City of Gresham, Oregon

Stormwater Monitoring and Quality Assurance Plan

for
Water Pollution Control Facility (WPCF) Permit
for Class V Stormwater Underground Injection Control (UIC)
Systems (File #112110)
&
Wet Weather Stormwater Monitoring requirements of
National Pollutant Discharge Elimination System (NPDES)
Municipal Separate Storm Sewer System (MS4)

Permit Compliance

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UIC Monitoring Plan Distribution List

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1.0 INTRODUCION

1.1 Overview

The purpose of this Stormwater Monitoring and Quality Assurance Plan (hereafter referred to as the Stormwater Monitoring Plan) is to describe the actions that the City of Gresham will undertake in order to comply with the Water Pollution Control Facilities (WPCF) permit, as well as the "Stormwater Monitoring – Storm Event" requirements of the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit (permit #101315) issued to the City on December 30, 2010. This Stormwater Monitoring Plan contains both overlapping and unique elements pertaining to these permits. As such, modifications to this plan pertaining to unique WPCF or NPDES MS4 elements will follow the requirements for modifications as described in the respective permit. Likewise, each permit has annual reporting requirements for which the monitoring data generated by this plan will be prepared accordingly. A brief history about each of these permits is included below.

1.2 WPCF Permit History

In 1974, Congress enacted Underground Injection Control (UIC) rules under the federal Safe Drinking Water Act (SDWA). These rules are administered by the U.S. Environmental Protection Agency (EPA) under 40 CFR 144-148. EPA delegated UIC rule primacy to the Oregon Department of Environmental Quality (DEQ) in 1984. Federal UIC rules were modified in 1999. In response to the new federal rules, delegated states were required to update their state UIC rules within 270 days. DEQ released revised UIC rules (Oregon Administrative Rules (OAR) 340-044) in September 2001. OAR 340-044 includes special requirements for municipalities with more than 50 UICs. As a result of these requirements, the City of Gresham conducted an inventory and system assessment and determined that most City UICs qualified for rule authorization, but a handful would require a permit. In 2006 the City obtained approximately 350 UICs from Multnomah County, when responsibility for all formerly County-owned roads within Gresham were transferred to City ownership. Upon review of the new UICs, many of which were paved over, the City determined the new UICs would require permit coverage. In consultation with DEQ, the City updated its permit application in 2008 to include all City UICs—including those eligible for rule authorization.

An applicant review draft of a Water Pollution Control Facilities (WPCF) permit was presented to the City by DEQ in September 2011. The City developed a UIC Monitoring Plan in response to the 2011 permit draft and began implementing components of that monitoring plan in wet weather season 2011-12. Based on feedback received on the 2011 permit draft, DEQ decided to hold off issuance of the permit to address additional concerns. In September 2012, DEQ issued an updated applicant review draft of the WPCF permit to the City of Gresham (DEQ File Number 112110). All references to "WPCF" refer to the September 2012 WPCF permit draft. The City submitted this Stormwater Monitoring and Quality Assurance Plan (Stormwater Monitoring Plan) to meet the requirements outlined in this draft and to be released for public comment along with the WPCF permit. An updated system-wide assessment was also submitted to provide context for the monitoring plan.

1.3 NPDES MS4 Permit History

The City has a National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Discharge Permit issued by DEQ under the federal Clean Water Act and Oregon Revised Statute 468B.050. The original permit (DEQ Permit Number 101315) was issued in 1996, and based on a re-submittal package presented to DEQ was re-issued in December 2010. The Clean Water Act (CWA) 40 CFR 122.26(d)(2)(iii)(A) through (D) and Schedule B (Monitoring and Reporting Requirements) of the NPDES MS4 permit require the City to characterize stormwater discharges. Because patterns of development and management of stormwater are generally the same across the City, stormwater draining to UICs should not be different from that draining to the MS4. Both the UIC and MS4 areas are comprised of a mixture of residential, commercial, and industrial land uses, and a mixture of high volume and low volume traffic patterns. Based on this information, the monitoring approach presented in this UIC Monitoring Plan collects constituents required under the NPDES MS4 permit related to wet weather monitoring, along with the additional constituents required under the WPCF permit, at the UIC sampling locations outlined in this plan. All other NPDES MS4 permit monitoring requirements are described within the MS4 Monitoring Plan.

1.4 Stormwater Wet Weather Monitoring Plan (for WPCF and MS4 compliance)

The WPCF permit requires the City to develop a monitoring plan for stormwater entering City-owned or operated UICs. This Stormwater Monitoring Plan was prepared to meet the stormwater monitoring conditions established in the WPCF permit, while also meeting the "Stormwater Monitoring – Storm Event" requirement in Table B-1 of the NPDES MS4 permit. For ease of implementing the monitoring requirements in both permits, the stormwater monitoring elements have been combined into this single monitoring plan. The following Stormwater Monitoring Plan presents the methodology for selecting representative sampling locations, collecting stormwater samples, performing laboratory analyses, ensuring quality control, and managing and reporting data.

This plan is organized into the following sections:

- Section 1 Introduction;
- Section 2 Sampling Design;
- Section 3 Sampling Locations;
- Section 4 Analytical Procedures;
- Section 5 Sample Collection and Handling;
- Section 6 Quality Control Procedures; and
- Section 7 Data Management, Validation, Assessment and Reporting.

1.5 WPCF Permit Requirements

The draft Water Pollution Control Facility (WPCF) permit issued to the City of Gresham (Schedule B.2.) requires development of a stormwater monitoring plan that describes how the City will monitor stormwater and other fluid discharges. The plan must:

a. Propose a sampling program for your injection systems based on the results of the system-wide assessment that characterizes the stormwater injected below ground so that you can demonstrate compliance with action levels in Schedule A.2 Table 1. You may prioritize the monitoring based on potential risks to groundwater.

b. Unless otherwise approved by us in writing, the plan must include annual sampling of Schedule A.2 Table 1 constituents.

c. Include a list of underground injection system sampling locations.

The Stormwater Monitoring Plan presented here includes the required aspects as described in the WPCF permit. The method for selecting sampling locations representative of the UICs identified in the system-wide assessment is described in **Section 2.2**, and the specific sampling locations to be monitored during the permit term are described in **Section 3.0**. The sampling frequency is described in **Section 2.3.1**, and the analytical schedule during which each pollutant specified in WPCF permit Schedule A.2 Table 1 is specified in **Section 4.3**. The method for comparing stormwater monitoring data against the action levelsspecified in Table 1 is described in **Section 7.0**. In addition to the procedures documented in other sections of this plan, **Section 6.0** describes specific quality control procedures used to ensure that high quality data is collected to provide input to the City on UIC system management, determine whether groundwater is being protected, and demonstrate compliance with permit requirements.

1.6 Goals and Objectives

The stormwater monitoring approach presented in this Stormwater Monitoring Plan is intended to characterize the status and, if possible, determine trends in stormwater quality. The overall objective of the monitoring approach is to conduct monitoring and obtain data that demonstrate compliance with the permit standards and protection of surface and groundwater to support the most sensitive beneficial uses. Additionally, the approach outlined in this Stormwater Monitoring Plan will provide data that informs decision-making for actions implemented to improve the overall attainment of watershed goals related to stormwater in areas draining to surface water (MS4) as well as groundwater (WPCF). To meet monitoring requirements in the WPCF and MS4 permits, the City will collect stormwater samples from representative locations. Specifically this monitoring effort is designed to satisfy the following objectives:

1. Characterize stormwater quality throughout the City.
   - Patterns of development and management of stormwater are the generally the same across the City, therefore stormwater draining to UICs should not be different from that draining to the MS4. Both the UIC and MS4 areas are comprised of a mixture of residential, commercial, and industrial land uses, and a mixture of high volume and low volume traffic patterns (See section 2.2.2).

2. Demonstrate that stormwater discharged into City owned and operated UICs is protective of groundwater by evaluating results against Table 1 action levels established in Schedule A.2 of the WPCF permit.
   - From a watershed perspective, stormwater injected into the subsurface provides a source of shallow groundwater recharge for maintaining baseflows for surface waterbodies, in addition to water which may recharge deeper aquifers. Stormwater analytical results will be evaluated against action levels to determine potential risks to groundwater and to trigger response actions necessary to protect groundwater.

3. Provide a high degree of confidence that cost effective sampling design is representative of all UICs covered by the permit. As mentioned above, the sample sites have also been evaluated to ensure that the UIC sites are representative of the differing land uses and vehicle trip classes within the City, including the MS4 area.
   - The monitoring program presented in this Stormwater Monitoring Plan is based on statistical methods designed specifically to characterize large systems with a high

degree of confidence that the size and nature of the sample is appropriately representative of the entire system identified in the UIC System-wide Assessment.

4. Provide data that will be used to conduct trend analysis of the stormwater quality discharged into City owned and operated UICs, and into the MS4 system.

- Fixed sampling locations monitored each year of the permit will be analyzed to determine if trends in stormwater quality can be observed over the life of the permit. The presence or absence of stormwater quality trends will yield information vital to refining strategies and management actions that improve stormwater quality and watershed health. Trend analysis is less important to the proposed sampling design than evaluating stormwater status, but long term trends will be evaluated over the WPCF permit term. (Trend analysis is conducted of *instream* quality for the NPDES permit because of the mixing that occurs when stormwater enters a stream.)

5. Identify factors that strongly influence the quality of stormwater draining to City owned and operated UICs and MS4 area to assist in enhanced protection of ground and surface waters over time.

- The findings from the ACWA (2009) stormwater analysis, which included MS4 data and limited data from UICs indicated that stormwater data is highly variable and that vehicle trips per day may be more strongly correlated to differences in the data than land use. Based on that finding, the strategy outlined in this UIC Monitoring Plan is stratified by traffic volume.

  Field reconnaissance will be conducted at the UIC sampling locations prior to initiating monitoring, and field observations will be recorded during each UIC sampling event. These efforts will assist the City in determining the factors that may influence water quality, and in identifying and selecting applicable response actions needed to address UICs in which one or more analytes have been detected at or near action levels or where an unacceptable risk to groundwater has otherwise been determined. This evaluation of water quality data in conjunction with source investigations will provide information necessary to identify, prioritize and manage the array of sources that could present a threat to groundwater quality. Stormwater analysis will examine associations and relationships among stormwater quality, identified sources of pollution, and the effectiveness of structural and non-structural BMPs.

6. Evaluate the effectiveness of actions implemented to improve stormwater quality and comply with action levels.

- Monitoring will occur at UIC sample locations (fixed and rotating panels) prior to and subsequent to structural or non-structural actions taken to improve stormwater quality in order to comply with action levels specified in Schedule A.2 Table 1 of the WPCF permit. Over time, the monitoring data may provide information related to system-wide BMP implementation or corrective actions implemented to protect surface and ground waters and meet action levels.

1.7 Relationship to Other Plans

While this Stormwater Monitoring Plan is designed to fulfill the stormwater monitoring requirements specified in the WPCF permit, it also addresses the "Stormwater Monitoring – Storm Event" requirement for compliance with the NPDES MS4 permit issued to the City. The City's overall stormwater monitoring program is intended to characterize stormwater, assess trends, and demonstrate compliance with both the MS4 and the WPCF permit. In an effort to make sure that stormwater monitoring addresses both WPCF and MS4 goals, some water quality constituents associated with MS4 only may be modified when that permit is re-issued in 2015. To ensure compliance with the WPCF permit, the monitoring locations will be updated as needed to ensure that it is representative of newly discovered or constructed City owned and operated UICs identified after the November 21, 2011 System-wide Assessment.

Although this plan is designed to comply with both the NPDES and WPCF permit requirements related to stormwater monitoring, most of this narrative explicitly addresses the WPCF permit. Unless otherwise noted, the NPDES requirements are met by the actions taken to comply with the WPCF permit.

In addition to the Stormwater Monitoring Plan and System-Wide Assessment, the WPCF permit requires the City to prepare an Underground Injection Control System Management Plan (UICMP) describing how the City will protect groundwater quality, including:

- Injection control system decommissioning
- Employee education and public outreach;
- Injection system operation and maintenance;
- Protecting injection systems from accidental spills or illicit disposal of wastes or contaminants;
- Preventing injection of stormwater from loading docks, refueling areas, areas of hazardous and toxic material storage or handling, materials storage or handling areas, or other discharges that may contain pollutants above levels of concern;
- Housekeeping practices to protect groundwater quality.

The City has maintained a Stormwater Management Plan under the MS4 permit since 1995. The City plans to combine the two stormwater management plans to minimize duplication of effort.

Monitoring data collected through this Stormwater Monitoring Plan will be used to ensure compliance with action levels listed in WPCF Schedule A.2 Table 1, but may also help identify needed corrective actions, need for groundwater monitoring, or UIC closure. Data collected in accordance with UIC closure, groundwater, or other plans developed for the UIC program may be used to supplement the compliance monitoring data set as appropriate. All data collected under the UIC program will be used to:

- Ensure that infiltration of stormwater runoff from urban areas through City-owned UIC structures occurs in a manner that protects watershed health and the beneficial use of groundwater, including use of groundwater as a drinking water;
- Develop and implement strategies and actions that contribute to achieving watershed goals, objectives, and targets; and
- Meet regulatory mandates and permit requirements for all City-owned UICs.

1.8 Modifications to Stormwater Monitoring Plan

Potential changes or modifications to the Stormwater Monitoring Plan may be identified during sampling activities or during review and evaluation of the field and/or analytical data. Plan modifications are useful to ensure continual improvement of approaches utilized for the overall stormwater monitoring program. Modifications help ensure the ongoing protection of beneficial uses, review of available technologies and practices, and ongoing evaluation of the resources needed to successfully implement the program. Stormwater Monitoring Plan modifications proposed that only affect NPDES MS4 permit requirements will follow the process as described in Schedule B.2.e. of that permit.

Modifications to the Stormwater Monitoring Plan that address only WPCF permit requirements will be evaluated according to the adaptive management approach developed as part of WPCF permit Schedule D.6. Generally, changes to the Stormwater Monitoring Plan that do not change the basic intent of the DEQ approved Plan, or those with low environmental and public health significance, will not require DEQ to provide public notice or an opportunity for public participation. Minor changes will be summarized and submitted to DEQ as part of the WPCF permit Schedule B.4. Annual Report.

The City interprets the following types of actions/modifications to be minor and will notify DEQ of these changes in the subsequent Annual Report:

- Correction of typographical errors;
- Selection of Rotating Panel locations;
- Incorporation of new data discovered/determined by UIC investigations/inspections, complaint responses, system-wide assessment, etc.;
- Incorporation of UICs constructed or discovered after the date of the permit issuance;
- Increased sampling frequency or increased analytical testing;
- Schedule changes not defined by the permit;
- Changes in City data management, evaluation methods, or annual report content;
- Changes in field procedures or analytical methods consistent with the permit;
- Change in contract laboratory;
- Collection and evaluation of source identification or corrective action data;
- Collection and evaluation of groundwater data;
- Collection and evaluation of BMP effectiveness monitoring data;
- Change in data evaluation and trend analyses; or
- Changes in City program staff

The following types of actions/modifications may be considered “major” and will be submitted to the DEQ for review to determine whether the proposed change is a “Category 2” action as defined by OAR 340-045-0027:

- Decrease in sampling frequency or analytical testing;
- Decrease in number of sampling locations; or
- Decrease in number of samples collected for a particular location.

The City will submit these types of proposed modifications to DEQ for approval prior to implementation. Approved changes will be summarized and submitted to DEQ as part of the

WPCF permit Schedule B.4. Annual Report. If DEQ does not provide approval in writing or provide an alternate review timeline to respond to the permittee within 30 days, the permittee may proceed with implementation of the proposed modification.

2.0 Sampling Design

2.1 General Considerations

Stormwater monitoring provides a direct measure of the water quality of stormwater within the permit area. Stormwater action levels and other limits on the waters authorized to be injected in the UICs are established in the WPCF permit to protect the beneficial use of groundwater. The permit requires the City to implement a stormwater monitoring program that describes how the City will monitor stormwater and other fluid discharges entering the City's UIC system and compare that stormwater data to action levels that ensure UICs are operated in a manner that is protective of the beneficial uses of groundwater. Using a probabilistic monitoring design that allows assessment of stormwater within the permit area provides the City with useful management information for both the MS4 and UIC system management.

There are approximately 1,100 active, City-owned and operated UICs. It is not technically practicable or financially feasible to routinely collect and analyze stormwater from each of these UICs during every storm event. Therefore, statistical methods designed specifically to select an appropriate sampling design (number of sites, pattern of re-visiting sites, and number of samples collected at each site) were used to ensure a high degree of confidence that the subset chosen is appropriately representative of the entire system.

In addition to developing a representative sampling design for UICs, the City also wanted the sampling design to be appropriate for collecting stormwater data that would inform the MS4 program. A major benefit to using a combined stormwater monitoring approach to address both the MS4 and WPCF permit requirements is that rather than using the three large MS4 drainage outfalls, stormwater monitoring will be conducted annually at a greater number of small UIC drainages (0.5 to 5 acres). Sites selected using a spatially-balanced and random probabilistic sampling design (see Stevens and Olsen 2004) result in small drainage areas that are typically comprised of a single land use, versus the mixed use inherent in the past MS4 stormwater outfall monitoring that focused on drainage areas that were hundreds of acres in size.

Based on findings from Portland and Gresham stormwater sampling summarized in ACWA (2009), stormwater data may be affected more by vehicle trips per day than land use zoning. Therefore, monitoring locations will be stratified by vehicle trips (< and > 1000 trips per day), which will also allow data to be regionally comparable to the UIC monitoring approach conducted by the City of Portland.

The entire system of UICs identified during the UIC System-wide Assessment (WPCF permit Schedule B.1) is the "target population" that this stormwater monitoring intends to characterize. The permit requires that this target population be divided into two sub-populations based discharge pollutant factor risks. Based on the 2009 ACWA study, the lower traffic volume category (<1,000 trips per day) is presumed to be lower risk based on discharge pollutant factors. Conversely, the higher traffic volume category (>1,000 trips per day) is presumed to be higher risk based on discharge pollutant factors. The set of UICs selected for monitoring is referred to as the "sample" and is a representative subset of the two target sub-populations. This section describes how the selected sample for both sub-populations was drawn probabilistically and is therefore representative of the entire UIC system, so the measured characteristics of this subset of all UICs can be inferred to apply to the entire system.

2.2 Sampling Locations

2.2.1 Determination of Representative Sample Size

Performing a sample size determination is an important aspect of sampling design to ensure that sample size is not too high or too low. If sample size is too low, the monitoring program will lack the precision to provide reliable answers to the monitoring goals and objectives – in the case of this permit to evaluate status and trends in stormwater entering UICs. If sample size is too large, time and resources will be wasted, often for minimal gain.

Meeting the City's multiple monitoring goals and objectives is best accomplished by determining a statistically representative number of underground injection devices to be monitored. The term "representative" has many definitions in scientific literature, but in the field of statistics, the professionally accepted definition of representative refers to a probability sample (i.e., a sample in which every item has a nonzero probability of being selected and each sample has a known probability of being selected). Using a probabilistic site selection method, like the Generalized Random Tesselation Stratified (GRTS) procedure described in **Section 2.2.3**, ensures that a stratified, spatially balanced sample of UICs is selected and as such is representative as required by the permit.

There are several approaches to calculating a sample size that is representative of the population. One option is to specify the desired width of a confidence interval and determine the sample size that achieves that goal. Portland's Sampling and Analysis Plan (Portland 2006a) used a method described by Agresti and Coull (1998) that determined sample size for the UIC monitoring network based on a specified confidence level (90%), half interval width (12%), and the estimated proportion of UICs exceeding the pentachlorophenol limit (8.1%). Portland selected those values since EPA's Environmental Monitoring and Assessment Program uses those levels to detect a 2% per year change in observed monitoring value. This method provided Portland with an annual sample size of 30. The approach did not consider the power of the entire sampling design, which would also take into account the study length and number of samples collected at each location.

Lenth (2011) believes that the best method for evaluating sampling design is to determine sample size based on the power[1] of the study design. One such design is the method developed by Urquhart and Kincaid (1999) specifically for probability surveys in environmental monitoring. This method allows evaluation of the power to detect a hypothetical percent change in the population mean of a parameter. The method uses a variance components model to assess power

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[1] Power is the probability that a statistical test will reject a false null hypothesis (where the null hypothesis is a statement about a population parameter). As power increases, the chance of rejecting a false null hypothesis increases. Power analysis can be used to calculate the minimum sample size needed to reject a false null hypothesis with a particular level of confidence.

in light of the contributions to the overall variance by random effects associated with the components of the sampling design, which for UIC monitoring include:

1. The number of UICs sampled,
2. The number of samples collected each year from each UIC, and
3. The pattern of revisits to UICs over time.

In an effort to compare the power of various monitoring approaches, the City looked at three scenarios: the Portland Design, the Proposed Gresham, and a Modified Gresham design, which are described and evaluated below.

Portland Design

Portland's sampling design has 15 stationary locations (panel 6), and 15 rotating locations (panels 1 through 5) repeated on a 5 year recurrence (see **Table 1**). This sampling design ends up sampling 15 + (15 x 5) = 90 locations over the 10-year permit term. Five samples are collected from each UIC annually.

Table 1: Portland Sampling Design

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Panel 1	15	0	0	0	0	15	0	0	0	0
Panel 2	0	15	0	0	0	0	15	0	0	0
Panel 3	0	0	15	0	0	0	0	15	0	0
Panel 4	0	0	0	15	0	0	0	0	15	0
Panel 5	0	0	0	0	15	0	0	0	0	15
Panel 6	15	15	15	15	15	15	15	15	15	15

Proposed Gresham

Gresham's proposed sampling design has 5 stationary locations (panel 1), and 25 rotating locations (panels 2 through 11) which are not repeated (see **Table 2**). This sampling design ends up sampling 5 + (25 x 10) = 255 locations over the 10-year permit term. One sample is collected from each UIC annually.

Table 2: Proposed Gresham Sampling Design

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Panel 1	5	5	5	5	5	5	5	5	5	5
Panel 2	25	0	0	0	0	0	0	0	0	0
Panel 3	0	25	0	0	0	0	0	0	0	0
Panel 4	0	0	25	0	0	0	0	0	0	0
Panel 5	0	0	0	25	0	0	0	0	0	0
Panel 6	0	0	0	0	25	0	0	0	0	0
Panel 7	0	0	0	0	0	25	0	0	0	0
Panel 8	0	0	0	0	0	0	25	0	0	0
Panel 9	0	0	0	0	0	0	0	25	0	0
Panel 10	0	0	0	0	0	0	0	0	25	0
Panel 11	0	0	0	0	0	0	0	0	0	25

Modified Gresham (not proposed)

In an effort to understand what the added power would be for re-visiting rotating panel locations, similar to Portland's sampling design, the City evaluated a third option. The Modified Gresham sampling design has 5 stationary locations (panel 1), and 25 rotating locations (panels 2 through 6) repeated on a 5 year recurrence (see **Table 3**). This sampling design ends up sampling 5 + (25 x 5) = 130 locations over the 10-year permit term. One sample is collected from each UIC annually.

Table 3: Modified Gresham Sampling Design

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Panel 1	5	5	5	5	5	5	5	5	5	5
Panel 2	25	0	0	0	0	25	0	0	0	0
Panel 3	0	25	0	0	0	0	25	0	0	0
Panel 4	0	0	25	0	0	0	0	25	0	0
Panel 5	0	0	0	25	0	0	0	0	25	0
Panel 6	0	0	0	0	25	0	0	0	0	25

Power Calculations

The three sampling designs described above were evaluated using the Urquhart and Kincaid (1999) method. The results of the power calculation for detecting a 10% trend per year is shown in **Figure 1**.

