ENVIRONMENTAL SERVICES
systems analysis
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Draft Memorandum

To:	Carolyn Sharp and Marguerite Feuersanger
From:	David Whitaker
Reviewed By:	Derek Forseth
Date:	May 19, 2005
Project:	Willamette Watershed Modeling
Subject:	Linnton Area Pipe Hydraulic Modeling Evaluation and Cost Estimate to Construct a New Sanitary Sewer System in Whitwood Court

Summary

The purpose of the pipe hydraulic modeling was to evaluate the capacity of the existing pump and pipe system that conveys combined and sanitary sewer flows from the study area to the Guilds Lake pump station. The study area consists of five neighborhoods that are located along NW St. Helens Highway (see Sheet 1 of 6).

The capacity of the system was evaluated for the existing condition. The primary purpose of the capacity analysis was to analyze the two main components of the system. These components are the Guilds Lake Interceptor pipe, which runs from the Linnton pump station to the Guilds Lake pump station and the Linnton pump station, which pumps combined flow from the Linnton neighborhood. It is assumed that the Guilds Lake pump station has the capacity to pump the flows delivered through the Interceptor.

The results of the analysis indicate that the Linnton pump station is at full capacity under the existing condition. This pump station receives both sanitary and stormwater flows through the combined pipe system that drains to the pump station. When flows directed to the pump station exceed the pumping capacity, overflows occur out of Outfall 24. With the existing configuration of the outfall, an overflow nearly occurs during the 3-year summer storm. The City is required by the State of Oregon to not have combined sewer overflows out of Outfall 26 during the 3-year summer storm. Therefore, there is no additional capacity in the Linnton combined pipe system to direct additional stormwater to the system. If additional sanitary flows were directed to the system it would be recommended to remove some of the stormwater that is currently directed to the system to reduce the chance for a combined sewer overflow out of Outfall 24.

The results of the analysis indicate that the Guilds Lake interceptor has sufficient capacity for future development within the study area. The interceptor receives pumped combined sewer flows from the Linnton pump station and sanitary sewer flows from the neighborhoods and industrial areas along St Helens Rd. The maximum flows that the Linnton pump station can pump is 6.5 cubic foot per second (cfs). The sanitary flows from the study area are not as significant. Using 1999 water use data it is estimated that a little over 1 cfs of sanitary and rainfall derived inflow and infiltration (RDII) flows to the interceptor under the existing condition. It is estimated that future development in the study area will contribute another 1 cfs of sanitary and RDII flows to the system.

An order of magnitude cost estimate to install a sanitary sewer system in the Whitwood Court neighborhood was completed. It was estimated that 14,400 feet of sewer line would have to be installed at a relatively high unit cost of $175/linear foot. This adds up to a total cost of approximately 2.5 million dollars. This is the estimated cost to construct the system. There would be additional cost for design and for the purchase of easements. Factors that lead to the relatively high unit cost for construction are steep slopes, shallow rock, landslide potential and close proximity to drainage ways.

Model Development

The development of a model included the following steps.

Perform a quality control review of the existing GIS pipe data in the area. A quality control review was completed at the initiation of the project. The review found that most of the pipe data existed, but it was not all correct. As-built drawings were reviewed in an attempt to fill in missing information and to correct obvious errors. In areas where there were no pipe invert elevations, it was assumed that the pipes were laid at the same slope as the ground.

Development of an access database and MapInfo table of lots that have the capacity to be developed. Information on lots that are currently developed and lots that have the capacity to be developed was received from Carmen Piekarski at Bureau of Planning (BuP). This information was converted to a MapInfo format and utilized for modeling purposes. This data was compared to the "building" and "parking" layers that have been developed by Systems Analysis (SA). The layer from BuP was similar, but not exactly the same. The analysis was completed using the BuP layers.

Add sewer laterals into the model. Laterals that were missing for existing buildings in the study areas were added. Also, laterals were added for the lots that have the capacity to be developed.

Delineate surface subcatchments. Surface subcatchments were delineated for use in the pipe model (XP-SWMM). Flow from these subcatchments is directed to the combined sewer system. In areas that have a sanitary only system, the surface subcatchments were delineated and then modeled using the HEC-HMS model. The surface subcatchment information for the sanitary areas was not used in this pipe hydraulic modeling since stormwater runoff is not directed to the sanitary system.

Develop Existing Condition Model. An existing condition pipe hydraulic model was developed using the development (total capacity) data provided by BuP. The GIS coverage of existing development is; Refinedeveloptls.shp – this is the GIS layer of the lots that are currently developed in the study area. These lots were chosen by querying out the lots in the study area that have bldgval/totval>=0.5.

