Herrera Environmental Consultants, Inc.

Memorandum

To	Kimberly Swan, Clackamas River Water Providers
From	Jennifer Schmidt, Herrera Environmental Consultants
Date	June 12, 2015
Subject	Updated GIS Hazardous Materials Spill Risk Analyses Results and Recommendations

Introduction

The Clackamas River is a source of drinking water for more than 300,000 people in Clackamas County and is an important resource for helping to meet future water demand in the region. The Clackamas River Water Providers (CRWP) represents five municipal surface water intakes on the Clackamas River: City of Estacada, Clackamas River Water, North Clackamas County Water Commission, South Fork Water Board, and City of Lake Oswego. In 2010, the CRWP developed a drinking water protection plan identifying potential threats to source water quality and outlining a series of strategies and programs to help protect the Clackamas River as a viable long-term source of high-quality drinking water. As part of this effort, the CRWP identified hazardous materials spills as being a high risk factor that could affect drinking water quality in the Clackamas River watershed. Potential spills from commercial and industrial areas, railroad lines, transportation activities along I-205, HWY 26 (crosses North Fork of Deep Creek near junction of HWY 26 and 212), HWY 211 and HWY 212/224, and road bridges crossing the Clackamas River are of particular concern (Clackamas River Water Providers 2010).

In 2014, the CRWP hired Herrera Environmental Consultants (Herrera) to complete a series of GIS risk analyses to assess potential and historic spill risk hot spots and identify sensitive downstream resources to protect in the event of a release near the Clackamas River or its tributaries. The goal of this effort was to highlight small, manageable portions of the watershed that are most likely to experience significant impacts in the event of a spill, as well as where spills are most likely to occur. These analyses were completed for four risk categories:

- Transportation Infrastructure and Safety
- Historic and Repeat Spills
- Hazardous Substance Storage Facilities and Potential Contaminant Sources
- Sensitive Resources

The results of these GIS analyses showed a high risk hotspot near the commercial and industrial area at the bottom of the watershed from historic and repeat spills, hazardous substance storage facilities, and roadway safety and historic vehicle crashes. In addition to being at risk, this section of the Clackamas River between Johnson Creek and the confluence with the Willamette River is also critical for protection; it contains four surface water intakes, as well as downstream wetlands and critical fish habitat for Chinook and Steelhead salmon. This region, bounded by I-205 to the west, HWY 212/224 to the east, and north of the Clackamas River, is a primary focus area for future emergency response planning efforts (Herrera 2014).

More than 500 facilities store reportable quantities of 3,500 different hazardous substances in the Clackamas River watershed, with the largest concentration of facilities being located in the focus area (Herrera 2014). The analysis of Hazardous Substance Storage (HSIS) facilities in 2014 grouped substances by physical state and quantity, but did not distinguish by substance type, toxicity, or potential pathways to surface water. This information is critical for planning effective spill response. To better assess the distribution and magnitude of risk in the focus area, Herrera refined the GIS spill risk analyses in 2015 to focus specifically on facilities storing large quantities of key categories of hazardous substances. This effort also including identifying potential spill pathways to the Clackamas River.

This memorandum focuses specifically on the methods, results, and limitations of this GIS Hazardous Materials Spill Risk Analyses. Discussion of how these results can be used to inform emergency response efforts and recommendations for next steps are also included.

Potential Threats from Hazardous Material Spills

The Clackamas River Water Providers (CRWP) have identified potential spills involving the release of hazardous materials or petroleum products from commercial or industrial facilities with hazardous material storage tanks as being a significant source of risk to drinking water quality in the Clackamas River watershed. The commercial and industrial region at the bottom of the watershed, bounded by I-205 to the west, HWY 212/224 to the east, and north of the Clackamas River, is of particularly high concern. A recurring theme associated with major spills or release is confusion and uncertainty for first responders in the initial hours following an event. It is during these early hours however when the possibility to contain the spill still exists. Once a large spill enters a flowing body of water, it can quickly become out of control, impacting downstream critical resources such as drinking water intakes, endangered or threatened species habitat, spawning beds, nesting areas, hydroelectric facilities, wetlands, and well fields (Clackamas River Water Providers 2010).

GIS Hazardous Materials Spill Risk Analyses

Herrera completed a series of GIS analyses to 1) map the locations and density of facilities storing or transporting large quantities of reportable hazardous substances in the Clackamas River watershed in four categories; and 2) identify potential pathways from facilities in the commercial and industrial focus area at the bottom of the watershed to the Clackamas River. The

following sections provide more detailed information on these analyses, including analysis objectives, methods used to quantify risk, data sources used and limitations, and results.

Analysis Objectives

The primary objectives of the GIS hazardous materials spill risk analyses were to:

1. Group facilities storing reportable quantities of hazardous substances from the HSIS database into 4 general categories based on chemical properties:
    - Oil (Petroleum or Vegetable)
    - Light or Medium Fractioned Petroleum
    - Solvents (Alcohols, Ketones, Chlorinated)
    - Acids and Bases
2. Analyze facility spill risk by category based on the total reported substance amount stored onsite, as well as the quantity being transported to and from the facility.
3. Identify potential spill pathways to the Clackamas River or its tributaries in the commercial and industrial focus area at the bottom of the watershed in the event of a hazardous substance release.

Data Sources and Limitations

The primary GIS datasets required to assess the potential impact of a hazardous materials spill on source water quality in the Clackamas River are 1) facility locations from the Oregon State Fire Marshall (OSFM) Hazardous Substance Information System and 2) stormwater infrastructure (pipes, structures, and open channels). The following sections describe these datasets in more detail, including any major limitations that are important to keep in mind when interpreting the GIS hazardous materials spill risk analysis results. Documentation on all datasets used in the analyses can be found in Table 1. Herrera converted all GIS datasets used to the Oregon State Plane North HARN 83 map projection, with both the vertical and horizontal datum measured in feet.

Oregon OSFM Hazardous Substance Information System (HSIS) Database

The Oregon Community Right to Know Unit (CR2K) collects, validates, and disseminates information on hazardous substances located throughout the state. This information is then made available to the public, emergency responders and planners, and local and state agencies via the Hazardous Substance Information System (HSIS) database so that informed decisions can be made on how to protect the environment and the public from hazardous material incidents (OSFM 2013). Facilities that use, store, manufacture, or dispose of reportable quantities of a hazardous substance are required to complete an HSIS form annually; detailed information on

reporting requirements can be found in the HSIS Survey Instruction booklet (http://www.oregon.gov/osp/SFM/docs/cr2k/cr2k_general/surveyinstrbook.pdf).