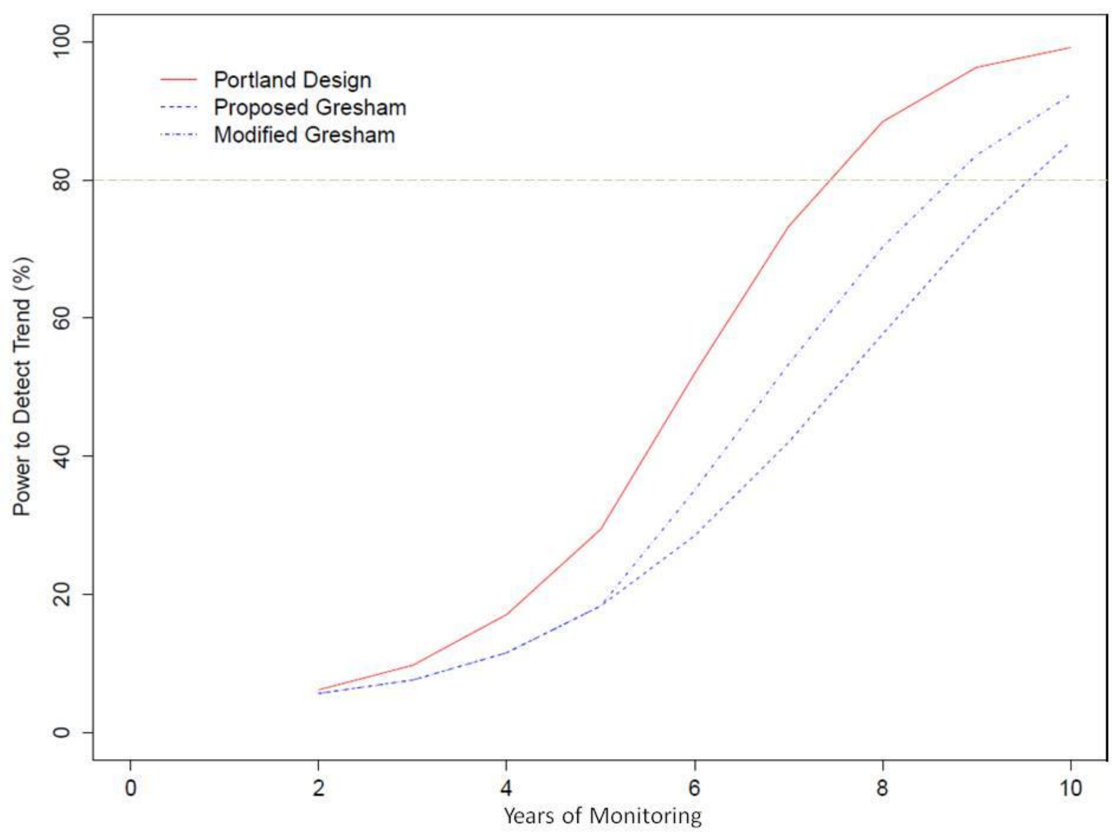


Figure 1: Power Analysis of Sampling Designs for Detecting 10% per Year Trend (α=0.05)

Properly designed experiments must ensure that power will be adequate to detect reasonable departures from the null hypothesis; the typical professional standard is a power of 0.8 or greater. Since any of the three sampling designs would result in a power to detect trends greater than 0.8, but the Proposed Gresham design would have the added benefit of characterizing the status of a much higher proportion of the UIC population, the City is willing to sacrifice some trending power in order to demonstrate compliance at a larger percentage of City owned and operated UICs. Over the 10-year permit term, the Proposed Gresham design will sample 255 locations, which is nearly one-quarter of the UIC population (255 / 1100 = 23%)

2.2.2 Stratification

The WPCF permit Schedule B.2.a. specifies that the sampling program be) based on the results of the System-wide Assessment. The criteria related to risk specified in the System-wide Assessment requirements include:

- Vehicle trips per day,
- UICs discharging directly to groundwater (inadequate vertical separation distances);
- UICs without adequate horizontal setback distances, and
- Sites with the potential to have hazardous or toxic materials (generally related to land use, primarily commercial and industrial sites).

The City is currently working on a multi-phase Capital Improvement Project (CIP) to address UICs which do not have adequate separation distances. Because the City plans to address these UICs in the next several years, locations which pose a risk based on separation distance will not be weighted more heavily in the stratification process. They will have an equal probability of being selected randomly using the GRTS approach described in **Section 2.2.3.** UICs that are randomly selected which will be decommissioned through the CIP will be removed from the sampling group.

Land use based wet weather outfall monitoring (primarily industrial and commercial land uses) has been conducted in Gresham and throughout the State of Oregon for the past 20 years. Historical stormwater sampling in Gresham includes:

- ACWA land use based outfall study conducted between 1990-1996 (ACWA 1997),
- NPDES outfall monitoring conducted by the City between 1996-2011 as part of the monitoring requirements in the NPDES MS4 permit,
- ACWA UIC BMP study conducted between 2002-2010, and
- Special study of 60 probabilistically selected UIC locations conducted in 2009-10.

Data collected by Gresham, along with data collected by Portland for their UIC permit and UIC and MS4 data collected by other jurisdictions throughout the state, was compiled and analyzed through a study managed by the Oregon Association of Clean Water Agencies (ACWA 2009). The 2009 ACWA data analysis provided statewide stormwater characterization and compared the influence of land use and vehicle trips on runoff quality. The ACWA evaluation of statewide stormwater data indicated that vehicle trips per day more closely correlates with pollutant concentrations than does land use. Statistical comparisons of Gresham versus Portland and other statewide data have demonstrated that there is little to no statistical difference between jurisdictions. Therefore, the effect of vehicle trips per day was selected as the primary factor used for stratification of high and low risk locations to be monitored through this UIC Monitoring Plan.

Of the roughly 1100 small City-owned and operated UIC catchments, approximately 60% are in residential areas, and have <1000 vehicle trips per day (TPD), while the other 40% have >1000 TPD and surrounding land use is primarily commercial and multi-family residential with some industrial. In order to ensure that data is collected from a greater number of high vehicle trip sites, a weighting factor will be applied during site selection so that a disproportionately high number of sites with greater than 1000 TPD will be monitored each year. The goal is to have a roughly equal number of sites within the two traffic strata by the end of the permit term. Since the majority of active UICs are in the <1000 TPD, the sample design is conservative in that it will be overly representative of sampling locations from streets with higher traffic counts (>1000 TPD).

<u>Determination of Traffic Strata</u>
Measured vehicle trips per day (TPD) have been measured for many, but not all city streets. The City categorizes streets by the purpose served by the street—which roughly correlates to street size and vehicle trips. Staff reviewed TPD data for each street classification and concluded that most Community level streets, and all streets in larger classifications have greater than 1,000 TPD. Nearly all residential streets have less than 1,000 TPD.

For the System-wide Assessment and Stormwater Monitoring Plan, all residential streets were categorized as less than 1,000 TPD, and all streets that have a functional class of community street or greater (freeways, arterials, boulevards, parkways, and collectors) were assumed to have greater than 1000 TPD. While some community functional class streets had actual vehicle counts less than 1,000, the majority of streets within this class have greater than 1,000 TPD. The traffic volumes on some streets vary from year to year, and based on the fact that the WPCF permit term is ten years, the actual vehicle counts are expected to increase over time to better match the functional classifications. Two residential streets measured more than 1,000 TPD in 2010, but the next segment of those neighborhood streets measured below 1,000 TPD in 2011. Despite the variability from 2010 to 2011, the decision to classify these two streets along with other residential streets as less than 1,000 TPD seems justified.

Random UICs selected for sampling under the Stormwater Monitoring Plan will be evaluated to ensure that the traffic categorization seems appropriate. UICs on streets for which TPD class is uncertain or in flux will be omitted from consideration for water quality sampling, in an effort to avoid introducing error into future statistical analyses that stratify results by TPD. The pre-sampling field inspection described in the Stormwater Monitoring Plan Section 3.3 describes this process.

2.2.3 Sampling Location Selection Method

The GRTS survey design developed by Dr. Don L. Stevens Jr. (Department of Statistics, Oregon State University) and Dr. Anthony R. Olsen (EPA National Health and Environmental Effects Research Laboratory) is specifically designed to efficiently characterize a large system with many potential sampling locations, such as a stream network or stormwater system. It randomly selects sampling locations from a population of potential locations whose members (stormwater structures for potential sampling) are distributed over a large space in a manner that produces a spatially balanced sample.

Selection of stratified, spatially-balanced and random sampling locations using the GRTS procedure was accomplished by:

- Determining the exact geographic locations (latitude-longitude) of all UICs within the permit boundary that are owned and operated by the City of Gresham;[2]
- Running the GRTS selection tool, which places nested random grids over the City's entire UIC system. Each grid is further divided into smaller nested grids until the smallest grid scales contain only a single UIC;
- In order to have a disproportionately greater number of >1000 TPD sites selected, a weighting factor was applied to the GRTS selection run. For the initial selection run, where a higher number of sites was selected than is needed to account for sites that will be eliminated after field screening for determining whether the sampling location is feasible/suitable, 390 locations (188 <1000 TPD and 202 >1000 TPD) were selected using weighting factors of 6.78 for <1000 TPD and 10.25 for >1000 TPD;
- The program systematically selected a random and evenly spaced sample from the UIC locations within the nested grids. Output is a ranked list of locations;
- In order to end up with an equal number of sites in the two traffic strata each year (15 sites in both the <1000 and >1000 TPD), the number of sites randomly selected within each traffic strata were evaluated. Since a fixed panel of 5 locations will be monitored each year (consisting of the top 3 ranked sites with <1000 TPD and the top 2 ranked sites with >1000 TPD), the rotating panel for each year was determined by selecting the next 12 locations with <1000 TPD and 13 locations from >1000 TPD. Selecting slightly more sites in the higher traffic strata of the rotating panel was deliberate to ensure that a disproportionately large number of these sites will be sampled over the permit term (4 more >1000 TPD sites over 5 years and 9 more over 10 years).
- Before sampling the 25 rotating sites selected for each year, field reconnaissance will be performed to determine if the randomly selected sites are unsuitable for sampling (e.g., unsafe or inaccessible due to design). Replacement sites will be selected in ranked order from the list of oversample panel locations, and, likewise, inspected for safety and suitability.

Section 3.0 discusses the specific locations of fixed, rotating and oversample panels selected for compliance with the representative monitoring requirements of the WPCF permit.

2.3 Sampling Event Criteria

2.3.1 Sampling Frequency and Timing

A single sample will be collected annually for each of the 30 sites (5 fixed and 25 rotating locations) described in **Section 3.0**. A maximum of 10 sites will be sampled per storm event, so that sampling will be conducted during a minimum of 3 different storm events. The City will attempt to sample the first predicted storm occurring each fall (the "seasonal first flush") in order

[2] Sites selected from UIC System-wide Assessment conducted November 2011.

to investigate any water quality differences that may be associated with the first significant rainfall of the fall season. The remaining events will be distributed throughout the rest of the wet weather season as storm events allow. First flush storms are notoriously difficult to collect, due to the unreliability of storm patterns early in the season (the same is true for spring and summer storms). If the City is unable to capture a seasonal first flush, the data should not be significantly affected: extensive sampling by City of Portland has shown that for most pollutants, storms sampled in the dead of winter carry the heaviest pollutant concentrations. This is believed to be true because of the high intensity of such storms.

Sampling will primarily occur between October 1 and May 31 of each year, unless a late summer/early fall event is predicted that meets the Storm Event Criteria in **Section 2.3.2**. Storms not likely to result in enough runoff for samples from 5 sites to be collected will not be targeted. This will likely result in average pollutant concentrations that are slightly higher than the true average, because pollutant loads correlate with rainfall intensity.

Because of the unpredictable nature of suitable storm events, it is possible that a sampling event may be missed due to conditions beyond the City's reasonable control. Conditions beyond the City's control, such as atypical climatic conditions, weather conditions that would make collection or analysis of samples unsafe or impracticable, unavoidable equipment failure are discussed in **Section 5.14.2** of this Stormwater Monitoring Plan.

2.3.2 Storm Event Criteria

Prior to initiating a sampling event, the storm will be predicted and evaluated against the criteria listed below to assess whether the predicted storm should be targeted as a potential sampling event.

- Predicted rainfall amount of ≥ 0.2 inches per storm;
- Predicted rainfall duration ≥ 6 hours;
- Antecedent dry period ≥ 6 hours (as defined by < 0.1 inches of precipitation over the previous 6 hours). When possible, samples will be collected after an antecedent dry period of 24 hours.
- The first stormwater sampling event will be targeted to occur during the first predicted late summer/early fall storm meeting the storm monitoring criteria. Storms meeting these criteria that were either unpredicted or were predicted to have less rainfall intensity or duration are not included as potential sampling events.

Based on experience and review of historic weather data related to stormwater monitoring in this region, storms meeting these criteria are expected to provide the volume of runoff necessary to implement sampling. Smaller storms, or storms of shorter duration, are considered to have a low probability of producing sufficient runoff to warrant the extensive preparation and mobilization time required for stormwater monitoring. It is likely that a sampled storm may not meet the target criteria listed above when the sampling event is completed, but so long as sufficient runoff is generated from a storm predicted to meet the listed quantity or duration, data collected from that event will be deemed representative. It is also likely that unpredicted events will occur that do meet the criteria, which will be tracked in case the City needs to apply for a sampling waiver (see Section 5.14.2). Adhering to target storm event criteria, to the extent practicable, will help ensure that stormwater runoff will be adequate for sample collection, be representative of stormwater runoff, and be consistent between sampling events.

Hourly and daily rainfall records are maintained and available on the HYDRA Data Report System. This data is available on the web at:
http://or.water.usgs.gov/non-usgs/bes/raingage_info/clickmap.html

Storm event characteristics for all sampling events will be documented and summarized for the required WPCF and MS4 Annual Reports, as applicable. In the event one or more storm events are missed due to atypical climatic conditions, representative climatic data will be provided to document these conditions.

2.3.3 Weather Forecasting

The Monitoring Program Lead, or another experienced member of the Watershed Division, if needed, tracks weather patterns and selects the events to be monitored. The City utilizes multiple weather forecasting services to monitor weather patterns. The Monitoring Program Lead monitors weather forecasts daily during the stormwater sampling season, which include quantity of precipitation forecasts. When a candidate storm approaches, the Monitoring Program Lead communicates frequently with responsible staff to make a determination about mobilizing a Sampling Team to commence sampling operations as outlined in **Section 2.5**.

2.4 Responsible Sampling Coordinator

Stormwater monitoring is coordinated by the Monitoring Program Lead within the City of Gresham's Department of Environmental Services Watershed Division. The Monitoring Program Lead, or another experienced member of the Watershed Division, if needed, tracks weather patterns and selects the events to be monitored. These events may occur at any time during a 24-hour day, 7 days a week; although federal holidays are avoided to minimize conflicts with analytical laboratory and personnel schedules. Storm tracking and sampling is time-intensive, and sampling staff are responsible for other duties that often preclude sampling during the workday, making storm sampling a common overtime activity. When a target storm has been identified, the Monitoring Program Lead will obtain the latest weather forecasts and updates, and make the "Go/No-Go" decision.

The Monitoring Program Lead attempts to provide the analytical laboratory and one additional field monitoring assistant with 72-hour advance notification of a potential monitoring event, which is necessary to ensure adequate staffing availability and proper laboratory preparation. Laboratory analysis for stormwater samples is conducted by Portland's Water Pollution Control Laboratory under an IGA with the City of Gresham for laboratory services (see **Appendix E**).

The Sampling Team will typically be composed of the Monitoring Program Lead or other trained personnel from the Watershed Division. Sampling Teams will be primarily two person teams (required for traffic control locations), with at least one team member trained in UIC sampling procedures. Individual samplers may be utilized at sites where no traffic control is required and other safety considerations allow.

Staff who lead monitoring events are required to read, understand and follow all procedures documented in the Stormwater Monitoring and Quality Assurance Plan. At a minimum, Sampling Team members will be responsible for the following:

- Inspecting and calibrating field sampling equipment prior to use to ensure that it is in proper working order;
- Ensuring that all field sampling collection forms (*e.g.*, Chain of Custody forms, Field Data Sheets) are properly and completely filled out; and
- Ensuring that samples are collected, stored, and delivered to the laboratory in accordance with this UIC Monitoring Plan.

3.0 Sampling Locations

The proposed sampling locations for Wet Weather Stormwater Monitoring are listed in **Tables 5, 6** and **Appendix A**. Since exact sampling locations to be monitored each year may vary based on changes to the stormwater system, **Table 4** lists the number of fixed and rotating sites that will be monitored in each year of the WPCF permit cycle. Each year, monitoring will occur at one panel of 5 fixed locations (**Table 5**) and one panel of 25 rotating locations that will be monitored once during the permit term (proposed locations for permit year 1 listed in **Table 6** and proposed locations for entire permit term listed in **Appendix A**).

The goal of including fixed and rotating sample locations is to assess status and trends in stormwater – status being evaluated by covering a large random sample of the permit area, and trends being evaluated by long-term assessment of the same locations. As described in Section 2.2.3, the sampling locations will result in 15 high traffic (2 fixed and 13 rotating) and 15 low traffic sites (3 fixed and 12 rotating) being monitored annually. While the numbers are equal on an annual basis, the sampling design was purposely skewed to sampling more high traffic rotating sites. The result is that over the course of the 10 year permit term, 13 x 10 = 130 rotating + 2 fixed = 132 high traffic sites will be evaluated and 12 x 10 = 120 rotating + 3 fixed = 123 low traffic sites will be evaluated. The result is that 23% of the total population of UICs will be evaluated over the 10 year permit term, with 30% of high traffic sites being sampled and 19% of low traffic sites being sampled.

Table 4: Stormwater Sampling Locations to be Monitored During Permit Term

Permit Year	Fixed Locations*	Rotating Locations	Wet Season
0**	5 (Panel 1)	25 (Panel 2)	2011-12
1	5 (Panel 1)	25 (Panel 3)	2012-13
2	5 (Panel 1)	25 (Panel 4)	2013-14
3	5 (Panel 1)	25 (Panel 5)	2014-15
4	5 (Panel 1)	25 (Panel 6)	2015-16
5	5 (Panel 1)	25 (Panel 7)	2016-17
6	5 (Panel 1)	25 (Panel 8)	2017-18
7	5 (Panel 1)	25 (Panel 9)	2018-19
8	5 (Panel 1)	25 (Panel 10)	2019-20

9	5 (Panel 1)	25 (Panel 11)	2020-21
10	5 (Panel 1)	25 (Panel 12)	2021-22

* One panel of five fixed sampling locations will be monitored each year, The 25 rotating sampling locations monitored each year will consist of 13 UICs on >1000 TPD and 12 locations on <1000 TPD locations.

** The City began implementing the aspects of the monitoring design outlined in this Stormwater Monitoring Plan in 2011-12, prior to receiving the most recent version of the WPCF permit. Since all of the constituents required in the current permit were monitored at sites in Panel 2, the data collected prior to issuance of the permit (Year 0) will be incorporated into future analyses of the entire permit area.

3.1 Fixed Panel

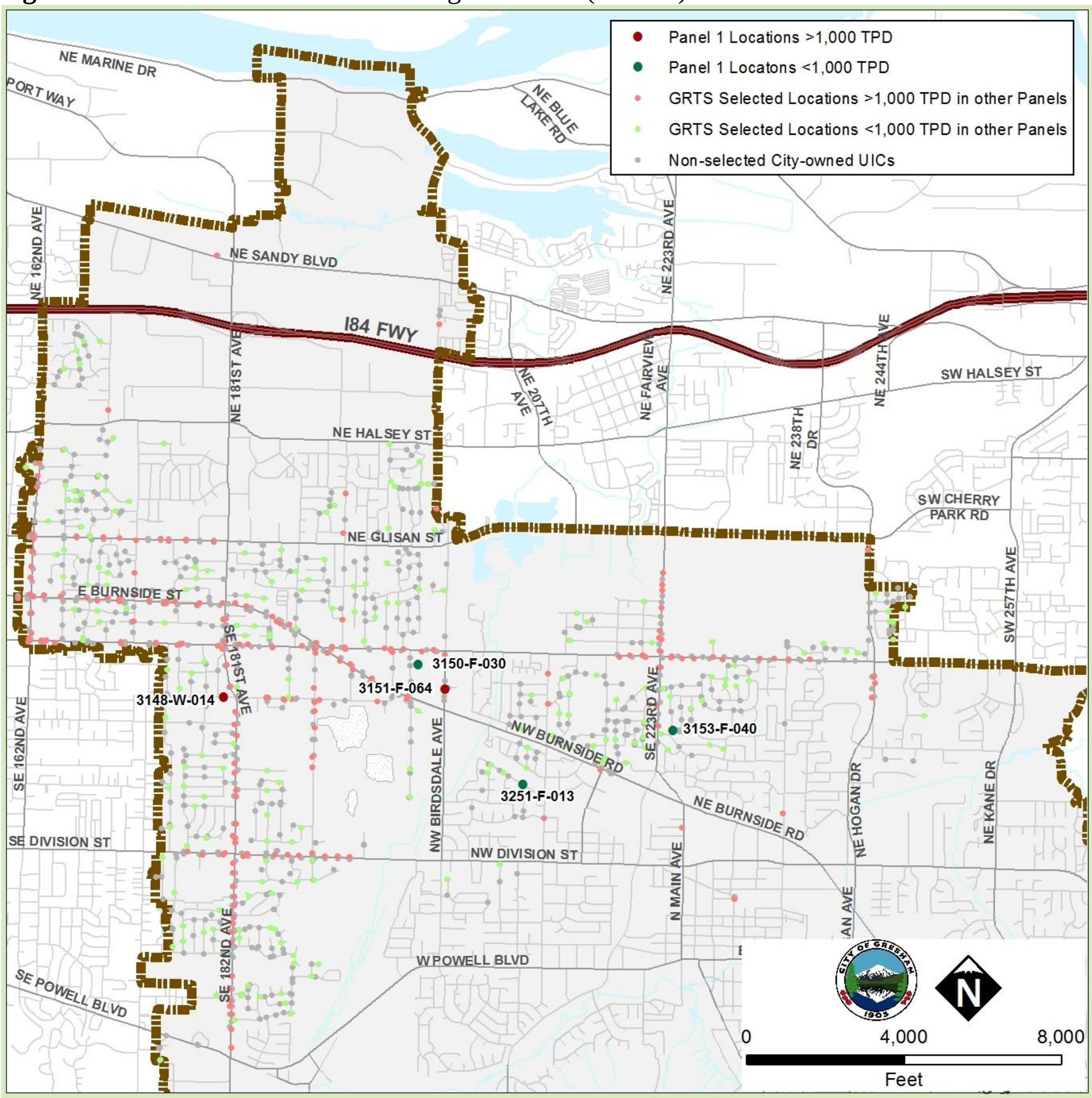
Table 5: Fixed Panel Sampling Locations*

Gresham System ID	Functional Class	Trips per Day	Land Use	Latitude	Longitude
3151-F-064	Collector	>1000	COM	45.5164	-122.4551
3251-F-013	Residential	<1000	RES	45.5099	-122.4471
3148-W-014	Community	>1000	RES	45.5155	-122.4771
3150-F-030	Residential	<1000	RES	45.5181	-122.4578
3153-F-040	Residential	<1000	RES	45.5139	-122.4324

* Sites subject to change contingent upon field verification as described in Section 3.3

The 5 sampling locations in the fixed monitoring panel (Panel 1) consists of the first sites selected probabilistically using the GRTS survey design described previously in **Section 2.2.3**. In order to ensure that the annual balance of high and low traffic sites was equal, while allowing a higher proportion of high traffic sites to be sampled over the permit term, the fixed panel was biased towards low traffic locations (three <1000 and two >1000 TPD).