Sheets 2 through 6 show the assumed condition for each of the neighborhoods. Note that there is no sewer piping shown in the Harborton and Whitwood Court neighborhoods. The houses in these neighborhoods discharge to septic or cesspool systems and are not currently served by a sewer system.

The existing condition model was developed using the EMGAATS modeling system and was modeled using the XP-SWMM hydraulic model. The results of the analysis indicate that the Linnton pump station is at full capacity under the existing condition. This pump station receives both sanitary and stormwater flows through the combined pipe system that drains to the pump station. When flows directed to the pump station exceed the pumping capacity, overflows occur out of Outfall 24. With the existing configuration of the outfall, an overflow nearly occurs during the 3-year summer storm. The City is required by the State of Oregon to not have combined sewer overflows out of Outfall 26 during the 3-year summer storm. Therefore, there is no additional capacity in the Linnton combined pipe system to direct additional stormwater to the system. If additional sanitary flows were directed to the system it would be recommended to remove some of the stormwater that is currently directed to the system to reduce the chance for a combined sewer overflow out of Outfall 24.

The results from the modeling indicate that there is adequate capacity in the Guilds Lake interceptor pipe that runs from the Linnton Pump Station to the Guilds Lake Pump Station. A peak flow of approximately 7.5 cfs is conveyed in the interceptor pipe during the 25-year design storm. Note, that the 25-year design storm is only applicable to the combined sewer system that drains to the Linnton pump station. The pumping capacity of the Linnton pump station is 6.5 cfs, so the pump station restricts the flow that is conveyed to the interceptor from the Linnton neighborhood. An additional 1.1 cfs is directed to the interceptor from the sanitary only basins. It was assumed that an RDII rate of 1,000 gallons per acre per day (gpad) would flow into this sanitary system.

The interceptor pipe is laid at a very flat slope with individual pipe segments laid at slopes around 0.5% at the upstream end to 0.01% at the downstream end of the interceptor. The existing condition model results indicate that the interceptor runs between half and three-quarters full during the 25-year design storm. This seems to align with historical pumping information at the Guilds Lake Pump Station and with discussions with Dan Hebert (pump station manager).

Develop Future Conditions Model. During the development of a future condition model, there was a need to discuss assumptions about growth in the study area. The BuP provided a GIS layer named Refinzonecap.shp, which is the GIS layer of the residential lots in the study area that have the capacity to develop in the future. It takes into account only existing conditions, not future possibilities (i.e. partitions, consolidations, etc.). In addition to the residential lots, there are industrial lands that also contribute sanitary flows to the Guilds Lake Interceptor. The existing industrial area is expected to add additional industrial business under the 2040 growth assumptions that were received from BuP for the CSO tunnel sizing project For the tunnel project it was assumed that the industrial area along the river would be much more densely developed than it currently is (about 320 additional impervious acres – roofs and pavement). It was decided by BuP staff that for this future condition analysis, it would be appropriate to include the assumption that this new industrial development would occur.

The level of effort involved in the development of a future condition model was expected to grow with the assumption that the industrial area would become denser. Rather than build a future conditions model, an initial spreadsheet analysis of the "capacity to develop" database (refinezonecap) was performed to see what magnitude of additional flows would be contributed from these lots. It was assumed that all new developments would only contribute sanitary and RDII flow to the system. The assumptions from the Sewer Design Manual were used. The table below shows the difference in flows from the different land use designations for both the comp plan and the proposed land use zoning.

	Zone (acres)	Zone Peak Flow (cfs)	Comp (acres)	Comp Peak Flow (cfs)
R2	2.5	0.067	2.5	0.067
R2.5	4.3	0.104	4.3	0.104
R5	10.3	0.131	39.0	0.497
R7	18.4	0.176	0.2	0.002
R10	24.2	0.173	28.8	0.206
R20	15.1	0.066	0.0	0.000
IH	25.6	0.288	0.0	0.000
IS	0.0	0.000	25.6	0.288
OS	0.4	0.000	0.4	0.000
Total	103.0	1.004	103.0	1.163

This estimate of additional flow generated by new development is somewhat conservative since there is no routing of flows through the pipe system. The routing of flows tends to dampen the peak flow. As can be seen from the totals, there is not a significant difference in the future condition sanitary flows that would be generated between the two land use assumptions.

