Revised Report
Second-Tier Risk Analysis for Hydrogen Chloride Emissions
Pasco Sanitary Landfill
Pasco, Washington

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Prepared for

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LIST OF ABBREVIATIONS AND ACRONYMS

$\mu g/m^3$	Microgram per Cubic Meter
AERMOD	American Meteorological Society/U.S. EPA Regulatory Model
ASIL	Acceptable Source Impact Level
BACT	Best Available Control Technology
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
ft	Feet
HCl	Hydrogen Chloride
HIA	Health Impact Assessment
HQ	Hazard Quotient
IWAG	Industrial Waste Area Generators Group III
m	Meter
mg/kg	Milligrams per Kilogram
MIBR	Maximally Impacted Boundary Receptor
MICR	Maximally Impacted Commercial/Industrial Receptor
MIRR	Maximally Impacted Residential Receptor
NOC	Notice of Construction
OEHHA	California Office of Environmental Health Hazard Assessment
REL	Reference Exposure Level
RfC	Reference Concentration
RTO	Regenerative Thermal Oxidizer
Site	Pasco Sanitary Landfill Site
SQER	Small-Quantity Emission Rate
SVE	Soil Vapor Extraction
TAP	Toxic Air Pollutant
tBACT	Toxics Best Available Control Technology
VOC	Volatile Organic Compound
WAC	Washington Administrative Code

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1.0 EXECUTIVE SUMMARY

1.1 PROPOSED PROJECT

The Industrial Waste Area Generators Group III (IWAG) proposes to install a regenerative thermal oxidizer (RTO) at the Pasco Sanitary Landfill Site in Pasco, Washington ("Site"; Figure 1-1). The proposed RTO is designed to control volatile organic compound (VOC) emissions generated from a soil vapor extraction (SVE) system that removes VOCs from Zone A of the Site (Figure 1-2). The SVE system is currently being operated, and the proposed RTO will be operated, as components of IWAG's ongoing compliance with the requirements of Agreed Order No. DE 9240 (the Order). Installation of the proposed RTO is expected to begin in the spring of 2015.

The IWAG evaluated air quality impacts associated with the proposed project in a Notice of Construction (NOC) Application and Revised NOC Application Supporting Information Report submitted to the Washington State Department of Ecology (Ecology) Eastern Regional Office (NOC Report; Landau Associates 2014). As documented in the NOC application, potential emissions of hydrogen chloride (HCl) from the RTO may cause ambient air impacts that exceed the Washington State acceptable source impact level (ASIL). Based on that modeled exceedance, the IWAG is required to submit a second-tier petition per Chapter 173-460 of the Washington Administrative Code (WAC).

This second-tier health impact assessment (HIA) considers the cumulative impacts of HCl from the proposed RTO and other regional background sources of HCl.

1.2 HEALTH IMPACTS EVALUATION

In order to evaluate the potential for non-cancer health effects that may result from exposure to HCl and other toxic air pollutants (TAPs) with emission rates above the Washington Small-Quantity Emission Rates (SQERs) that may have non-cancer health effects that are additive to HCl [i.e., hydrogen fluoride (HF)], exposure concentrations at each receptor location were compared to relevant non-cancer risk-based toxicological values. The HIA demonstrates that the ambient non-cancer risks caused by emissions of HCl and HF from the proposed project result in a hazard index (HI) of less than 1, indicating that non-cancer effects are not likely to result from acute or chronic exposure to cumulative TAP impacts at nearby residential, commercial/industrial, sensitive/institutional or maximum impacted boundary receptors.

1.3 CONCLUSIONS

Project-related health risks are less than the limits permissible under WAC 173-460-090. Therefore, the project is approvable under WAC 173-460-090.

2.0 PASCO SANITARY LANDFILL
REGENERATIVE THERMAL OXIDIZER PROJECT

2.1 DESCRIPTION OF PROPOSED EQUIPMENT

The IWAG proposes to install a RTO at the Site. The Site layout and nearby adjacent properties are shown on Figure 2-1. The proposed RTO will be designed to control VOC emissions generated from a SVE system that removes VOCs from Zone A of the Site. The SVE system is currently being operated as a component of IWAG's ongoing compliance with the requirements the Order. The proposed location of the RTO will be within a fenced area of the Site to the west of Dietrich Road (Figure 2-1).

The proposed RTO will be designed to accommodate a maximum inlet flow rate of 1,000 standard cubic feet per minute (scfm) from the SVE conveyance pipeline and 1,000 scfm of dilution air. Additionally, the RTO will be designed to process up to 12 gallons per hour of process condensate generated within the SVE condensate knockout system. The 2,000-scfm RTO system will be manufactured and installed by Gulf Coast Environmental Systems (GCE) of Conroe, Texas. According to GCE, the total VOC destruction and removal efficiency (DRE) for the RTO would be at least 98 percent or the maximum total VOC concentration at the stack outlet would be less than or equal to 20 parts per million by volume (ppmv). Supplemental fuel usage for the RTO would vary; however, it is anticipated that during startup conditions the RTO would use 750 standard cubic feet per hour (scfh) of natural gas (or the equivalent amount of propane based on heating value). Additionally, during regular operation the RTO would use about $^{1}/_{10}$ the fuel used during startup (i.e., about 75 scfh). Installation of the proposed RTO is expected to begin in the spring of 2015.

Current and expected future land use in the area surrounding the Site is primarily agricultural or industrial/commercial. The ambient air impacts associated with installation of the RTO are discussed in the NOC air permit application submitted under separate cover. The RTO will have a 20-foot-tall vertical exhaust stack.

2.2 FORECAST EMISSION RATES

Air pollutant emission rates were calculated for the RTO in accordance with WAC 173-460-050. Emission rates were quantified for criteria pollutants and TAPs. Detailed emission calculation spreadsheets are provided in the NOC Report.

The emission estimates presented in this report were conservatively calculated based on operation of the RTO 24 hours per day, 365 days per year at maximum flow capacity and using historical maximum VOC inlet mass loading rates.

The basis for determining appropriate HCl emission factors and calculating emission rates is provided in the NOC Report. Per that report, the maximum potential HCl emission rate for the proposed project is 22 tons per year. Table 2-1 summarizes the facility-wide calculated emission rates for the proposed project. The maximum daily emission rate presented in Table 2-1 was used in the NOC permit application to model compliance with the 24-hour average ASIL and to evaluate non-cancer health risks.

2.3 LAND USE AND ZONING

Land uses in the vicinity of the Site are shown on Figure 2-2. The topography in the vicinity of the Site is relatively flat with elevations ranging between approximately 400 and 480 feet (ft) above sea level. The zoning designation for the proposed location of the RTO is City of Pasco Light Industry (I-1). Zoning designations on adjacent lands include City of Pasco I-1 to the north, west, and south and Franklin County Agricultural Production Zone (AP-20) to the east. Additionally, zoning designations for land more than 0.5 miles to the southwest of the proposed location of the RTO (beyond State Route 12) include General Business (C-3), Low Density Residential (R-1), Medium Density Residential (R-2), High Density Residential (R-4), Low Density Residential Alternative (R-1-A), Retail Business (C-1), Residential Transition (RT), and Residential Park (R-P) zones. Detailed zoning information for the area surrounding the Site is shown on Figure 2-2 (City of Pasco website 2013; Franklin County website 2014). Zoning and land use developments for properties surrounding the proposed RTO location are shown in Table 2-2.

2.4 SENSITIVE RECEPTORS

The following sensitive receptors are near the proposed location of the RTO stack at the Site and are presented on Figure 2-3:

- The nearest residence (located within Sundance Home Park) is 0.6 miles southwest of the proposed location for the RTO stack.
- The nearest school grounds are Ochoa Middle School, which is approximately 0.6 miles southwest of the proposed location for the RTO stack.
- The nearest church is located approximately 1.1 miles southwest of the proposed location for the RTO stack.
- The nearest daycare or pre-school is Benton Franklin Head Start Program, which is approximately 1.5 miles southwest of the proposed location for the RTO stack.
- The nearest medical facility, Lourdes Medical Center, is approximately 2.1 miles southwest of the proposed location of the RTO stack.
- The nearest convalescent home, Brenda's Elder Care, is approximately 2.2 miles southwest of the proposed location of the RTO stack.

3.0 PERMITTING REQUIREMENTS FOR NEW SOURCES OF TOXIC AIR POLLUTANTS

3.1 OVERVIEW OF THE REGULATORY PROCESS

The requirements for conducting a toxics screening are established in Chapter 173-460 WAC. This rule requires a review of any non-*de minimis*[1] increase in TAP emissions for all new or modified stationary sources in Washington State. Sources subject to review under this rule must apply best available control technology (BACT) for toxics (tBACT) to control emissions of all TAPs subject to review.

There are three levels of review when processing an NOC application for a new or modified emissions unit emitting TAPs in excess of the *de minimis* levels: 1) first-tier (toxics screening, presented in the NOC Report); 2) second-tier (health impact assessment, presented herein); and 3) third-tier (risk management decision).

All projects with emissions exceeding the *de minimis* levels are required to undergo a toxics screening (first-tier review) as required by WAC 173-460-080. The objective of the toxics screening is to establish the systematic control of new sources emitting TAPs in order to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality to protect human health and safety. If modeled emissions exceed the trigger levels called ASILs, a second-tier review is required. This report presents the health impact assessment (HIA) that is required for the proposed project.

As part of a second-tier petition, described in WAC 173-460-090, the applicant submits a site-specific HIA. The objective of an HIA is to quantify the increase in lifetime cancer risk for persons exposed to increased concentrations of carcinogens, and to quantify the increased health hazard from any non-carcinogen that would result from the proposed project. Once quantified, the cancer risk is compared to the maximum risk allowed by a second-tier review, which is 10 in 1 million, and the concentration of any non-carcinogen that would result from the proposed project is compared to its effect threshold concentration.

In evaluating a second-tier petition, background concentrations of the applicable TAPs must be considered. If the emission of a TAP results in an increased cancer risk of greater than 10 in 1 million (equivalent to 1 in 100,000), then an applicant may request that the Washington State Department of Ecology (Ecology) conduct a third-tier review. For the proposed RTO, no TAP emission results in a greater than 10 in 1 million cancer risk, and no third-tier review is required. For non-carcinogens, a

[1] If the estimated increase of emissions of a TAP or TAPs from a new or modified project is below the *de minimis* emissions threshold(s) found in WAC 173-460-150, the project is exempt from review under Chapter 173-460 WAC.

similar path exists, but there is no specified numerical criterion to indicate when a third-tier review is triggered. A third-tier review is not required for this project, because estimated non-carcinogenic impacts are below the risk-based concentration criterion as described in the following sections of this report.

3.2 BEST AVAILABLE CONTROL TECHNOLOGY

Ecology is responsible for determining BACT for controlling criteria pollutants and TAPs (tBACT) emitted from the proposed project. The BACT analysis is presented in the NOC Report (Landau Associates 2014). The BACT analysis recommended that the proposed RTO be implemented as BACT without an HCl scrubber. As presented in the NOC Report, an economic evaluation was conducted to determine whether installing a wet scrubber would be cost-prohibitive. Cost-effectiveness calculation tables were provided to Ecology on July 2, 2014 (Brunner 2014). The economic evaluation determined that a wet scrubber is rejected as tBACT on the basis of the disproportionate cost analysis.

3.3 FIRST-TIER TOXICS SCREENING REVIEW

The first-tier TAP assessment compares the forecast emission rates to the SQERs and compares the maximum ambient air impacts at any sensitive receptor to the ASILs.

Table 3-1 shows the calculated emission rates for each TAP emitted from the proposed project, and compares the emission rates to the SQERs. The SQERs are emission thresholds, below which Ecology does not require an air quality impact assessment for the listed TAP. The maximum emission rates for benzene, ethylbenzene, methylene chloride, trichloroethene, vinyl chloride, HCl, HF, and 1,2-dichloroethane exceed their respective SQERs, so an ambient air impact assessment based on atmospheric dispersion modeling was required for those TAPs.