Figure 2: Locations of Fixed Monitoring Locations (Panel 1)



3.2 Rotating Panels

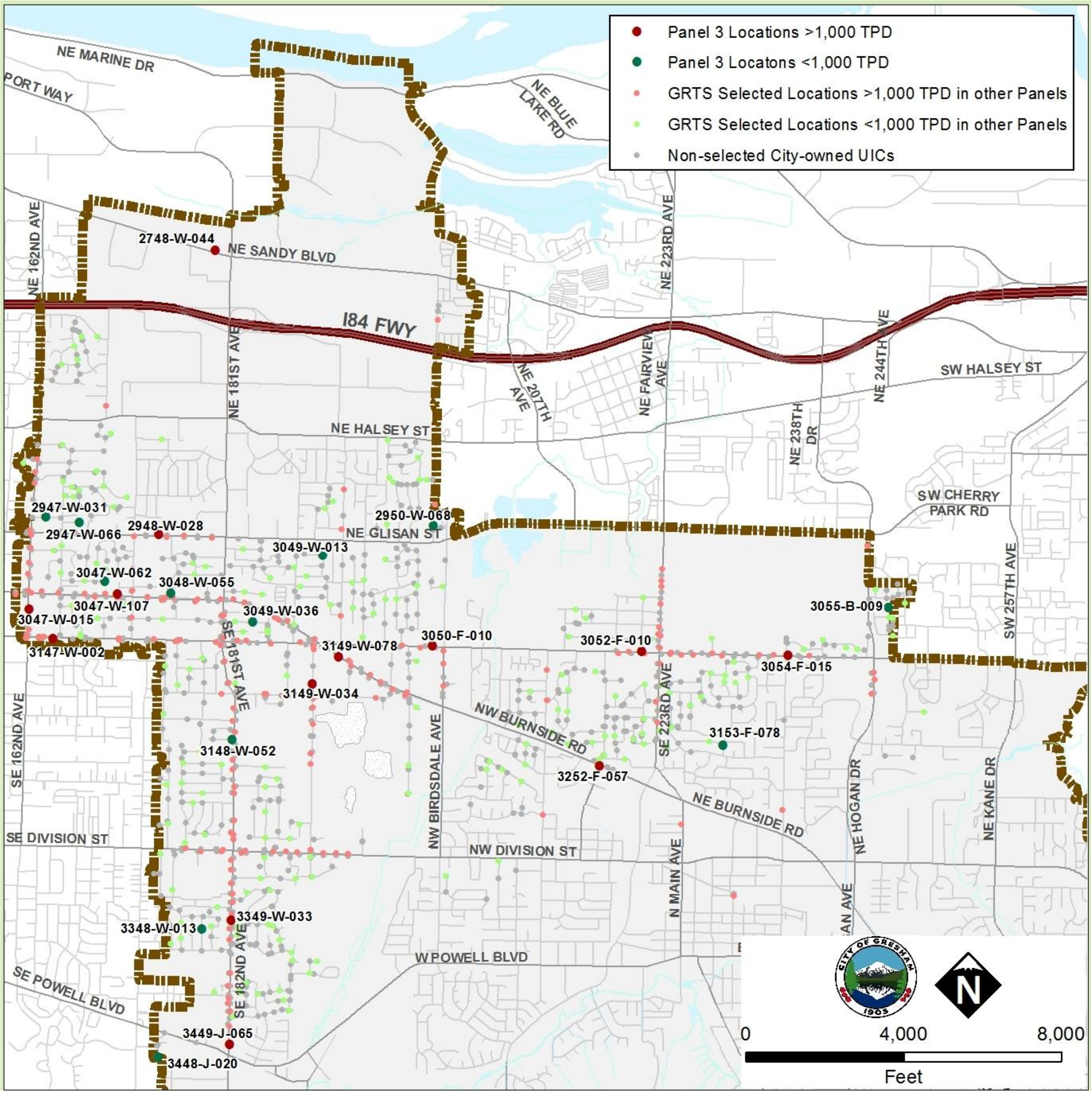
As described in **Section 3.0**, the rotating panels to be monitored each year will be comprised of 13 high traffic and 12 low traffic strata locations. Sites selected for the panels to be monitored each year (Year 1 in **Table 6** (Panel 3) and proposed locations for years 2-10 (Panels 4-12), listed in **Appendix A**) are the top ranked GRTS-selected sites meeting the desired traffic strata. The rotating panel locations to be monitored each year are subject to change as a result of field reconnaissance or system changes, so an updated list will be reported to DEQ each year as part of the WPCF permit (Schedule B.4.) required Annual Report.

Table 6: Proposed Rotating Panel Locations for Permit Year 1 (Panel 3)

Gresham System ID	Functional Class	Vehicle TPD	Land Use	Latitude	Longitude
3047-W-062	Residential	<1000	RES	45.5231	-122.4889
2947-W-031	Residential	<1000	RES	45.5275	-122.4950
3348-W-013	Residential	<1000	RES	45.4990	-122.4785
3448-J-020	Residential	<1000	MRES	45.4901	-122.4825
3049-W-013	Residential	<1000	RES	45.5253	-122.4674
3048-W-055	Residential	<1000	RES	45.5224	-122.4824
3050-F-010	Minor Arterial	>1000	COM	45.5192	-122.4563
3252-F-057	Boulevard	>1000	COM	45.5111	-122.4394
2947-W-066	Residential	<1000	MRES	45.5272	-122.4916
3147-W-002	Minor Arterial	>1000	COM	45.5190	-122.4939
3052-F-010	Minor Arterial	>1000	COM	45.5192	-122.4355
3149-W-034	Community	>1000	MRES	45.5163	-122.4681
3148-W-052	Residential	<1000	MRES	45.5123	-122.4760
3449-J-065	Minor Arterial	>1000	VAC	45.4911	-122.4754
3054-F-015	Minor Arterial	>1000	RES	45.5191	-122.4210
3049-W-036	Residential	<1000	MRES	45.5206	-122.4742
3349-W-033	Minor Arterial	>1000	VAC	45.4997	-122.4755
3055-B-009	Residential	<1000	RES	45.5226	-122.4111
2950-W-068	Residential	<1000	RES	45.5276	-122.4565
3153-F-078	Residential	<1000	RES	45.5127	-122.4272
3047-W-107	Community	>1000	RES	45.5223	-122.4877
3149-W-078	Boulevard	>1000	COM	45.5182	-122.4656
2748-W-044	Minor Arterial	>1000	VAC	45.5464	-122.4788
2948-W-028	Minor Arterial	>1000	COM	45.5265	-122.4837
3047-W-015	Minor Arterial	>1000	RES	45.5210	-122.4964

It is anticipated that the random panel of sites listed in **Appendix A** will be representative of the City's UIC system, since any UICs constructed or discovered during the permit term will equal a tiny minority of the 1100+ future active UICs owned and operated by the City of Gresham. The current probability of randomly selecting a single site from a population of 1100 UICs is 1 in 1100 or 0.091%. While new UICs may be constructed or discovered over the permit term, it is anticipated that only 5 new UICs would likely be added annually. Over a 10 year period, this would mean 50 potential new sampling locations could be added. The probability of selecting a single site after those 50 sites were added to the system would be 1 in 1150 or 0.087%. The probability that any of the 50 newly added sites would be selected would be 50 in 1150 or 4.3%. Based on a similar criteria used by Portland in their Sampling and Analysis Plan (Portland 2006a), sampling locations will not be re-selected using GRTS unless the probability for selecting a newly constructed or discovered sampling site becomes greater than 5% (more than 57 UICs added over 10 year permit term). The inventory of UICs will be evaluated annually and a determination will be made prior to the beginning of each wet weather sampling season.

Figure 3: Proposed Rotating Panel Locations for Permit Year 1 (Panel 3)



3.3 Sampling Location Suitability

Prior to sampling, each identified UIC sample location will be investigated and inspected for the purpose of determining if the UIC is suitable for sampling. The pre-sampling investigation will obtain and/or confirm the following information:

- Gresham's system identification number;
- Street address or intersection location;
- Latitude and longitude in decimal degrees;
- The type of construction;
- Street functional classification taken from the Gresham Transportation System Plan; and

- Predominant land use in UIC drainage area.

The pre-sampling field inspection will identify and/or confirm the following to the extent practicable:

- UIC accessibility;
- Potential health and safety concerns for sampling activities (e.g., traffic, UIC location, visibility (e.g., blind corners));
- General stormwater system condition;
- Maintenance (e.g., cleaning) or repair needed prior to initiating sampling;
- The type of pretreatment BMP (if any);
- Sediment depth in sedimentation manhole or in catch basins for UICs that do not have sedimentation manholes;
- Qualitative observations of traffic types (e.g., trucks, cars) and volume; and
- Potential pollutant sources (e.g., site activities, construction, unimproved street) in the estimated UIC drainage area.

The results of either the pre-sampling investigation or field inspection will be used to determine whether or not a UIC location is unsuitable for sampling. UICs may be determined to be unsuitable for sampling, based on one of the following factors, or other unforeseen factors approved by DEQ:

- Unsafe sampling conditions;
- Incorrect traffic categorization;
- Location already included in the monitoring program;
- Physical barrier or denied access to the location;
- UIC has been decommissioned;
- Maintenance or repair needed prior to initiating sampling or conditions that prevent collection of representative samples;
- UIC does not receive adequate flow during rain events;
- UIC location could not be found or no longer exists;
- UIC location is not a member of the target population (i.e., UIC does not capture drainage from rights-of-way such as drinking fountain drains, aquifer storage and recovery wells, drains receiving potable water, trenches, roof drainage, etc.); and/or
- UIC lacks access or has structural constraints that make sampling infeasible.

If a UIC is deemed unsuitable for sampling, a replacement UIC will be selected, following the process described in **Section 3.4**. UICs determined unsuitable for sampling will be reported in the WPCF permit (Schedule B.5.) required Annual Report, along with an explanation of why the UIC is unsuitable.

3.4 Replacement Locations – Oversample Panel

In the event any UIC in Panels 3 through 12 is determined to be unsuitable for sampling (e.g., incorrect traffic categorization, decommissioned, unsafe conditions), based on the results of the pre-sampling investigation or field inspection described in **Section 3.3**, a replacement UIC (i.e., location) will be selected. The permit (Schedule D(4)(c)) requires that any newly identified injection systems be prepresented by the monitoring plan. So long as the probability of not selecting newly discovered, identified or constructed UICs is less than 5% (average of 6 sites added per year or ≤57 added over 10 year permit term), the City will not regenerate a new list of sampling locations for **Appendix A**.

Replacement locations will be selected using the following process:

- If it is determined that a UIC is unsuitable for sampling, a replacement UIC will be selected from the oversample panel list;
- The replacement location will be selected by choosing the first UIC on the oversample panel list with the same traffic category as the UIC being replaced; and
- The replacement UIC will be investigated and field verified as described in **Section 3.3** to confirm its suitability for sampling.

Additional information regarding the location, separation distance, and system maintenance will be provided in the event that a UIC is used from the oversample panel.

4.0 Analytical Procedures

Samples will be submitted to the City of Portland's Water Pollution Control Laboratory (WPCL), or other lab with similar capabilities, should the Intergovernmental Agreement with Portland be (unexpectedly) terminated. The WPCL will conduct some analyses, while contracting out some analyses to a contract laboratory, Test America (TA), for low level analysis of other stormwater quality analytes. Low level pesticide analyses are performed by Portland-based Pacific Agricultural Laboratories (PAL). **Table 7** shows the laboratory performing the analyses, the analytical methods chosen with method reporting limits (MRLs) below the permit-specified action levels. All analytical methods selected are EPA-approved.

4.1 Methods and Reporting Limits

The recommended analytical methods and the corresponding laboratory method reporting limits (MRLs) for the analytes of interest are identified in **Table 7**. The permit-specified action levels are also included in this table. The analytical methods were selected to achieve low-level MRLs, particularly for hydrophobic organic compounds. Portland's Water Pollution Control Laboratory and Test America have their own QAPPs to ensure that samples achieve the listed MRLs.

Table 7: Analytical Methods, Reporting Limits and Laboratory Performing Analyses

Constituent	Analytical Lab*	Analytical Method	MRL**	Action Level***
General				
Biochemical Oxygen Demand (BOD_5)	WPCL	SM 5210 B	2 mg/L	NA
Total Suspended Solids	WPCL	SM 2540 D	2 mg/L	NA
Hardness	WPCL	SM 2340 B	0.5 mg/l	NA
E. coli	WPCL	COLILERT QT	10 MPN/ 100mL	NA
Nutrients				
Nitrate Nitrogen	WPCL	EPA 300.0	100 µg/L	10000 µg/L
Total Kjeldahl Nitrogen	WPCL	PAI-DK03 [1]	200 µg/L	NA
Ammonia Nitrogen	WPCL	EPA 350.1	20 µg/L	NA

Total Phosphorus	WPCL	EPA 365.4	20 µg/L	NA
Ortho-phosphorus	WPCL	EPA 365.1	20 µg/L	NA
Total Metals				
Antimony (Total)	WPCL	EPA 200.8	0.1 µg/L	60 µg/L
Copper (Total)	WPCL	EPA 200.8	0.2 µg/L	1000 µg/L
Lead (Total)	WPCL	EPA 200.8	0.1 µg/L	500 µg/L
Mercury[2] (Inorganic)	WPCL	WPCLSOP M-10.02	0.005 µg/L	NA
Zinc (Total)	WPCL	EPA 200.8	0.5 µg/L	50000 µg/L
Dissolved Metals				
Copper	WPCL	EPA 200.8	0.2 µg/L	NA
Lead	WPCL	EPA 200.8	0.1 µg/L	NA
Zinc	WPCL	EPA 200.8	0.5 µg/L	NA
PAHs + Phthalates				
Benzo(a)pyrene	TA	EPA 8270-SIM	0.01 µg/L	2.0 µg/L
Di(2-ethylhexyl) phthalate	TA	EPA 8270-SIM	0.5 µg/L	300 µg/L
Pesticides				
2,4-D	PAL	EPA 8321B	0.2 µg/L	4.0 µg/L
Dinoseb	PAL	EPA 8321B	0.2 µg/L	NA
Pentachlorophenol	PAL	EPA 8321B	0.08 µg/L	10 µg/L
Glyphosate	PAL	EPA 547	10.0 µg/L	NA
Triclopyr	PAL	EPA 8321B	0.2 µg/L	NA
Trifluralin	PAL	EPA 8081B	0.2 µg/L	NA
BTEX				
Benzene	WPCL	EPA 8260B	0.2 µg/L	NA
Toluene	WPCL	EPA 8260B	0.5 µg/L	NA
Ethylbenzene	WPCL	EPA 8260B	0.5 µg/L	NA
Xylenes (Total)	WPCL	EPA 8260B	1.0 µg/L	NA

* Analytical labs included in table include Portland's Water Pollution Control Lab (WPCL), Test America (TA) and Pacific Agricultural Laboratories (PAL)
** Method Reporting Limit (MRL)
*** Action Levels established in WPCF permit Schedule A.2 Table 1. NPDES and screening constituents listed in table do not have action levels established in permit, so listed as Not Applicable (NA).
[1] The PAI-DK03 method for TKN is a 40 CFR 136 method (flow injection gas method, see footnote 41, Table 1B, 40 CFR Part 136.3).
[2] The WPCL has pending ATP approval on their EPA 200.8 w/CEM digestion method (footnote 4, Table 1B, 40 CFR Part 136.3), which is cited as WPCLSOP M-10.02.

4.2 Pesticides

The NPDES MS4 permit required an evaluation of pesticides available and used within the City of Gresham. Gresham staff prepared an assessment of 15 DEQ-requested pesticides, as well as pesticides used by the City during operations and maintenance activities, pesticides identified by DEQ or other regional research in local water bodies, and pesticides available to residents based on a shelf survey conducted by Metro. The City conducted the evaluation so that it would be applicable and evaluate risk for pesticides that could threaten surface and groundwater. The "Pesticide Assessment for Stormwater Monitoring" (2011) is submitted in **Appendix D**.

Based on a preliminary assessment of current use pesticides used within the permit area, the City will conduct sampling for the following:

- **2,4-D (Dichlorophenoxyacetic acid, dimethylamine salt):** The most widely available and used phenoxy herbicide; selected because of its widespread use, known toxicity to fish and aquatic invertebrates, potential for groundwater pollution (due to high mobility), and likelihood for transport in urban stormwater. In addition, the City has conducted residential outreach to discourage use of this and other lawn chemicals, and trends over time are of interest.
- **Pentachlorophenol:** A previously widely used, but now is a restricted-use fungicide that was identified through Portland's stormwater monitoring as a potential concern based on use as a utility pole wood preservative. Gresham also found pentachlorophenol during a special stormwater study conducted in wet season 2009-10. This chemical has the potential to be a surface and groundwater pollutant, is known to be toxic to aquatic organisms and humans and is a suspected carcinogen, mutagen and teratogen.
- **Glyphosate:** One of the most widely available and utilized herbicides. Glyphosate was ranked 6th on the City's pesticide assessment, primarily based on use and availability. Screening for this herbicide may occur peridically, although the low mobility and relatively short half-life (i.e., low persistence) makes it a low risk to groundwater with adequate vertical separation. Glyphosate detections may increase over time, because a longer half-life formula is now being marketed.
- **Trifluralin and Triclopyr:** Based on the results of the pesticide assessment conducted by the City, these herbicides were highly ranked (2nd and 3rd) based on use, toxicity and mobility. Both are classified as general use pesticides that are available and used by both residents and the City. Trifluralin ranked slightly higher than Triclopyr based on toxicity, while Triclopyr is likely a greater groundwater risk based on higher mobility. Based on the ranks of these two pesticides, the City to screen for these pesticides at least once during the permit term.

4.3 Analytical Schedule

The WPCF permit requires constituents listed on Schedule A.5 Table 1 to be monitored annually. The City also has a few additional pollutants of interest it plans to screen for periodically during the permit term. To avoid large variations in annual monitoring costs, the City plans to evaluate some screening pollutants each year. **Table 8** outlines the permit years in which WPCF-required and additional NPDES MS4 permit constituents will be evaluated at the sampling locations scheduled for that year.

Table 8: Sampling Schedule for Analytes

Constituent	Permit Mandate*	Permit Years Monitored
General		
Biochemical Oxygen Demand (BOD_5)	MS4	Annual**
Total Suspended Solids	MS4	Annual**
Hardness	MS4	Annual**
E. coli	MS4	Annual**
Nutrients		

Nitrate Nitrogen	MS4	Annual**
Total Kjeldahl Nitrogen (TKN)	MS4	Annual**
Ammonia Nitrogen	MS4	Annual**
Total Phosphorus	MS4	Annual**
Ortho-phosphorus	MS4	Annual**
Total Metals		
Antimony (Total)	WPCF	Annual
Copper (Total)	WPCF, MS4	Annual
Lead (Total)	WPCF, MS4	Annual
Mercury (Total Inorganic)	MS4	Annual**
Zinc (Total)	WPCF, MS4	Annual
Dissolved Metals		
Copper (Dissolved)	MS4	Annual**
Lead (Dissolved)	MS4	Annual**
Zinc (Dissolved)	MS4	Annual**
PAHs + Phthalates		
Benzo(a)pyrene	WPCF	Annual
Di(2-ethylhexyl) phthalate	WPCF	Annual
Pesticides		
2,4-D	WPCF; MS4	Annual
Pentachlorophenol	WPCF; MS4	Annual
Glyphosate	Screen	Year 1 and 6
Triclopyr	Screen	Annual
Trifluralin	Screen	Year 2 and 7
BTEX		
Benzene	Screen	Year 3 and 8
Toluene	Screen	Year 3 and 8
Ethylbenzene	Screen	Year 3 and 8
Xylenes (Total)	Screen	Year 3 and 8

* Permit mandate refers to WPCF permit and NPDES MS4 permit constituents which will be monitored at all UIC sites for at least the first five years of the WPCF permit. Pollutants listed as “Screen” were identified as constituents of interest to the City to screen for periodically during the permit term.
** Annual monitoring of MS4 constituents may be modified if permit conditions change with reissuance of NPDES MS4 permit in 2015.

5.0 Sampling Collection and Handling

Guidelines for sample collection procedures have been developed for this Stormwater Monitoring Plan to provide data of sufficient quality to demonstrate permit compliance and/or evaluate potential risks to human health and the environment associated with urban stormwater discharges. Adherence to the procedures described in this section will help ensure consistency between stormwater sampling events and over the duration of the permit, and prevent sample contamination due to field activities. This section focuses primarily on field sampling procedures including:

- Personal safety;
- Sampling equipment preparation;
- Sampling equipment decontamination;
- Sampling container preparation;
- Analytical field meter calibration;
- Clean sampling techniques;
- Sampling station access procedures;
- Sample collection and handling;
- Field QC sample collection;
- Sample labeling;
- Field parameter measurements;
- Sample collection documentation; and
- Sample transport and delivery to the laboratory.

5.1 Personal Safety

All sampling locations are in urban areas, typically requiring traffic control. In addition, sample collection typically requires prolonged fieldwork hours and is often performed throughout the night and on weekends. Sleep deprivation, fatigue, increased exposure to drunken drivers, etc. are all increased risk factors that are associated with this type of work. Personal safety is of primary concern while conducting all stormwater sampling related activities. Given the hazardous nature of performing this type of stormwater sampling, at least one member of each Sampling Team should have the following certifications (at a minimum, to be able to identify and avoid hazards):

- Confined Space Entry and Work Practices certification;
- Traffic Control and Flagging certification; and
- First Aid and Cardiopulmonary Resuscitation (CPR) certification.

Persons involved in sampling will be made aware of the hazards associated with the fieldwork and be given the opportunity to freely voice any concerns, if potential hazards become apparent; if personal safety is an issue, sampling will be terminated. The following list provides basic health and safety recommendations to minimize risks to sampling personnel:

- Turn on Vehicle hazard lights and overhead yellow warning lights, prior to initiating field activities;
- Do not access sampling stations until traffic control has been established, if required. A traffic control plan will be developed by the Sampling teams for each location requiring traffic control;
- At certain times of day, or during certain traffic scenarios (e.g., rush hour, delivery zone, police activity, etc.); it may not be possible to safely access a sampling location. If a location cannot be accessed safely or if a location becomes unsafe during sampling, proceed to other locations and return to the location later during the storm or a subsequent storms;
- Remove and replace manhole covers using a manhole cover puller;
- Never leave an open manhole unattended; and

- Avoid confined space entries (CSEs). Since only grab sampling is required, staff will break the manhole plane with equipment only. Sampling staff will not enter any UIC or sediment manhole unless the sampling consists of two staff that are properly trained and have all of the necessary CSE equipment.

5.2 Sampling Equipment Preparation

The equipment required for collecting stormwater discharge grab samples includes:

- Stainless steel beaker (decontaminated at the WPCL laboratory);
- Swing sampler with telescoping pole;
- Laboratory provided sample containers;
- Volatile organic compound (VOC) trip blank;
- Disposable gloves (non-talc nitrile);
- Cooler with blue ice;
- Manhole cover puller;
- Traffic control equipment;
- Analytical field meters (pH, specific conductance and temperature);
- Sample collection documentation (Daily Field Reports, Field Data Sheets, Chains-of-Custody Forms); and
- Field file with location maps, location photos, and traffic control plans.