Herrera obtained statewide hazardous substance facility locations extracted from the HSIS Public Version database that are current as of January 1, 2015. This database is identical to the Fire Version database made available to fire service personal and other emergency responders, but all confidential and secured information (such as the specific onsite storage location at a facility) have been removed. The Public Version dataset contains detailed facility and hazardous substance information, including the facility name, type of business activity, number of employees, the substance type, quantity, physical state, and hazard class for each hazardous substance reported by the facility, whether the substance meets Environmental Protection Agency (EPA) Extremely Hazardous Substance (EHS) reporting levels, and the current hazard ranking used to determine the facility fee schedule. This data was used to group hazardous substances into categories and to identify facilities with high maximum reported storage or transport quantities. It was also used to identify the number of hazardous substances reported at each facility.

Approximately 38% of reported hazardous substances in the HSIS database did not contain latitude and longitude coordinates. Herrera used street address or intersection data where available to map facilities without coordinate information; however, 5% of reported hazardous substances statewide did not contain sufficient information to map their locations. These records were removed from further analysis.

There are limitations to this data that are important to keep in mind when interpreting the analysis results. First, the quantity information provided in the database (average and maximum amounts stored onsite, and the average amount annually transported in and out of the facility) are provided as reportable ranges rather than exact values, and in some cases these ranges are quite broad. Another important limitation is that this database only containing facilities with reportable quantities of hazardous substances; facilities storing hazardous substances in quantities below reportable quantities are not included in the analysis.

Stormwater Utility Data

The commercial and industrial area focus at the bottom of the watershed is within the Clackamas Water Environment Services (WES) service boundary and has extensive stormwater infrastructure that discharges to the Clackamas River at several outfalls. Clackamas WES provided Herrera with GIS stormwater infrastructure data, including the locations of stormwater pipes, structures, open channels, and detention ponds. This data was used in combination with topographic data to delineate areas draining to several major outfalls to the Clackamas River. Stormwater infrastructure data was not available for areas outside of the Clackamas WES service

Methodology

This section describes the GIS methods that Herrera used to assess the potential risk from hazardous material spills to the Clackamas River watershed from commercial and industrial facilities in the focus area at the bottom of the watershed. A brief discussion of the results of

Table 1. GIS Datasets Used to Assess Risk from Hazardous Material Spills to Source Water Quality in the Clackamas River watershed.

Dataset Description	Source	Date	Online Metadata (if available)
Hazardous Substance Information System (HSIS) database	Oregon State Police Office of State First Marshal (OSFM)	January 2015	http://www.oregon.gov/osp/SFM/docs/CR2K/CR2K_General/ManualHSIS.pdf
Clackamas River watershed boundary	Oregon Metro RLIS	January 2015	http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=2100
Streams and water bodies	Oregon Metro RLIS	January 2015	http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=1596
Highways or major arterials	Oregon Metro RLIS	January 2015	http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=576
Stormwater structures	Clackamas County Water Environment Services	April 2015	None – provided via E-mail
Stormwater lines	Clackamas County Water Environment Services	April 2015	None – provided via E-mail
Stormwater pipes	Clackamas County Water Environment Services	April 2015	None – provided via E-mail
Open channels	Clackamas County Water Environment Services	April 2015	None – provided via E-mail
Surface water intakes	Oregon Department of Environmental Quality/Water Quality/Drinking Water Protection (ODEQ)	December 2010	None – provided via E-mail

each analysis category is included in this section; discussion of overall results and relationships between analysis categories are included in the Results section.

Hazardous Substance Storage Facilities

The improper handling and storage of petroleum and hazardous chemicals by facilities in close proximity to the Clackamas River poses a significant potential threat to source water quality. To better assess the distribution and magnitude of this risk, Herrera completed a series of GIS analyses focusing on the density and storage capacity of known hazardous material storage facilities in the Clackamas River watershed.

Mapping Hazardous Substance Storage Facilities

Herrera extracted and mapped 548 facilities that use, store, manufacture, or dispose of reportable quantities of more than 3,500 hazardous substances in the Clackamas River watershed. Hazardous substances are stored as liquids, solids, and gases: 6% of the reported substances have a current hazard ranking of 1 (minimally hazard), 90% have a current hazard ranking of 2 (generally hazardous), less than 1% have a current hazard ranking of 3 (very hazardous), and 4% have a current hazard ranking of 4 (registered chemicals).

Identifying Key Hazardous Substance Categories

Herrera used a screening process with several steps to identify the most relevant facilities to target for spill response planning efforts. First, all reported hazardous substances identified as either gases or solids were removed from further analysis due to slower rates of dispersion and longer travel times to the Clackamas River. Although hazardous gas and solids could also pose a significant risk to source water quality under certain circumstances, liquid spills are much more common and have a broader travel radius, making them of particular concern to surface water quality.

As a next step, Herrera reviewed the list of storage container types in use by facilities in the Clackamas River watershed and removed all hazardous substances being stored in underground storage tanks (USTs) from the analysis. Spills from USTs certainly pose a serious environmental risk; however, theses spills are more likely to results in groundwater and soil contamination rather than direct contamination to surface water. Oregon Department of Environmental Quality (DEQ) is responsible for maintaining permitting and clean-up programs for more than 5,000 operating permits in Oregon for large USTs (greater than 110 gallons for commercial or industrial facilities and greater than 1,100 gallons for residential or farm use); an analysis of UST permits in the Clackamas River watershed, as well as other permitted facilities, was completed as part of the hazardous materials spill analysis completed by Herrera in 2014 and is available on the CRWP website (http://www.clackamasproviders.org/wp-content/uploads/2014/09/GIS_Hazardous_Materials_Risk_Analysis_Results_12102013-1.pdf).

After applying these filtering criteria, the HSIS database still contained records for nearly 200 unique chemical names stored at reportable quantities in the Clackamas River watershed. To help facilitate a more targeted analysis of risk in the lower watershed focus area, Herrera coordinated with CRWP and the Oregon Department of Ecology to group substances into 4 broad categories based on similar chemical properties, buoyancy in water, and potential response strategies that

could be implemented if a spill were to occur. These categories, along with the numbers of facilities in the Clackamas River watershed, are shown in Table 2. The distribution of facilities by substance category is shown in Figure 1.

Table 2. Aggregation of Chemical Names in the Hazardous Substance Storage database in the Clackamas River watershed.

Category	Number of Unique Chemical Names	Number of Reporting Facilities
Light/Medium Fractioned Petroleum	38	61
Oil (Petroleum or Vegetable)	22	44
Solvents (Alcohols, Ketones, Chlorinated)	15	9
Acids and Bases	45	15

Analyzing Risk from HSIS Storage Facilities By Quantity

Each facility that submits reportable quantities of hazardous substances to the HSIS database is required to provide the following information on quantities:

- **Average Amount**: This is the average amount of the chemical that the facility possessed during the previous 12 months, expressed as a range.
- **Maximum Amount**: This is the maximum amount of the chemical that the facility possessed during the previous 12 months, expressed as a range.
- **Amount In:** This is the amount of the substance transported to the facility during the previous 12 months, expressed as a range.
- **Amount Out:** This is the amount of the substance of the substance transported from the facility during the previous 12 months. This does not include 1) amounts transported from the facility due to accidental or intentional releases, 2) the fuel, gas, oil, etc. used in the facility vehicles, or 3) substances used up at the site.