Ecology requires facilities to conduct a first-tier screening analysis for each TAP whose emission exceeds its SQER by modeling the 1st-highest 1-hour, 1st-highest 24-hour, or annual impacts (based on the averaging period listed for each TAP in WAC 173-460-150) at or beyond the project boundary, then comparing the modeled values to the ASILs (WAC 173-460-080). For this analysis, annual-average impacts were modeled based on a worst-case operational scenario of 24 hours per day for 365 days per year for 5 years, with the American Meteorological Society/U.S. Environmental Protection Agency (EPA) Regulatory Model (AERMOD).

Table 3-2 presents the first-tier ambient air concentration screening analysis for each TAP whose emission rate exceeds its SQER. Details on the methodologies for the modeling are provided in the NOC Report (Landau Associates 2014). All of the modeled maximum impacts occur at unoccupied locations near the facility fenceline (i.e., locations where there are currently no buildings). The maximum 24-hour average HCl impact near the unoccupied fenceline exceeds its ASIL, while the impacts for all TAPs other than HCl are less than their respective ASILs. Therefore, HCl is the only TAP triggering a requirement for a second-tier HIA. Note, the ambient impacts presented in Table 3-2 are based on modeling conducted during preparation for the first-tier NOC application. Based on guidance received from Ecology's toxicologist during the second-tier HIA pre-application meeting (Kadlec, M., 2014, personal communication), modeling conducted for this second-tier HIA was conducted with a more refined receptor grid. The more refined receptor grid that was developed, based on Ecology guidance, limits modeled receptors at the Site to only those locations where the public would be likely to spend an hour or more (i.e., nearby agricultural fields within the Site boundary or along Dietrich Road, which bisects the Site). The HCl [72 micrograms per cubic meter ($\mu g/m^3$)] and HF (1.8 $\mu g/m^3$) impacts modeled herein are less than the impacts presented in the NOC Report. The decrease in modeled concentration results from the use of the more refined receptor grid requested by Ecology.

3.4 SECOND-TIER REVIEW PROCESSING REQUIREMENTS

In order for Ecology to review the second-tier petition, each of the following regulatory requirements under WAC 173-460-090 must be satisfied:

(a) The permitting authority has determined that other conditions for processing the NOC Order of Approval have been met, and has issued a preliminary approval order.

(b) Emission controls contained in the preliminary NOC approval order represent at least BACT.

(c) The applicant has developed an HIA protocol that has been approved by Ecology.

(d) The ambient impact of the emissions increase of each TAP that exceeds ASILs has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol.

(e) The second-tier review petition contains an HIA conducted in accordance with the approved HIA protocol.

Ecology provided comments to Landau Associates' HIA protocol [item (c) above; (Kadlec, M., 2014, personal communication)]. Ecology's comments were addressed as part of this HIA.

3.5 SECOND-TIER REVIEW APPROVAL CRITERIA

As specified in WAC 173-460-090(7), Ecology may recommend approval of a project that is likely to cause an exceedance of ASILs for one or more TAPs only if:

- Ecology determines that the emission controls for the new and modified emission units represent BACT
- The applicant demonstrates that the increase in emissions of TAPs is not likely to result in an increased cancer risk of more than 1 in 100,000
- Ecology determines that the non-cancer hazard is acceptable.

The remainder of this document discusses the HIA completed by Landau Associates on behalf of the IWAG.

4.0 HEALTH IMPACT ASSESSMENT

This HIA was conducted in accordance with the requirements of WAC 173-460-090 and guidance provided by Ecology. The HIA addresses the public health risk associated with exposure to HCl and HF from the proposed RTO at the Site and existing background concentrations of HCl in the vicinity. While an HIA is not a full risk assessment, it generally follows the four steps of the standard health risk assessment approach proposed by the National Academy of Sciences (NAS 1983, 1994). These four steps are: 1) hazard identification; 2) exposure assessment; 3) dose-response assessment; and 4) risk characterization. As described later in this document, the HIA does not consider exposure pathways other than inhalation relative to RTO emissions.

4.1 HAZARD IDENTIFICATION

Hazard identification involves gathering and evaluating toxicity data on the types of health injury or disease that may be produced by a chemical, and on the conditions of exposure under which injury or disease are produced. It may also involve characterization of the behavior of a chemical within the body and the interactions it undergoes with organs, cells, or even parts of cells. This information may be of value in determining whether the forms of toxicity known to be produced by a chemical agent in one population group or in experimental settings are also likely to be produced in human population groups of interest. Note that risk is not assessed at this stage. Hazard identification is conducted to determine whether and to what degree it is scientifically correct to infer that toxic effects observed in one setting will occur in other settings (e.g., Are chemicals found to be carcinogenic or teratogenic in experimental animals also likely to be so in adequately exposed humans?).

The second-tier HIA is triggered solely by potential ambient air impacts of HCl. Based on discussions with Ecology's toxicologist, acute toxic effects associated with HF are additive to the toxicological effects that would result from acute HCl impacts (Kadlec 2014). However, toxic effects associated with other TAPs with calculated emission rates from the RTO that may exceed the SQERs—benzene, ethylbenzene, methylene chloride, trichloroethene, vinyl chloride, and 1,2-dichloroethane—are not additive to the toxicological effects that would result from HCl and HF impacts (Kadlec, M., 2014, personal communication). Therefore, at Ecology's direction, only the toxicity for HCl (acute and chronic) and HF (acute only) have been evaluated in this HIA.

4.1.1 OVERVIEW OF HYDROGEN CHLORIDE TOXICITY

HCl is a typical byproduct during combustion of the chlorinated VOCs that will be treated by the RTO. HCl is extremely hygroscopic, so when in the vapor phase, it quickly absorbs into ambient water droplets. As a result, ambient HCl normally exists as an atmospheric aerosol; this influences the mobility and bioavailability of the substance. The target organ systems for human health risk are the respiratory system and eyes. Some chronic exposure studies report bleeding of nose and gums, ulcerations of mucous membranes, and etching or erosion of the front teeth by repeated exposure to HCl mist in occupational settings (Wohlslagel et al. 1976; CalEPA website 2000, 2008).

It is important to note that the estimated HCl concentrations from the proposed project that could potentially impact people will be much lower than levels presented in the studies evaluating industrial workplace exposures where the health effects (listed above) were noted. HCl is not carcinogenic. Non-cancer hazards for the proposed RTO-related HCl emissions are quantified and presented in the remaining sections of this document.

4.1.2 OVERVIEW OF HYDROGEN FLUORIDE TOXICITY

HF is an anticipated byproduct of combustion of trichlorofluoromethane (CFC-11) and dichlorodifluoromethane (CFC-12) from the SVE stream. Human exposure consideration for airborne HF from the proposed RTO is by acute inhalation (CalEPA website 2002). Most adverse health effects from acute HF exposure are by action of the fluoride ion (F^-). HF inhalation or skin absorption commonly results with burns, irritation to the eyes, nose and throat, and systemic fluoride poisoning (CalEPA website 1999). Acute exposure inhalation of HF results in coughing and choking, and may cause life-threatening pulmonary edema. Based on an email exchange with Ecology's toxicologist and our understanding of HF toxicity, it is determined that the chronic toxic effects of HF are not additive to the chronic toxic effects of HCl (Kadlec 2014); therefore, an evaluation of the chronic toxic effects of HF is not included in this HIA.

The estimated HF concentrations from the proposed project that could potentially impact people will be much lower than levels presented in the studies evaluating exposures where the health effects (listed above) were noted. HF is not carcinogenic. Because the target organs and critical non-cancer health effects for acute exposure to HF and HCl are very similar, an evaluation is provided in Section 4.4.1.2 of this HIA to determine the potential for additive adverse health impacts that could result from acute exposure to both compounds.

4.2 DOSE-RESPONSE ASSESSMENT

Dose-response assessment describes the quantitative relationship between the amounts of exposure to a substance (the dose) and the incidence or occurrence of injury (the response). The process often involves establishing a toxicity value or criterion to use in assessing potential health risk.

4.2.1 DOSE-RESPONSE ASSESSMENT FOR HYDROGEN CHLORIDE

The U.S. EPA developed an inhalation Reference Concentration (RfC) for HCl of 20 µg/m^3. The California Environmental Protection Agency (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) has derived inhalation Relevant Exposure Limits (RELs) for HCl of 9 µg/m^3 for chronic exposure and 2,100 µg/m^3 for acute exposure (CalEPA website 2000, 2008, 2014; EPA website 2012).

These assessments are based on two subchronic bioassays and a single-dose chronic study with limited toxicological measurements. Only one controlled human study and one occupational exposure study (with non-quantified exposure concentrations) were available for dose-response evaluations, amongst limited controlled animal studies; therefore, both agencies consider these estimations low in confidence. The U.S. EPA has yet to undertake a complete evaluation to determine evidence of human carcinogenicity potential but has established that HCl is a potential human carcinogen. However, the U.S. EPA has not established a cancer slope factor or a unit risk factor for HCl.

4.2.2 DOSE-RESPONSE ASSESSMENT FOR HYDROGEN FLUORIDE

The CalEPA OEHHA has derived an acute inhalation REL for HF of 240 µg/m^3 (CalEPA website 1999). The REL for HF was developed based on a single controlled human study where 20 healthy, male volunteers were exposed to HF concentrations ranging from 200 to 5,200 µg/m^3 in an exposure chamber for 1 hour. A no-observed adverse-effect-level range of 700 to 2,400 µg/m^3 was developed based on the study. The U.S. EPA's IRIS program has not undertaken a complete evaluation and determination for evidence of human carcinogenic potential from HF (EPA website 2013).

4.3 EXPOSURE ASSESSMENT

An exposure assessment involves estimating the extent to which the public is exposed to a chemical substance emitted from a facility. This includes:

- Identifying routes of exposure
- Estimating long- and/or short-term offsite pollutant concentrations
- Identifying exposed receptors
- Estimating the duration and frequency of receptors' exposure.

4.3.1 IDENTIFYING ROUTES OF POTENTIAL EXPOSURE

Humans can be exposed to chemicals in the environment through inhalation, ingestion, or dermal contact. The primary route of exposure to most air pollutants is inhalation; however, some air pollutants may also be absorbed through ingestion or dermal contact. Ecology uses guidance provided in

California's *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (CalEPA 2003) to determine which routes and pathways of exposure to assess for chemicals emitted from a facility. Chemicals for which Ecology assesses multiple routes and pathways of exposure are presented in Table 4-1. Exposure to HCl via inhalation is the only exposure route considered significant for this project. According to the EPA Integrated Risk Information System (IRIS) Database (EPA website 2012), there are "No Data" available for the toxicity of HCl via the oral exposure route, and the only toxicity data listed in that database is for the inhalation pathway. The National Institutes of Health website (NIH, Undated) states the following regarding the environmental fate and transport of hydrochloric acid:

> Hydrogen chloride and hydrochloric acid's production and use in the production of chemicals, or for applications such as a metal pickling, ore refining, food processing, manufacture of fertilizers and dyes, and in the rubber and textile industries may result in the release of hydrogen chloride or hydrochloric acid to the environment through various waste streams. Hydrogen chloride can be formed during the burning of many plastics. Hydrochloric acid is found in the gases evolved from volcanoes, particularly ones found in Mexico and South America. Hydrochloric acid is also found in the digestive tract of most mammals. If released to air, hydrogen chloride will be removed by rainfall. If released to water, hydrogen chloride dissociates readily in water to chloride and hydronium ions, decreasing the pH of the water. A Henry's law constant of 2.04X10+6 mol/L atm (4.90X10-10 cu m atm/mol) has been reported for hydrochloric acid. This Henry's Law constant indicates that hydrochloric acid is expected to be essentially nonvolatile from water surfaces. If released to soil, hydrogen chloride will evaporate from dry soil surfaces and dissociate into chloride and hydronium ions in moist soil. Hydrogen chloride does not accumulate in the food chain.

4.3.2 Estimating Hydrogen Chloride Concentrations

To estimate where and to what degree pollutants would likely disperse after they are emitted from the proposed RTO, Landau Associates conducted air dispersion modeling that incorporates emissions, meteorological, geographical, and terrain information to estimate pollutant concentrations downwind from a source.