5.3 Sampling Equipment Decontamination

The only equipment that will contact the sample media (stormwater) is the stainless steel beaker used to collect the grab samples. Stainless steel beakers are decontaminated, dried, and wrapped in aluminum foil at the WPCL prior to fieldwork. The WPCL provides Gresham with a sufficient number of decontaminated beakers for the planned number of UIC sampling locations.

5.4 Sample Container Preparation

All sample containers will be provided pre-cleaned and, if required, pre-preserved from the laboratory. **Table 9** provides the required sample volumes, containers, and preservatives required for laboratory analyses, based on standard EPA-approved methodologies. If additional analyses are required (e.g., QA/QC samples) additional samples will be collected. Bottles will be transported in coolers with blue ice to keep chilled and to prevent breakage.

Table 9: Sample Containers, Preservation and Holding Times

Constituent	**Permit Mandate***	**Minimum Sample Volume/Bottle**	**Preservation**	**Holding Time**
General				
Biochemical Oxygen Demand (BOD_5)	MS4	250 mL Poly	Cool to 4° C	24 hours
Total Suspended Solids	MS4	500 mL Poly	Cool to 4° C	7 days
Hardness	MS4	250 mL Poly	Cool to 4° C	6 months
E. coli	MS4	100 mL Sterile Plastic	Cool to 4° C	6 hours (max 24 hrs)

Nutrients				
Nitrate Nitrogen	MS4	100 mL Poly	Cool to 4° C	48 hours
Total Kjeldahl Nitrogen (TKN)	MS4	100 mL Poly	Cool to 4° C	28 days
Ammonia Nitrogen	MS4	100 mL Poly	Cool to 4° C	28 days
Total Phosphorus	MS4	100 mL Poly	Cool to 4° C	28 days
Ortho-phosphorus	MS4	250 mL Poly	Cool to 4° C	48 hours
Total Metals				
Antimony (Total)	WPCF	500 mL Poly	HNO_3 to pH<2; Cool to 4° C	6 months
Copper (Total)	WPCF, MS4			
Lead (Total)	WPCF, MS4			
Mercury (Total Inorganic)	MS4			
Zinc (Total)	WPCF, MS4			
Dissolved Metals				
Copper (Dissolved)	MS4	500 mL Poly	Cool to 4° C	6 months
Lead (Dissolved)	MS4			
Zinc (Dissolved)	MS4			
PAHs + Phthalates				
Benzo(a)pyrene	A.5.1	1-L Amber Glass	Cool to 4° C	7/40 days
Di(2-ethylhexyl) phthalate	A.5.1			
Pesticides				
2,4-D	WPCF; MS4	250 mL Amber Glass	Na_2SO_3; Cool to 4° C	14 days
Dinoseb	Screen			
Pentachlorophenol	WPCF; MS4			
Triclopyr	Screen			
Glyphosate	Screen	250 mL Amber Glass	Na_2SO_3; Cool to 4° C	14 days
Trifluralin	Screen	250 mL Amber Glass	Na_2SO_3; Cool to 4° C	14 days
BTEX				
Benzene	Screen	3 40-mL Glass VOC Vials	HCl to pH<2; Cool to 4° C	14 days
Toluene	Screen			
Ethylbenzene	Screen			
Xylenes (Total)	Screen			

*References are to the NPDES MS4 permit, or WPCF permit.

5.5 Analytical Field Meter Calibration

Stormwater samples will be analyzed in the field for pH, specific conductance, and temperature using portable analytical meters. The multi-meter probe used to collect field measurements (temperature, pH, DO, and conductivity) will be calibrated prior to each event at mobilization. pH will be calibrated using a 3-point calibration (pH 4, 7 and 10 buffers). Conductivity will be calibrated using a standard within the range of expected measurement (typically 100 µS/cm). Meter calibration will be recorded in an electronic calibration log. Meters will be calibrated halfway through the monitoring event if meter readings are outside the expected range during the monitoring event. After each sampling event the meter will be measured against known standards to check measurement accuracy.

5.6 Clean Sampling Techniques

Field personnel will follow clean sample collection techniques to minimize the potential for introducing contamination to stormwater samples.

Care must be taken during all sampling operations to avoid contamination of the stormwater samples by human, atmospheric, or other potential sources of contamination. The Sampling Team should prevent contamination of any of the following items: stainless steel beakers, sample bottles, lids, and sample media. Whenever possible, samples should be collected upgradient and upwind of sampling personnel to minimize contamination potential. Gloves used during sampling can also be a source of contamination. Sampling Teams will use a new pair of non-talc nitrile gloves when filling containers for each sampling location.

5.7 Sampling Location Access Procedures

During fieldwork activities, Sampling Teams should use the following procedure to access each sampling location:

- Set up location-specific traffic control;
- Observe and document conditions in UIC drainage basin that may affect stormwater discharge quality, such as:
  - System integrity (e.g., catch basin covers in place, catch basins or inlets operational, sedimentation manhole “gooseneck” intact and operational);
  - Debris (e.g., litter, plastic, leaves), sheen, etc. in catch basins, along curbs, or in surface water sheet flow;
  - Traffic volume (e.g., light, medium, heavy, unusual traffic conditions), type (e.g., passenger cars, trucks, buses);
  - Road conditions (e.g., unimproved streets, streets with unimproved shoulders, new asphalt, numerous potholes);
  - New asphalt or sealant on roads or near-by parking lots; and
  - Potential pollutant sources (e.g., utility poles; parked cars, sheen, landscaping, commercial/industrial activity).
- Remove manhole cover with manhole cover puller; and
- Determine if flow rate at EOP is sufficient to sample

5.8 Sample Collection and Handling

Grab samples will be collected using decontaminated stainless steel beakers connected to telescoping poles by swing samplers. To eliminate the need for field decontamination, a separate decontaminated beaker will be dedicated to each sample location. Care will be taken by the Sampling Team not to place the decontaminated beaker on the ground or to hit the side of the UIC during sampling activities.

The beaker will be positioned at the sample point to collect EOP discharge and brought to the surface grade to fill sample containers. To the extent practicable, the beaker will be filled and emptied slowly and carefully to avoid degassing the sample. Samples will be placed in pre-cleaned bottles provided by the analytical laboratory and specified in **Table 9**. Sample bottles will be filled in the following order, after donning non-talc nitrile gloves:

- Metals bottles;
- Inorganic analyses;
- Organic analyses (except VOCs); and when collected
- VOC analyses (40 mL VOCs).
-

Samples will be placed in ice chests with ice ("wet" ice or blue ice) immediately after sample collection and labeling pending transport to the WPCL.

End of Pipe (EOP) will be the primary sampling point for stormwater sampling. In the event a probabilistically selected UIC is slow draining and fills quickly during a storm event such that the water level in the UIC rises above the EOP, the Sampling Team may opt to:

1) Return to the UIC on another sampling event,
2) Collect a grab sample from standing water within the UIC by dipping the sample beaker into the standing water, or
3) In the event a sampling location develops maintenance issues (e.g., no flow to UIC, clogged inlets, plugged inlet covers or pipes), collect a grab sample at an alternative location as close to the EOP as possible (e.g., water discharging into the sedimentation manhole, flowing into a catch basin, etc.).

Departure from the procedures previously in this Stormwater Monitoring Plan will be documented and described in the WPCF permit (Schedule B.4.) required Annual Report. DEQ will be notified if unusual sampling conditions are encountered.

5.9 Field Quality Control Sample Collection

Field QC samples are used to assess sample collection procedures, environmental conditions during sample collection and shipment, and the adequacy of equipment decontamination. Field QC samples include equipment blanks, field decontamination blanks, duplicate samples, trip blanks, and temperature blanks. Minimum quality control samples for field sampling are summarized in **Table 10**.

Table 10: Minimum Quality Control Samples for Field Sampling

Equipment Blank	Field Blank	Field Duplicate	Trip Blank	Temperature Blank
1 per compliance season	10%	10%	1 per cooler containing VOC samples	1 per Cooler
Performed annually by WPCL on decontaminated beakers	Prior to collection of first field sample, DI water used to fill 1 set of sample containers using	Second sample collected from 1 of 10 locations sampled each event	Analyzed only when one of the VOC samples has a detection above MRL	Temperature of water-filled container in each cooler measured at sample receiving

	decontaminated beaker			

5.10 Sample Labeling

Sample labels are necessary to prevent misidentification of samples. Each sample that is collected in the field will be labeled with a unique sample point code labeled on the bottle using indelible ink. The unique sample point code used by the City is the system id number, which is the unique identifier developed by the City's GIS division. This information will be written directly onto the sample container (polyethylene bottles) or onto permanently affixed labels (glass jars). This number is also recorded on the Chain of Custody form and the Field Data Sheet.

5.11 Field Parameter Measurement

Field parameters (pH, specific conductance, and temperature) will be measured at each sample location immediately after filling the last sample container. Field measurements will be measured from collected stormwater by inserting the analytical field meter probes into stormwater collected within the stainless steel beaker.

5.12 Sample Collection Documentation

The Sample Team will complete two documents while performing sampling activities: Field Data Sheet and Chain of Custody forms. Since stormwater sampling activities are correlated to rainfall data, and the HYDRA rain gage network provides time series data in Pacific Standard Time (PST); all times on field sampling documents will be recorded in 24-hour PST.

5.12.1 Field Data Sheets

A Field Data Sheet (FDS) will be completed for each sample collected. The FDS details specific observations pertaining to each sample. Required information to be recorded on the FDS includes:

- Date, sample collection time, and personnel present for each sample collected;
- Sample site address and sample point code;
- Weather and flow conditions at each sampling location;
- Presence of floatable objects, oily sheens, catch basin conditions, potential pollution sources, or other conditions that that may impact stormwater quality observed at the time of sample collection;
- UIC system integrity (e.g., catch basin covers in place, catch basins or inlets operational, sedimentation manhole "gooseneck" intact and operational);
- General traffic conditions and type;
- Deviations to sampling procedure;
- Collection of field QC samples;
- Field measurement (pH, specific conductance, and temperature); and
- Summary of sampling activities and field observations.

Information recorded should be detailed enough to allow the sampling event to be reconstructed without having to rely on memory and to allow the Sampling Team for subsequent sampling events to recognize or identify any changes in the immediate proximity of the UIC that may impact the quality of stormwater quality. The Sampling Team should photodocument significant site features and/or changes.

5.12.2 Chain of Custody

A Chain of Custody (COC) form is a legal document designed to track samples and persons who are responsible for them during preparation of the sample container, sample collection, sample delivery, and sample analysis. "Chain of Custody" refers to both the form and the documented account of changes in possession that occur for samples. For each sample collected, sample information must be recorded on the sampling event-specific COC form. Required information on the COC includes:

- Sampling event;
- Sample date and time;
- Sample matrix and type;
- Name of person(s) collecting the samples;
- Sample identification code;
- Analysis requested; and
- Printed name, signature, date, and time for each person relinquishing or receiving the samples.

To ensure that all necessary information is documented, a COC form must be completely filled out, and accompany each set of samples. COC forms will be printed on "Rite in the Rain" paper. They will be photocopied after the laboratory personnel have signed off on sample receipt so that all personnel handling the samples may maintain a copy. When transferring custody of samples, the transferee will sign and record the date and time of each transfer. Each person who takes custody will complete the appropriate portion of the COC documentation.

5.12.3 Photographic Documentation

In addition to the FDS and COC documents, the Sampling Team will take digital photographs if unusual or noteworthy conditions are present at the sampling sites (i.e. vehicle leaking fluids into catch basin, etc.) during sample collection. Site photographs are not necessary for every site visit if reasonably normal site conditions seem to exist while the Sampling Team is on site. If digital photographs are taken, they must be documented on the FDS. Upon returning to the Laboratory, digital photographs must be downloaded, labeled, and electronically filed in accordance with the data management plan described in the QAPP.

5.13 Sample Transport and Delivery to the Laboratory

Immediately following sample collection, sample containers will be placed on ice in coolers and protected from breakage. A separate cooler will be used to transport the VOC samples and an associated trip blank. The trip blank must accompany the VOC vials from the time they leave the WPCL until the filled vials are relinquished to the WPCL.

Samples will be submitted to the WPCL by the Sampling Team under strict COC procedures. The Sample Custodian or designated alternate will assign a unique sample identification code to each sample. These codes are preprinted on gummed labels and are affixed to the sample containers and the COC form during the sample receiving and log-in process. Both samples analyzed at WPCL and any contract laboratories are labeled with these unique codes.

No sample shipping is anticipated. The Sample Team will deliver samples to the WPCL within 12 hours of sampling. Some analytical tests will be performed by one the WPCL's contract laboratories, Test America, located in Beaverton, Oregon, or Pacific Agricultural Laboratories in SW Portland. After log-in, sample containers destined for TA or PAL will be stored on a designated shelf in the temperature-controlled and monitored sample receiving refrigerator. The WPCL Sample Custodian will complete a COC and schedule a pick-up by either TA or PAL. Samples will be retrieved from the WPCL by a courier, transported in coolers containing blue ice packs, and delivered to the contract lab following standard COC procedures. When sample collection occurs after normal business hours, the Sampling Team will sign and date the COC form and place the samples in the sample-receiving refrigerator. The laboratory will accept samples as soon as possible, following COC procedures.

5.14 Change Notification

5.14.1 Field Procedures

All field changes to sampling procedures, including the reasons necessitating the change, will be recorded on field documentation maintained by the Sampling Team. The City will notify DEQ of significant changes to field procedures identified in this Stormwater Monitoring Plan in the next Annual Report. In the event substantial modifications are identified for future sampling events, the City will prepare addenda for approval by the DEQ WPCF Permit Manager.

5.14.2 Missed Monitoring Events

If a sampling event is missed for reasons beyond the City's reasonable control, the City will notify the DEQ WPCF Permit Manager to discuss the need for a waiver or alternative response. These conditions include atypical climatic conditions, such as drought year, rainfall 20% below three year average, infrequency of storms of sufficient magnitude to produce run-off, weather conditions that would make collection or analysis of samples unsafe or impracticable, unavoidable equipment failure, or other conditions determined by DEQ to be beyond the City's control.

6.0 Quality Control Procedures

6.1 Quality Assurance

The data quality objectives for field measurements are listed in **Table 11**. Precision and accuracy are referenced from the DEQ Data Quality Matrix. Because field measurements for temperature, pH, and conductivity are made using a multi-meter probe, precision between replicates is usually not assessed since meter values are continuously assessed and not documented until they stabilize. Accuracy for field measurements is determined by measuring standards before and after each sampling event and assessing deviation from the standard in comparison to accuracy ranges in **Table 11**.

Table 11: Accuracy and Precision Targets for Stormwater Field Measurements

Parameter	Precision	Accuracy	Measurement Range
Temperature	± 1.0 ºC	± 0.5 ºC	-5 to 45 ºC
pH	± 0.3 SU	± 0.2 SU	0 to 14 SU

Conductivity	± 10% of Std. Value	± 7% of Std. Value	0 to 200 mS/cm
Turbidity	± 5% of Std. Value ± 1 NTU if NTU <20	± 5% of Std. Value	0 to 1000 NTU

Analytical methods for grab samples analyzed at Portland's Water Pollution Control Laboratory use an appropriate balance of quality assurance/quality control measures, including replicates, blanks, spiked samples and other measures approved under 40 CFR 136 to ensure that data meet quality objectives appropriate for compliance with state and federal regulatory requirements. A copy of the WPCL's QAPP is included in **Appendix F**.

Field duplicate samples will be collected at a minimum of 10% of the total number of monitoring locations (1 duplicate for every 10 sites). For wet weather stormwater sampling, one lab replicate will be collected from one of the 10 stormwater sampling sites. Since the goal is to monitor 10 stations each wet weather event, a field duplicate will typically be gathered during each event. Any data or sample values outside of the expected range for the constituent being measured will be rechecked for validity with the laboratory or in the field by the field team as appropriate. Data that continue to be outside the expected values will be further investigated in an effort to determine the cause.

Duplicate measurements are not collected for field constituents (pH, temperature, conductivity, turbidity). Instead, quality assurance for field constituents will be assessed by calibrating the equipment prior to mobilization on the day of the monitoring event and by measuring equipment with a known standard after each monitoring event to measure how accurately the equipment can still read the standard within the accuracy ranges specified in **Table 11**.

Field decontamination blanks will also be collected for 10% of sampling mobilization events. Equipment blanks will be generated annually by the City of Portland WPCL to ensure that equipment and bottles provided by the lab are not producing false positive readings.

6.1.1 Representativeness

Stormwater samples are collected from the center of the flow to obtain a well mixed sample representative of the stormwater conditions. Sampling sites are selected using the GRTS study design, so data collected using this random and spatially balanced approach is assumed to be representative of conditions within the entire permit area.

6.1.2 Comparability

The objective is to ensure that collected data are either directly comparable, or comparable with defined limitations, to literature data or other applicable criteria. UIC stormwater samples are collected and analyzed in a similar manner as those collected for other monitoring conducted by the City, including MS4 Instream Monitoring and Structural Best Management Practice Monitoring. Laboratory samples for WPCF and NPDES MS4 monitoring are analyzed at Portland's Water Pollution Control Laboratory to minimize variability and increase comparability of data collected on streams flowing through both jurisdictions. Portland utilizes the GRTS approach in the selection of their UIC stormwater sampling locations, so regional assessment of stormwater data will be possible based on using a similar study design.

6.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from the analytical measurement system compared to the amount that was expected to be obtained. It is defined as the total number of samples taken for which valid analytical data are obtained divided by the total number of samples collected and multiplied by 100.

Based on QA/QC procedures outlined in this Stormwater Monitoring Plan, the monitoring goal is to achieve a 100 percent complete data set for all analyses. It is anticipated that 30 samples will be collected annually. Over the 10 year permit term, 300 samples will be collected consisting of 5 monitoring locations being "fixed" sites monitored each year (5 x 10 = 50 samples) and 250 spatially balanced and random sites selected probabilistically that are each monitored once. Due to unforeseen circumstances some results may be lost. Field and Laboratory staff will attempt to minimize data loss to the best of their ability by carefully following all protocols and procedures. If data sets are not 100 percent complete, analyses will be evaluated on a case by case basis including review of permit requirements to determine whether additional samples are needed.

6.1.4 Instrument Inspection and Maintenance

Field sampling equipment is inspected before and after each monitoring event. The multi-meter and turbidimeter will be cleaned and maintained according to the manufacturer's guidelines. Multi-meters will be professionally inspected, maintained and calibrated annually by Quality Control Services (2340 SE 11th Ave, Portland, OR. 503-236-2712), unless another service is contracted by the City for reasons unforeseen at the time of this submittal.

Portland's Water Pollution Control Laboratory performs inspection and maintenance of laboratory instruments used for analysis of grab samples. A copy of the WPCL's QAPP is included in **Appendix F**.

6.2 Field Quality Control Procedures

Field observations and measurements will be made during sample collection operations, as described in **Section 5.12**. Field observations will be recorded on the Field Data Sheet (FDS). An example of this form is included in **Appendix C**. Samples will be analyzed in the field for pH, specific conductance, and temperature using portable analytical meters. These data will be recorded on the COC. Field equipment such as meters are maintained and calibrated according to field Standard Operating Procedures (SOPs) and manufacturer's specifications.

Immediately following each field event the Monitoring Program Lead or their designee will verify that FDS forms are completely filled out and correct. Changes or deletions to these forms will be made with a single line drawn through the incorrect entry and the recorder's initials and date added next to the revised entry. Information recorded should be detailed enough to allow the sampling event to be reconstructed without having to rely on memory and to allow the Sampling Team for subsequent sampling events to recognize or identify any changes in the immediate proximity of the UIC that may impact the quality of stormwater quality.

Field QC samples are used to assess sample collection procedures, environmental conditions during sample collection and shipment, and the adequacy of equipment decontamination. They are also used to estimate field precision and accuracy. Field QC samples include equipment blanks, field decontamination blanks, duplicates, trip blanks, and temperature blanks. If problems are identified using the field QC samples, the results may be verified by the laboratory, data may be flagged, and/or a thorough review of field and laboratory procedures may be performed to identify and correct problems, if any. A case-by-case determination will be made regarding data usability. Minimum field QC samples are summarized in **Table 10**.

6.2.1 Equipment Blanks

Equipment blanks (*i.e.*, rinsate blanks) are designed to check whether sampling equipment is properly decontaminated. Portland's WPCL performs one equipment blank for each wet weather monitoring season. The equipment decontamination procedure is considered acceptable if the concentrations of target analytes in the equipment blank are reported as less than the MRL.

6.2.2 Field Decontamination Blanks

Field decontamination blanks (*i.e.*, transfer blanks) are used to evaluate the decontamination procedure and test for any contamination introduced by atmospheric conditions or field sampling activities. Field decontamination blanks are prepared in the field by passing analyte-free water through the sample collection equipment (*i.e.*, a decontaminated stainless steel beaker). One field decontamination blank will be collected during each field sampling event (target is 10 sites per event, so 3 events/year). Field decontamination blanks are considered acceptable if the concentrations of target analytes are reported as less than the MRL. If any target analyte is detected in the field decontamination blank, samples will be flagged, and the sample decontamination, collection, and handling procedures will be evaluated and corrected as appropriate. Any changes or revisions made will be documented as required by the permit.

6.2.3 Field Duplicates

Field duplicate samples are collected as a check on sample collection, handling, shipment, storage, and analysis. They are also used to assess the combination of field and laboratory precision and reproducibility. In addition duplicate samples provide an indication of the variability within a sample. Field duplicates are collected by simultaneously filling two sample containers for each analyte with sample. They will be collected at a 10% frequency. Field duplicate samples are given unique sample identification numbers and are submitted blind to the laboratory.

6.2.4 Trip Blanks

Trip blanks are vials of analyte-free water (*i.e.*, de-ionized water) created in the laboratory and transported to the field and back to the laboratory unopened. They are used to evaluate the potential introduction of contaminants during sampling handling and transport or potential laboratory contamination. Trip blanks are particularly important when collecting samples for VOC analysis. Each cooler containing samples for VOC analysis will have a trip blank. If an analyte is detected in the trip blank, the associated samples will be flagged and the source of contamination investigated. Any changes or revisions made will be documented as required by the permit.

6.2.5 Temperature Blanks

Temperature blanks are containers of water packaged along with the environmental samples in the cooler and used to measure the temperature of the cooler upon receipt to the laboratory. The temperature will be read and recorded on the COC by the Sample Custodian or designated alternate at the beginning of the sample login process. One temperature blank will be included in every cooler containing samples. A temperature range of 4°C ± 2°C is acceptable for sample transport and receipt. Based on proximity to the laboratory, it is likely that samples will be collected and delivered to the laboratory within a relatively short period of time. Consequently, samples may not have time to sufficiently cool before they arrive at the laboratory. It is assumed that since these samples will have been placed on ice immediately after collection and stored in a chilled cooler until delivery to the laboratory, they are acceptable for analysis.

7.0 Data Management, Validation, Assessment and Reporting

Consistent with permit requirements specified in WPCF permit Schedule E, Section 3(b), the City will retain records of all monitoring information, including: all calibration, major maintenance records, all original lab and field data (see **Appendix C** for example of field data sheet), copies of all reports required by the permit, and records of data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report, or application.

Records will contain:

1. The date, exact place, time, and methods of sampling or measurements;
2. The individual(s) who performed the sampling or measurements;
3. The date(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and
6. The results of such analyses.