To help facilitate further analysis, it was necessary to convert the reported amounts from gallon ranges to discrete numbers. Herrera used the top value in the reported range to assign a conservative discrete average, maximum, amount in, and amount out value to each facility by chemical category and then calculated the total amount of all hazardous substances stored onsite. The quantities used in this analysis are approximate and may in some cases be an overestimate. Figures 2 through 17 show the total amount for each type of reported quantity by substance category.

Potential Spill Pathways

The final step in this analysis was to look at potential pathways from spills in the commercial and industrial focus area at the bottom of the watershed to the Clackamas River. Herrera used

topographic data and Clackamas WES stormwater infrastructure data to delineate the contributing area draining to four outfalls discharging to the Clackamas River. These areas are shown in Figure 18. These boundaries are approximate and have not been field verified; however, they serve as a good starting point for identifying where a spill from a facility storing hazardous substances in the lower watershed could end up discharging to the Clackamas River. This information will allow the CRWP to plan spill response strategies that are able to potentially stop the spread of a hazardous substance before it is able to reach the Clackamas River.

Results and Recommendations

The results of the 2014 hazards materials spill risk analyses for the Clackamas River watershed clearly that the commercial and industrial region, bounded by I-205 to the west, HWY 212/224 to the east, and north of the Clackamas River, should be a primary focus area for future emergency response planning effort. The goal of the analysis completed in 2015 was to help further focus what is at risk by analyzing the distribution and intensity of hazardous substances stored in the watershed in key chemical categories rather than by facility. This analysis helps to illuminate patterns in the data that can only be seen by analyzing the facilities by chemical categories rather than in aggregate.

As an example, the Oil (Petroleum/Vegetable) category contains the largest number of facilities, the largest number of gallons stored, and the densest concentration within the focus area at the bottom of the watershed; by comparison, there are only a handful of facilities in the Solvents categories, and although they are all located in the lower watershed, they are not intensely clustered. This implies that broad planning efforts are appropriate for spill response for facilities where oil is being stored, since these facilities are numerous and densely clustered, while targeted facility-specific outreach might be more effective for the limited number of facilities storing solvents.

The results of the GIS risk analyses described in this document and the information gathered in an emergency response planning workshop are the core components needed to develop a web-based and/or mobile GIS watershed emergency response tool that can be distributed to first responders for use in the event of an emergency. As a next step in this process, the CRWP should conduct a needs assessment to identify key hardware, software, personnel resources, and application requirements to support this system.

References

Clackamas River Water Providers. 2010. *Drinking Water Protection Plan for the Clackamas River*. September 2010. Obtained December 20, 2010, from agency website: http://www.clackamasproviders.org/contacts/7.html.

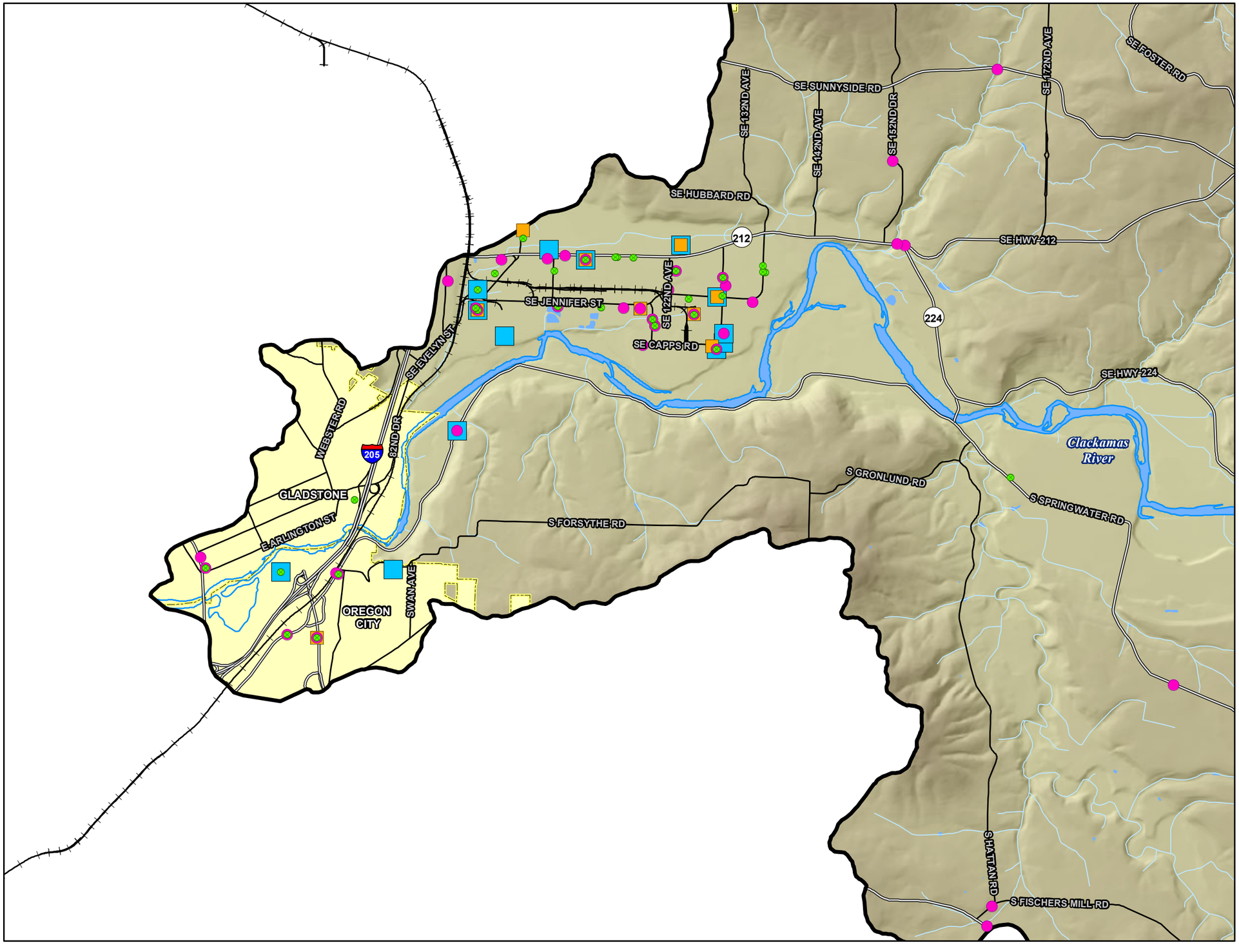
DEQ. 2013. *How to Report a Spill.* December 6, 2013. Oregon Department of Environmental Quality. http://www.deq.state.or.us/lq/cu/emergency/reportspill.htm

OSFM. 2013. *Community Right to Know.* December 6, 2013. Oregon State Police – Oregon Office of State Fire Marshal. http://www.oregon.gov/OSP/SFM/Pages/CR2K_Home.aspx

Herrera. 2013. Hazardous Materials Risk Analysis Results. Herrera Environmental Consultants. December 2013. http://www.clackamasproviders.org/wp-content/uploads/2014/09/GIS_Hazardous_Materials_Risk_Analysis_Results_12102013-1.pdf).