The proposed RTO was modeled as an individual discharge point. HCl ambient air impacts from the proposed project were modeled using the following air dispersion model inputs:

- AERMOD with the Plume Rise Model Enhancements algorithm for building downwash (Version 14134).
- Five years of sequential hourly meteorological data from the Tri-Cities International Airport (2007 to 2011).
- Five years of twice-daily upper air data from Spokane, Washington (2007 to 2011) to define mixing heights.
- Franklin County area digital topographical data in the form of Shuttle Radar Topography Mission files (which describe local topography and terrain) with a resolution of approximately 98 feet (ft) [30 meters (m)].
- Franklin County area digital land classification files (which describe surface characteristics).

- The emissions for the proposed RTO were modeled with a stack height of 20 ft above ground level.
- The building dimensions for the multiple buildings within the fenceline at the Site were included to account for building downwash.
- The receptor grid for the AERMOD modeling domain at or beyond the facility boundary was established using a variable Cartesian grid:
  - 33-ft (10-m) spacing from emission source to 1,148 ft (350 m)
  - 82-ft (25-m) spacing from 1,148 ft (350 m) to 2,625 ft (800 m)
  - 164-ft (50-m) spacing from 2,625 ft (500 m) to 3,281 ft (1,000 m).
- The receptor grid within the Site boundary was limited to areas where a member of the public could conceivably spend at least 1 hour (i.e., nearby agricultural fields and along Dietrich Road). Note, after air modeling was completed, it was determined that a fence with a gate will be installed across Dietrich Road to the east-southeast of the RTO, which will restrict public access to the north of the gate. The modeled receptor grid currently extends to the north of the gate where a member of the public would have no access to the Site. Therefore, any worst-case impacts that are evaluated based on concentrations modeled at the receptors north of the gate are conservatively high.

4.3.3 IDENTIFYING POTENTIALLY EXPOSED RECEPTORS

There are several different land use types within the general vicinity of the Site. Locations where people could be exposed to project-related emissions are identified on Figure 2-3. The nearest single-family residences are located on residentially-zoned land approximately 0.6 miles southwest of the proposed RTO. Those houses represent the Maximally Impacted Residential Receptor (MIRR). Additionally, a commercial building owned by Dwight & Sherree Lovitt Trucking is located on industrially-zoned land approximately 0.25 miles to the south of the proposed RTO. This building represents the Maximally Impacted Commercial/Industrial Receptor (MICR). Also, Ochoa Middle School, located approximately 0.6 miles southwest of the proposed RTO, represents the Maximally Impacted Institutional/Sensitive Receptor (MIIR).

As shown on Figure 2-1, the immediate area surrounding the proposed RTO will be surrounded by a fence to restrict public access. However, a private road (Dietrich Road) bisects the Site, portions of the Site are used for crop production, and fences do not restrict access to all areas of the Site. The eastern property boundary is demarcated with fence posts and signs indicating the boundary and that the Site is a contaminated property. That signage is a component of the Institutional Controls implemented under the Order. Therefore, there is a limited potential for public exposure to project-related emissions within the Site boundary for a duration of 1 hour. Two locations within the Site boundary were identified where a public receptor could be exposed for at least 1 hour: (1) an agricultural field adjacent to the west of the proposed RTO, or (2) along Dietrich Road, where a traveler could be stopped due to a flat tire or other automotive problem. Additional attention was therefore drawn to these two areas to estimate potential onsite public exposure. Typically, Ecology considers exposures occurring at maximally exposed boundary, residential, and industrial/commercial areas and sensitive receptor locations to capture worst-case exposure scenarios. Therefore, boundary, residential, industrial/commercial, and sensitive receptors are modeled for exposure to project-related emissions. HCl concentrations at the two onsite locations where a public receptor could be exposed for at least an hour are greater than HCl concentrations at the Site boundary; therefore, for the purposes of this assessment, the maximally impacted boundary receptor (MIBR) was identified as one of the two onsite receptors described above (i.e., whichever has the highest HCl concentration for each averaging period).

4.3.3.1 Receptors Maximally Exposed to Hydrogen Chloride

Maximally exposed receptors of different use types, and the direction and distance of those receptors from the proposed RTO are summarized in Tables 4-2 and 4-3. Additionally, Table 4-2 shows the estimated 1-hour average exposure concentrations attributable to the proposed RTO at each maximally exposed receptor. Table 4-3 shows the estimated annual-average exposure concentrations attributable to the proposed RTO at each maximally exposed receptor.

The 1-hour average HCl concentrations at the MIBR (B-1), MIRR (R-1), MICR (C-1), and MIIR (I-1) are shown on Figure 4-1. For a 1-hour time-weighted average, the MIBR was identified as an onsite receptor located along the edge of the adjacent agricultural field. As shown on Figure 4-1, the maximum 1-hour average HCl concentrations are significantly less than the CalEPA OEHHA REL of 2,100 $\mu g/m^3$ for acute HCl exposure.

The annual-average HCl concentrations at the MIBR (B-2), MIRR (R-2), MICR (C-1), and MIIR (I-1) are shown on Figure 4-2. For an annual time-weighted average, the MIBR was identified as a receptor located on Dietrich Road approximately 246 ft (75 m) northeast of the proposed RTO. As shown on Figure 4-2, the maximum annual-average HCl concentrations are below the CalEPA OEHHA REL of 9 $\mu g/m^3$ for chronic HCl exposure. However, plans to install a fence with a gate across Dietrich Road to the east-southeast of the RTO will restrict public access to the MIBR. Therefore, the MIBR annual average impacts presented in this report are conservatively high.

The 24-hour average HCl impacts were modeled and are presented on Figure 4-3. Figure 4-3 is color-coded according to the estimated average HCl concentrations attributable solely to emissions from the proposed RTO. Note, there are no relevant health-based criteria to compare with the 24-hour average impacts. The 24-hour average HCl impacts are shown because the ASIL for HCl is based on a 24-hour averaging period.

4.3.4 EXPOSURE FREQUENCY AND DURATION

The likelihood that someone would be exposed to HCl from the proposed RTO at the Site depends on local wind patterns and how much time people spend in the immediate area. As discussed previously, the air dispersion model uses emission and meteorological information (and other assumptions) to determine ambient HCl concentrations in the vicinity of the proposed RTO.

This analysis considers the land use surrounding the proposed RTO to estimate the amount of time a given receptor could be exposed. For example, people are more likely to be exposed frequently and for a longer duration at the source impacts residential locations because people spend much of their time at home. People working at industrial or commercial properties in the area are likely exposed to project-related emissions only during the hours that they spend working near the facility.

This analysis uses simplified assumptions about receptors' exposure frequency and duration and assumes that people located at residential, institutional, industrial, and boundary receptors are potentially continuously exposed, meaning they never leave their property. These behaviors are not realistic; however, these assumptions are intended to simplify the assessment while avoiding underestimating exposure so that public health protection is ensured.

The maximum 1-hour and annual-average HCl concentrations at all receptors were less than the respective RELs. Therefore, no exposure frequency analysis was conducted for the 1-hour and annual averaging periods.

As shown on Figure 4-3, HCl 24-hour average concentrations are estimated to be above the ASIL at the MICR. HCl impacts above the ASIL are not expected at the MIRR or the MIIR. AERMOD Threshold Violation output files were analyzed to determine the frequency of occurrence for 24-hour average HCl impacts above the ASIL at the MICR and MIBR. Based on the modeling results, the frequency of occurrence for impacts above the 24-hour ASIL at the MICR are 1 day out of the 5 years of meteorological data (0.05 percent occurrence rate). Additionally, the frequency of occurrence for impacts above the 24-hour ASIL at the MIBR is 8 days out of the 5 years of meteorological data (0.4 percent occurrence rate). The receptor with the greatest frequency of occurrence is located approximately 260 ft northeast of the RTO along Dietrich Road with a frequency of occurrence of 527 days out of the 5 years of meteorological data (29 percent occurrence rate). However, plans to install a fence with a gate across Dietrich Road to the east-southeast of the RTO will restrict public access to this receptor. Therefore, the greatest frequency of occurrence presented for this receptor grid is conservatively high. The ASIL was developed as a regulatory screening value, not a health-based criterion; therefore, 24-hour HCl concentrations above the ASIL will not necessarily result in adverse health impacts.

4.3.5 BACKGROUND EXPOSURE TO POLLUTANTS OF CONCERN

WAC 173-460-090 states, "Background concentrations of TAPs will be considered as part of a second-tier review." The word "background" is often used to describe exposures to chemicals that come from existing sources, or sources other than those being assessed.

There are no significant local background HCl or HF emissions within the vicinity of the Site. The regional background concentration of HCl (0.07 $\mu g/m^3$) used for this analysis was obtained from the U.S. EPA's National Air Toxics Assessment database and is specific to the census tract for the Site (EPA website 2011).

4.3.6 CUMULATIVE EXPOSURE TO HYDROGEN CHLORIDE

Tables 4-4 and 4-5 show the calculated cumulative HCl concentrations at the MIBR, MICR, MIRR, and the MIIR based on allowable project emissions. As shown in Tables 4-2 and 4-4, the predicted MIBR for acute exposure (1-hour average) is approximately 160 ft southwest of the proposed RTO site with an estimated cumulative (post-project) HCl concentration of 194 $\mu g/m^3$. As shown in Tables 4-3 and 4-5, the predicted MIBR for chronic exposure (annual-average) is approximately 230 ft northeast of the proposed RTO site with an estimated cumulative (post-project) HCl concentration of 8.7 $\mu g/m^3$. However, plans to install a fence with a gate across Dietrich Road to the east-southeast of the RTO will restrict public access to the MIBR for a chronic exposure scenario. Therefore, the MIBR annual-average impacts presented in this report are conservatively high. The MIBR for both exposure durations are predicted to occur within the Site boundary. The acute and chronic exposure concentrations for all receptors are below the RELs for HCl.

4.4 RISK CHARACTERIZATION

Risk characterization involves the integration of data analyses from each step of the HIA to determine the likelihood that the human population in question will experience any of the various health effects associated with a chemical under its known or anticipated conditions of exposure.

4.4.1 EVALUATING NON-CANCER HAZARDS

In order to evaluate the potential for non-cancer health effects that may result from exposure to HCl, exposure concentrations at each receptor location were compared to relevant non-cancer toxicological values (i.e., RfC, REL). If a concentration exceeds the RfC or REL, this indicates only the potential for health effects. The magnitude of this potential can be inferred from the degree to which this value is exceeded. This comparison is known as a hazard quotient (HQ) and is given by the equation:

$$HQ = \frac{\text{Concentration of pollutant in air } (\mu g/m^3)}{\text{RfC or REL}}$$

An HQ of 1 or less indicates that the exposure to a substance is not likely to result in non-cancer health effects. As the HQ increases above 1, the potential of adverse human health effects increases by an undefined amount. However, it should be noted that an HQ above 1 would not necessarily result in health impacts due to the application of highly conservative uncertainty factors in deriving toxicological reference values (i.e., RfC and REL).

4.4.1.1 Hazard Quotient – Hydrogen Chloride

The HQs for HCl concentration exposure were calculated using the CalEPA OEHHA chronic and acute RELs:

$$HQ = \frac{\text{Annual average HCl concentration } (\mu g/m^3)}{\text{Chronic REL } (\mu g/m^3)} \quad \text{(or)}$$

$$= \frac{\text{1-Hour average HCl concentration } (\mu g/m^3)}{\text{Acute REL } (\mu g/m^3)}$$

HQs were calculated for the maximally exposed residential, workplace, boundary, and sensitive receptors. Because chronic toxicity values (RfCs and RELs) are based on continuous exposure, an adjustment is sometimes necessary or appropriate to account for shorter receptor exposure periods (e.g., people working at business/commercial properties who are exposed for only 8 hours per day, 5 days per week). While U.S. EPA risk assessment guidance recommends adjusting to account for periodic instead of continuous exposure, OEHHA does not employ this practice. For the purpose of this evaluation, both the acute REL of 2,100 $\mu g/m^3$ and the chronic REL of 9 $\mu g/m^3$ were used as the risk-based concentration for all scenarios where receptors might be exposed (e.g., residence, work place, or boundary receptors). A summary of toxicological values used in this analysis are summarized in Table 4-6.