7.1 Data Management

The City of Gresham contracts with Portland WPCL for sample custody and analysis (see **Appendix E**). While the City stores electronic data reports from the WPCL and enters data into a Monitoring Program database, the WPCL also maintains files containing any records necessary to reconstruct the analytical details associated with a particular rainfall event. Records maintained by the WPCL include:

- COC forms;
- Instrument calibration and tuning records (as applicable);
- Analytical standards preparation logs;
- Method SOPs;
- Analytical QC results (including method blanks, internal standards, surrogates, replicates, and spike and spike duplicate results, as applicable);
- Raw data, specifically instrument printouts;
- Bench work sheets and/or quantification reports; and
- Details of the QA/QC program in place at the time that the data analyses were conducted.

Precautions will be taken in the analysis and storage of data to prevent the introduction of errors or loss or misinterpretation of data. Original laboratory data sheets (*i.e.*, hard copy) will be maintained in a secure location where they will not be lost or tampered with. Copies of original data should be used for compiling the data to prevent loss or damage.

Laboratory data will be manually tabulated in an electronic format by UIC location and analytical constituent. Tables will be carefully checked against copies of the original final data sheets prior to data analyses. Data should be tabulated as it is shown on the original data sheets.

Sampling and analysis documents and records associated with this Stormwater Monitoring Plan will be stored and maintained in hard copy and/or electronic versions on the City's backed up network drive. Hardcopy information will be kept on file. Electronic information will be maintained on current industry-standard hardware and software. All records will be retained to comply with the WPCF permit Schedule E.3.b. requirements and the NPDES MS4 permit Schedule F. Section C.5., as applicable. The Monitoring Program Lead will be responsible for ensuring that field and laboratory activities are properly documented and that those records are stored and maintained.

7.2 Data Review, Validation and Verification

Lab data will be reviewed and entered as soon as practicable, with the goal of having data review take place within five working days of the Monitoring Program Lead receiving the data report from the lab. The initial data review will entail a simple confirmation that laboratory results do not result in an action level exceedance that endangers health or the environment.

Once the data has been entered in the monitoring program database, the Monitoring Program Lead will print a paper copy of the data and proofread it against the original field data sheets. Statistical and graphical analysis may be used to reveal whether keystroke errors occurred during data entry. Potential errors in the database will be checked against field data sheets and lab reports. Once verified, errors in data entry will be corrected at that time. Outliers and inconsistencies will be flagged for further review, investigation, and if appropriate, discarded. Data quality problems will be discussed as they occur and in the final report to data users.

Reconciliation with data quality objectives as noted above will be performed as soon as possible after each sampling event. Calculations and determinations for precision, completeness, and accuracy will be made and corrective action implemented if needed. If data quality indicators do not meet the monitoring program's specifications, data may be discarded and re-sampling may occur. The cause of the failure will be evaluated. If the cause is found to be equipment failure, calibration and/or maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, field techniques will be assessed, revised and retrained, as needed.

7.3 Data Assessment and Evaluation

Stormwater monitoring data will be assessed by comparing sites selected using the probabilistic Generalized Random Tessellation Stratified (GRTS) survey design. After randomly selecting sites with small drainage areas, the characteristics of each drainage area will be assessed, and a nonparametric statistical measure of difference between groups (e.g. Mann-Whitney) will be used to determine if stormwater is significantly different between sites based on factors such as land use, traffic patterns, power pole density, or other drainage characteristics. The significance of any difference would be evaluated against an alpha (α) value of at least 0.1, with a goal to demonstrate significance at α=0.05.

Data assessment and validation will be performed as appropriate for the data use. Assessment will include the following (but is not limited to):

- Review any information collected regarding UICs for consistency, reasonableness, and accuracy to the extent practicable, prior to use;
- Identify potential errors or inconsistencies in data obtained from available resources that may require further evaluation, prior to use of the data;
- Review applicable field and laboratory documentation to ensure that the applicable SOPs were followed;
- Review field and laboratory QC reports to understand quality and usability of data including:
    - Results of QC samples that were collected and analyzed;
    - Overall DQO performance for analytical laboratory data by reviewing precision, accuracy, and completeness, and evaluating representativeness, comparability, and sensitivity; and
    - Data qualifier flags assigned to analytical laboratory data to assess sample collection, handling, or laboratory QC issues.
- Calculation of basic quantitative characteristics of the data using common statistical parameters (e.g., range, mean, medium, frequency of detection);
- Graphing the data using appropriate methods to identify patterns or trends in the data. These patterns or trends may be used to describe the data, identify potential correlations or problems with the data set, and to convey information to others.

Data analysis to achieve the identified objectives, and the proposed timeline at which they will occur, include:

- Comparison of individual storm event results to permit action levels (2 days);
- Calculation of an annual geometric mean of analyte concentrations for permit compliance (Annually);
- Trend analysis to evaluate changes in analyte concentrations over time (Permit term);
- Comparison of data obtained in the two traffic categories to assess potential differences in analyte concentrations as associated with the two traffic categories (Annually);
- Evaluation of analyte concentrations relative to factors that may have influenced storm water quality (Annually); and
- Evaluation of analyte concentrations related to actions taken to improve stormwater quality to evaluate the effectiveness of the actions (Permit term).

This analysis will be used to develop recommendations for changes to UIC management, and necessary adjustments to the Stormwater Monitoring Plan

7.4 Data Reporting

7.4.1 Annual Reports

Both of the NPDES MS4 and WPCF permits contain an annual reporting requirement. The NPDES MS4 Annual Report requirements are described in Schedule B.5. of that permit and in the Environmental Monitoring Plan. The WPCF permit Schedule B.4. requirements are further described in this section.

The WPCF permit Annual Report will contain the following information:

1. *Results of stormwater monitoring conducted in accordance with this Stormwater Monitoring Plan. This must include a spreadsheet of all data from sampled UICs provided in the analytical laboratory reports;*
2. *Discuss any Table 1 action level exceedances and actions taken to address the exceedances; and*
3. *Provide soft copy format of analytical laboratory reports.*

The WPCF Annual Report will be submitted to DEQ by December 31 of each year and will summarize all laboratory data for the previous wet season (July 1 – June 30). The summary will include any data detected from any of the analytical methods used for the analytes discussed in **Section 5.0.**

7.4.2 Exceedance of Table 1 Action Level

The Monitoring Program Lead will be responsible for data review and notification of DEQ, if applicable. Workload and personal schedules may prevent review from taking place when the final validated report is received from the lab via email, but initial visual review will take place as soon as practicable to determine if any Table 1 Monitoring Parameter exceeds the permit-specific action levels. For an individual sampling event in which a common pollutant exceeds an action level, the City will:

1) Attempt to identify the source(s) of the pollutant exceeding the Table 1 action level;
2) When source identification efforts are complete, determine the set of UICs that require corrective action, based on the identified source(s) or other factors;
3) Assess whether best management practices need adjustment to eliminate or reduce influent concentrations, and make appropriate, practicable changes.

In addition to these actions, the City will also consider re-sampling the discharge to verify the exceedance and allow for calculation of a geometric mean that verifies or invalidates the original influent concentration, as well as evaluating the result against the Groundwater Protectiveness Demonstration to determine if the exceedance poses a risk to human health or the environment. If it is determined that the pollutant will not be attenuated to meet Maximum Contaminant Limits at the point of beneficial use and therefore may pose a risk to human health or the environment, the City will notify DEQ in accordance with Schedule E.4.f of the WCPF permit. Oral notification will occur within 24 hours after staff become aware of the risk to health or the environment, and written notification within 5 days of the time we become aware of the circumstances. The written report will include a description of the non-compliance and its cause, the period of the non-compliance if known, including exact dates and times, and if the non-compliance has not been corrected, the anticipated time it is expected to continue, and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the non-compliance.

8.0 References

Agresti, A. and Coull. B. 1998. Approximate is Better than ‘Exact’ for Interval Estimation of Binomial Proportion. The American Statistician, 52:119-125.

City of Portland, 2006a. Sampling and Analysis Plan: Stormwater Underground Injection Control System Monitoring. Prepared by City of Portland, Bureau of Environmental Services for WPCF Permit 102830.

City of Portland, 2006b. Quality Assurance Project Plan: Stormwater Underground Injection Control System Monitoring. Prepared by City of Portland, Bureau of Environmental Services for WPCF Permit 102830.

EPA. 2011. II. The Recommended Elements of a State Monitoring Program. U.S. Environmental Protection Agency, Water: Monitoring & Assessment. http://water.epa.gov/type/watersheds/monitoring/elements.cfm (Accessed November 2011).

Larsen, D.P., Olsen, A.R. and Stevens, D.L. 2008. Using a master sample to integrate stream monitoring programs. Journal of Agricultural, Biological, and Environmental Statistics 13:243-254.

Lenth, R.V. 2001. Some Practical Guidelines for Effective Sample-Size Determination. University of Iowa, Dept. of Statistics. http://www.stat.uiowa.edu/techrep/tr303.pdf

Oregon Association of Clean Water Agencies (ACWA). 2009. Compilation and Evaluation of Existing Stormwater Quality Data from Oregon. Prepared by Kennedy/Jenks, K/J Project No 0891020.00, Dec 16, 2009.

Stevens, D.L. and Olsen, A.R. 2004. Spatially balanced sampling of natural resources. Journal of the American Statistical Association, 99, (465): 262-278.

Urquhart, N.S. and Kincaid, T.M. 1999. Designs for detecting trend from repeated surveys of ecological resources. Journal of Agricultural, Biological and Environmental Statistics. 4:404-414

Appendix A

List of Proposed Sampling Locations to be Monitored During Permit Term

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 1	All	3151-F-064	GRTS-001	Great	COM	Collector	20300 WI/ SE Morrison Ter.	45.5164	-122.4551
Panel 1	All	3148-W-014	GRTS-003	Great	RES	Community	18105 SE Yamhill St.	45.5155	-122.4771
Panel 1	All	3251-F-013	GRTS-002	Less	RES	Residential	1511 NW 19TH St.	45.5099	-122.4471
Panel 1	All	3150-F-030	GRTS-005	Less	RES	Residential	19923 SE Washington Ct.	45.5181	-122.4578
Panel 1	All	3153-F-040	GRTS-006	Less	RES	Residential	22351 SE Salmon Ct.	45.5139	-122.4324
Panel 2	2011-12	3249-W-037	GRTS-004	Great	RES	Minor Arterial	18641-18645 SE DIVISION ST	45.5046	-122.4703
Panel 2	2011-12	3047-W-102	GRTS-007	Great	RES	Community	16801 E BURNSIDE ST	45.5221	-122.4898
Panel 2	2011-12	3050-W-056	GRTS-009	Great	RES	Community	125 SE 192nd Ave.	45.5212	-122.4654
Panel 2	2011-12	3047-W-008	GRTS-012	Great	RES	Minor Arterial	16211 NE EVERETT CT	45.5254	-122.4963
Panel 2	2011-12	3448-J-010	GRTS-016	Great	MRES	Minor Arterial	3734 SE 182nd Ave.	45.4952	-122.4757
Panel 2	2011-12	3048-W-092	GRTS-019	Great	RES	Community	17440 E BURNSIDE ST	45.5219	-122.4832
Panel 2	2011-12	3348-W-046	GRTS-020	Great	RES	Minor Arterial	2804 SE 182ND AVE	45.5023	-122.4757
Panel 2	2011-12	3150-W-054	GRTS-021	Great	RES	Boulevard	19515 BURNSIDE ST	45.5166	-122.4613
Panel 2	2011-12	3049-W-089	GRTS-030	Great	COM	Boulevard	18727 BURNSIDE RD	45.5207	-122.4707
Panel 2	2011-12	3250-W-006	GRTS-034	Great	COM	Minor Arterial	19201 SE DIVISION ST	45.5046	-122.4641
Panel 2	2011-12	3249-W-043	GRTS-036	Great	COM	Minor Arterial	2190-2400 SE 182ND AVE	45.5046	-122.4743
Panel 2	2011-12	3149-W-083	GRTS-277	Great	RES	Community	19002 SE YAMHILL STREET	45.5155	-122.4675
Panel 2	2011-12	3048-W-074	GRTS-278	Great	RES	Minor Arterial	17214 NE GLISAN	45.5263	-122.4861
Panel 2	2011-12	3248-W-064	GRTS-008	Less	MRES	Residential	17819 SE Division St.	45.5051	-122.4803
Panel 2	2011-12	2847-W-027	GRTS-010	Less	RES	Residential	2400 NE 166th Dr.	45.5402	-122.4918
Panel 2	2011-12	3047-W-060	GRTS-011	Less	RES	Residential	16737 NE Couch Ct.	45.5232	-122.4909
Panel 2	2011-12	3053-F-014	GRTS-013	Less	COM	Residential	333 SE 223rd Ave.	45.5200	-122.4346
Panel 2	2011-12	3249-W-033	GRTS-015	Less	RES	Residential	2209 SE 189th Ave.	45.5066	-122.4690
Panel 2	2011-12	3050-F-011	GRTS-017	Less	VAC	Residential	61 NE 202nd Ave	45.5234	-122.4554
Panel 2	2011-12	3152-F-096	GRTS-018	Less	RES	Residential	21226 SE Main St.	45.5134	-122.4443
Panel 2	2011-12	3152-F-007	GRTS-022	Less	RES	Residential	385 NW 25th St.	45.5145	-122.4351
Panel 2	2011-12	3047-W-023	GRTS-023	Less	RES	Residential	439 SE 167th Ave.	45.5194	-122.4911
Panel 2	2011-12	3148-W-011	GRTS-024	Less	RES	Residential	1232 SE 175th Ave.	45.5140	-122.4828
Panel 2	2011-12	3052-F-017	GRTS-025	Less	RES	Residential	21554 SE Ankeny Ter.	45.5214	-122.4411
Panel 2	2011-12	3049-W-009	GRTS-026	Less	RES	Residential	416 NE 186th Ave.	45.5259	-122.4717
Panel 3	2012-13	3050-F-010	GRTS-037	Great	COM	Minor Arterial	20121 SE STARK ST	45.5192	-122.4563
Panel 3	2012-13	3252-F-057	GRTS-038	Great	COM	Boulevard	1851-1867 NW CIVIC DR	45.5111	-122.4394
Panel 3	2012-13	3147-W-002	GRTS-040	Great	COM	Minor Arterial	16432 SE Stark St.	45.5190	-122.4939

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 3	2012-13	3052-F-010	GRTS-041	Great	COM	Minor Arterial	22017 SE STARK ST	45.5192	-122.4355
Panel 3	2012-13	3149-W-034	GRTS-042	Great	MRES	Community	820 SE 190th Ave.	45.5163	-122.4681
Panel 3	2012-13	3449-J-065	GRTS-044	Great	VAC	Minor Arterial	4322 SE 182ND AVE	45.4911	-122.4754
Panel 3	2012-13	3054-F-015	GRTS-045	Great	RES	Minor Arterial	23599 SE STARK	45.5191	-122.4210
Panel 3	2012-13	3349-W-033	GRTS-047	Great	VAC	Minor Arterial	3139 SE 182nd AVE	45.4997	-122.4755
Panel 3	2012-13	3047-W-107	GRTS-051	Great	RES	Community	17021 E BURNSIDE	45.5223	-122.4877
Panel 3	2012-13	3149-W-078	GRTS-053	Great	COM	Boulevard	<undetermined>	45.5182	-122.4656
Panel 3	2012-13	2748-W-044	GRTS-054	Great	VAC	Minor Arterial	17951 NE Sandy Blvd.	45.5464	-122.4788
Panel 3	2012-13	2948-W-028	GRTS-055	Great	COM	Minor Arterial	17309 WI/ NE GLISAN ST	45.5265	-122.4837
Panel 3	2012-13	3047-W-015	GRTS-056	Great	RES	Minor Arterial	128 SE 162ND AVE	45.5210	-122.4964
Panel 3	2012-13	3047-W-062	GRTS-027	Less	RES	Residential	16904 NE Couch Ct.	45.5231	-122.4889
Panel 3	2012-13	2947-W-031	GRTS-028	Less	RES	Residential	16324 NE Hoyt St.	45.5275	-122.4950
Panel 3	2012-13	3348-W-013	GRTS-031	Less	RES	Residential	3251 SE 179th Ave.	45.4990	-122.4785
Panel 3	2012-13	3448-J-020	GRTS-032	Less	MRES	Residential	933 SW Junction Pl.	45.4901	-122.4825
Panel 3	2012-13	3049-W-013	GRTS-033	Less	RES	Residential	18951 NE Flanders St.	45.5253	-122.4674
Panel 3	2012-13	3048-W-055	GRTS-035	Less	RES	Residential	17 NE 176th Ave.	45.5224	-122.4824
Panel 3	2012-13	2947-W-066	GRTS-039	Less	MRES	Residential	16571 NE Hoyt Ter.	45.5272	-122.4916
Panel 3	2012-13	3148-W-052	GRTS-043	Less	MRES	Residential	1427 SE 182nd Ave.	45.5123	-122.4760
Panel 3	2012-13	3049-W-036	GRTS-046	Less	MRES	Residential	18360 SE Pine St.	45.5206	-122.4742
Panel 3	2012-13	3055-B-009	GRTS-048	Less	RES	Residential	2115 NE 36th Ct.	45.5226	-122.4111
Panel 3	2012-13	2950-W-068	GRTS-049	Less	RES	Residential	639 NE 201st Ave.	45.5276	-122.4565
Panel 3	2012-13	3153-F-078	GRTS-050	Less	RES	Residential	415 NE 23rd St.	45.5127	-122.4272
Panel 4	2013-14	3053-F-027	GRTS-057	Great	COM	Minor Arterial	22309 SE STARK ST	45.5192	-122.4326
Panel 4	2013-14	3149-W-038	GRTS-058	Great	RES	Community	18501 SE Yamhill St.	45.5155	-122.4726
Panel 4	2013-14	3148-W-057	GRTS-062	Great	COM	Minor Arterial	18012 STARK ST	45.5191	-122.4777
Panel 4	2013-14	3155-F-033	GRTS-064	Great	COM	Primary Arteri*	2870 NE HOGAN DR	45.5181	-122.4124
Panel 4	2013-14	3151-F-070	GRTS-065	Great	IND	Collector	614 SE 202nd Ave.	45.5180	-122.4552
Panel 4	2013-14	3348-W-035	GRTS-068	Great	MRES	Minor Arterial	17910 SE DIVISION ST	45.5045	-122.4787
Panel 4	2013-14	3150-F-034	GRTS-069	Great	RES	Minor Arterial	19850 WI/ SE STARK ST	45.5191	-122.4574
Panel 4	2013-14	3047-W-010	GRTS-076	Great	COM	Minor Arterial	16200 NE GLISAN ST	45.5262	-122.4963
Panel 4	2013-14	3053-F-003	GRTS-077	Great	RES	Minor Arterial	<undetermined>	45.5225	-122.4337
Panel 4	2013-14	3149-W-058	GRTS-078	Great	COM	Boulevard	19010 SE Stark St.	45.5190	-122.4681
Panel 4	2013-14	2950-W-079	GRTS-081	Great	RES	Collector	824 202ND	45.5291	-122.4564

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 4	2013-14	3048-W-089	GRTS-083	Great	MRES	Community	173--	45.5222	-122.4847
Panel 4	2013-14	3348-W-048	GRTS-084	Great	IND	Minor Arterial	2624 SE 182ND AVE	45.5039	-122.4757
Panel 4	2013-14	3348-W-006	GRTS-052	Less	RES	Residential	3408 SE 176th Pl.	45.4980	-122.4815
Panel 4	2013-14	3249-W-015	GRTS-059	Less	RES	Residential	18511 SE MILL ST	45.5105	-122.4726
Panel 4	2013-14	3449-J-016	GRTS-060	Less	RES	Residential	3752 SW 4th St.	45.4942	-122.4702
Panel 4	2013-14	3153-F-062	GRTS-061	Less	RES	Residential	101 NE 29TH Dr.	45.5178	-122.4286
Panel 4	2013-14	3349-W-501	GRTS-063	Less	RES	Residential	19004 SE Clinton St.	45.5029	-122.4676
Panel 4	2013-14	3251-F-079	GRTS-066	Less	RES	Residential	21012 SE Clay Ct.	45.5111	-122.4468
Panel 4	2013-14	3148-W-028	GRTS-067	Less	RES	Residential	609 SE 179th Ave.	45.5179	-122.4790
Panel 4	2013-14	3252-F-053	GRTS-070	Less	COM	Residential	555 NW Fariss Rd.	45.5116	-122.4369
Panel 4	2013-14	3047-W-057	GRTS-071	Less	RES	Residential	16601 SE Ankeny St.	45.5214	-122.4921
Panel 4	2013-14	3248-W-023	GRTS-072	Less	RES	Residential	17805 SE Lincoln St.	45.5078	-122.4796
Panel 4	2013-14	3050-W-029	GRTS-073	Less	RES	Residential	40 SE 193rd Ave.	45.5217	-122.4642
Panel 4	2013-14	2847-W-062	GRTS-074	Less	RES	Residential	2379 NE RUSSELL ST	45.5402	122.4902
Panel 5	2014-15	3147-W-008	GRTS-088	Great	COM	Minor Arterial	16246 STARK ST	45.5191	-122.4953
Panel 5	2014-15	3148-W-010	GRTS-091	Great	RES	Minor Arterial	1123 SE 182ND AVE	45.5145	-122.4759
Panel 5	2014-15	3053-F-009	GRTS-093	Great	VAC	Minor Arterial	<undetermined>	45.5250	-122.4337
Panel 5	2014-15	3054-F-018	GRTS-096	Great	RES	Minor Arterial	<undetermined>	45.5191	-122.4188
Panel 5	2014-15	2949-W-020	GRTS-097	Great	RES	Community	19154 NE Hoyt St.	45.5272	-122.4655
Panel 5	2014-15	3048-W-083	GRTS-099	Great	COM	Minor Arterial	17627 STARK ST	45.5192	-122.4813
Panel 5	2014-15	3150-W-067	GRTS-101	Great	COM	Boulevard	19245 SE BURNSIDE ST	45.5180	-122.4645
Panel 5	2014-15	3047-W-098	GRTS-104	Great	RES	Community	<undetermined>	45.5223	-122.4935
Panel 5	2014-15	3052-F-011	GRTS-105	Great	COM	Minor Arterial	21855 SE STARK ST	45.5191	-122.4368
Panel 5	2014-15	3149-W-051	GRTS-106	Great	RES	Community	19002 SE Yamhill St.	45.5153	-122.4680
Panel 5	2014-15	3248-W-012	GRTS-107	Great	RES	Minor Arterial	1705 SE 182ND AVE	45.5102	-122.4758
Panel 5	2014-15	3449-J-066	GRTS-108	Great	COM	Minor Arterial	4100 SE 182ND AVE	45.4923	-122.4755
Panel 5	2014-15	3049-W-067	GRTS-110	Great	COM	Boulevard	18225 WI/ SE STARK ST	45.5192	-122.4748
Panel 5	2014-15	2947-W-049	GRTS-075	Less	RES	Residential	524 NE 167th Ave.	45.5265	-122.4907
Panel 5	2014-15	3249-W-031	GRTS-079	Less	RES	Residential	2106 SE 185th Ave.	45.5074	-122.4724
Panel 5	2014-15	3449-J-081	GRTS-080	Less	VAC	Residential	4157 SW 3rd St.	45.4947	-122.4744
Panel 5	2014-15	3251-F-009	GRTS-082	Less	RES	Residential	1811 NW 19th	45.5112	-122.4503
Panel 5	2014-15	3050-W-040	GRTS-085	Less	RES	Residential	35 NE 197th Ave.	45.5224	-122.4600
Panel 5	2014-15	3152-F-051	GRTS-086	Less	RES	Residential	1075 SE 214th Ave.	45.5149	-122.4427

