 5.

LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

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U.S. Environmental Protection Agency. 1994a. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. USEPA Office of Solid Waste and Emergency Response.

U.S. Environmental Protection Agency. 1994b. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. USEPA Office of Solid Waste and Emergency Response.

U.S. Environmental Protection Agency. 1996. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846, Revision #2.

TABLES

Table 1

Objectives for Measurement of Data — Chemical Analyses
Sampling and Analysis Plan
New City Cleaners

Variable	Units	Typical Method Detection Limit	Accuracy[a]	Precision[a]	Completeness	Method No.[b]	Bottle/Preservative	Maximum Holding Time
Water								
VOCs	µg/L	0.07 to 5.6	±40%	±15%	95%	8021B	Two 40-mL vials; PTFE-lined silicon septum cap/HCl to pH <2; fill completely with no headspace/keep on ice (4°C)	14 days

[a] Accuracy and precision results may deviate from these criteria as identified by the analytical method reference on a substance specific basis.
[b] Method numbers and analytical methods are from USEPA, 1996.
[c] Dry weight basis.

Table 2

Required Laboratory Deliverables
Sampling and Analysis Plan
New City Cleaners

The following items will be delivered to support data validation:

- A transmittal letter and case narrative which includes information about receipt of the samples, the analytical results, and any significant problems in any aspect of sample analysis (e.g., deviation from methodologies or quality control.
- Sample analytical results:
  - Water results in mg/L or µg/L
  - Method detection limit for undetected values reported for each analyte on a sample-by-sample basis
  - Date of sample preparation/extraction
  - Date of sample analysis
- Method blank results, including the samples associated with each blank
- Surrogate recovery results reported as percent recoveries, including actual spike levels
- Duplicate results for VOC analyses
- Matrix spike/matrix spike duplicate (MS/MSD) results for VOC analyses, reported as percent recoveries, including actual spike levels
- Copies of signed chain-of-custodies

Table 3

Data Validation of Chemical Analyses
Sampling and Analysis Plan
New City Cleaners

The following items will be reviewed for data validation:

- Holding times
- Method blank results
- Surrogate recovery results for organic analyses
- Field duplicate results
- Laboratory duplicate results for VOC analyses
- Matrix spike/matrix spike duplicate (MS/MSD) results for VOC analyses
- Matrix spike results for VOC analyses
- Completeness
- Reported detection limits
- Laboratory control sample results
- Copies of signed chain-of-custodies

Table 4

Objectives for Measurement of Data - Field Analyses
Sampling and Analysis Plan
New City Cleaners

Variable	Units	Lower Limit of Detection	Accuracy[a]	Precision[a]	Completeness	Method	Bottle	Maximum Holding Time
Water								
pH	—	0.01	±10%	±10%	90%	Probe	500-mL beaker	Immediate
Conductivity	µS/cm	5	±10%	±10%	90%	Probe	500-mL beaker	Immediate
Temperature	°C	0.5	±10%	±10%	90%	Mercury thermometer	500-mL beaker	Immediate
Dissolved Oxygen	mg/L	0.05	±15%	±15%	90%	Probe	500-mL beaker	Immediate

[a] Accuracy and precision results may deviate from these criteria as identified by the analytical method reference.

Table 5

Field Equipment and Supplies
Sampling and Analysis Plan
New City Cleaners

Forms/Documentation
• Field logbooks • Boring Log • Field sampling data sheet • Chain-of-custody form • Custody seal • Project photo log • Drum labels • Field sampling and analysis plan (SAP)
Tools
• Fiberglass tape with stainless-steel weight • Tape measure calibrated to 0.1 inch • Decon brushes • Extension cord • Flashlight • Padlocks with matching keys • Stop watch • Tool kit • Small sledge hammer
Groundwater Investigation and Sampling
• pH/conductivity meter • Water-level probe • Dissolved oxygen meter • Generator (100-volt Honda or equivalent) • Large and small capacity peristaltic pump • Thermometers (°C) • Disposable plastic beakers • pH paper • In-line filtration cartridges (0.45 micron) • Polyethylene tubing • Silicon tubing for peristaltic pump • Peristaltic pump • Sample jars and labels • Distilled Water
Health and Safety Equipment
• Fire extinguisher • Half-face respirators • Organic vapor/acid gas cartridges with dust filters • First aid kits • Safety glasses • Eyewash • Ear plugs • Tyvek® disposable coveralls • Gloves-vinyl, nitrile, and neoprene • Duct tape