Table 4-7 shows the corresponding HQs attributable to HCl exposure at each identified maximally exposed receptor near the Site. As shown in Table 4-7, HQs are less than 1 at all residential, institutional/sensitive, industrial/commercial, and boundary receptors. The maximum HQ resulting from RTO operation is 0.98 at the MIBR based on an annual average HCl impact. However, plans to install a fence with a gate across Dietrich Road to the east-southeast of the RTO will restrict public access to the MIBR. Therefore, the HQ presented for the MIBR is conservatively high. It may be concluded, therefore, that non-cancer effects are not likely to result from acute or chronic exposure to HCl by the estimated project emissions.

4.4.1.2 Combined Hazard Index for Acid Gas Compounds

The maximum calculated HF emission rate for the proposed RTO exceeds the SQER and, therefore, has the potential to cause ambient concentrations high enough to cause acute non-cancer inhalation health risks that are additive to inhalation health risks associated with HCl. Table 4-8 presents the maximum 1-hour average HF concentrations at the MIBR, MICR, MIRR, and MIIR. HF concentrations were derived using a dispersion factor[2] that was calculated based on the 1-hour average results for HCl.

Table 4-9 presents modeled concentrations, RELs, and HQs for each maximally impacted receptor type. The acute hazard index (HI) for each location is the sum of acute HQs for HCl and HF. As shown in Table 4-9, the acute HIs at the MIBR, MICR, MIRR, and MIIR are much lower than 1.0. This indicates that the MIBR, MICR, MIRR, and MIIR are not likely to experience acute non-cancer adverse health effects attributable to emissions from the RTO.

The information in Table 4-9 suggests that acute health effects are unlikely to occur even under worst-case conditions at the maximally impacted locations. Even during times when unfavorable air dispersion conditions occur coincident with a maximum emission rate, the combined HQs (i.e., the hazard index) from HF and HCl are modeled to be much less than 1. If the HI is less than 1, then the risk is considered acceptable.

[2] When stack parameters (i.e., exhaust exit velocity and temperature and stack diameter and height) and meteorological inputs in an air dispersion model remain unchanged, changes to the maximum modeled ambient concentrations for non-reactive compounds are directly proportional to changes to the emission rate input for a specific time-weighted average. Therefore, a dispersion factor was calculated (based on the 1-hour average HCl model) to estimate HF concentrations at the MIBR, MICR, MIRR, and MIIR.

5.0 UNCERTAINTY CHARACTERIZATION

Many factors of the HIA are prone to uncertainty. Uncertainty relates to the lack of exact knowledge regarding some of the assumptions used to estimate the human health impacts of HCl emissions from the proposed project and background sources of HCl. The assumptions used given uncertainty may either overestimate or underestimate the health risks in the HIA.

5.1 EMISSION RATES AND EXPOSURE DURATION UNCERTAINTY

Two major uncertainties in this analysis are the calculation of emission rates for TAPs by the RTO and the assumed exposure duration. Both the emission rates and the exposure duration are likely overestimated.

The forecasted long-term emission rates for the RTO used for this analysis were calculated based on the highest instantaneous VOC concentrations observed at the Site to date (43,835 micrograms per liter of total VOCs). Since concentrations at or near that level have not since been observed in the SVE system influent, this approach provides an extremely conservative estimate of long-term VOC influent concentrations to the RTO. Additionally, the forecast RTO emission rates were calculated assuming the maximum influent flow rate capacity to the RTO (i.e., 1,000 scfm). The use of extremely conservative VOC influent concentrations to the RTO, along with the assumption of a maximum allowable influent flow rate for 24 hours per day, 365 days per year, results in overestimated emission rates.

It is difficult to characterize the amount of time that people could reasonably be exposed to HCl emissions from the proposed RTO. For simplicity, this analysis assumed that residential, industrial, and boundary receptors could potentially be present 24 hours per day, 365 days per year. These assumptions also overestimate exposure, particularly with respect to the boundary and industrial receptors. Flow to the RTO will be managed at steady levels below the calculated assumptions.

5.2 AIR DISPERSION MODELING UNCERTAINTY

The transport of pollutants through the air is a complex process. Regulatory air dispersion models have been developed to estimate the transport and dispersion of pollutants as they travel through the air. The models are frequently updated as techniques that are more accurate become known, but are developed to avoid underestimating the modeled impacts. Even if all of the numerous input parameters to an air dispersion model are known, random effects found in the real atmosphere will introduce uncertainty. Typical of the class of modern steady-state Gaussian dispersion models, the AERMOD model used for the Site analysis approximates but will likely slightly overestimate the short-term (1-hour and 24-hour average) impacts and somewhat underestimate the annual pollutant concentrations.

Accordingly, the expected magnitude of the dispersion modeling uncertainty is likely much lower than the emission rate and toxicity uncertainty.

5.3 TOXICITY UNCERTAINTY

One of the largest sources of uncertainty in any risk evaluation is associated with the scientific community's limited understanding of the toxicity of most chemicals in humans following exposure to the low concentrations generally encountered in the open environment. To account for uncertainty when developing toxicity values (in this case RfCs and RELs), the U.S. EPA and other agencies apply "uncertainty" factors to doses or concentrations that were observed to cause non-cancer effects in animals or humans. The U.S. EPA applies these uncertainty factors so that it derives a toxicity value that is considered protective of humans including susceptible populations. In the case of the chronic REL, the CalEPA OEHHA acknowledges (CalEPA website 2000):

> U.S. EPA evaluated this RfC as having a low level of confidence because of (1) the use of only one dose; (2) limited toxicity evaluation; (3) the lack of reproductive toxicity data; and (4) the lack of chronic exposure studies. OEHHA agrees with this assessment. The database for chronic exposure to this common chemical is limited.

Table 5-1 presents a summary of how the uncertainty affects the quantitative estimate of risks or hazards.

6.0 OTHER CONSIDERATIONS

6.1 EXPOSURE TO OTHER TOXIC AIR POLLUTANTS

The potential impacts of other TAPs (with the exception of HCl and HF) have not been evaluated because the ambient concentrations for those compounds will not exceed the ASILs. Additionally, the potential toxic effects of other TAPs (with the exception of HF) are not additive to the toxic effects associated with HCl exposure. Therefore, because only HCl impacts from the project exceeded the ASIL and based on guidance from Ecology, no further review is required for other TAPs (Kadlec, M., 2014, personal communication).

7.0 DISCUSSION OF ACCEPTABILITY OF RISK WITH REGARD TO SECOND-TIER REVIEW GUIDELINES

As described previously, the maximum HQ or HI related to RTO operation at any maximally impacted receptor is 0.98. Because all HIs and HQs are below 1, it may be concluded that unacceptable health effects are not anticipated as a result of the proposed RTO operation.

The analysis presented herein is very conservative and uses worst-case assumptions for mass loading and HCl and HF emissions. Additionally, the emissions presented and the potential exposures are overestimated to provide a very conservative assessment of potential health impacts, consistent with standard HIA practices.

8.0 USE OF THIS REPORT

This Second-Tier Health Impact Assessment has been prepared for the exclusive use of the IWAG and applicable regulatory agencies for specific application to the proposed RTO installation at the Site in Pasco, Washington. The reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

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MWB/JMW/ccy

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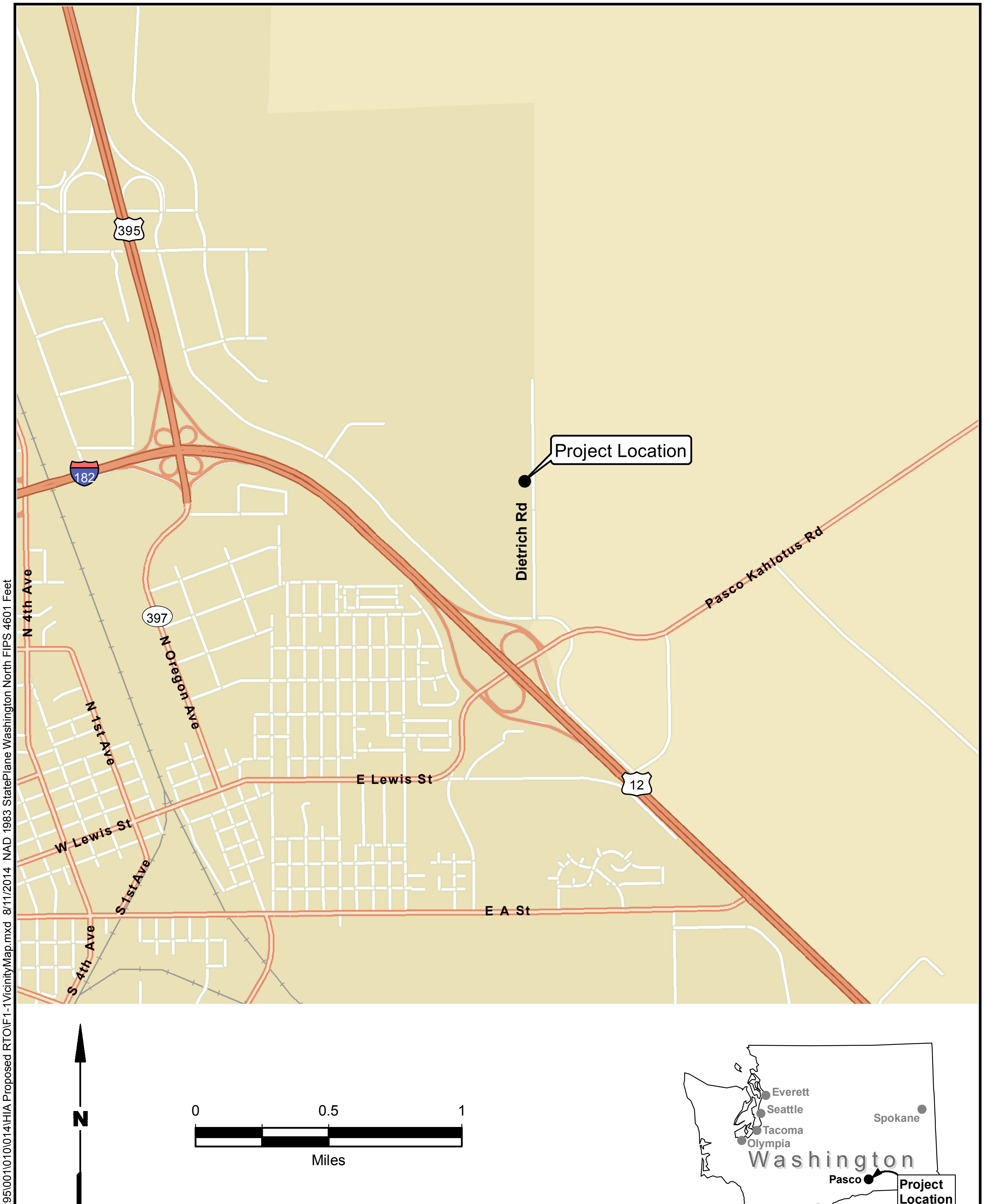