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 5	2014-15	3047-W-022	GRTS-087	Less	RES	Residential	439 SE 167th Ave.	45.5193	-122.4912
Panel 5	2014-15	3152-F-036	GRTS-089	Less	RES	Residential	21600 SE Alder St.	45.5177	-122.4400
Panel 5	2014-15	3049-W-040	GRTS-090	Less	RES	Residential	18851 NE Davis St.	45.5239	-122.4689
Panel 5	2014-15	2947-W-027	GRTS-092	Less	RES	Residential	16524 NE Pacific Ter.	45.5290	-122.4931
Panel 5	2014-15	3049-W-086	GRTS-094	Less	VAC	Residential	18425 NE COUCH	45.5225	-122.4733
Panel 5	2014-15	3348-W-020	GRTS-095	Less	RES	Residential	3233 SE 180th Ave.	45.4993	-122.4775
Panel 6	2015-16	3349-W-034	GRTS-111	Great	RES	Minor Arterial	3106 SE 182ND AVE	45.5001	-122.4755
Panel 6	2015-16	3254-F-072	GRTS-114	Great	RES	Collector	1685 NE Cleveland St.	45.5083	-122.4212
Panel 6	2015-16	3047-W-106	GRTS-115	Great	RES	Community	17030 NE BURNSIDE ST	45.5220	-122.4877
Panel 6	2015-16	3150-W-068	GRTS-117	Great	COM	Boulevard	19220 SE STARK ST	45.5191	-122.4650
Panel 6	2015-16	3048-W-077	GRTS-119	Great	RES	Minor Arterial	17512 NE GLISAN ST	45.5264	-122.4829
Panel 6	2015-16	3046-W-006	GRTS-120	Great	RES	Minor Arterial	221 NE 162ND AVE	45.5243	-122.4965
Panel 6	2015-16	3153-F-091	GRTS-121	Great	COM	Minor Arterial	22350 NE STARK ST	45.5190	-122.4315
Panel 6	2015-16	3149-W-016	GRTS-123	Great	IND	Community	1220 SE 190th Ave.	45.5135	-122.4679
Panel 6	2015-16	3048-W-050	GRTS-126	Great	COM	Minor Arterial	15 NE 181ST AVE	45.5221	-122.4774
Panel 6	2015-16	3155-F-025	GRTS-128	Great	MRES	Primary Arteri*	24050 SE STARK ST	45.5166	-122.4126
Panel 6	2015-16	3348-W-037	GRTS-132	Great	COM	Minor Arterial	18110 SE DIVISION ST	45.5045	-122.4767
Panel 6	2015-16	3150-W-051	GRTS-133	Great	RES	Boulevard	19850 E BURNSIDE ST	45.5161	-122.4601
Panel 6	2015-16	3147-W-005	GRTS-135	Great	VAC	Minor Arterial	17050 SE Stark St.	45.5191	-122.4874
Panel 6	2015-16	3351-F-011	GRTS-098	Less	COM	Residential	1620 NW Division St.	45.5043	122.4492
Panel 6	2015-16	3349-J-003	GRTS-100	Less	RES	Residential	30 NW Hartley Ave.	45.4976	-122.4695
Panel 6	2015-16	3252-F-059	GRTS-102	Less	RES	Residential	21643-21645 SE Fariss Rd.	45.5116	-122.4395
Panel 6	2015-16	2947-W-013	GRTS-103	Less	RES	Residential	16577 NE Pacific Dr.	45.5297	-122.4924
Panel 6	2015-16	3053-F-026	GRTS-109	Less	COM	Residential	300 NE Hood Ave.	45.5202	-122.4286
Panel 6	2015-16	3055-B-007	GRTS-112	Less	RES	Residential	3509 NE Francis St.	45.5219	-122.4107
Panel 6	2015-16	3050-F-043	GRTS-113	Less	RES	Residential	121 NE 199th Ave.	45.5234	-122.4579
Panel 6	2015-16	3348-W-043	GRTS-116	Less	RES	Residential	3233 SE 177th Ave.	45.4994	-122.4805
Panel 6	2015-16	2847-W-028	GRTS-118	Less	RES	Residential	2116 NE 165th Ave.	45.5385	-122.4921
Panel 6	2015-16	3049-W-041	GRTS-122	Less	RES	Residential	18821 NE Couch St.	45.5231	-122.4695
Panel 6	2015-16	3449-J-010	GRTS-124	Less	RES	Residential	4021 SW 3rd St.	45.4946	-122.4727
Panel 6	2015-16	3153-F-054	GRTS-125	Less	RES	Residential	2881 NE Kelly Pl.	45.5171	-122.4261
Panel 7	2016-17	2947-W-048	GRTS-139	Great	RES	Minor Arterial	16845-16923 NE GLISAN ST	45.5265	-122.4894
Panel 7	2016-17	3053-F-022	GRTS-141	Great	COM	Minor Arterial	223 SE 223RD AVE	45.5204	-122.4339

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 7	2016-17	3049-W-082	GRTS-142	Great	COM	Boulevard	<undetermined>	45.5195	-122.4680
Panel 7	2016-17	3249-W-055	GRTS-148	Great	COM	Minor Arterial	2323 SE 182ND AVE	45.5054	-122.4755
Panel 7	2016-17	3050-F-017	GRTS-149	Great	VAC	Minor Arterial	19850 WI/ SE STARK ST	45.5192	-122.4593
Panel 7	2016-17	3046-W-002	GRTS-152	Great	COM	Minor Arterial	SE 162nd Ave. & SE Stark St.	45.5193	-122.4965
Panel 7	2016-17	3149-W-002	GRTS-155	Great	RES	Minor Arterial	1400 SE 182ND AVE	45.5129	-122.4756
Panel 7	2016-17	3054-F-016	GRTS-157	Great	RES	Minor Arterial	<undetermined>	45.5191	-122.4224
Panel 7	2016-17	3048-W-033	GRTS-158	Great	MRES	Boulevard	18200 E BURNSIDE	45.5221	-122.4761
Panel 7	2016-17	3150-W-020	GRTS-165	Great	RES	Boulevard	741 SE 193RD AVE	45.5177	-122.4643
Panel 7	2016-17	3046-W-011	GRTS-168	Great	VAC	Community	<undetermined>	45.5221	-122.4977
Panel 7	2016-17	3153-F-031	GRTS-169	Great	RES	Minor Arterial	1011 SE 223RD AVE	45.5157	-122.4340
Panel 7	2016-17	3249-W-022	GRTS-171	Great	COM	Minor Arterial	1910 SE 182ND AVE	45.5086	-122.4755
Panel 7	2016-17	3349-W-050	GRTS-127	Less	RES	Residential	18433 SE Clinton St.	45.5027	-122.4728
Panel 7	2016-17	3151-F-032	GRTS-129	Less	RES	Residential	21045 SE Yamhill St.	45.5162	-122.4465
Panel 7	2016-17	3251-F-015	GRTS-130	Less	RES	Residential	1691 NW 19th St.	45.5107	-122.4490
Panel 7	2016-17	3149-W-073	GRTS-131	Less	COM	Residential	740 SE 182nd Ave.	45.5162	-122.4758
Panel 7	2016-17	3152-F-086	GRTS-134	Less	RES	Residential	393 NW 23rd Ct.	45.5127	-122.4351
Panel 7	2016-17	3248-W-014	GRTS-136	Less	RES	Residential	17709 SE Stephens St.	45.5092	-122.4808
Panel 7	2016-17	3050-W-027	GRTS-137	Less	RES	Residential	106 SE 195th Ave.	45.5213	-122.4622
Panel 7	2016-17	3048-W-028	GRTS-138	Less	RES	Residential	17900 NE Everett Ct.	45.5244	-122.4790
Panel 7	2016-17	2947-W-010	GRTS-140	Less	RES	Residential	1010 NE 165th Ave.	45.5300	-122.4933
Panel 7	2016-17	3349-W-010	GRTS-143	Less	RES	Residential	286 NW Linneman St.	45.4993	-122.4749
Panel 7	2016-17	3448-J-012	GRTS-144	Less	RES	Residential	3845 SE 180th Pl.	45.4947	-122.4771
Panel 7	2016-17	2950-W-067	GRTS-145	Less	RES	Residential	19620 NE Holliday St.	45.5306	-122.4606
Panel 8	2017-18	3253-F-025	GRTS-178	Great	RES	Community	1453 N Main Ave.	45.5072	-122.4311
Panel 8	2017-18	3047-W-105	GRTS-179	Great	RES	Community	<undetermined>	45.5223	-122.4888
Panel 8	2017-18	3050-W-015	GRTS-181	Great	COM	Boulevard	19201 SE STARK ST	45.5192	-122.4651
Panel 8	2017-18	2948-W-026	GRTS-183	Great	VAC	Minor Arterial	17636 NE GLISAN ST	45.5265	-122.4811
Panel 8	2017-18	3153-F-022	GRTS-185	Great	COM	Minor Arterial	22300 SE STARK ST	45.5184	-122.4336
Panel 8	2017-18	3149-W-072	GRTS-186	Great	COM	Boulevard	18510 SE STARK ST	45.5191	-122.4723
Panel 8	2017-18	3249-W-007	GRTS-187	Great	COM	Community	1541 SE 190th Ave.	45.5108	-122.4681
Panel 8	2017-18	3449-J-071	GRTS-188	Great	RES	Minor Arterial	4020 SE 182ND AVE	45.4934	-122.4755
Panel 8	2017-18	3048-W-045	GRTS-190	Great	COM	Boulevard	202 SE 181ST AVE	45.5210	-122.4770
Panel 8	2017-18	2955-B-004	GRTS-192	Great	IND	Primary Arteri*	<undetermined>	45.5269	-122.4133

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 8	2017-18	3152-F-023	GRTS-193	Great	RES	Community	610 SE 212th Ave.	45.5177	-122.4449
Panel 8	2017-18	3148-W-026	GRTS-195	Great	MRES	Boulevard	637 SE 182ND AVE	45.5178	-122.4768
Panel 8	2017-18	3150-F-014	GRTS-197	Great	VAC	Boulevard	19919 SE BURNSIDE ST	45.5159	-122.4587
Panel 8	2017-18	3251-F-070	GRTS-146	Less	RES	Residential	1813 NW 18TH ST	45.5107	-122.4506
Panel 8	2017-18	3048-W-037	GRTS-147	Less	RES	Residential	17448 SE Pine St.	45.5206	-122.4831
Panel 8	2017-18	3152-F-021	GRTS-150	Less	RES	Residential	2312 SE 217th Ave.	45.5132	-122.4390
Panel 8	2017-18	2947-W-038	GRTS-151	Less	VAC	Residential	17050 NE Pacific St.	45.5290	-122.4869
Panel 8	2017-18	3152-F-030	GRTS-153	Less	RES	Residential	21333 SE ALDER ST	45.5174	-122.4433
Panel 8	2017-18	3049-W-054	GRTS-154	Less	RES	Residential	172 NE 184th Pl.	45.5237	-122.4726
Panel 8	2017-18	2950-W-023	GRTS-156	Less	RES	Residential	1428 NE 196th Ave.	45.5335	-122.4612
Panel 8	2017-18	3349-W-041	GRTS-159	Less	RES	Residential	18333 SE Brooklyn Pl.	45.5017	-122.4741
Panel 8	2017-18	3054-B-002	GRTS-160	Less	RES	Residential	24030 SE Oak St.	45.5198	-122.4153
Panel 8	2017-18	3050-W-035	GRTS-161	Less	RES	Residential	111 NE 194th St.	45.5237	-122.4632
Panel 8	2017-18	3250-F-011	GRTS-162	Less	COM	Residential	1702 NW Eleven Mile Ave.	45.5089	-122.4583
Panel 8	2017-18	3148-W-018	GRTS-163	Less	RES	Residential	906 SE 176th Pl.	45.5160	-122.4815
Panel 9	2018-19	3047-W-024	GRTS-199	Great	RES	Minor Arterial	17030 SE Stark St.	45.5192	-122.4874
Panel 9	2018-19	2947-W-071	GRTS-204	Great	RES	Minor Arterial	1047-1049 NE 162ND AVE	45.5307	-122.4961
Panel 9	2018-19	3053-F-020	GRTS-205	Great	COM	Minor Arterial	22309 SE STARK ST	45.5203	-122.4336
Panel 9	2018-19	3449-J-067	GRTS-208	Great	COM	Minor Arterial	3600 SE 182ND AVE	45.4960	-122.4755
Panel 9	2018-19	3249-W-012	GRTS-210	Great	COM	Minor Arterial	19059 SE DIVISION ST	45.5046	-122.4666
Panel 9	2018-19	3048-W-093	GRTS-211	Great	RES	Community	<undetermined>	45.5221	-122.4829
Panel 9	2018-19	3249-W-053	GRTS-212	Great	IND	Minor Arterial	2311 SE 182ND AVE	45.5057	-122.4755
Panel 9	2018-19	3050-W-019	GRTS-213	Great	MRES	Boulevard	425 SE 196TH AVE	45.5192	-122.4612
Panel 9	2018-19	3146-W-002	GRTS-216	Great	COM	Minor Arterial	16150 SE STARK ST	45.5190	-122.4966
Panel 9	2018-19	3054-F-017	GRTS-221	Great	VAC	Minor Arterial	<undetermined>	45.5191	-122.4238
Panel 9	2018-19	3049-W-075	GRTS-222	Great	COM	Boulevard	18245 E BURNSIDE	45.5219	-122.4750
Panel 9	2018-19	3349-W-078	GRTS-223	Great	RES	Minor Arterial	2906 SE 182ND AVE	45.5016	-122.4755
Panel 9	2018-19	3353-J-020	GRTS-226	Great	IND	Community	620 NE 7th St.	45.5023	-122.4258
Panel 9	2018-19	3349-J-015	GRTS-164	Less	RES	Residential	157 NW Royal St.	45.4985	-122.4707
Panel 9	2018-19	2946-W-008	GRTS-166	Less	RES	Residential	1127 NE 161st St.	45.5312	-122.4973
Panel 9	2018-19	2947-W-019	GRTS-167	Less	RES	Residential	16626 NE Pacific Dr.	45.5295	-122.4917
Panel 9	2018-19	3149-W-031	GRTS-170	Less	MRES	Residential	746 SE 187th Ave.	45.5169	-122.4707
Panel 9	2018-19	3449-J-008	GRTS-172	Less	RES	Residential	3680 SW 5th Dr.	45.4936	-122.4696

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 9	2018-19	3153-F-084	GRTS-173	Less	VAC	Residential	942 SE 226th Ave.	45.5155	-122.4305
Panel 9	2018-19	3049-W-032	GRTS-174	Less	COM	Residential	18233 SE Oak St.	45.5198	-122.4751
Panel 9	2018-19	3349-W-048	GRTS-175	Less	RES	Residential	2522 SE 185th Ave.	45.5041	-122.4724
Panel 9	2018-19	3055-B-008	GRTS-176	Less	RES	Residential	3500 NE 35th St.	45.5219	-122.4111
Panel 9	2018-19	2949-W-026	GRTS-177	Less	RES	Residential	748 NE 191 St.	45.5286	-122.4673
Panel 9	2018-19	3348-W-029	GRTS-180	Less	RES	Residential	2826 SE 176th Pl.	45.5018	-122.4815
Panel 9	2018-19	2948-W-051	GRTS-182	Less	RES	Residential	17439 NE Clackamas St.	45.5331	-122.4836
Panel 10	2019-20	3149-W-068	GRTS-229	Great	COM	Boulevard	<undetermined>	45.5188	-122.4669
Panel 10	2019-20	2947-W-070	GRTS-230	Great	RES	Minor Arterial	1214 NE 162ND AVE	45.5315	-122.4960
Panel 10	2019-20	3046-W-004	GRTS-232	Great	COM	Minor Arterial	203 NE 162nd AVE	45.5224	-122.4965
Panel 10	2019-20	3149-W-042	GRTS-234	Great	RES	Community	18655 SE Yamhill Cir.	45.5154	-122.4710
Panel 10	2019-20	3249-W-051	GRTS-235	Great	RES	Minor Arterial	2151 SE 182ND AVE	45.5067	-122.4755
Panel 10	2019-20	3053-F-032	GRTS-237	Great	VAC	Minor Arterial	<undetermined>	45.5192	122.4285
Panel 10	2019-20	3048-W-042	GRTS-238	Great	COM	Boulevard	440 SE 181ST AVE	45.5194	-122.4771
Panel 10	2019-20	3249-W-039	GRTS-239	Great	RES	Minor Arterial	2421-2423 SE 186TH CT	45.5046	-122.4716
Panel 10	2019-20	2950-W-033	GRTS-241	Great	RES	Community	948 NE 192nd Ave.	45.5299	-122.4654
Panel 10	2019-20	3047-W-079	GRTS-243	Great	RES	Community	16715 E BURNSIDE	45.5223	-122.4909
Panel 10	2019-20	3248-W-032	GRTS-244	Great	RES	Minor Arterial	17807-17819 SE DIVISION ST	45.5047	-122.4802
Panel 10	2019-20	2847-W-018	GRTS-246	Great	RES	Community	1715 NE 169TH AVE	45.5354	-122.4891
Panel 10	2019-20	3049-W-047	GRTS-250	Great	COM	Boulevard	18601 E BURNSIDE ST	45.5207	-122.4716
Panel 10	2019-20	3047-W-039	GRTS-184	Less	RES	Residential	156 NE 165th Ave.	45.5237	-122.4933
Panel 10	2019-20	3153-F-059	GRTS-189	Less	RES	Residential	400 NE 30th Dr.	45.5186	-122.4263
Panel 10	2019-20	3249-W-036	GRTS-191	Less	RES	Residential	18720 SE Caruthers St.	45.5055	-122.4700
Panel 10	2019-20	3152-F-050	GRTS-194	Less	RES	Residential	1047 SE 213th Ave.	45.5149	-122.4437
Panel 10	2019-20	3248-W-074	GRTS-196	Less	RES	Residential	17922 SE Caruthers St.	45.5057	-122.4784
Panel 10	2019-20	3152-F-074	GRTS-198	Less	RES	Residential	2342 NW Stanley Ave.	45.5134	-122.4353
Panel 10	2019-20	3248-W-006	GRTS-200	Less	RES	Residential	17710 SE Mill St.	45.5106	-122.4807
Panel 10	2019-20	3052-F-026	GRTS-201	Less	RES	Residential	21434 SE OAK STREET	45.5201	-122.4427
Panel 10	2019-20	3048-W-030	GRTS-202	Less	RES	Residential	17800 NE Davis St.	45.5237	-122.4800
Panel 10	2019-20	3047-W-064	GRTS-203	Less	RES	Residential	16907 NE Davis St.	45.5240	-122.4889
Panel 10	2019-20	3049-W-035	GRTS-206	Less	COM	Residential	18801 E Burnside St.	45.5204	-122.4701
Panel 10	2019-20	3349-W-012	GRTS-207	Less	RES	Residential	192 NW Linneman Ave.	45.4987	-122.4749
Panel 11	2020-21	3448-J-008	GRTS-252	Great	RES	Minor Arterial	3911 SE 182ND AVE	45.4943	-122.4757

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 11	2020-21	3153-F-061	GRTS-253	Great	RES	Minor Arterial	22766 NE STARK ST	45.5190	-122.4275
Panel 11	2020-21	3048-W-098	GRTS-254	Great	VAC	Community	17727 E BURNSIDE	45.5221	-122.4797
Panel 11	2020-21	3249-W-048	GRTS-255	Great	RES	Community	2446 SE 190th Ave.	45.5048	-122.4678
Panel 11	2020-21	2947-W-050	GRTS-260	Great	RES	Minor Arterial	16601 NE GLISAN ST	45.5265	-122.4921
Panel 11	2020-21	3047-W-097	GRTS-264	Great	COM	Minor Arterial	410 NE 162ND	45.5197	-122.4964
Panel 11	2020-21	3152-F-027	GRTS-265	Great	COM	Minor Arterial	21825 SE STARK ST	45.5190	-122.4378
Panel 11	2020-21	3148-W-009	GRTS-266	Great	RES	Minor Arterial	18147 SE Main St.	45.5136	-122.4759
Panel 11	2020-21	3049-W-088	GRTS-267	Great	COM	Boulevard	18525 BURNSIDE RD	45.5213	-122.4724
Panel 11	2020-21	3349-W-083	GRTS-270	Great	COM	Minor Arterial	18238 SE DIVISION	45.5045	-122.4747
Panel 11	2020-21	3152-F-029	GRTS-271	Great	COM	Minor Arterial	22017 SE STARK ST	45.5190	-122.4352
Panel 11	2020-21	3248-W-009	GRTS-272	Great	RES	Minor Arterial	1617 SE 182ND AVE	45.5109	-122.4758
Panel 11	2020-21	3049-W-068	GRTS-273	Great	COM	Boulevard	18201 SE STARK ST	45.5192	-122.4756
Panel 11	2020-21	2950-W-061	GRTS-209	Less	RES	Residential	19902 NE Holladay St.	45.5308	-122.4580
Panel 11	2020-21	3152-F-060	GRTS-214	Less	RES	Residential	1331 SE 216th Ave.	45.5127	-122.4402
Panel 11	2020-21	2947-W-058	GRTS-215	Less	RES	Residential	16574 NE Pacific Ter.	45.5290	-122.4922
Panel 11	2020-21	3152-F-046	GRTS-217	Less	RES	Residential	919 SE 218th Ave.	45.5160	-122.4380
Panel 11	2020-21	3149-W-043	GRTS-218	Less	RES	Residential	932 SE 187th Ave.	45.5156	-122.4706
Panel 11	2020-21	3248-W-040	GRTS-219	Less	RES	Residential	17848 SE Clay St.	45.5114	-122.4790
Panel 11	2020-21	2950-W-042	GRTS-220	Less	RES	Residential	19900 NE Multnomah St.	45.5323	-122.4582
Panel 11	2020-21	3055-B-019	GRTS-224	Less	RES	Residential	3848 NE View Pl.	45.5239	-122.4125
Panel 11	2020-21	3050-F-058	GRTS-225	Less	OSP	Residential	322 NE 194th Ave	45.5251	-122.4612
Panel 11	2020-21	3148-W-029	GRTS-227	Less	RES	Residential	17735 SE Alder St.	45.5172	-122.4803
Panel 11	2020-21	3349-W-005	GRTS-228	Less	RES	Residential	3919 NW 3rd St.	45.4994	-122.4714
Panel 11	2020-21	3048-W-053	GRTS-231	Less	RES	Residential	17659 NE Couch St.	45.5230	-122.4810
Panel 12	2021-22	3148-W-063	GRTS-279	Great	COM	Boulevard	18012 SE STARK ST	45.5189	-122.4772
Panel 12	2021-22	3155-F-034	GRTS-280	Great	COM	Primary Arteri*	2870 NE HOGAN DR	45.5176	-122.4123
Panel 12	2021-22	3047-W-027	GRTS-282	Great	RES	Community	276 SE 172nd AVE	45.5207	-122.4862
Panel 12	2021-22	2946-W-011	GRTS-284	Great	COM	Minor Arterial	16145 NE GLISAN ST	45.5266	-122.4965
Panel 12	2021-22	3053-F-006	GRTS-285	Great	RES	Minor Arterial	<undetermined>	45.5237	-122.4337
Panel 12	2021-22	3348-W-016	GRTS-286	Great	RES	Minor Arterial	3149 SE 182ND AVE	45.4991	-122.4757
Panel 12	2021-22	2750-W-043	GRTS-290	Great	RES	Collector	2648 NE 201st Ave.	45.5419	-122.4565
Panel 12	2021-22	3148-W-053	GRTS-294	Great	RES	Minor Arterial	<undetermined>	45.5191	-122.4818
Panel 12	2021-22	3149-W-052	GRTS-295	Great	RES	Community	1102 SE 190th Ave.	45.5147	-122.4680