Table 5

Field Equipment and Supplies
Sampling and Analysis Plan
New City Cleaners

Miscellaneous Equipment
• Spray paint, pencils, pens, labels
• Waterproof markers
• Paint pens for drums
• Bubble wrap and tape for shipping
• Cameras and film
• Vermiculite
• Resealable plastic bags
• Paper towels
• Visqueen sheets
• Buckets
• Squirt bottle (wash)
• Nalgene wash bottles
• Reagent bottles
• Coolers (sample shipping)
• Scrub brushes
• Plastic tubs
• Ice, in leak-proof bags
• Drinking water
• Large-scale site map

FIGURES

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LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME _____

PROJECT # _____

GEOLOGIST/ENGINEER _____

DRILLING CONTRACTOR _____

DRILLING METHOD _____

HOLE DIA _____

BORING NO. _____

DATE BEGAN _____

DATE COMPLETED _____

TOTAL DEPTH _____

SHEET _____ OF _____

FIELD LOCATION OF BORING:

GROUND ELEVATION _____

DATUM _____

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	WATER LEVEL DATA				LITHOGLOGIC DESCRIPTION
								DEPTH				
								TIME				
								DATE				
								BORING DEPTH				

REMARKS:

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

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FIGURE 1
NEW CITY CLEANERS
747 STEVENS DRIVE
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BORING LOG FORM

SOIL DESCRIPTION CHECKLIST FOR FIELD LOGS - EMCON 1998 (Bothell)

Guide for Sample Description

1 . Depth interval of lithologic unit encountered in sample, in feet below ground surface
2 . USCS classification **GROUP NAME** and (SYMBOL)
3 . Color
4 . Grain size distribution, as volume percentages from most to least abundant, including plasticity of fines, particulate shapes, lithology, and mineral composition, if identifiable
5 . Relative density or consistency
6 . Moisture conditions
7 . Additional information, i.e., structures, odors, organic or man-made material (including percentages)
8 . Geologic interpretation (e.g., FILL, ALLUVIUM)

Example: 5 to 6.5 feet: SILTY SAND (SM); gray; 80% fine sand, subrounded, micaceous; 15 to 20 percent nonplastic fines, < 5% subrounded volcanic fine gravel; dense; wet. Some organic debris. Laminations consisting of fines without sand. Petroleum hydrocarbon-like odor. (ALLUVIUM)