FIGURES

Figure 1.
Hazardous Substance Storage Facilities in the Clackamas River Watershed.



Legend

- Facilities storing oil (petroleum or vegetable)
- Facilities storing light or medium fractioned petroleum
- Facilities storing solvents
- Facilities storing acids and bases
- Railroad
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

Clackamas River Water Providers
Working together to protect and conserve our drinking water.

HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Chemical_Categories_at_Watershed_Scale.mxd (6/16/2015)

Figure 2.
Facilities Storing Reportable Quantities of Oil (Petroleum or Vegetable): Average Gallons Stored Onsite.

Legend

Total average gallons stored onsite

- < 500 gallons
- 500 to 5,000 gallons
- 5,000 to 10,000
- 10,000 to 50,000
- > 50,000

- Railroad
- Highway or major arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

Clackamas River Water Providers
Working together to protect and conserve our drinking water.

HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 3.
Facilities Storing Reportable Quantities of Oil (Petroleum or Vegetable): Maximum Gallons Stored Onsite.

Legend

Total maximum gallons stored onsite

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons

- Railroad
- Highway or major arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

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Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 4.
Facilities Storing Reportable Quantities of Oil (Petroleum or Vegetable): Total Gallons Transported to the Facility Annually

Legend

Total maximum gallons transported in

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons

- Railroad
- Highway or major arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

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HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 5.
Facilities Storing Reportable Quantities of Oil (Petroleum or Vegetable): Total Gallons Transported from the Facility Annually

Legend

Total maximum gallons transported out

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons

- Railroad
- Highway or major arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

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Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 6.
Facilities Storing Reportable Quantities of Light or Medium Fractioned Petroleum: Average Gallons Stored Onsite.

Legend

Light or medium fractioned petroleum

- < 500 gallons
- 500 to 5,000 gallons
- 5,000 to 10,000
- 10,000 to 50,000
- > 50,000

- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

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HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 7.
Facilities Storing Reportable Quantities of Light or Medium Fractioned Petroleum: Maximum Gallons Stored Onsite.

Legend

Light or medium fractioned petroleum

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons

Highway or major arterial

Arterial

County boundary

Clackamas River Watershed boundary

City limits

River

Waterbody

Stream

National Forest boundary

N

0 1,750 3,500 7,000

Feet

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HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 8.
Facilities Storing Reportable Quantities of Light or Medium Fractioned Petroleum: Total Gallons Transported to the Facility Annually.

Legend

Light or medium fractioned petroleum

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons

Highway or major arterial

Arterial

County boundary

Clackamas River Watershed boundary

City limits

River

Waterbody

Stream

National Forest boundary

N

0 1,750 3,500 7,000

Feet

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Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 9.
Facilities Storing Reportable Quantities of Light or Medium Fractioned Petroleum: Total Gallons Transported from the Facility Annually.

Legend

Light or medium fractioned petroleum

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons

Highway or major arterial

Arterial

County boundary

Clackamas River Watershed boundary

City limits

River

Waterbody

Stream

National Forest boundary

N

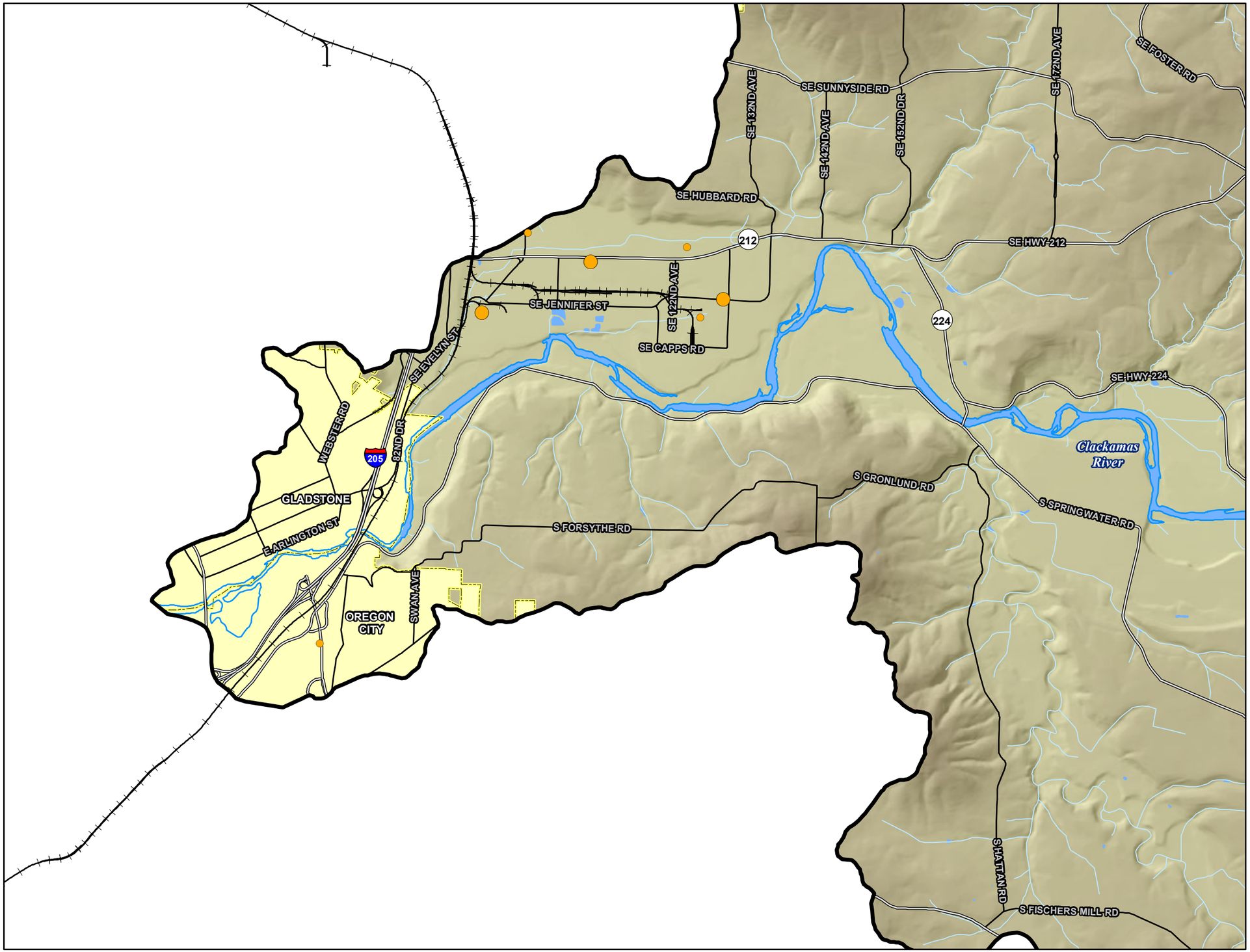
0 1,750 3,500 7,000

Feet

Coordinates: Oregon State Plane North HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Light_Medium_Fractioned_Petroleum.mxd (6/16/2015)