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Panel 12	2021-22	3046-W-005	GRTS-302	Great	RES	Minor Arterial	129 NE 162ND AVE	45.5235	-122.4965
Panel 12	2021-22	2947-W-047	GRTS-308	Great	RES	Minor Arterial	17025 NE GLISAN ST	45.5265	-122.4878
Panel 12	2021-22	3049-W-071	GRTS-309	Great	COM	Boulevard	18853 SE STARK ST	45.5192	-122.4694
Panel 12	2021-22	3249-W-013	GRTS-311	Great	VAC	Minor Arterial	19201 WI/ SE DIVISION ST	45.5046	-122.4653
Panel 12	2021-22	3153-F-027	GRTS-233	Less	RES	Residential	22303 SE Morrison St.	45.5169	-122.4333
Panel 12	2021-22	3449-J-043	GRTS-236	Less	RES	Residential	57 SW Hartley Ave.	45.4970	-122.4694
Panel 12	2021-22	3054-F-005	GRTS-240	Less	RES	Residential	329 SE 238th Ave.	45.5203	-122.4176
Panel 12	2021-22	3153-F-083	GRTS-242	Less	RES	Residential	22313 SE Salmon Dr.	45.5137	-122.4335
Panel 12	2021-22	3049-W-063	GRTS-245	Less	MRES	Residential	19126 SE 191st PLACE	45.5219	-122.4665
Panel 12	2021-22	3047-W-065	GRTS-247	Less	RES	Residential	230 NE 168th Ave.	45.5244	-122.4898
Panel 12	2021-22	3047-W-036	GRTS-248	Less	RES	Residential	16345 NE Everett Ct.	45.5252	-122.4941
Panel 12	2021-22	3152-F-041	GRTS-249	Less	MRES	Residential	810 SE 221st Ave.	45.5169	-122.4351
Panel 12	2021-22	3249-W-023	GRTS-251	Less	RES	Residential	18463 SE Stephens St.	45.5091	-122.4725
Panel 12	2021-22	3153-F-043	GRTS-257	Less	RES	Residential	145 NW 22nd St.	45.5126	-122.4328
Panel 12	2021-22	3248-W-080	GRTS-258	Less	RES	Residential	2202 SE 176Th AVE	45.5064	-122.4820
Panel 12	2021-22	3050-W-020	GRTS-259	Less	VAC	Residential	388 SE 194th Ave.	45.5197	-122.4632
Over		3248-W-025	GRTS-312	Great	IND	Minor Arterial	2311 SE 182ND AVE	45.5059	-122.4758
Over		3249-W-021	GRTS-320	Great	RES	Minor Arterial	1910 SE 182ND AVE	45.5091	-122.4755
Over		3153-F-035	GRTS-323	Great	RES	Minor Arterial	1124 SE 223 AVE	45.5143	-122.4338
Over		3049-W-008	GRTS-325	Great	COM	Boulevard	19109 SE STARK ST	45.5192	-122.4664
Over		3047-W-047	GRTS-326	Great	RES	Community	211 NE 172nd Ave.	45.5241	-122.4862
Over		3048-W-068	GRTS-327	Great	COM	Boulevard	205 SE 181ST AVE	45.5210	-122.4772
Over		3150-F-013	GRTS-329	Great	VAC	Boulevard	2515 NW ELEVEN MILE AVE	45.5157	-122.4589
Over		3048-W-079	GRTS-331	Great	COM	Minor Arterial	17910-17990 NE GLISAN ST	45.5264	-122.4784
Over		2947-W-072	GRTS-332	Great	RES	Minor Arterial	930 NE 162ND AVE	45.5299	-122.4961
Over		3053-F-012	GRTS-333	Great	RES	Minor Arterial	22222 SE ASH ST	45.5209	-122.4338
Over		3348-W-009	GRTS-334	Great	RES	Minor Arterial	3305 SE 182ND AVE	45.4984	-122.4757
Over		3048-W-095	GRTS-336	Great	RES	Community	17695 E BURNSIDE	45.5221	-122.4821
Over		3149-W-045	GRTS-337	Great	RES	Community	932 SE 187th Ave.	45.5155	-122.4703
Over		3349-W-038	GRTS-340	Great	RES	Minor Arterial	18202 SE BROOKLYN CT	45.5010	-122.4755
Over		3047-W-081	GRTS-344	Great	MRES	Minor Arterial	<undetermined>	45.5222	-122.4962
Over		3153-F-093	GRTS-345	Great	COM	Minor Arterial	22555 NE STARK ST	45.5190	122.4304
Over		3150-W-025	GRTS-347	Great	COM	Minor Arterial	19700-19720 SE Stark St.	45.5189	-122.4604

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Over		3252-F-048	GRTS-353	Great	RES	Community	1107 NW 15th St.	45.5076	-122.4449
Over		3249-W-035	GRTS-354	Great	RES	Minor Arterial	18805 SE DIVISION ST	45.5046	-122.4692
Over		3348-W-047	GRTS-356	Great	COM	Minor Arterial	2624 SE 182ND AVE	45.5032	-122.4757
Over		3150-W-065	GRTS-357	Great	RES	Community	19549 YAMHILL	45.5155	-122.4618
Over		3149-W-035	GRTS-359	Great	RES	Community	18501 SE Yamhill St.	45.5155	-122.4728
Over		3151-F-055	GRTS-361	Great	COM	Collector	<undetermined>	45.5189	-122.4552
Over		3148-W-020	GRTS-362	Great	COM	Boulevard	829 SE 181st Ave	45.5163	-122.4764
Over		3048-W-015	GRTS-364	Great	COM	Minor Arterial	17405 SE Stark St.	45.5192	-122.4839
Over		3047-W-017	GRTS-366	Great	COM	Minor Arterial	16321 SE STARK ST	45.5192	-122.4953
Over		3047-W-034	GRTS-368	Great	MRES	Community	<undetermined>	45.5223	-122.4952
Over		3053-F-016	GRTS-369	Great	COM	Minor Arterial	22309 SE STARK ST	45.5194	-122.4337
Over		3249-W-004	GRTS-370	Great	COM	Community	1541 SE 190th Ave.	45.5115	-122.4681
Over		3248-W-027	GRTS-372	Great	COM	Minor Arterial	18145 SE DIVISION ST	45.5046	-122.4765
Over		3050-W-018	GRTS-373	Great	MRES	Minor Arterial	400-432 SE 196TH AVE	45.5192	-122.4605
Over		3150-W-056	GRTS-375	Great	MRES	Boulevard	19500 SE STARK	45.5171	-122.4623
Over		3149-W-079	GRTS-377	Great	COM	Community	19010 E BURNSIDE	45.5188	-122.4680
Over		3448-J-007	GRTS-380	Great	RES	Minor Arterial	3911 SE 182ND AVE	45.4939	-122.4757
Over		3152-F-049	GRTS-381	Great	RES	Community	1008 SE 212th Ave.	45.5156	-122.4448
Over		3047-W-048	GRTS-382	Great	RES	Community	35 NE 172nd Ave.	45.5226	-122.4862
Over		3047-W-018	GRTS-384	Great	COM	Minor Arterial	16321 SE STARK ST	45.5192	-122.4948
Over		3153-F-019	GRTS-385	Great	COM	Minor Arterial	22350 SE STARK ST	45.5190	-122.4326
Over		3048-W-097	GRTS-389	Great	RES	Community	17730 E BURNSIDE ST	45.5219	-122.4799
Over		3049-W-091	GRTS-261	Less	VAC	Residential	Between Pine & Oak on SE 185t	45.5200	-122.4727
Over		3449-J-084	GRTS-262	Less	VAC	Residential	4209 SW 3rd St.	45.4948	-122.4746
Over		3152-F-097	GRTS-263	Less	RES	Residential	21432 SE MAIN St.	45.5126	-122.4425
Over		3449-F-001	GRTS-268	Less	VAC	Residential	3425 NW 1st St.	45.4970	-122.4670
Over		3351-F-047	GRTS-269	Less	RES	Residential	885 NW Cascade Ct.	45.5032	-122.4544
Over		3055-B-002	GRTS-274	Less	VAC	Residential	2112 NE 33rd St.	45.5207	-122.4106
Over		3153-F-076	GRTS-275	Less	RES	Residential	255 NE 23RD ST	45.5130	-122.4286
Over		3348-W-010	GRTS-276	Less	RES	Residential	3311 SE 177th Ave.	45.4984	-122.4805
Over		3150-F-008	GRTS-281	Less	COM	Residential	2450 NW Eleven Mile Ave.	45.5149	-122.4577
Over		3049-W-010	GRTS-283	Less	RES	Residential	18230 NE Flanders St.	45.5256	-122.4753
Over		3050-W-039	GRTS-287	Less	RES	Residential	14 NE 196th Ave.	45.5224	-122.4611

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Over		2947-W-039	GRTS-288	Less	RES	Residential	999 NE 169th Dr.	45.5298	-122.4892
Over		3049-W-044	GRTS-289	Less	RES	Residential	18733 NE Everett Ct.	45.5245	-122.4702
Over		3153-F-051	GRTS-291	Less	RES	Residential	2863 NE Elliott Ave.	45.5176	-122.4249
Over		3348-W-026	GRTS-292	Less	RES	Residential	18101 SE Tibberts St.	45.5006	-122.4770
Over		3050-W-031	GRTS-293	Less	RES	Residential	19235 NE Couch St.	45.5235	-122.4644
Over		3449-J-073	GRTS-296	Less	COM	Residential	4020 SE 182nd Ave.	45.4930	-122.4751
Over		3153-F-072	GRTS-297	Less	RES	Residential	2655 NE Roberts Ave.	45.5161	-122.4295
Over		3249-W-041	GRTS-298	Less	RES	Residential	18526 SE Caruthers St.	45.5055	-122.4724
Over		2949-W-029	GRTS-299	Less	RES	Residential	19125 NE Holladay St.	45.5291	-122.4665
Over		3047-W-050	GRTS-300	Less	MRES	Residential	71 SE 171st Ave.	45.5215	-122.4869
Over		2847-W-038	GRTS-301	Less	RES	Residential	2300 NE 165th Ave.	45.5395	-122.4925
Over		3153-F-055	GRTS-303	Less	RES	Residential	2800 NE Beech Dr.	45.5172	-122.4272
Over		3349-W-075	GRTS-304	Less	RES	Residential	18528 SE Brooklyn Ct.	45.5019	-122.4718
Over		3152-F-078	GRTS-305	Less	RES	Residential	2351 NW Aubrey Ln.	45.5130	-122.4361
Over		3248-W-057	GRTS-306	Less	RES	Residential	1849 SE 176th Ave.	45.5091	-122.4823
Over		3052-F-020	GRTS-307	Less	RES	Residential	21414 SE ANKENY STREET	45.5220	-122.4421
Over		3449-J-076	GRTS-310	Less	RES	Residential	237 SW Nancy Cir.	45.4954	-122.4739
Over		3152-F-066	GRTS-313	Less	VAC	Residential	833 SE 214th Ave.	45.5164	-122.4427
Over		3248-W-011	GRTS-314	Less	RES	Residential	18103 SE Mill St.	45.5106	-122.4769
Over		3049-W-084	GRTS-315	Less	RES	Residential	18247 NE COUCH	45.5226	-122.4750
Over		3054-B-001	GRTS-316	Less	RES	Residential	24147 SE Oak St.	45.5197	-122.4142
Over		3250-F-007	GRTS-317	Less	IND	Residential	1919 NW Eleven Mile Ave.	45.5108	-122.4583
Over		3349-W-006	GRTS-318	Less	RES	Residential	3986 NW 3rd St.	45.4995	-122.4719
Over		3153-F-029	GRTS-319	Less	RES	Residential	831 SE 224th Ave.	45.5163	-122.4327
Over		3048-W-059	GRTS-321	Less	RES	Residential	18188 SE Pine St.	45.5206	-122.4759
Over		3055-B-012	GRTS-322	Less	VAC	Residential	3731 NE Country Club Ave.	45.5230	-122.4095
Over		3348-W-040	GRTS-324	Less	COM	Residential	17530 SE Division St.	45.5043	-122.4827
Over		3047-W-045	GRTS-330	Less	RES	Residential	16825 SE Pine St.	45.5206	-122.4895
Over		2950-W-060	GRTS-335	Less	VAC	Residential	19914 NE Holladay St.	45.5308	-122.4572
Over		3054-F-007	GRTS-339	Less	RES	Residential	23622 SE Oak St.	45.5196	-122.4194
Over		2950-W-032	GRTS-341	Less	RES	Residential	621 SE 196th Ave.	45.5276	-122.4611
Over		3148-W-034	GRTS-342	Less	RES	Residential	672 SE 175th Pl.	45.5174	-122.4827
Over		2847-W-020	GRTS-343	Less	RES	Residential	16352 NE Tillamook St.	45.5382	-122.4937

Panel	Year	System ID	GRTS rank	TPD	Land Use	Funtional Class	Address	Latitude	Longitude
Over		3349-W-060	GRTS-346	Less	RES	Residential	2640 SE 187th Pl.	45.5028	-122.4693
Over		3047-W-055	GRTS-348	Less	RES	Residential	16812 SE Ankeny St.	45.5213	-122.4898
Over		2947-W-001	GRTS-349	Less	RES	Residential	16931 NE Clackamas St.	45.5334	-122.4887
Over		3047-W-037	GRTS-350	Less	RES	Residential	350 SE 165th	45.5256	-122.4933
Over		3153-F-056	GRTS-351	Less	RES	Residential	2880 NE Beech Dr.	45.5176	-122.4272
Over		3349-W-063	GRTS-352	Less	RES	Residential	2515 SE 190th AVE	45.5043	-122.4679
Over		3151-F-038	GRTS-355	Less	RES	Residential	20948 SE Main Dr.	45.5139	-122.4475
Over		2947-W-034	GRTS-358	Less	RES	Residential	16805 NE Hassalo St.	45.5308	-122.4900
Over		3449-J-013	GRTS-360	Less	RES	Residential	3780 SW 3RD ST	45.4949	-122.4706
Over		2950-W-047	GRTS-363	Less	RES	Residential	19615 NE Holladay St.	45.5309	-122.4609
Over		3152-F-016	GRTS-365	Less	RES	Residential	2336 NW Norman Ave.	45.5132	-122.4380
Over		2947-W-062	GRTS-367	Less	RES	Residential	16431 NE WASCO	45.5326	-122.4935
Over		3151-F-050	GRTS-371	Less	RES	Residential	20929 SE Burnside Ct.	45.5125	-122.4467
Over		2947-W-042	GRTS-374	Less	RES	Residential	16935 NE Oregon St.	45.5283	-122.4882
Over		3048-W-058	GRTS-376	Less	RES	Residential	311 NE 178th Ave.	45.5246	-122.4803
Over		3449-F-003	GRTS-378	Less	RES	Residential	144 SW Pleasant View Ave.	45.4962	-122.4677
Over		3049-W-033	GRTS-379	Less	VAC	Residential	SE 185th Ave. & SE Oak St.	45.5199	-122.4727
Over		3152-F-020	GRTS-383	Less	RES	Residential	621 NW Farris Rd.	45.5119	-122.4390
Over		3248-W-021	GRTS-386	Less	RES	Residential	17914 SE Harrison St.	45.5085	-122.4787
Over		3052-F-023	GRTS-387	Less	RES	Residential	22011 NE Couch St.	45.5229	-122.4355
Over		3249-W-017	GRTS-388	Less	RES	Residential	18619 SE Stephens Cir.	45.5097	-122.4714
Over		3155-F-064	GRTS-390	Less	MRES	Residential	24950 E/ SE Stark St.	45.5154	-122.4073
Disqualified	2011-12	3049-W-078	GRTS-014	Great	COM	Boulevard	<undetermined>	45.5209	-122.4720
Disqualified	2011-12	3053-F-007	GRTS-029	Great	RES	Minor Arterial	<undetermined>	45.5241	-122.4337

Appendix B

Maps of Proposed Rotating Monitoring Locations (Panels 3-11) for Permit Years 2-10

Figure B.1: Proposed Sampling Locations for Panel 3, the rotating panel to be monitored in permit year 2.

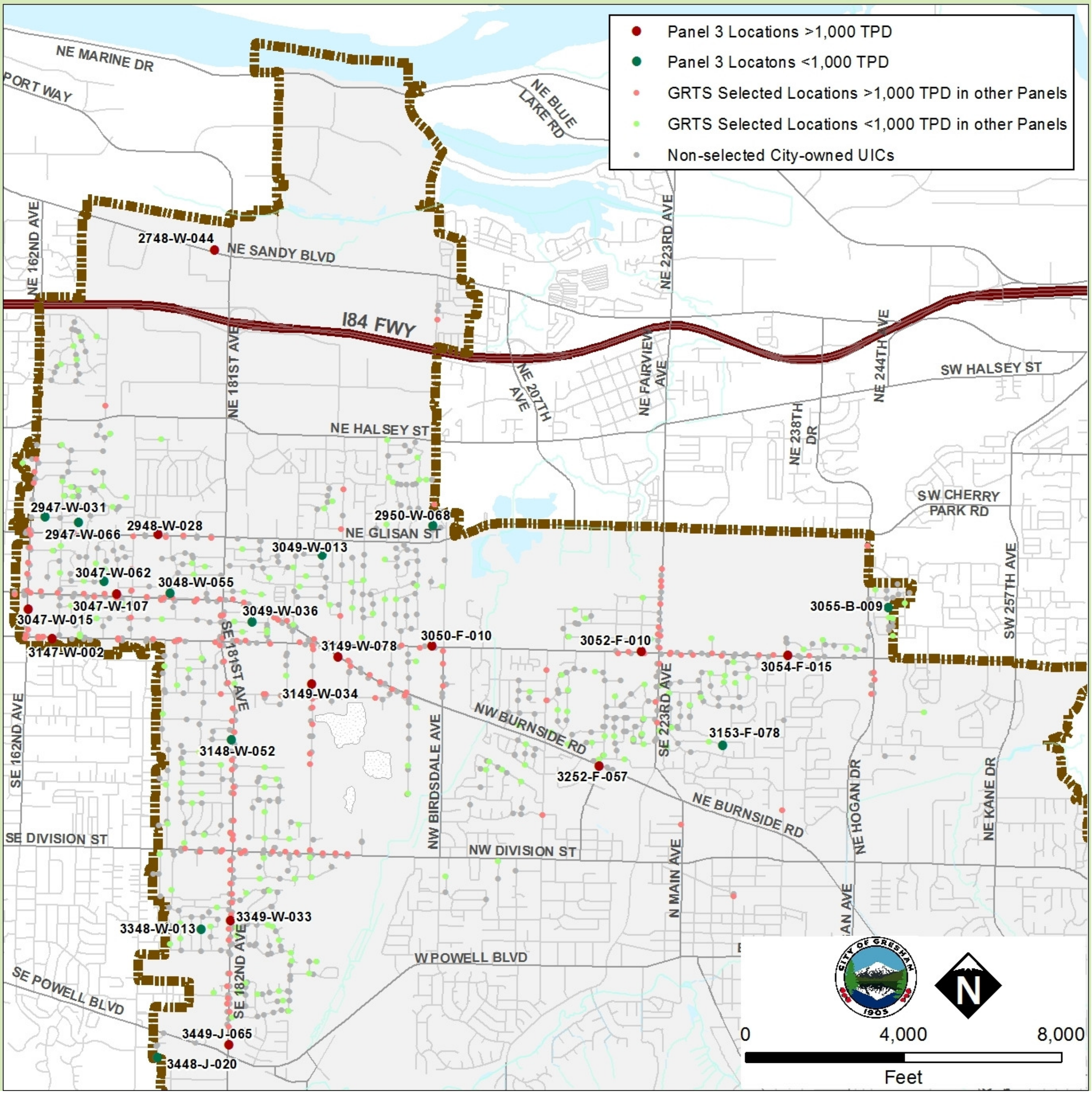


Figure A.2: Proposed Sampling Locations for Panel 4, the rotating panel to be monitoring in permit year 3.

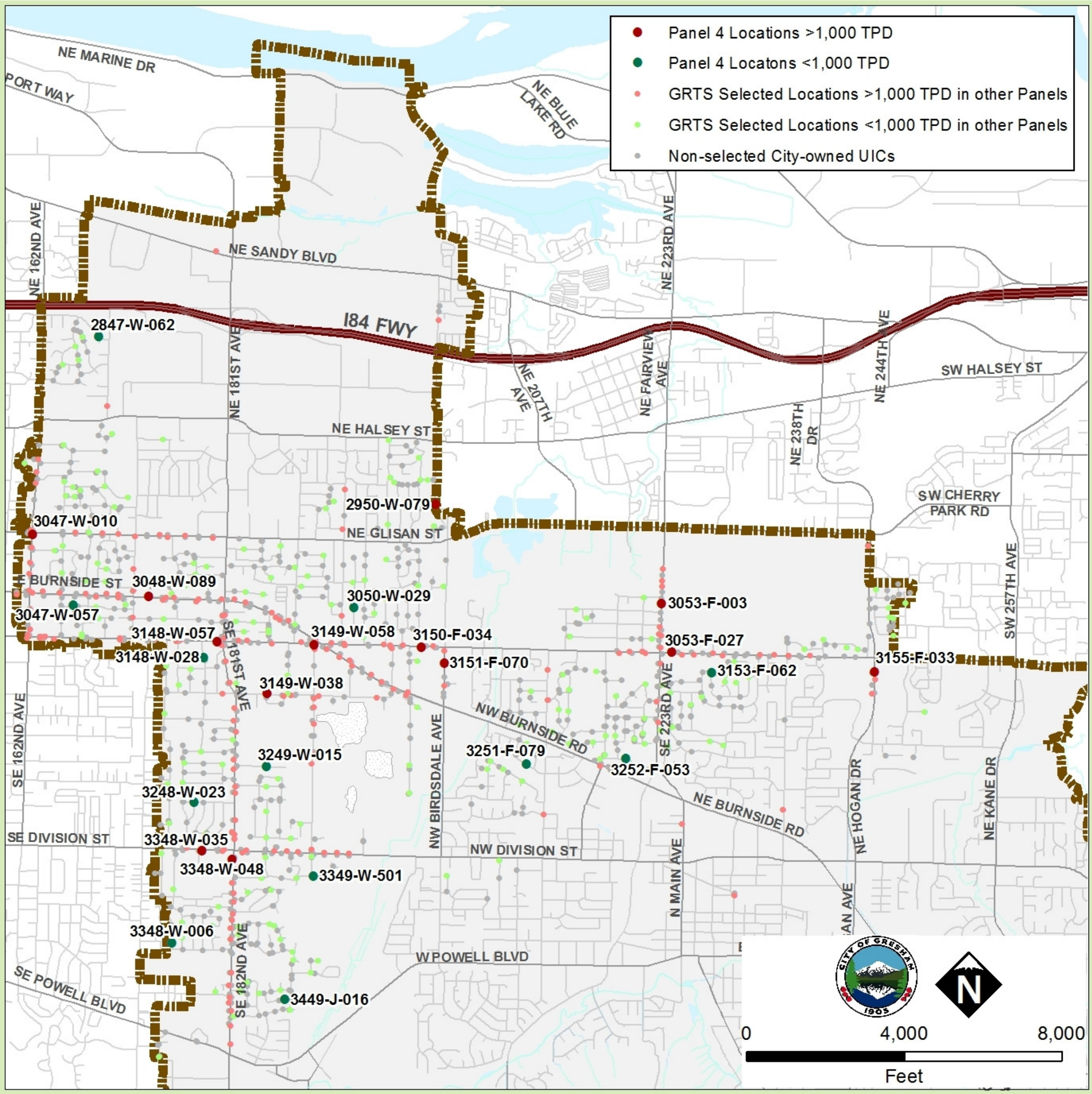


Figure A.3: Proposed Sampling Locations for Panel 5, the rotating panel to be monitoring in permit year 4.