Data Source: Esri 2012

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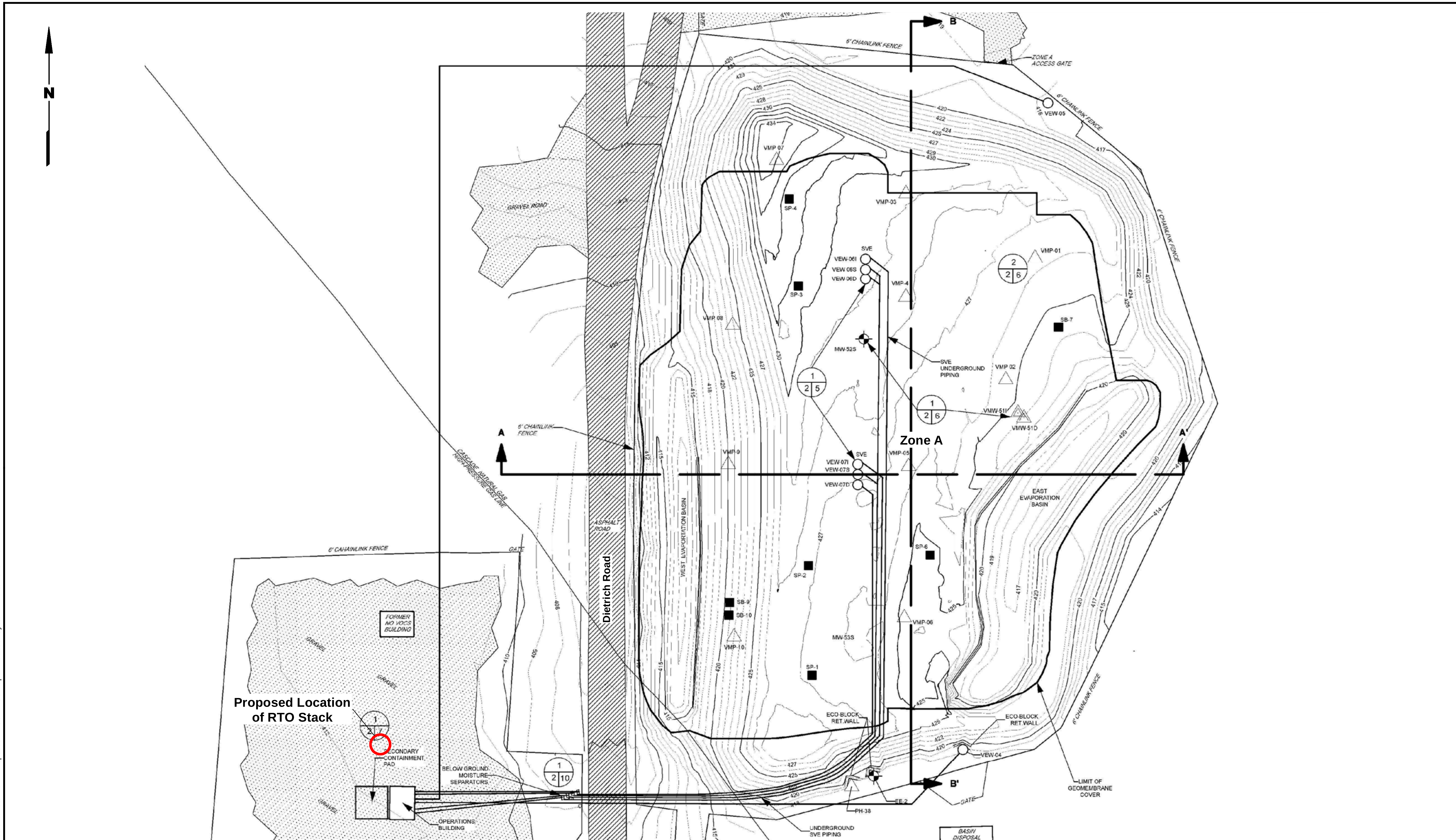
Pasco Sanitary Landfill Pasco, Washington	**Vicinity Map**	Figure 1-1



Data Source: Environmental Partners Inc.

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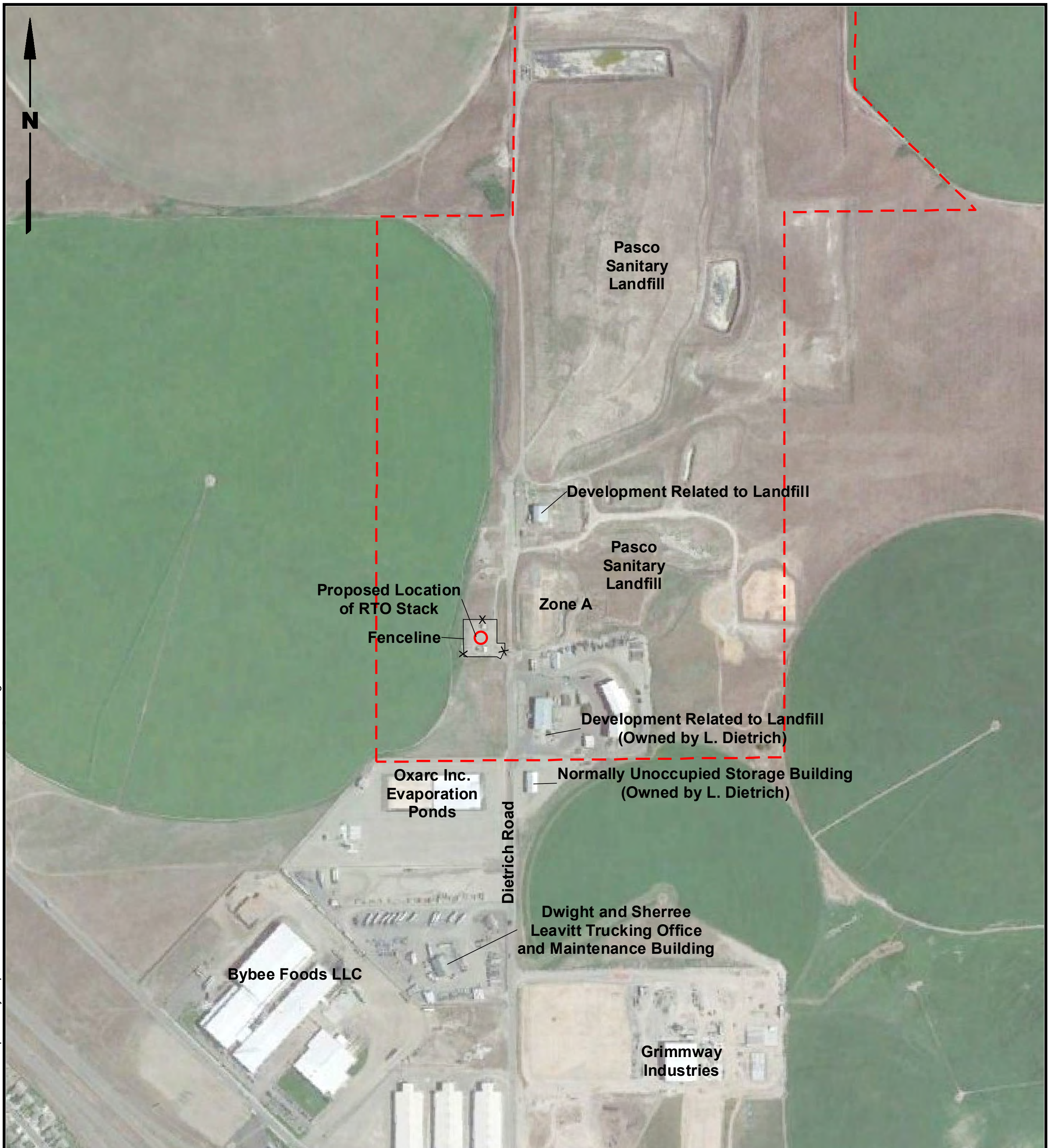
Pasco Sanitary Landfill Pasco, Washington	**Soil Vapor Extraction System**	Figure 1-2



Legend

- Proposed Location of RTO Stack
- Fenceline
- Pasco Sanitary Landfill Boundary

0 700 1,400

Scale in Feet

Note

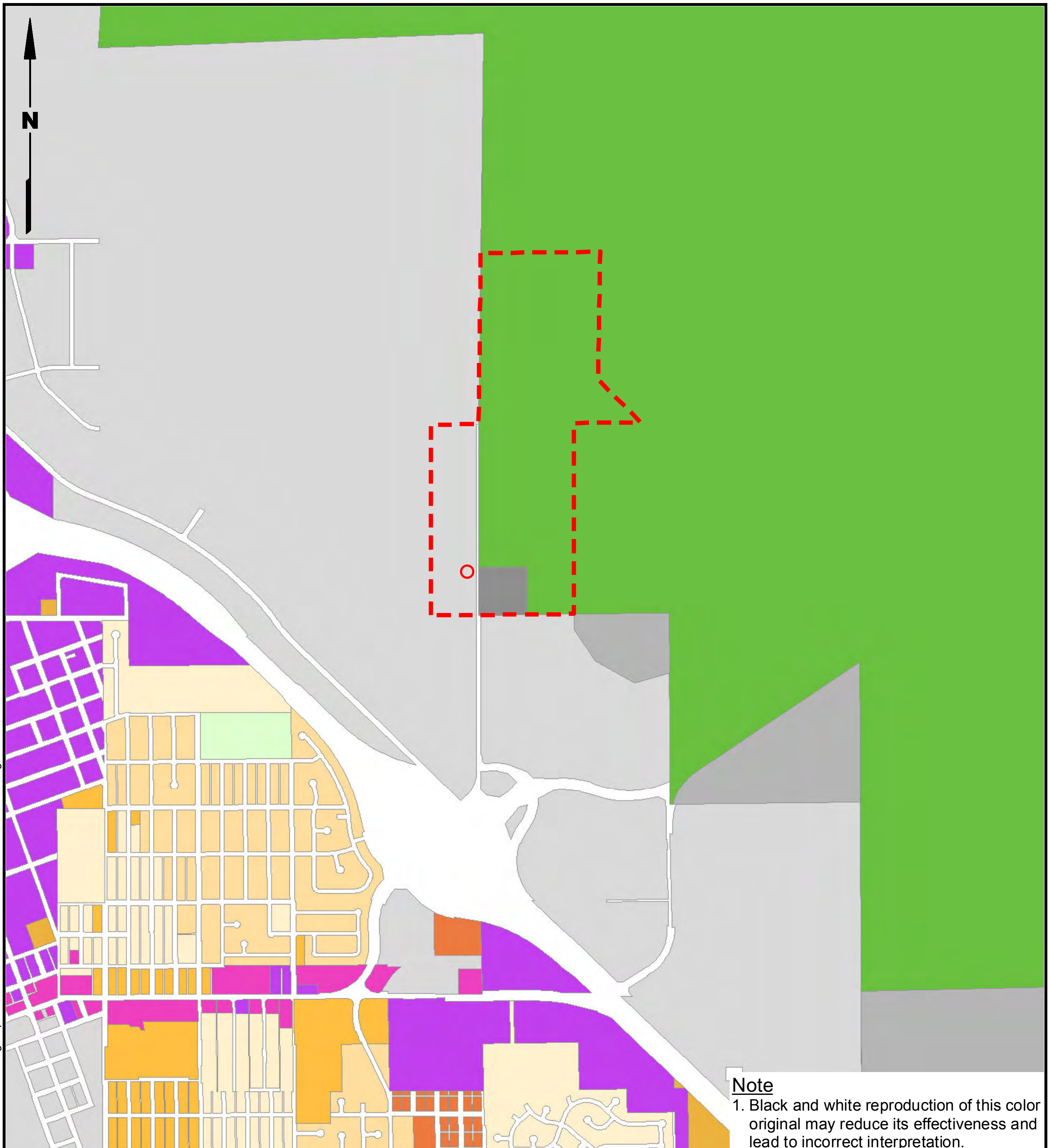
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Franklin County GIS; 2014 Google © USGS.

G:\Projects\1295\001\010\014\HIA Proposed RTO\F2-1 SiteMapNearbyProperties.mxd 8/25/2014 NAD 1983 StatePlane Washington South FIPS 4602 Feet

Landau Associates

Pasco Sanitary Landfill Pasco, Washington	**Site Map and Nearby Properties**	Figure 2-1



Note
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Legend

Zoning
- AP-20 Agricultural Production
- C-1 Retail Business
- C-3 General Business
- I-1 Light Industrial
- I-2 General Industrial Zone
- I-3 Heavy Industrial
- R-1 Low Density Residential
- R-1-A Low Density Residential Alternate
- R-2 Medium Density Residential
- R-3 Medium Density Residential
- RP Residential Park
- RT Residential Transition

- Pasco Sanitary Landfill Boundary
- Proposed Location of RTO Stack

0 2,000 4,000
Scale in Feet

Data Sources: City of Pasco GIS; Franklin County GIS.