Figure 10.
Facilities Storing Reportable Quantities of Solvents: Average Gallons Stored Onsite.



Legend

Facilities storing solvents

- < 500 gallons
- 500 to 5,000 gallons
- 5,000 to 10,000
- 10,000 to 50,000
- > 50,000
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
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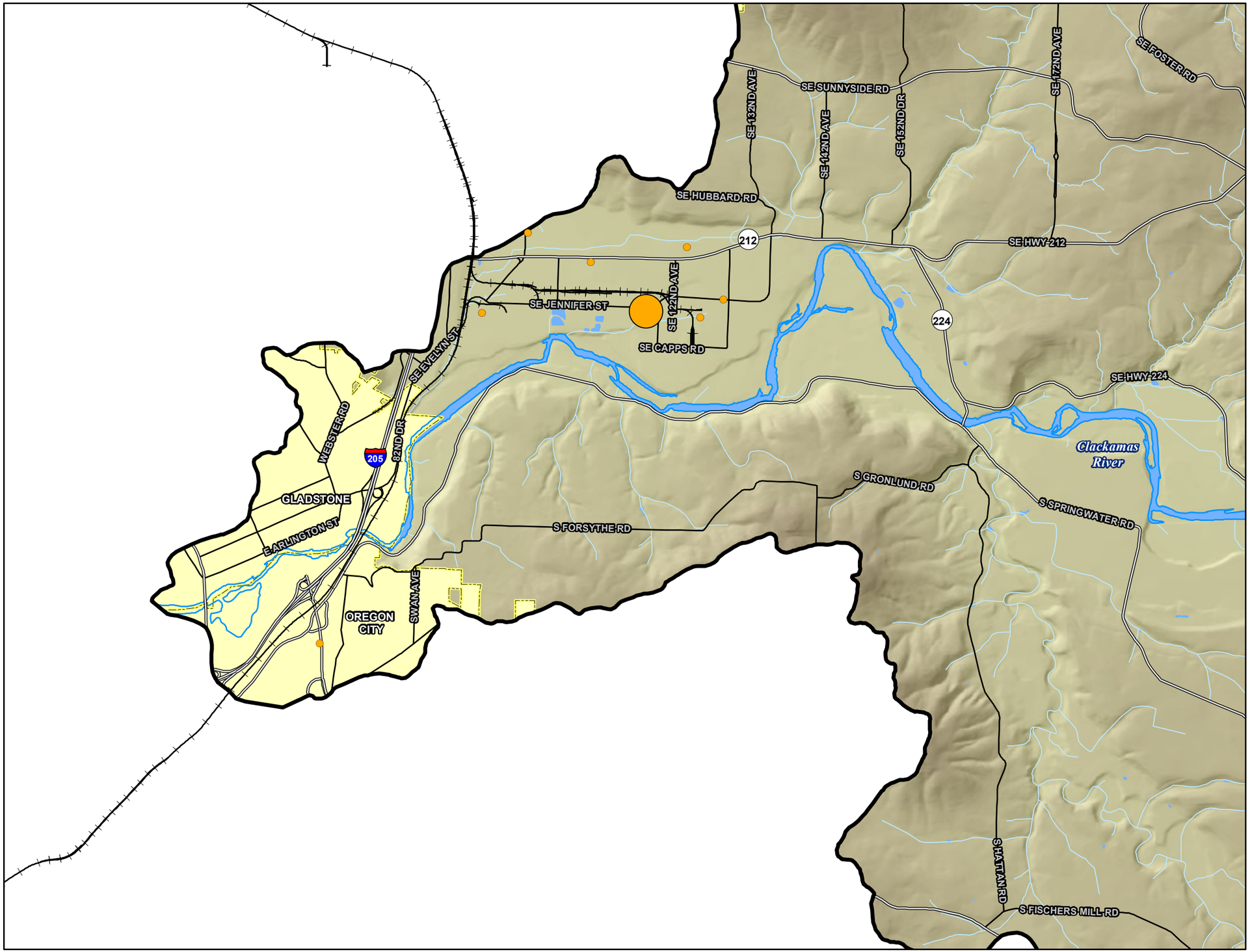
Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Solvents.mxd (6/16/2015)

Figure 11.
Facilities Storing Reportable Quantities of Solvents: Maximum Gallons Stored Onsite.