A similar exercise was completed for the 2040 growth assumptions in the Industrial area. It was determined that there would be an additional ~3 cfs of sanitary flow that is contributed to the sanitary interceptor pipe.

In summary, if the new residential and industrial development occurred, it would add approximately 4 cfs to the flow in the Guilds Lake interceptor. This would bring the estimated peak flow in the interceptor to approximately 11.5 cfs. One of the pipe segments (out of a total of 39 pipe segments) would be slightly surcharged during the

11.5 cfs peak flow. However, since the crown of this pipe segment is approximately 20 feet beneath the ground surface, the surcharge would not be expected to cause any basement flooding problems.

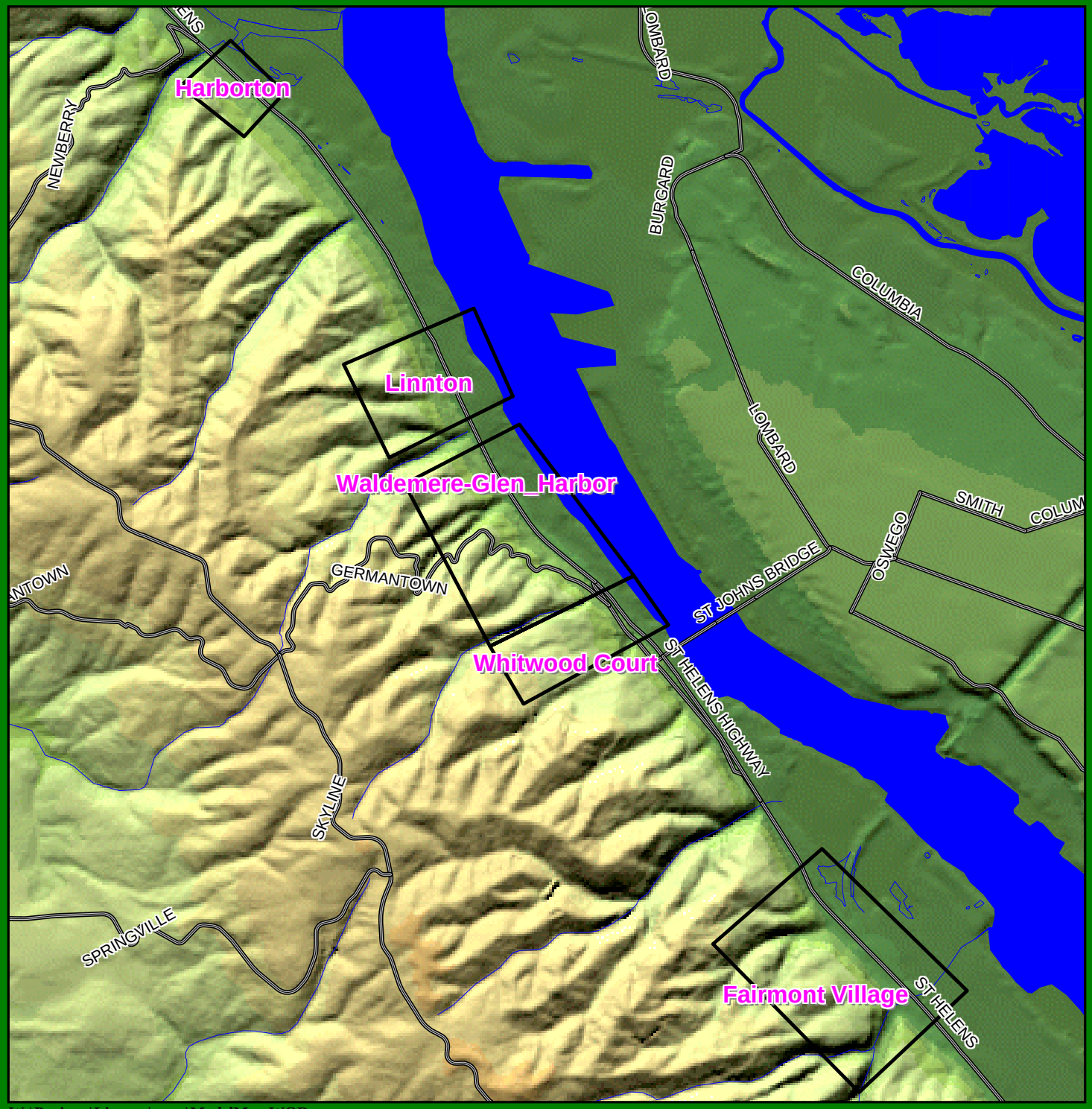
A pre design report for the Guilds Lake pump station was completed by URS Corporation (Guilds Lake Pump Station PreDesign Report – BES Proj #5507) in August 2001. In the report, it was stated that the pump station receives only limited flow, typically below 7.2 million gallons per day (mgd) = 11.1 cfs. It receives flow from the study area and industrial properties in the Guilds Lake industrial area. In this analysis it was estimated that the Guilds Lake pump station would receive a peak flow of approximately 7.5 cfs from the study area. Therefore, it is assumed that about 4 cfs would be directed to the pump station from the Guilds Lake industrial area. The pump station has the capacity to pump 28 mgd (43.3 cfs). Therefore, it is assumed that the pump station has the capacity to pump the estimated future peak flows (11.5 cfs) from the study area.