G:\Projects\1295\001\010\014\HIA Proposed RTO\F2-2ZoningMap.mxd 8/25/2014 NAD 1983 StatePlane Washington South FIPS 4602 Feet

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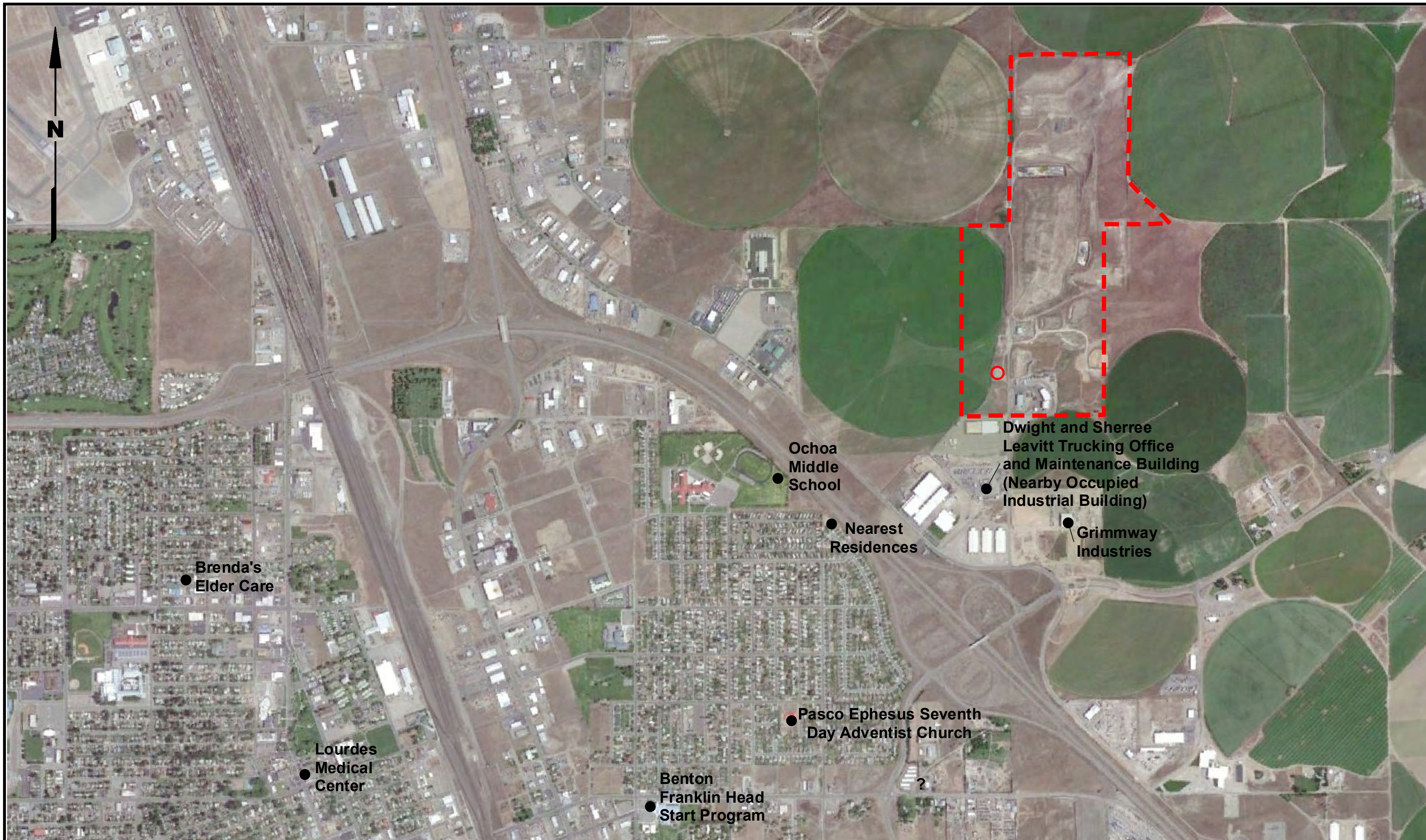
Pasco Sanitary Landfill
Pasco, Washington

Zoning Map

Figure 2-2

G:\Projects\1295\001\010\014\HIA Proposed RTO\F2-3SensitiveReceptors.mxd 8/25/2014 NAD 1983 StatePlane Washington South FIPS 4602 Feet



Legend

- Sensitive Receptors
- Proposed Location of RTO Stack
- Pasco Sanitary Landfill Boundary

0 2,000 4,000
Scale in Feet

Data Source: 2014 Google © USGS.

Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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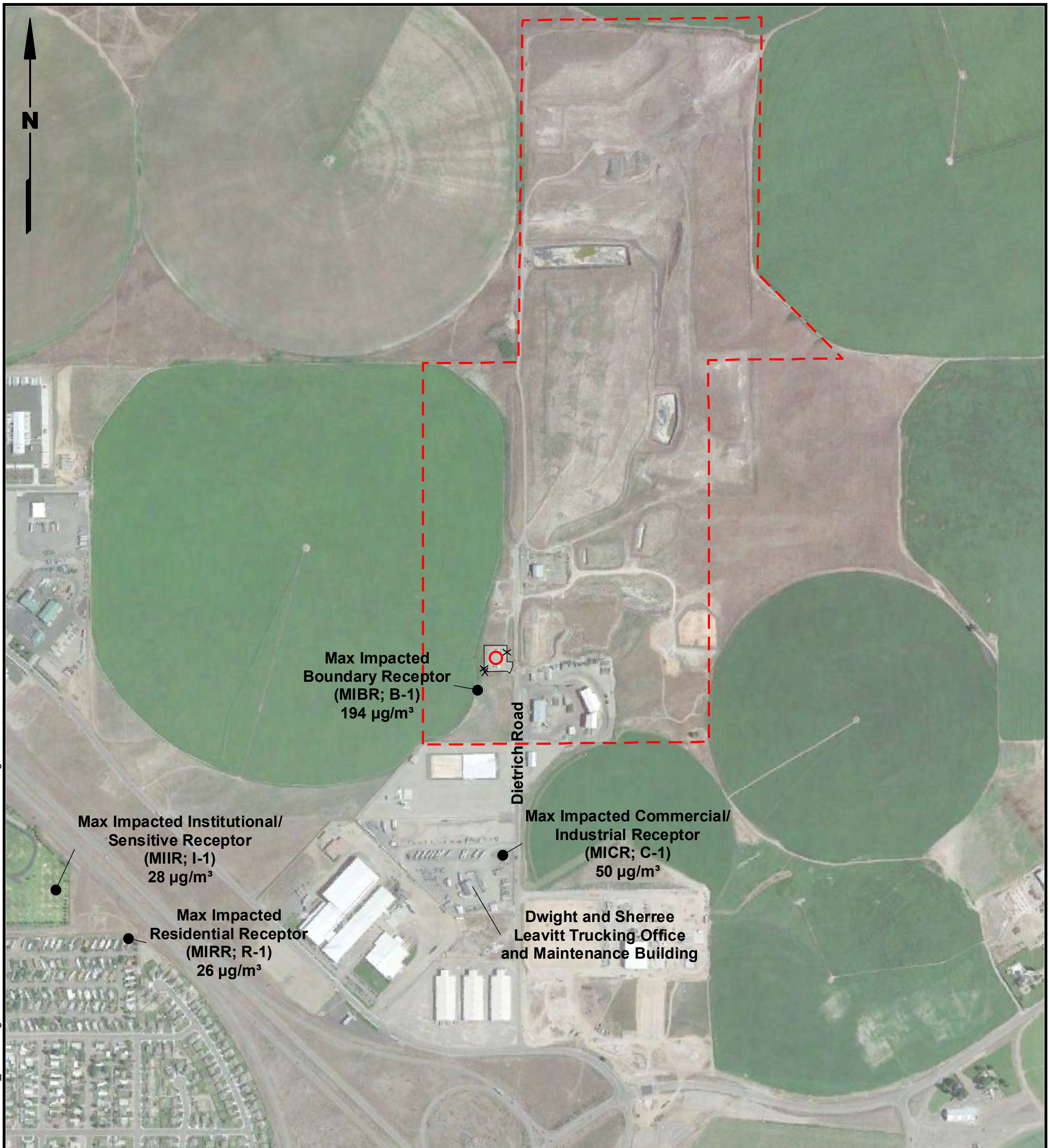
Pasco Sanitary Landfill
Pasco, Washington

Sensitive Receptors

Figure
2-3



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Legend

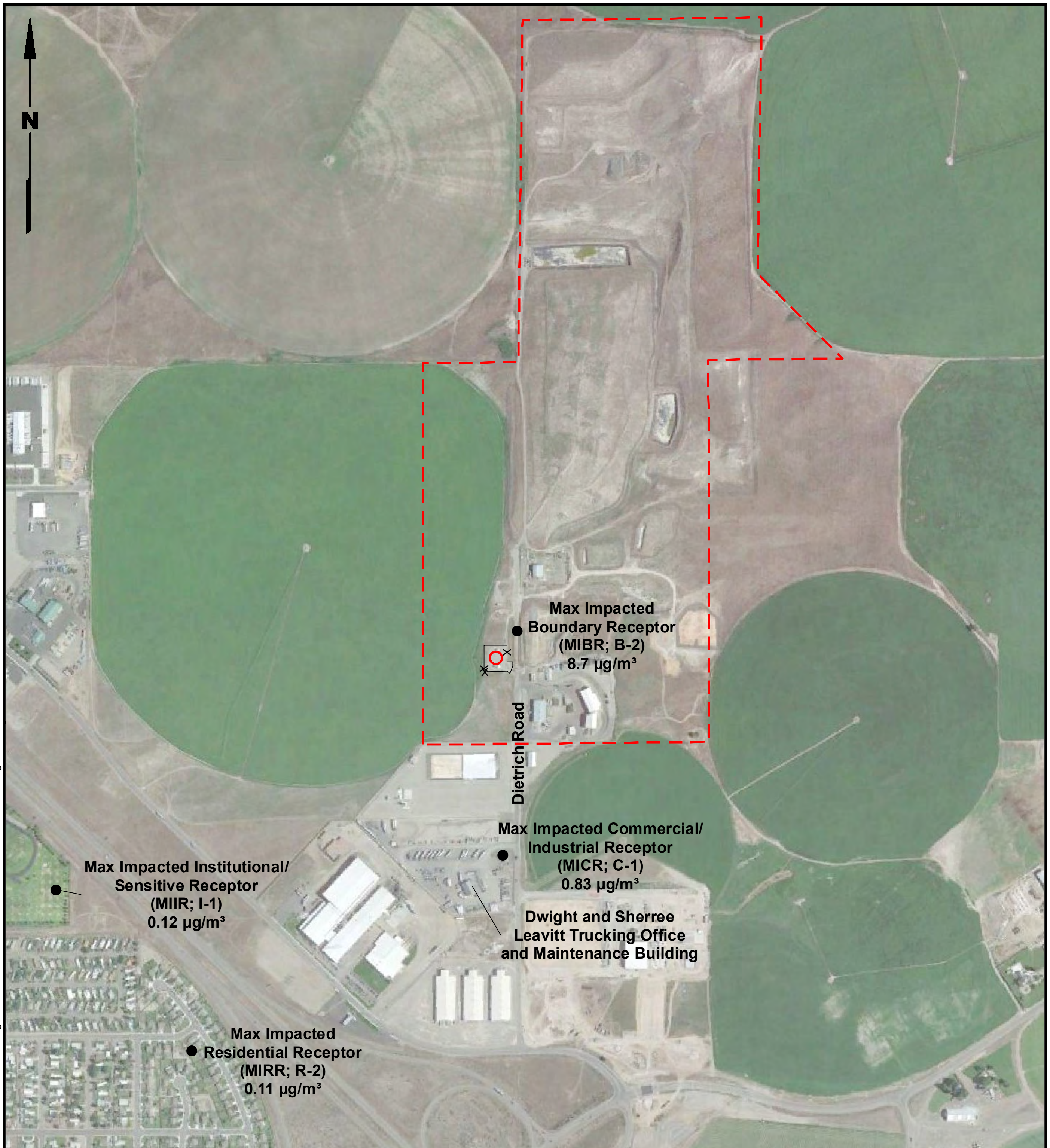
- Sensitive Receptors
- Proposed Location of RTO Stack
- Fenceline
- Pasco Sanitary Landfill Boundary

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Franklin County GIS; 2014 Google © USGS.