Legend

Facilities storing solvents

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
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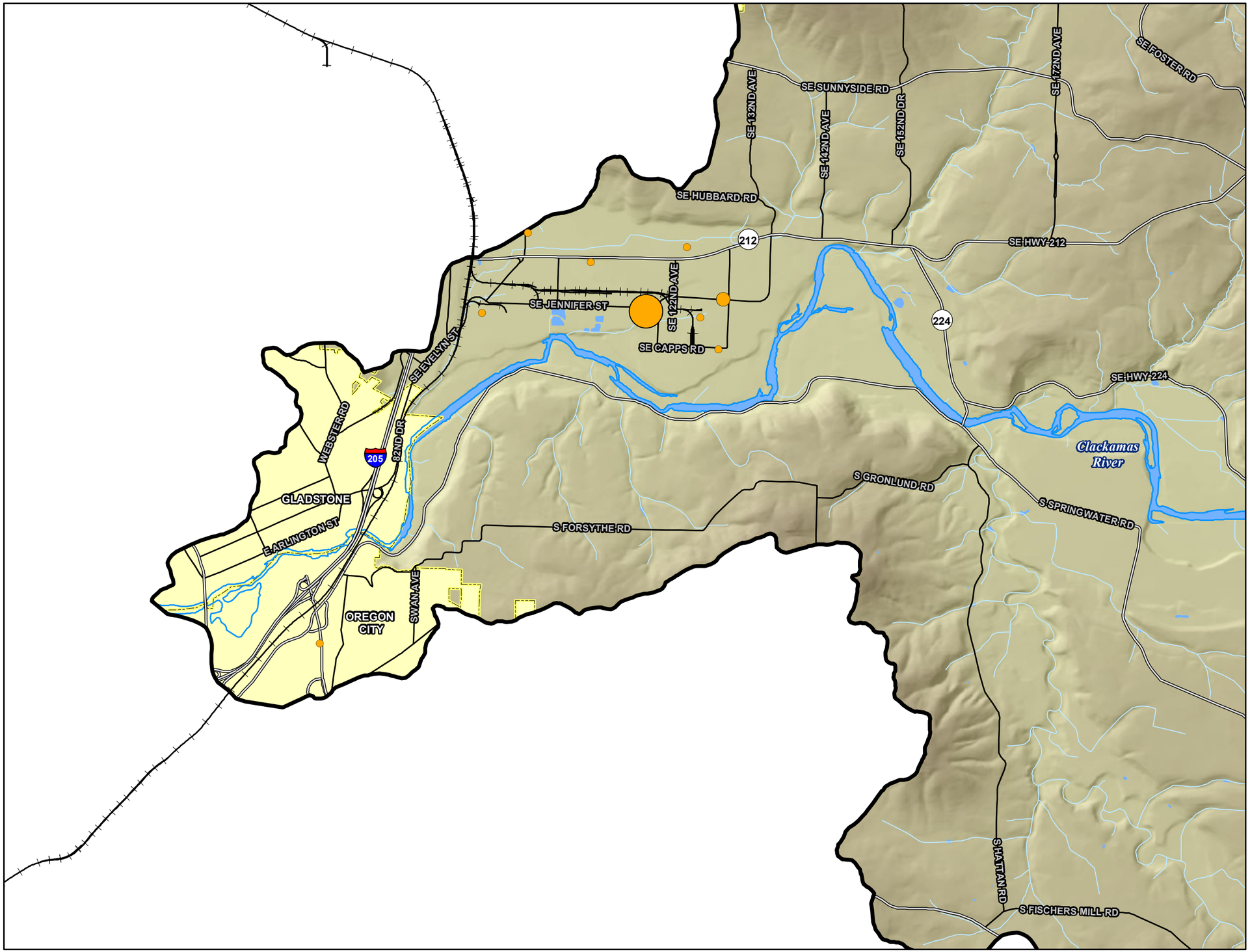
Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Solvents.mxd (6/16/2015)

Figure 12.
Facilities Storing Reportable Quantities of Solvents: Total Gallons Transported to the Facility Annually.



Legend

Facilities storing solvents

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
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Feet

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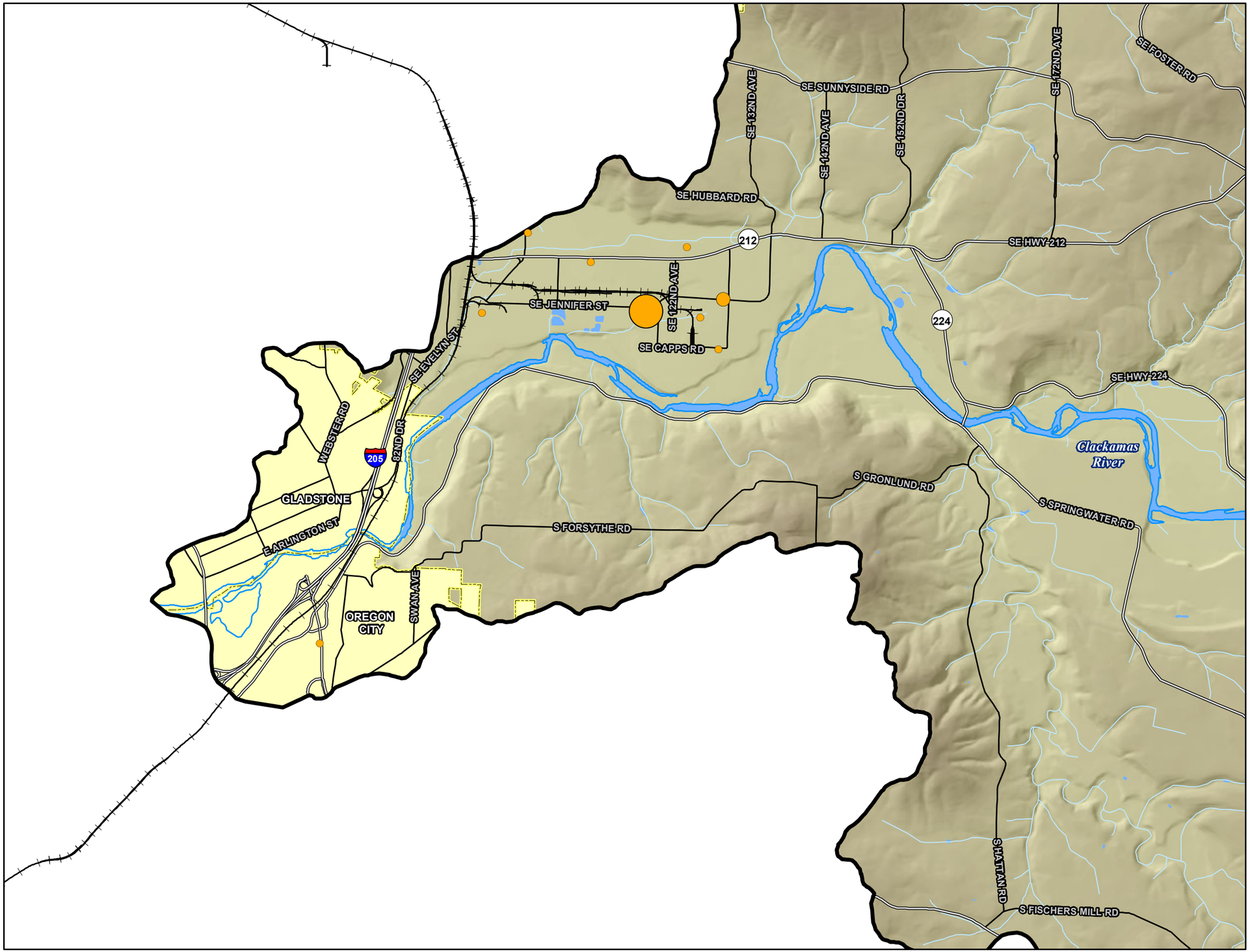
HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Solvents.mxd (6/16/2015)

Figure 13.
Facilities Storing Reportable Quantities of Solvents: Total Gallons Transported from the Facility Annually.