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GUIDELINES				Group Symbol	Group Name
GRAVEL coarse = 1 1/2 to 3 in 38 to 75 mm medium = 3/4 to 1 1/2 in 19 to 38 mm fine = 3/16 to 3/4 in 5 to 19 mm	50% of particles are 5 mm to 75 mm	≤ 5% fines		GW	GRAVEL (well graded)
				GP	GRAVEL (poorly graded)
		> 5% to ≤ 15% fines > 15% to < 50% sand, add SANDY modifier		GW-GM GP-GM	GRAVEL WITH SILT GRAVEL WITH SILT
				GW-GC GP-GC	GRAVEL WITH CLAY GRAVEL WITH CLAY
		> 15% to < 50% fines		GM	SILTY GRAVEL
				GC	CLAYEY GRAVEL
		> 15% to < 50% sand and < 5% fines		GP or GW	SANDY GRAVEL
SAND coarse = 2 to 5 mm #10 to #4 sieve medium = 0.4 to 2 mm #40 to #10 sieve fine = 0.075 to 0.4 mm #200 to #40 sieve	50% of particles are 0.075 to 5 mm	≤ 5% fines		SW	SAND (well graded)
				SP	SAND (poorly graded)
		> 5% to ≤ 15% fines > 15% to < 50% gravel, add GRAVELLY modifier		SW-SM SP-SM	SAND WITH SILT SAND WITH SILT
				SW-SC SP-SC	SAND WITH CLAY SAND WITH CLAY
		> 15% to < 50% fines		SM	SILTY SAND
				SC	CLAYEY SAND
		> 15% to < 50% gravel and < 5% fines		SP or SW	GRAVELLY SAND
SILT	Generally non- to low plasticity	None to low dry strength Slow to rapid dilatancy None to low toughness	< 15% coarse 15 to 30% coarse > 30% coarse	ML	SILT SILT WITH SAND OR GRAVEL SANDY OR GRAVELLY SILT
		Low to medium dry strength None to slow dilatancy Low to medium toughness	< 15% coarse 15 to 30% coarse > 30% coarse	MH	SILT SILT WITH SAND OR GRAVEL SANDY OR GRAVELLY SILT
CLAY	Generally medium to high plasticity	Medium to high dry strength None to slow dilatancy Medium toughness	< 15% coarse 15 to 30% coarse > 30% coarse	CL	CLAY CLAY WITH SAND OR GRAVEL SANDY OR GRAVELLY CLAY
		High to very high dry strength No dilatancy High toughness	< 15% coarse 15 to 30% coarse > 30% coarse	CH	CLAY CLAY WITH SAND OR GRAVEL SANDY OR GRAVELLY CLAY
High percentage of organic material	Enough organic material to affect soil properties			OL/OH	ORGANIC SOIL
	Predominantly organic material			PT	PEAT

NOTE: Oversize material grain size: boulders > than 12-in diameter; cobbles 3 to 12-in diameter.
Fines recognition: the #200 sieve size (0.075 mm) is about the smallest grain visible to the unaided eye.

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FIGURE 2
NEW CITY CLEANERS
747 STEVENS DRIVE
RICHLAND, WASHINGTON
SOIL DESCRIPTIONS

PROCEDURES FOR DESCRIPTION OF FINES

Plasticity Describe the plasticity based on the following criteria.

Description	Criteria
Nonplastic	A thread cannot be rolled at any water content
Low	A thread is barely rolled; a lump can't be formed after reaching the plastic limit
Medium	The easily rolled thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	Much time is required to reach the plastic limit and the thread can be rerolled afterwards. The lump can be formed when drier than the plastic limit

Dry Strength Mold a 1" ball of fines (no particles greater than medium sand), and allow to air dry. Make three 1/2-inch balls each. Crush ball between the fingers. Note the results.

Description	Criteria
None	Crumbles into powder with mere pressure of handling
Low	Crumbles into powder with some finger pressure
Medium	Fragments with considerable finger pressure
High	Fragments only between a thumb and a hard surface
Very High	Cannot be fragmented

Dilatancy Mold a 1/2" ball in the hand and smear it in palm. Hit hand horizontally and note the release of water. Then squeeze the sample and note the disappearance of water.

Description	Criteria
None	No visible change in the sample
Slow	Water appears and disappears slowly upon shaking and squeezing
Rapid	Water appears and disappears quickly upon shaking and squeezing

Toughness Roll a 1/2" ball between the palms into a 1/8" diameter thread. Fold and reroll the thread until it crumbles at the "plastic limit" moisture content. Lump the pieces together and knead until the lump crumbles.