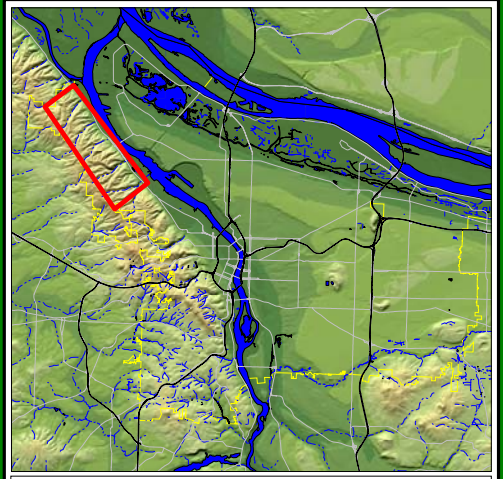
Construction Cost Estimate for Whitwood Court

A cost estimate to install a sanitary sewer system in the Whitwood Court neighborhood was completed. Homes in the Whitwood Court neighborhood currently discharge sanitary flows to septic and cesspool systems. There was a desire to get a "rough" estimate of what it would cost to provide sanitary sewer service to the neighborhood. The cost estimate was completed by Al Iverson, BES employee, and is believed to be ± 50% of the actual cost of construction. Additional costs would be incurred for the design of the system and to potentially purchase easements.

It is estimated that approximately 14,400 lf of sanitary sewer line (8" diameter) would be required to service the neighborhood. There would be main lines that run up Mills Ave., Midway Ave., and Springville Rd. It would tie into the Guilds Lake Interceptor at Manhole AAE395.

It is estimated that it would cost $175/lf to design and construct the sanitary sewer system. The total cost of the system would be approximately 2.5 million dollars. The relatively high cost for construction is due to a variety of factors. The slopes are steep in many areas and there is bedrock that is relatively shallow, so that rock blasting may have to occur to lay the pipe. Also, there have been a number of landslides that have occurred around this area, so it is expected that there is a high landslide potential for the steep portions of the area. In addition, there are a number of drainage ways that run through the neighborhood and the pipe system would have to cross and run parallel to some of the drainage ways in a few locations.





Study Area Legend

Neighborhoods

0 1000 2000 3000 FEET

0 0.25 0.50 MILES

N W E S

Linnton Area Modeling Evaluation Study Area

Sheet No.	Date Printed:
1 of 6	05/13/2005
Ref. No.	
145-32-040	environmental services systems analysis