Legend

Facilities storing solvents

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

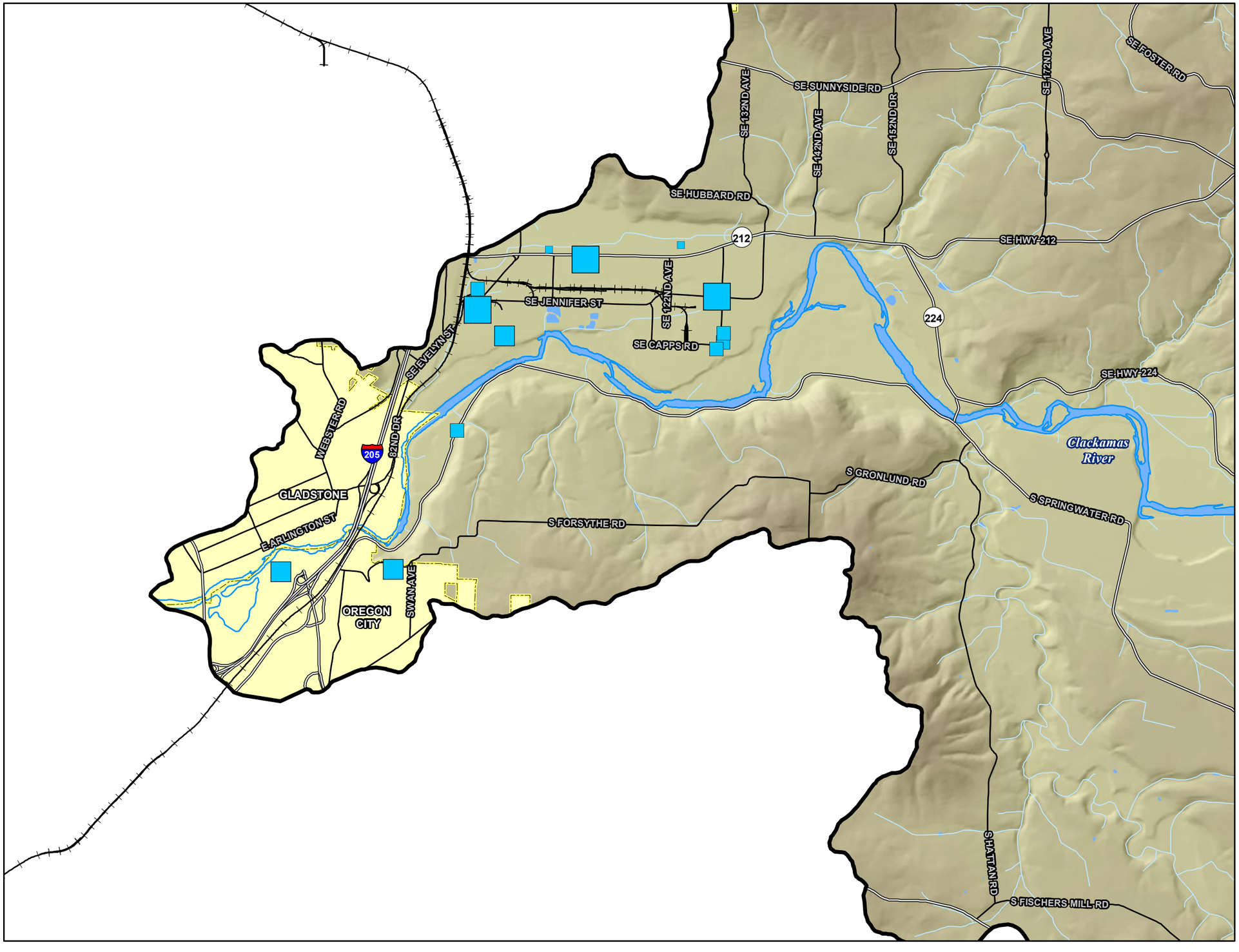
Clackamas River Water Providers
Working together to protect and conserve our drinking water.

HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Solvents.mxd (6/16/2015)

Figure 14.
Facilities Storing Reportable Quantities of Acids or Bases: Average Gallons Stored Onsite.



Legend

Facilities storing acids and bases

- < 500 gallons
- 500 to 5,000 gallons
- 5,000 to 10,000
- 10,000 to 50,000
- > 50,000
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

Clackamas River Water Providers
Working together to protect and conserve our drinking water.

HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

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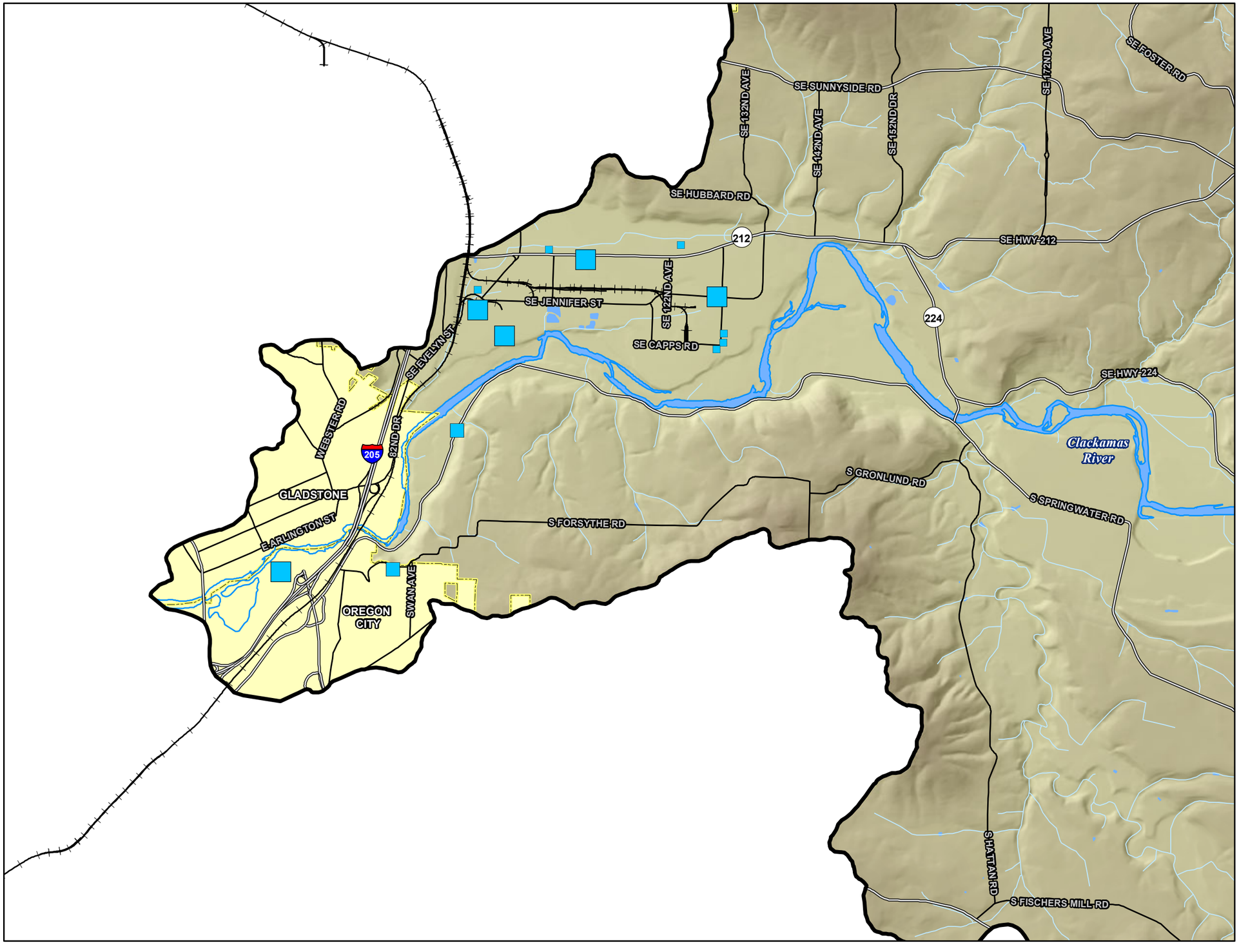
Project: K:\Projects\Y2010\10-04900-005\Project\Acids_and_Bases.mxd (6/16/2015)