Description	Criteria
Low	Slight pressure rolls the weak and soft thread and lump to the plastic limit
Medium	Medium pressure rolls the medium stiff thread and lump to the plastic limit
High	High pressure rolls the highly stiff thread and lump to the plastic limit

SAND AND GRAVEL DENSITY				SILT AND CLAY CONSISTENCY					
	Blows per foot (N)				Blows per foot (N)			Pocket Penetrometer	Tactile Test
Term	1.4" i.d.	2.0" i.d.	2.5" i.d.	Term	1.4" i.d.	2.0" i.d.	2.5" i.d.	(tons/sq ft)	(field observation)
very loose	0 - 4	0 - 5	0 - 7	very soft	< 2	< 2	< 2	0 - 1/4	Sags or slumps
loose	5 - 10	6 - 12	8 - 18	soft	2 - 4	2 - 4	2 - 4	1/4 - 1/2	Easily imprinted 1"
medium	11 - 29	13 - 37	19 - 51	firm	5 - 8	5 - 9	5 - 9	1/2 - 1	Easily imprinted 1/4
dense	30 - 47	38 - 60	52 - 86	stiff	9 - 15	10 - 12	10 - 18	1 - 2	Readily indented by thumb
very dense	> 47	> 60	> 86	very stiff	16 - 30	13 - 39	19 - 42	2 - 4	Indented with thumbnail
				hard	> 30	> 39	42	> 4	Pierced with sharp point

NOTE: N is sum of blow counts for last two 6-inch intervals (bottom 12 inches).
i.d. = inside diameter.

Coarse-grained soil using field observation: Can dig with shovel—loose; Requires pick—compact.

MOISTURE CONTENT

Dry	No discernible moisture present, dusty, dry to the touch
Damp	Enough moisture to darken appearance, no moisture adheres to hand
Moist	Will moisten the hand, squeezes tight and maintains shape
Wet	Visible free water; plastic materials will leave sticky residue in hand when remolded

STRUCTURES

Stratified	Alternating 6 mm or thicker layers of varying material or color
Laminated	Alternating 6 mm or thinner layers of varying material or color
Fissured	Breaks along definite planes of fracturing
Lensed	Inclusions of lens shaped masses of soil within matrix
Homogeneous	Same color and appearance throughout, no structure

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FIGURE 2 (CONT.)
NEW CITY CLEANERS
747 STEVENS DRIVE
RICHLAND, WASHINGTON
SOIL DESCRIPTIONS

FIELD SAMPLING DATA SHEET

EMCON
18912 North Creek Parkway, Suite 100
Bothell, Washington 98011-8016
Office: (425) 485-5000 Fax: (425) 486-9766

Project Name: **Well ID:**

Site Address: **Sample ID:**

EMCON Contact: **Client Contact:** **Project #**

Weather:	(Part) Sun	(Part) Cloudy	Rain		Temperature: °F

WATER LEVEL MEASUREMENTS (Nearest 0.01 ft)

[Product Thickness]

Date	Time	DT-Bottom	DT-Water	DTB-DTW	DT-Product	DTP-DTW

Well dia. = Gal/ft: 1"=0.041 2"=0.163 4"=0.653 6"=1.469 10"=4.080 12"=5.875

[Water Col x Gal/ft]

	Volume (gal)
X 1	
X 3	

WATER QUALITY DATA

Pore Vol	Method §	Purged (gal)	pH	Temp (°C)	E Cond (µS)	D.O.		Other
1								
2								
3								
4								
5								

§ METHOD: (SB) Submersible Pump (PP) Peristaltic Pump (DB) Disposable Bailer (PTB) PVC/Teflon Bailer (Ded B) Dedicated Bailer (DP) Dedicated Pump

GROUNDWATER SAMPLING DATA (if product is detected, do NOT sample)

Parameter	Date	Time	Method §	# Bottles	Volume (ml)	Type	Preservative	Ice	Filter

Total Bottles (Include duplicate count): | Duplicate ID: | Time:

Water Characterization			Decontamination Materials			
Color	Clarity	Odor	Liquinox	Methanol	HCl	Nitric
			D.I. Water	Distilled water	Hexane	

Notes:

SAMPLER:

(PRINTED NAME) (SIGNATURE)

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FIGURE 3
NEW CITY CLEANERS
747 STEVENS DRIVE
RICHLAND, WASHINGTON
FIELD SAMPLING DATA FORM

SAMPLING ALTERATION CHECKLIST

Sample program identification: _____

Material to be sampled: _____

Measurement variable: _____

Standard procedure for analysis: _____

_____

Reference: _____

_____

_____

Variation from standard procedure: _____

_____

_____

_____

_____

_____

Reason for variation: _____

_____

_____

_____

Resultant change in field sample procedure: _____

_____

_____

_____

Special equipment, material, or personnel required: _____

_____

_____

Author's name: _____ Date: _____

Approval: _____ Title: _____

Date: _____

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FIGURE 4
NEW CITY CLEANERS
747 STEVENS DRIVE
RICHLAND, WASHINGTON
SAMPLING ALTERATION CHECKLIST

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CHAIN OF CUSTODY/LABORATORY ANALYSIS REPORT FORM

DATE_____ PAGE _____ OF_____

PROJECT NAME_____ #_____

PROJECT _____

COMPANY/ADDRESS _____

_____

_____PHONE_____

SAMPLERS SIGNATURE:_____

SAMPLE I.D.	DATE	TIME	LAB I.D.	SAMPLE MATRIX	NUMBER OF CONTAINERS	ANALYSIS REQUEST: PETROLEUM HCS: TPH - HCID State:	PETROLEUM HCS: TPH - G ___ BTEX___ State:	PETROLEUM HCS: TPH - D OIL___ State:	PETROLEUM HCS: TPH - 418.1 State:	PETROLEUM HCS: TPH - Other	ORGANIC: Halogenated or Aromatic Volatiles 601/8010 ___ 602/8020___	ORGANIC: Volatile Organics GC/MS 624-8240	ORGANIC: Base/Neu/Acid Organics GC/MS 625/8270	ORGANIC: Pesticides/PCBS 8080 PCB ONLY	ORGANIC: PAH 8310 HPCL___ 8100 GC___	ORGANIC: TCLP Semi VOA___ VOA___ Pest/Herb___	ORGANIC: Metals___ Total___ DISS___	ORGANIC METALS/INORGANICS: List Below	ORGANIC METALS/INORGANICS: Cyanide	ORGANIC METALS/INORGANICS: pH Cond Cl SO_4 PO_4 F Br	ORGANIC METALS/INORGANICS: NO_2 NO_3 (Circle)	ORGANIC METALS/INORGANICS: NH_3 - N COD Total-P TKN TOC TOX (Circle)	REMARKS

RELINQUISHED BY:

Signature

Printed Name

Firm

Date/Time

RECEIVED BY:

Signature

Printed Name

Firm

Date/Time

TURNAROUND REQUIREMENTS

___ 24 hr ___ 48 hr. ___ 5 day

___ Standard (10-15 working days)

___ Provide Verbal Preliminary Results

___ Provide FAX preliminary Results

Requested Report Date _____

REPORT REQUIREMENTS

___ I. Routine Report

___ II. Report (includes DUP.MAS. MSD, as required, may be charged as samples)

___ III. Data Validation Report (includes All Raw Data)

___ IV. CLP Deliverable Report

INVOICE INFORMATION:

P.O.# _____

Bill To _____

SAMPLE RECEIPT:

Shipping VIA: _____

Shipping to: _____

Condition: _____

Lab No: _____

RELINQUISHED BY:

Signature

Printed Name

Firm

Date/Time

RECEIVED BY:

Signature

Printed Name

Firm

Date/Time

SPECIAL INSTRUCTIONS/COMMENTS:

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APP _____
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FIGURE 5
NEW CITY CLEANERS
747 STEVENS DRIVE
RICHLAND, WASHINGTON
CHAIN OF CUSTODY /
LABORATORY ANALYSIS REPORT FORM