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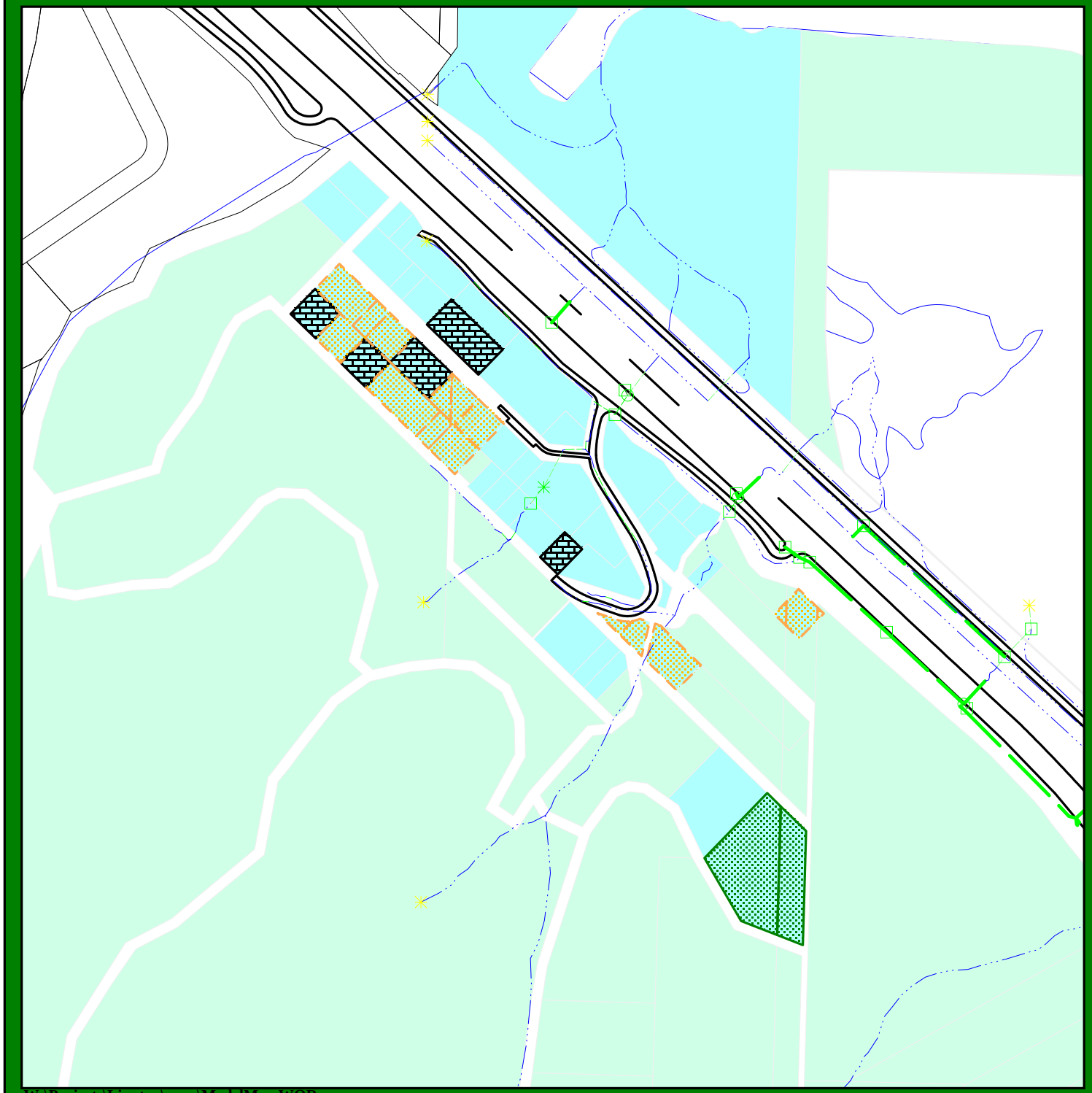

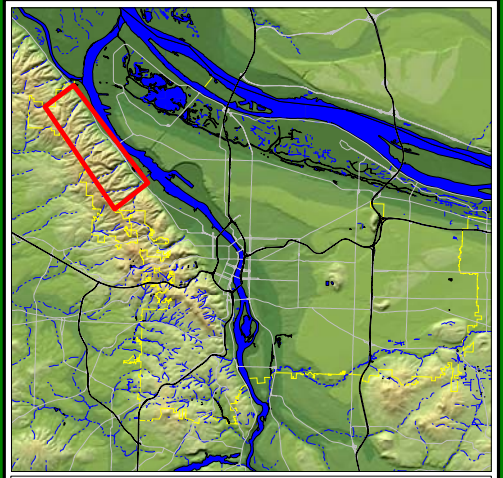

Sanitary Sewer
Combined Sewer
Force Main
Stormwater
Developed Lots (refinedeveloptls.shp)
Total Capacity to Develop (refinezonecap.shp)
City or Metro Owned Convert to Open Space
Pump Stations

subset_taxlots by GenEX

COM
IND
MFR
POS
SFR

0 200 400 FEET

0 0.025 0.05 MILES

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Linnton Area Modeling Evaluation
Harborton Neighborhood