Figure 15.
Facilities Storing Reportable Quantities of Acids or Bases: Maximum Gallons Stored Onsite.



Legend

Facilities storing acids and bases

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

Clackamas River Water Providers
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HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Acids_and_Bases.mxd (6/16/2015)

Figure 16.
Facilities Storing Reportable Quantities of Acids or Bases: Total Gallons Transported to the Facility Annually

Legend

Facilities storing acids and bases

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

Clackamas River Water Providers
Working together to protect and conserve our drinking water.

HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Acids_and_Bases.mxd (6/16/2015)

Figure 17.
Facilities Storing Reportable Quantities of Acids or Bases: Total Gallons Transported from the Facility Annually

Legend

Facilities storing acids and bases

- < 5,000 gallons
- 5,000 to 10,000 gallons
- 10,000 to 50,000 gallons
- 50,000 to 100,000 gallons
- > 100,000 gallons
- Highway or major arterial
- Arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

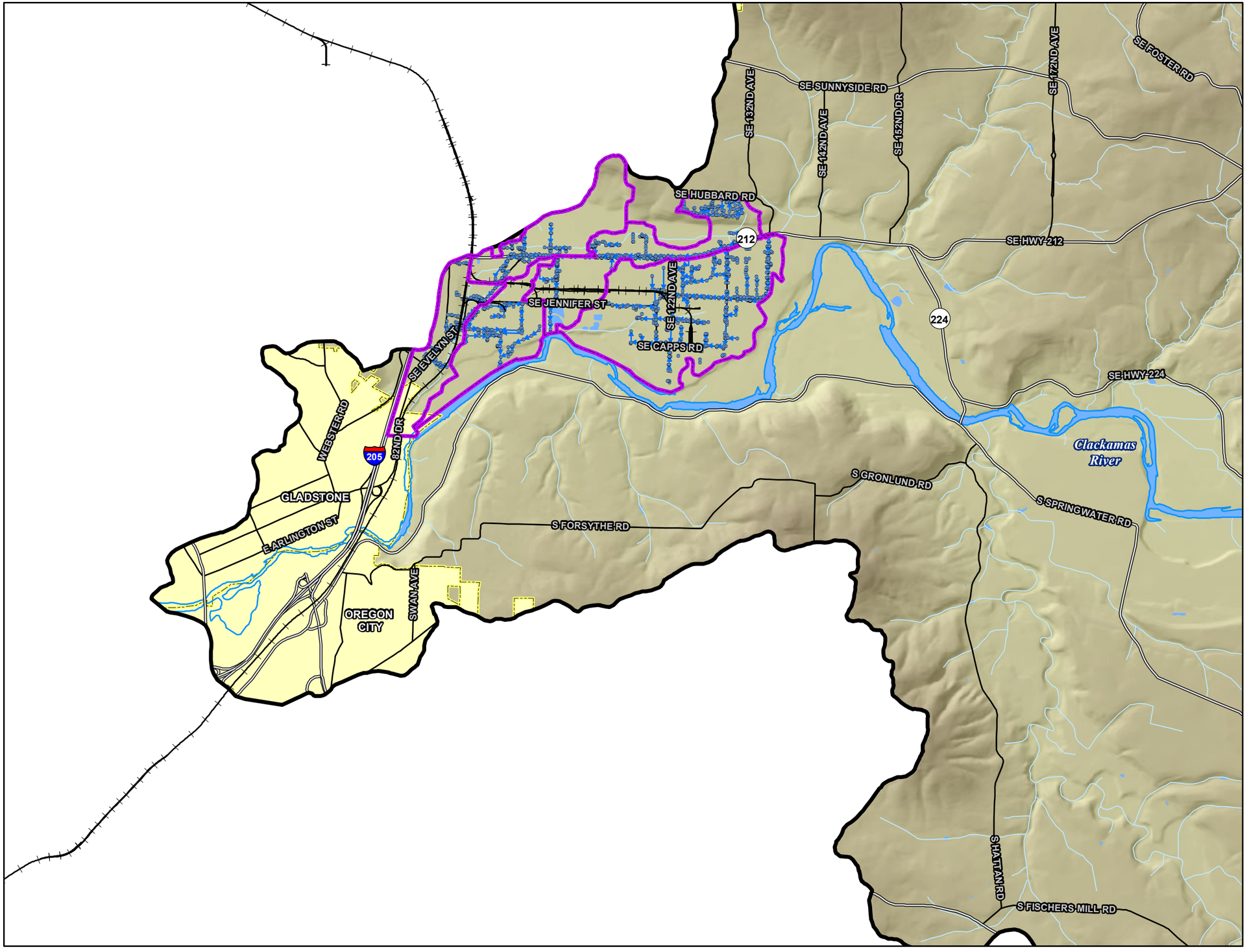
0 1,750 3,500 7,000

Feet

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Acids_and_Bases.mxd (6/16/2015)

Figure 18.
Drainage Areas and Stormwater Infrastructure.



Legend

- Approximate drainage area
- Stormwater structures
- Stormwater pipes
- Railroad
- Highway or major arterial
- County boundary
- Clackamas River Watershed boundary
- City limits
- River
- Waterbody
- Stream
- National Forest boundary

N

0 1,750 3,500 7,000

Feet

Clackamas River Water Providers
Working together to protect and conserve our drinking water.

HERRERA

Coordinates: Oregon State Plane North
HARN NAD83 (feet)

Produced By: GIS (JAS)
Project: K:\Projects\Y2010\10-04900-005\Project\Drainage_Infrastructure.mxd (6/16/2015)