Landau Associates	Pasco Sanitary Landfill Pasco, Washington	**1-Hour Average HCl Concentrations Caused by Emissions from RTO**	Figure 4-1



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Legend

- Sensitive Receptors
- Proposed Location of RTO Stack
- Fenceline
- Pasco Sanitary Landfill Boundary

0 1,000 2,000

Scale in Feet

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Data Sources: Franklin County GIS; 2014 Google © USGS.

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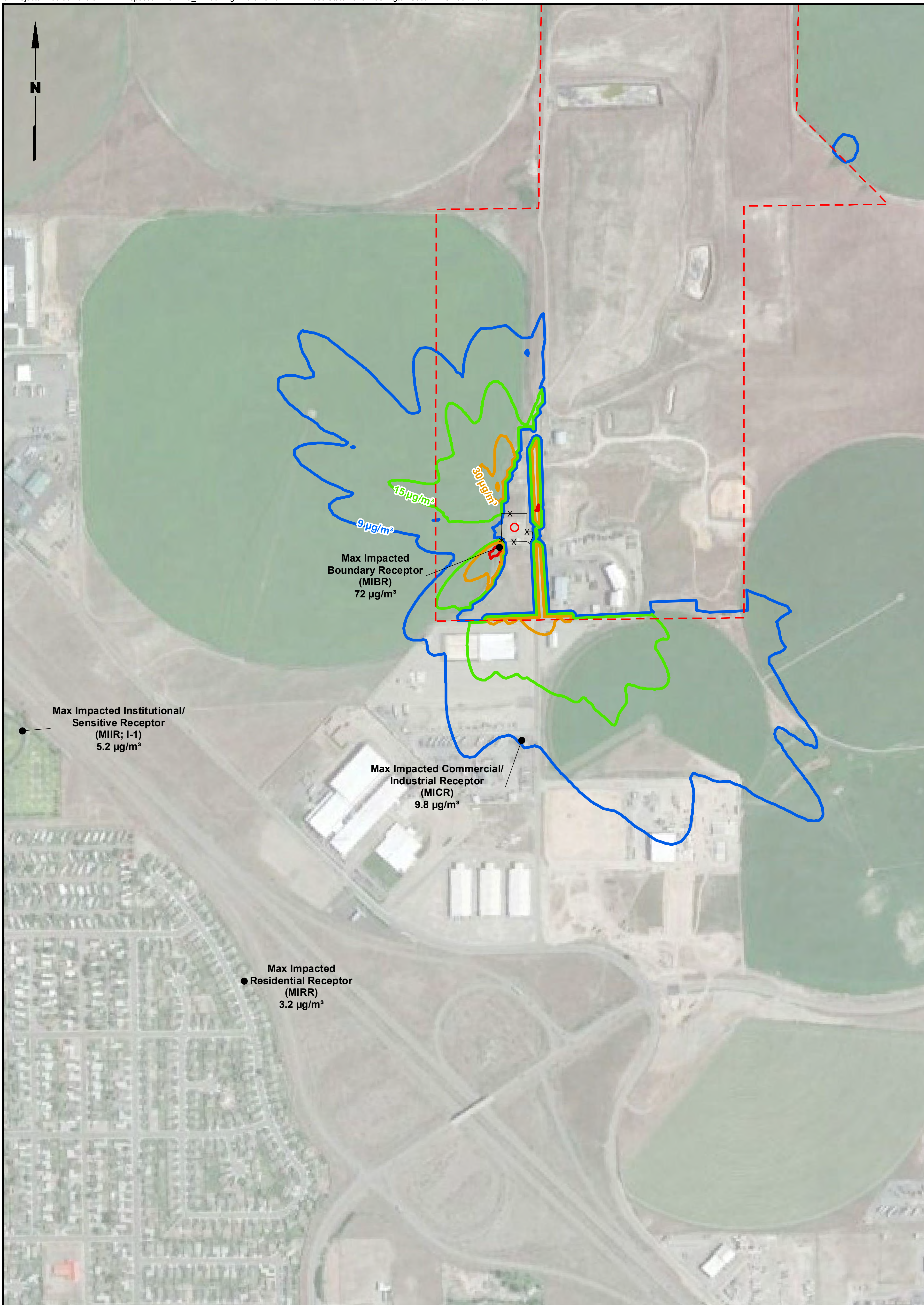
Pasco Sanitary Landfill Pasco, Washington	**Annual Average HCl Concentrations Caused by Emissions from RTO**	Figure 4-2

G:\Projects\1295\001\010\014\HIA Proposed RTO\F4-3_24HourAvg.mxd 8/25/2014 NAD 1983 StatePlane Washington South FIPS 4602 Feet



Legend

- Sensitive Receptors
- Proposed Location of RTO Stack
- Fenceline
- Pasco Sanitary Landfill Boundary

HCl Concentrations

- 9 µg/m³
- 15 µg/m³
- 30 µg/m³
- 60 µg/m³

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 600 1,200

Scale in Feet

Data Sources: Franklin County GIS; 2014 Google © USGS.

Landau Associates

Pasco Sanitary Landfill Pasco, Washington	24-Hour Average HCl Concentrations Caused by Emissions from RTO	Figure 4-3

TABLE 2-1
EMISSION RATES
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Compound	Maximum Emission Rates (a)			
	lbs/hr	lbs/day	lbs/yr	tons/yr
Criteria Pollutants				
PM (Total)	0.29	6.8	2,500	1.25
PM_{10}	0.17	4.1	1,500	0.75
$PM_{2.5}$	0.11	2.7	1,000	0.50
Nitrogen Oxides (NO_x)	0.46	11	4,000	2.0
Carbon Monoxide (CO)	50	1210	10,000	5.0
Volatile Organic Compounds (VOCs)	7	158	57,645	29
Sulfur Dioxide (SO_2)	1.5	35	4,000	2.0
Toxic Air Pollutants				
1,1,1-Trichloroethane	5.5	131	47,815	24
1,1-Dichloroethane	0.014	0.33	120	0.06
1,1-Dichloroethene	1.1	26.3	9,600	4.8
1,2-Dichloroethane	0.0082	0.20	72	0.036
1,2-Dichloropropane	0.0022	0.053	19.2	0.0096
1,4-Dichlorobenzene	0.0020	0.048	17.4	0.0087
2-butanone (MEK)	27.4	657	239,805	120
4-Methyl-2-pentanone (MIBK)	16.4	394	143,810	71.9
Acetaldehyde	0.0081	0.195	71	0.036
Acrolein	0.00033	0.0079	2.9	0.00144
Benzene	0.0035	0.080	29	0.015
Carbon disulfide	4.4	105	38,325	19.2
Chlorobenzene	5.5	131	47,815	23.9
Chloroform	0.000953	0.023	8.4	0.0042
Ethylbenzene	0.085	2.0	725	0.36
Formaldehyde	0.0037	0.088	32	0.016
Hexane	3.8	92	33,580	16.8
Isopropylbenzene	2.2	53	19,199	9.6
m,p-Xylene	1.2	29	10,585	5.3
Methylene chloride	0.12	2.9	1,077	0.54
Naphthalene	0.00064	0.015	5.6	0.00282
Nitrogen Dioxide (NO_2)	1.03	24.7	9,023	4.5
o-Xylene	1.2	29	10,585	5.3
Propylene	16.4	394	143,810	72
Tetrachloroethene	0.0037	0.089	32	0.0162
Toluene	27.4	657	239,805	120
Total Xylenes	1.2	29	10,585	5.3
trans-1,2-Dichloroethene	4.4	106	38,690	19.3
Trichloroethene	0.075	1.8	660	0.33
Vinyl chloride	0.00076	0.018	6.7	0.0034
Hydrogen chloride (HCl)	4.9	118	43,117	22
Hydrogen fluoride (HF)	0.25	5.9	2,148	1.1

Notes:

PM = Particulate matter

(a) Maximum emission rates are equal to the emission limits proposed in Table 9 of *Revised Notice of Construction Application Supporting Information Report, Pasco Sanitary Landfill, Pasco, Washington* (Landau Associates 2014).

TABLE 2-2
GENERAL LAND USE ZONES NEAR THE PROPOSED PROJECT
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Direction From Proposed Location of RTO	Zoning (from Pasco and Franklin County Zoning Maps)	Notable Development
North	Franklin County Agriculture (AP-20); Pasco Light Industrial (I-1)	Agricultural; landfill-related uses
East	Franklin County AP-20	Agricultural; landfill-related uses
West	Pasco I-1, then Pasco General Business (C-3)	Agricultural, then commercial
South	Pasco I-1, then Pasco C-3, Low Density Residential (R-1), Medium Density Residential (R-2), High Density Residential (R-4), Low Density Residential Alternative (R-1-A), Retail Business (C-1), Residential Transition (RT), and Residential Park (R-P).	Industrial, then residential and commercial

RTO = Regenerative thermal oxidizer

TABLE 3-1
EMISSION-BASED EXEMPTION EVALUATION
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Pollutant	Maximum Emission Rates (a)			TAP SQER (b)	
	lbs/hr	lbs/day	lbs/yr		
Carbon Monoxide (CO)	50	1210	10,000	50.4	lbs/hr
Sulfur Dioxide (SO_2)	1.5	35	4,000	1.45	lbs/hr
1,1,1-Trichloroethane	5.5	131	47,815	131	lbs/day
1,1-Dichloroethane	0.014	0.33	120	120	lbs/yr
1,1-Dichloroethene	1.1	26.3	9,600	26.3	lbs/day
1,2-Dichloroethane	0.0082	0.20	72	7.39	lbs/yr
1,2-Dichloropropane	0.0022	0.053	19.2	19.2	lbs/yr
1,4-Dichlorobenzene	0.0020	0.048	17.4	17.4	lbs/yr
2-butanone (MEK)	27.4	657	239,805	657	lbs/day
4-Methyl-2-pentanone (MIBK)	16.4	394	143,810	394	lbs/day
Acetaldehyde	0.0081	0.195	71	71	lbs/yr
Acrolein	0.00033	0.0079	2.9	0.00789	lbs/day
Benzene	0.0035	0.080	29	6.62	lbs/yr
Carbon disulfide	4.4	105	38,325	105	lbs/day
Chlorobenzene	5.5	131	47,815	131	lbs/day
Chloroform	0.000953	0.023	8.4	8.35	lbs/yr
Ethylbenzene	0.085	2.0	725	76.8	lbs/yr
Formaldehyde	0.0037	0.088	32	32	lbs/yr
Hexane	3.8	92	33,580	92	lbs/day
Isopropylbenzene	2.2	53	19,199	52.6	lbs/day
m,p-Xylene	1.2	29	10,585	29	lbs/day
Methylene chloride	0.12	2.9	1,077	192	lbs/yr
Naphthalene	0.00064	0.015	5.6	5.64	lbs/yr
Nitrogen Dioxide (NO_2)	1.03	24.7	9,023	1.03	lbs/hr
o-Xylene	1.2	29	10,585	29	lbs/day
Propylene	16.4	394	143,810	394	lbs/day
Tetrachloroethene	0.0037	0.089	32	32.4	lbs/yr
Toluene	27.4	657	239,805	657	lbs/day
Total Xylenes	1.2	29	10,585	29	lbs/day
trans-1,2-Dichloroethene	4.4	106	38,690	106	lbs/day
Trichloroethene	0.075	1.8	660	95.6	lbs/yr
Vinyl chloride	0.00076	0.018	6.7	2.46	lbs/yr
Hydrogen chloride (HCl)	4.9	118	43,117	1.18	lbs/day
Hydrogen fluoride (HF)	0.25	5.9	2,148	1.84	lbs/day

Notes:
Cells formatted with highlighting indicate exceedance of an SQER.