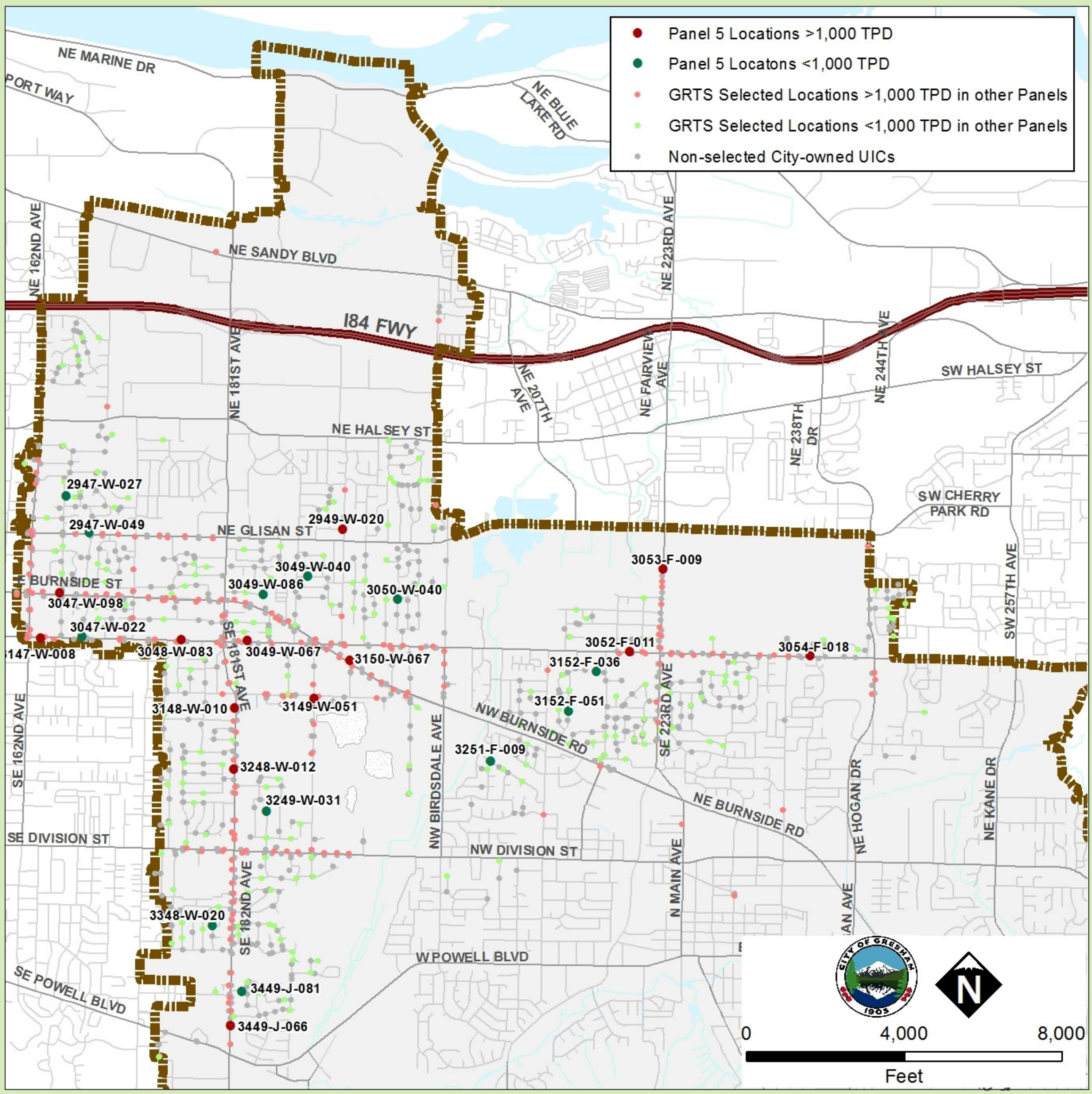


Figure A.4: Proposed Sampling Locations for Panel 6, the rotating panel to be monitoring in permit year 5.

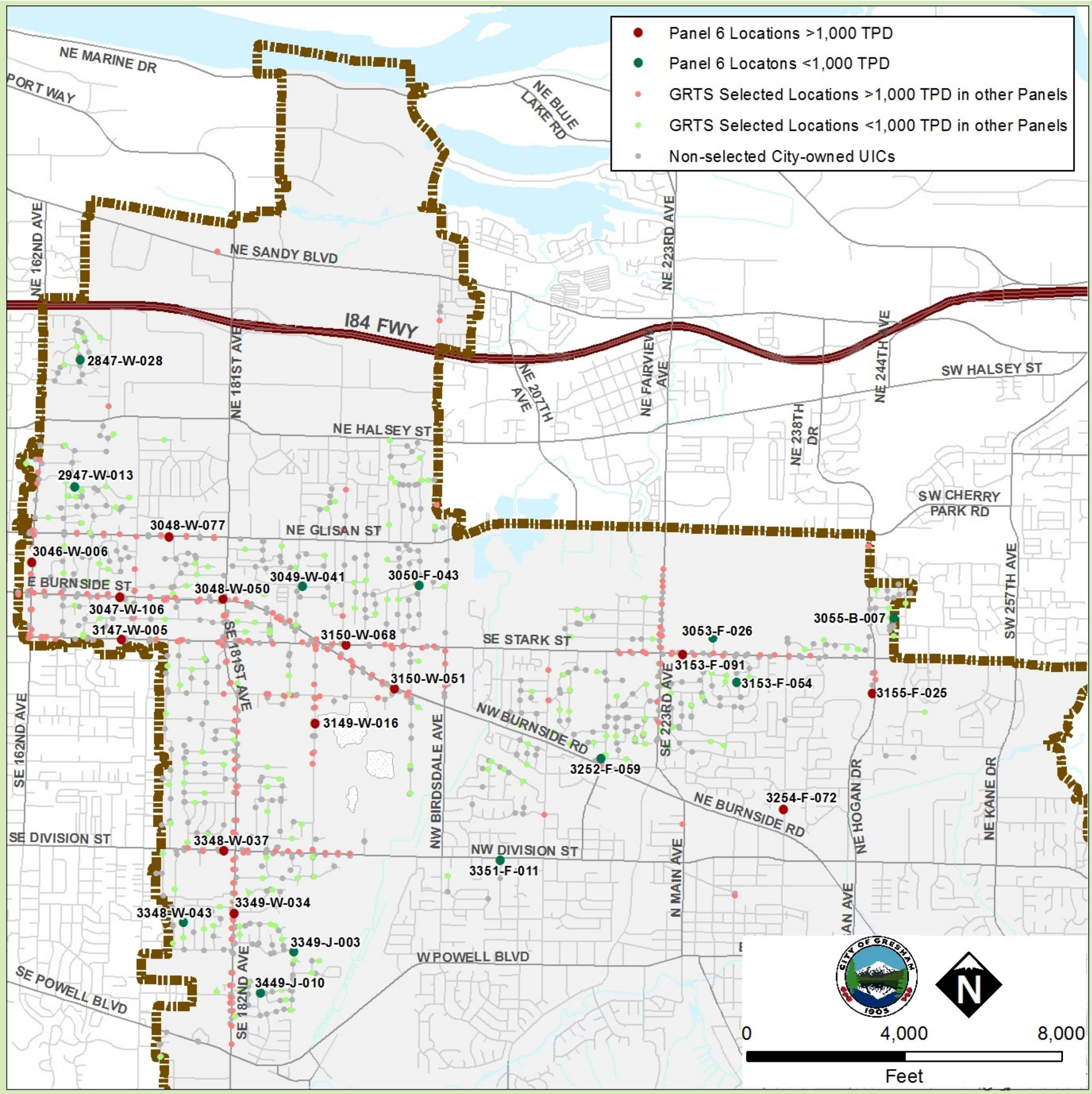


Figure A.5: Proposed Sampling Locations for Panel 7, the rotating panel to be monitoring in permit year 6.

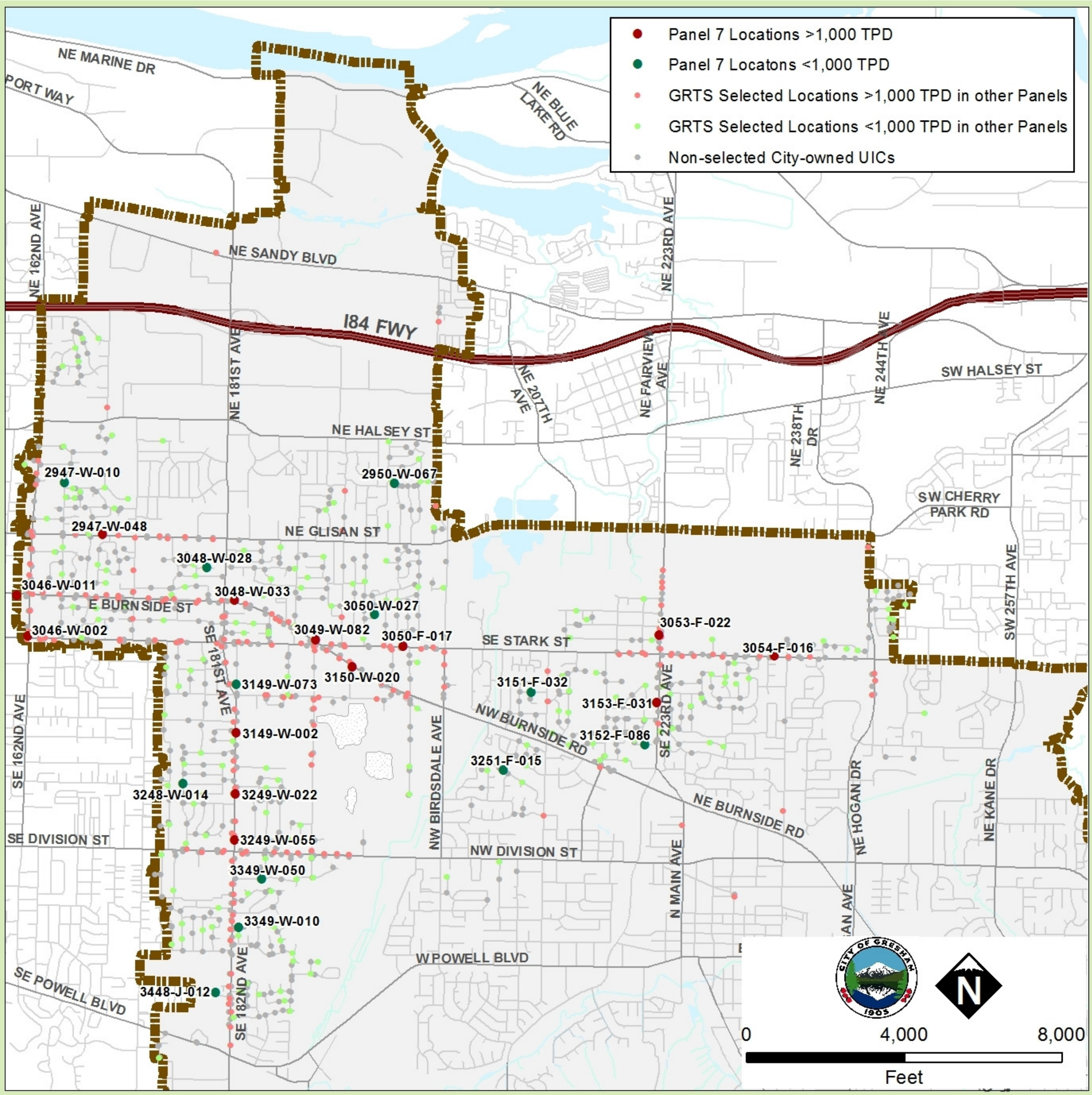


Figure A.6: Proposed Sampling Locations for Panel 8, the rotating panel to be monitoring in permit year 7.

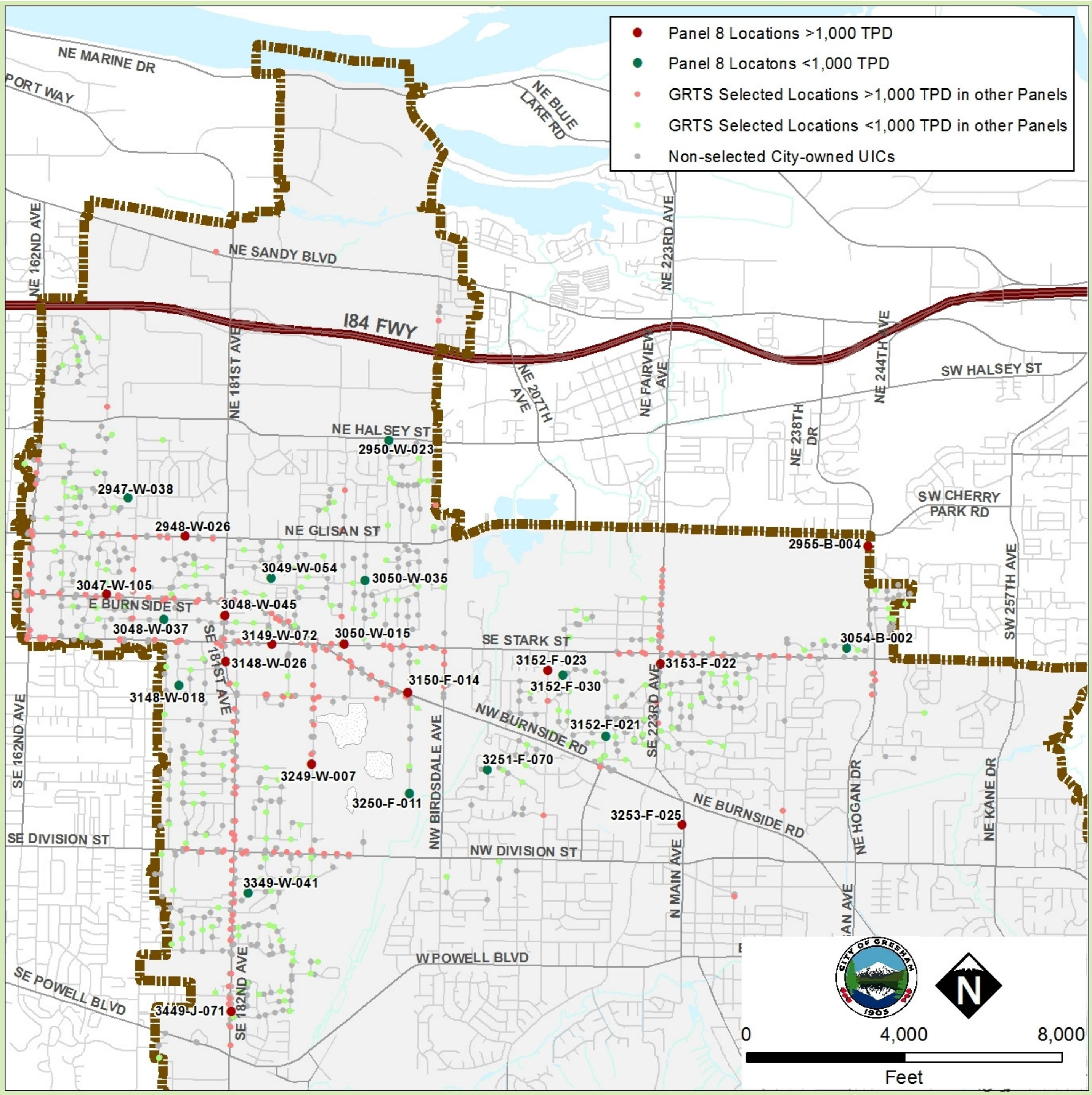


Figure A.7: Proposed Sampling Locations for Panel 9, the rotating panel to be monitoring in permit year 8.

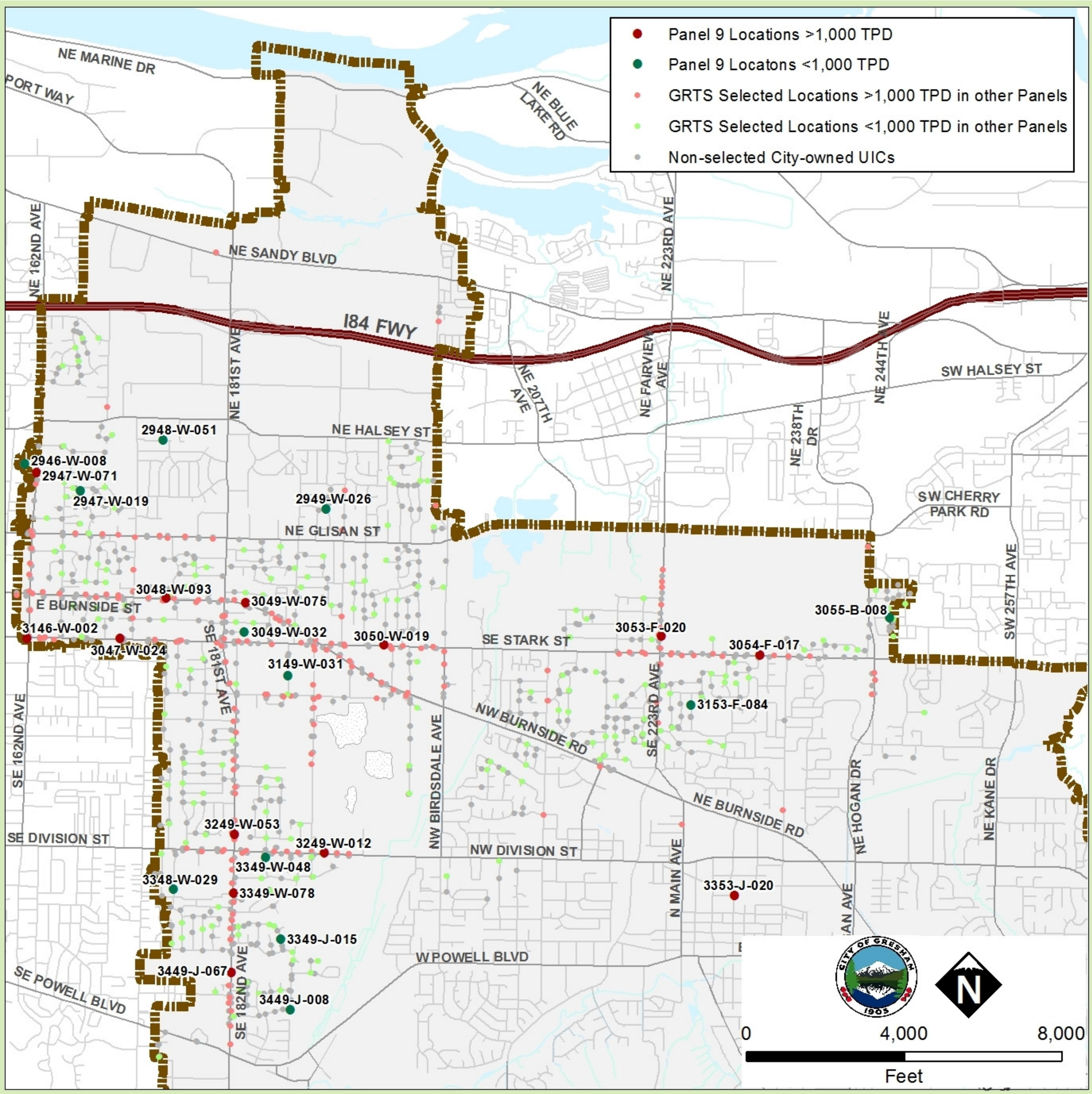


Figure A.8: Proposed Sampling Locations for Panel 10, the rotating panel to be monitoring in permit year 9.

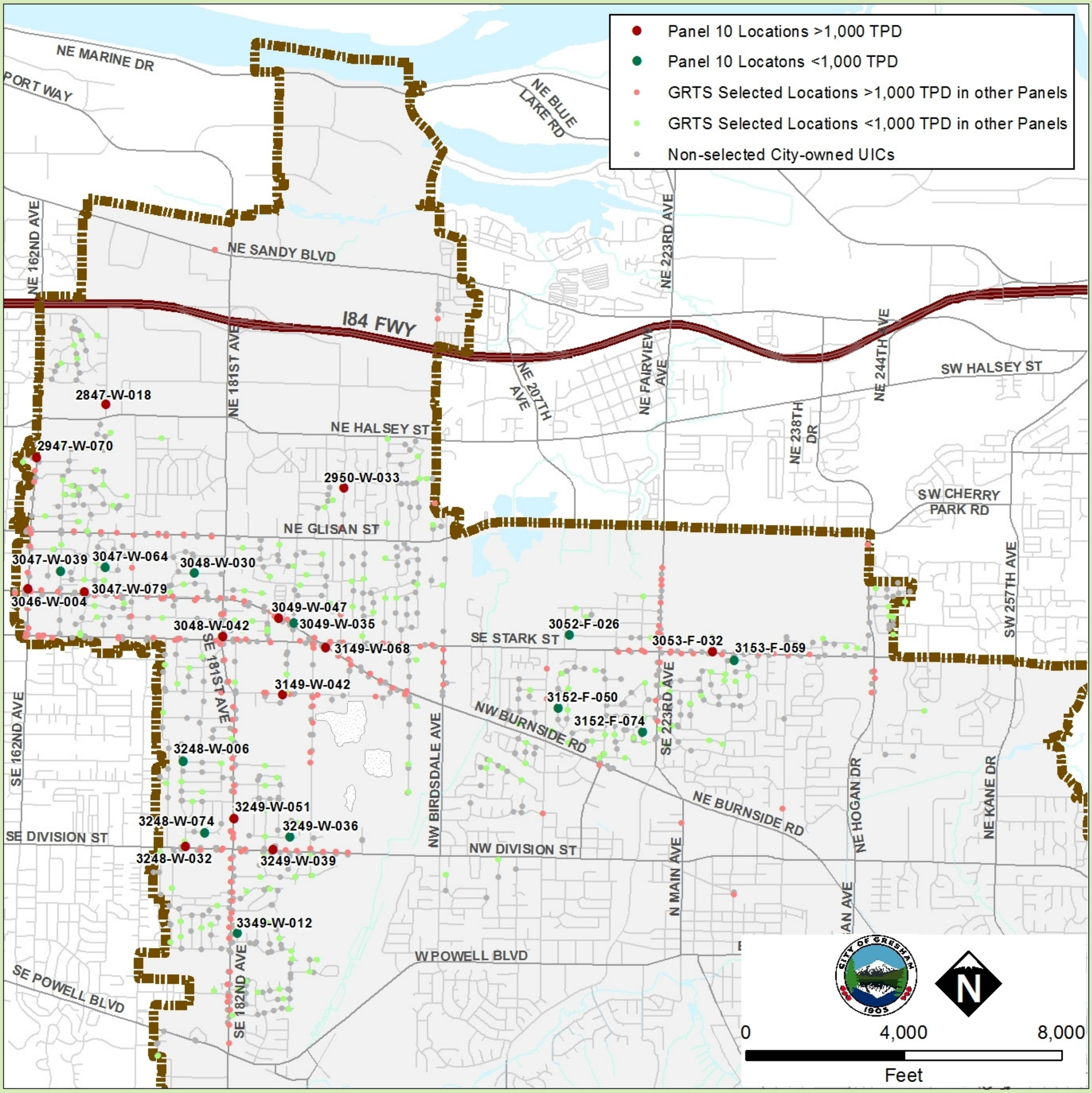


Figure A.9: Proposed Sampling Locations for Panel 11, the rotating panel to be monitoring in permit year 10.