(a) Maximum emission rates are equal to the emission limits proposed in Table 9 of *Revised Notice of Construction Application Supporting Information Report, Pasco Sanitary Landfill, Pasco, Washington* (Landau Associates 2014).
(b) Washington Small-Quantity Emission Rate as presented in WAC 173-460-150

TABLE 3-2
FIRST-TIER AMBIENT IMPACT ASSESSMENT FOR TOXIC AIR POLLUTANTS
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Toxic Air Pollutant	ASIL (µg/m^3)	Averaging Period	1st-Highest Ambient Concentration (µg/m^3)(a)
Hydrogen Chloride (HCl)	9	24-hour average	90 (using NOC application receptor grid) 72 (using refined receptor grid)
Hydrogen Fluoride (HF)	14	24-hour average	2.2 (using NOC application receptor grid) 1.8 (using refined receptor grid)
Benzene	0.0345	Annual average	0.0064
1,2-Dichloroethane	0.0385	Annual average	0.016
Ethylbenzene	0.4	Annual average	0.16
Methylene Chloride	1	Annual average	0.24
Trichloroethene	0.5	Annual average	0.15
Vinyl Chloride	0.0128	Annual average	0.0015

Notes:

ASIL = Acceptable Source Impact Level
µg/m^3 = Micrograms per cubic meter
NOC = Notice of Construction

(a) The 1st highest ambient concentration presented for HF using a refined receptor grid was calculated using a dispersion factor based on the results of the HCl model that was completed using a refined receptor grid. The HF ambient impact was calculated as follows: 1.8 µg/m^3 (Refined HF ambient impact)= 0.12 lbs/hr (HF emission rate) × 72 µg/m^3(Refined HCl ambient impact) ÷ 4.91 lbs/hr (HCl emission rate).

TABLE 4-1
CALIFORNIA'S AIR TOXICS HOTSPOTS RISK ASSESSMENT GUIDANCE ON SPECIFIC PATHWAYS TO BE ANALYZED FOR EACH MULTI-PATHWAY SUBSTANCE SOURCE IMPACT LEVEL COMPLIANCE AT FACILITY BOUNDARY
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

	Ingestion Pathway									
Substance	**Soil**	**Dermal**	**Meat, Milk & Egg**	**Fish**	**Exposed Vegetable**	**Leafy Vegetable**	**Protected Vegetable**	**Root Vegetable**	**Water**	**Breast Milk**
4,4'-Methylene dianiline	X	X		X	X	X	X	X	X	
Creosotes	X	X	X	X	X	X			X	
Diethylhexylphthalate	X	X		X	X	X	X	X	X	
Hexachlorocyclohexanes	X	X		X	X	X			X	
PAHs	X	X	X	X	X	X			X	
PCBs	X	X	X	X	X	X	X	X	X	X
Cadmium & compounds	X	X	X	X	X	X	X	X	X	
Chromium VI & compounds	X	X	X	X	X	X	X	X	X	
Inorganic arsenic & compounds	X	X	X	X	X	X	X	X	X	
Beryllium & compounds	X	X	X	X	X	X	X	X	X	
Lead & compounds	X	X	X	X	X	X	X	X	X	
Mercury & compounds	X	X		X	X	X	X	X	X	
Nickel	X	X	X		X	X	X	X	X	
Fluorides (including hydrogen fluoride)	To be determined									
Dioxins & furans	X	X	X	X	X	X	X		X	X

PAHs = Polycyclic aromatic hydrocarbons
PCBs = Polychlorinated biphenyls

TABLE 4-2
MAXIMALLY EXPOSED RECEPTORS (1-HOUR TIME-WEIGHTED AVERAGE)
HYDROGEN CHLORIDE IMPACTS ATTRIBUTABLE TO PROJECT
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Receptor Type	Direction From RTO	Estimated Distance From RTO		Coordinates (UTM)	Estimated Increase in HCl Concentration at Receptor Location from Project Only ($\mu g/m^3$)
		Feet	Meters		
Maximally Impacted Boundary Receptor (MIBR; B-1)(a)	Southwest	160	50	341524, 5123808	194
Maximally Impacted Residence (MIRR; R-1)	Southwest	3,180	970	340754, 5123298	26
Maximally Impacted Industrial/Commercial Receptor (MICR; C-1)	South	1,310	400	341554, 5123448	50
Maximally Impacted Institutional/Sensitive Receptor (MIIR; I-1)	Southwest	3,440	1,050	340604, 5123398	28

RTO = Regenerative thermal oxidizer
UTM = Universal transverse mercator
HCl = Hydrogen chloride
$\mu g/m^3$ = Micrograms per cubic meter

(a) For the purposes of this assessment, the MIBR was identified as the location with the highest HCl impact out of the following three locations: 1) highest impacted receptor within the onsite agricultural field to the west of the RTO; 2) highest impacted receptor on Dietrich Road to the east of the RTO; or 3) highest impacted receptor at or beyond the Pasco Sanitary Landfill boundary.

TABLE 4-3
MAXIMALLY EXPOSED RECEPTORS (ANNUAL TIME-WEIGHTED AVERAGE) HYDROGEN CHLORIDE IMPACTS ATTRIBUTABLE TO PROJECT
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Receptor Type	Direction From RTO	Estimated Distance From RTO		Coordinates (UTM)	Estimated Increase in HCl Concentration at Receptor Location from Project Only (μg/m^3)
		Feet	Meters		
Maximally Impacted Boundary Receptor (MIBR; B-2)(a)	Northeast	230	70	341604, 5123898	8.7
Maximally Impacted Residence (MIRR; R-2)	Southwest	3,440	1,050	340879, 5123048	0.11
Maximally Impacted Industrial/Commercial Receptor (MICR; C-1)	South	1,310	400	341554, 5123448	0.83
Maximally Impacted Institutional/Sensitive Receptor (MIIR; I-1)	Southwest	3,440	1,050	340604, 5123398	0.12

Notes:

RTO = Regenerative thermal oxidizer
UTM = Universal transverse mercator
HCl = Hydrogen chloride
μg/m^3 = Micrograms per cubic meter

(a) For the purposes of this assessment, the MIBR was identified as the location with the highest HCl impact out of the following three locations: 1) highest impacted receptor within the onsite agricultural field to the west of the RTO; 2) highest impacted receptor on Dietrich Road to the east of the RTO; or 3) highest impacted receptor at or beyond the Pasco Sanitary Landfill boundary.

TABLE 4-4
MAXIMALLY EXPOSED RECEPTORS
CUMULATIVE HYDROGEN CHLORIDE (1-HOUR AVERAGE)
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Attributable To	1-Hour Average HCl Concentration (µg/m^3) at Various Receptor Locations			
	Maximally Impacted Boundary Receptor (MIBR; B-1)	**Maximally Impacted Residential Receptor (MIRR; R-1)**	**Maximally Impacted Commercial/Industrial Receptor (MICR; C-1)**	**Maximally Impacted Institutional/Sensitive Receptor (MIIR; I-1)**
Pasco Landfill RTO	194	26	50	28
Regional Background	0.070	0.070	0.070	0.070
Cumulative (post-project)	194	26	50	28

HCl = Hydrogen chloride
µg/m^3 = Micrograms per cubic meter
RTO = Regenerative thermal oxidizer

TABLE 4-5
MAXIMALLY EXPOSED RECEPTORS
CUMULATIVE HYDROGEN CHLORIDE (ANNUAL AVERAGE)
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

	Annual Average HCl Concentration (µg/m^3) at Various Receptor Locations			
Attributable To	**Maximally Impacted Boundary Receptor (MIBR; B-2)**	**Maximally Impacted Residential Receptor (MIRR; R-2)**	**Maximally Impacted Commercial/Industrial Receptor (MICR; C-1)**	**Maximally Impacted Institutional/Sensitive Receptor (MIIR; I-1)**
Pasco Landfill RTO	8.7	0.11	0.83	0.12
Regional Background	0.070	0.070	0.070	0.070
Cumulative (post-project)	8.8	0.18	0.90	0.19

HCl = Hydrogen chloride
µg/m^3 = Micrograms per cubic meter
RTO = Regenerative thermal oxidizer

TABLE 4-6
TOXICITY VALUES USED TO ASSESS AND QUANTIFY NON-CANCER HAZARD
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Pollutant	Agency	Reference Value	
		Chronic Exposure	Acute Exposure
Hydrogen Chloride	U.S. Environmental Protection Agency	RfC = 20 µg/m^3	NA
	California EPA–Office of Environmental Health Hazard Assessment	REL = 9 µg/m^3	REL = 2,100 µg/m^3

REL = Reference exposure level
RfC = Inhalation reference concentration
NA = Not available
µg/m^3 = Micrograms per cubic meter

TABLE 4-7
HYDROGEN CHLORIDE NON-CANCER HAZARD QUOTIENTS FOR RESIDENTIAL, OCCUPATIONAL, AND BOUNDARY EXPOSURE SCENARIOS
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

	HCl Acute (1-Hour Average) Hazard Quotient at Various Receptor Locations				HCl Chronic (Annual Average) Hazard Quotient at Various Receptor Locations			
Attributable To	**MIBR B-1**	**MIRR R-1**	**MICR C-1**	**MIIR I-1**	**MIBR B-2**	**MIRR R-2**	**MICR C-1**	**MIIR I-1**
Pasco Landfill RTO	0.092	0.012	0.029	0.012	0.97	0.012	0.092	0.013
Regional Background	<0.001	<0.001	<0.001	<0.01	0.0078	0.0078	0.0078	0.0078
Cumulative (post-project)	0.092	0.012	0.029	0.012	0.98	0.020	0.10	0.021

Notes:

HCl = Hydrogen chloride
RTO = Regenerative thermal oxidizer

TABLE 4-8
AMBIENT HYDROGEN FLUORIDE IMPACTS CALCULATED WITH DISPERSION FACTORS
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Toxic Air Pollutant	Emission Rate (lbs/hr)	1-Hour Average Ambient Impact Concentration (µg/m3)				Model File Name
		MIBR	MICR	MIRR	MIIR	
Hydrogen Chloride (HCl)	4.91	194	50	26	28	HCl_072814a
Hydrogen Fluoride (HF)(a)	0.123	4.86	1.25	0.65	0.70	--

Notes:

MIBR = Maximally Impacted Boundary Receptor

MICR = Maximally Impacted Commercial/Industrial Receptor

MIRR = Maximally Impacted Residential Receptor

MIIR = Maximally Impacted Institutional Receptor

(a) HF emission rates calculated with the following equation:

$$HF\ Concentration = \frac{HCl\ Concentration}{HCl\ Emission\ Rate} \times HF\ Emission\ Rate$$

TABLE 4-9
COMBINED NON-CANCER HAZARDS AT MAXIMALLY IMPACTED RECEPTORS
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Pollutant	Receptor Type	MIBR	MICR	MIRR	MIIR
HCl	Maximum 1-hour Average Concentration (µg/m^3)	194	50	26	28
	Risk Based Concentration (µg/m^3)	2100	2100	2100	2100
	Hazard Quotient (HQ)	0.092	0.024	0.012	0.013
HF	Maximum 1-hour Average Concentration (µg/m^3)	4.86	1.25	0.65	0.70
	Risk Based Concentration (µg/m^3)	240	240	240	240
	Hazard Quotient (HQ)	0.020	0.0052	0.0027	0.0029
Combined HCl and HF	Maximum 1-hour Acute Hazard Index	0.11	0.029	0.015	0.016

Notes:

MIBR = Maximally Impacted Boundary Receptor

MICR = Maximally Impacted Commercial/Industrial Receptor

MIRR = Maximally Impacted Residential Receptor

MIIR = Maximally Impacted Institutional Receptor

TABLE 5-1
QUALITATIVE SUMMARY OF THE EFFECTS OF UNCERTAINTY ON QUANTITATIVE ESTIMATES OF RISKS OR HAZARDS
PASCO SANITARY LANDFILL
PASCO, WASHINGTON

Source of Uncertainty	How Does it Affect Estimated Risk From This Project?
Exposure assumptions	Likely overestimate of exposure
Emissions estimates	Likely overestimate of emissions
AERMOD air modeling methods	Possibly slightly overestimate the short-term ambient air concentrations and somewhat underestimate long-term ambient air concentrations
Toxicity of HCl at low concentrations	Possible overestimate of chronic and acute non-cancer hazard for sensitive individuals