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2 of 6	05/13/2005
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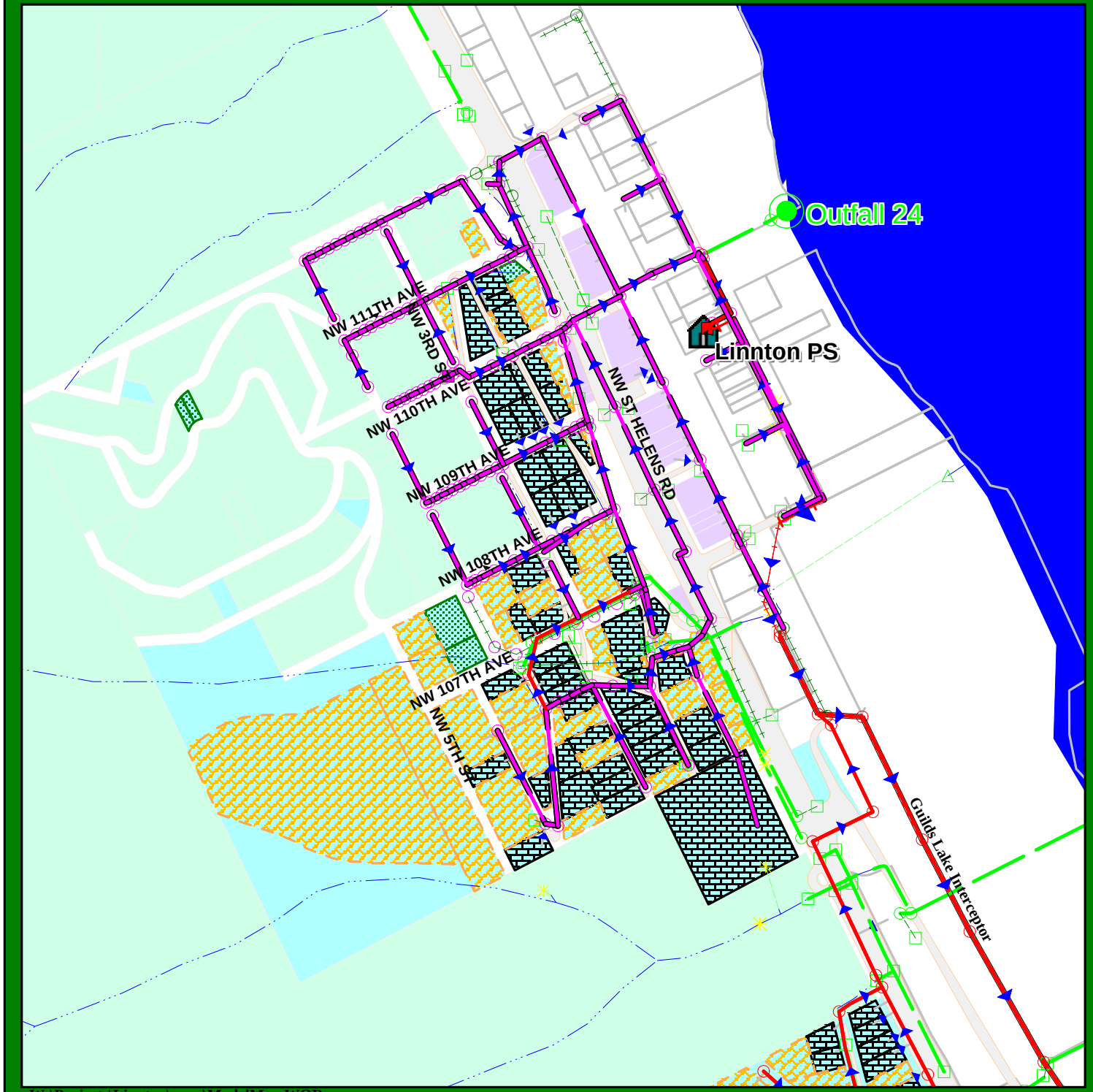

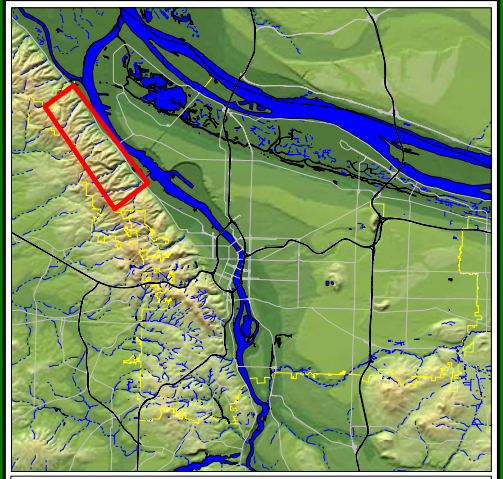

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Pump Stations

subset_taxlots by GenEX

COM
IND
MFR
POS
SFR

0 200 400 FEET

0 0.025 0.05 MILES

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Linnton Area Modeling Evaluation
Linnton Neighborhood

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3 of 6	05/13/2005
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145-32-040	

environmental services systems analysis

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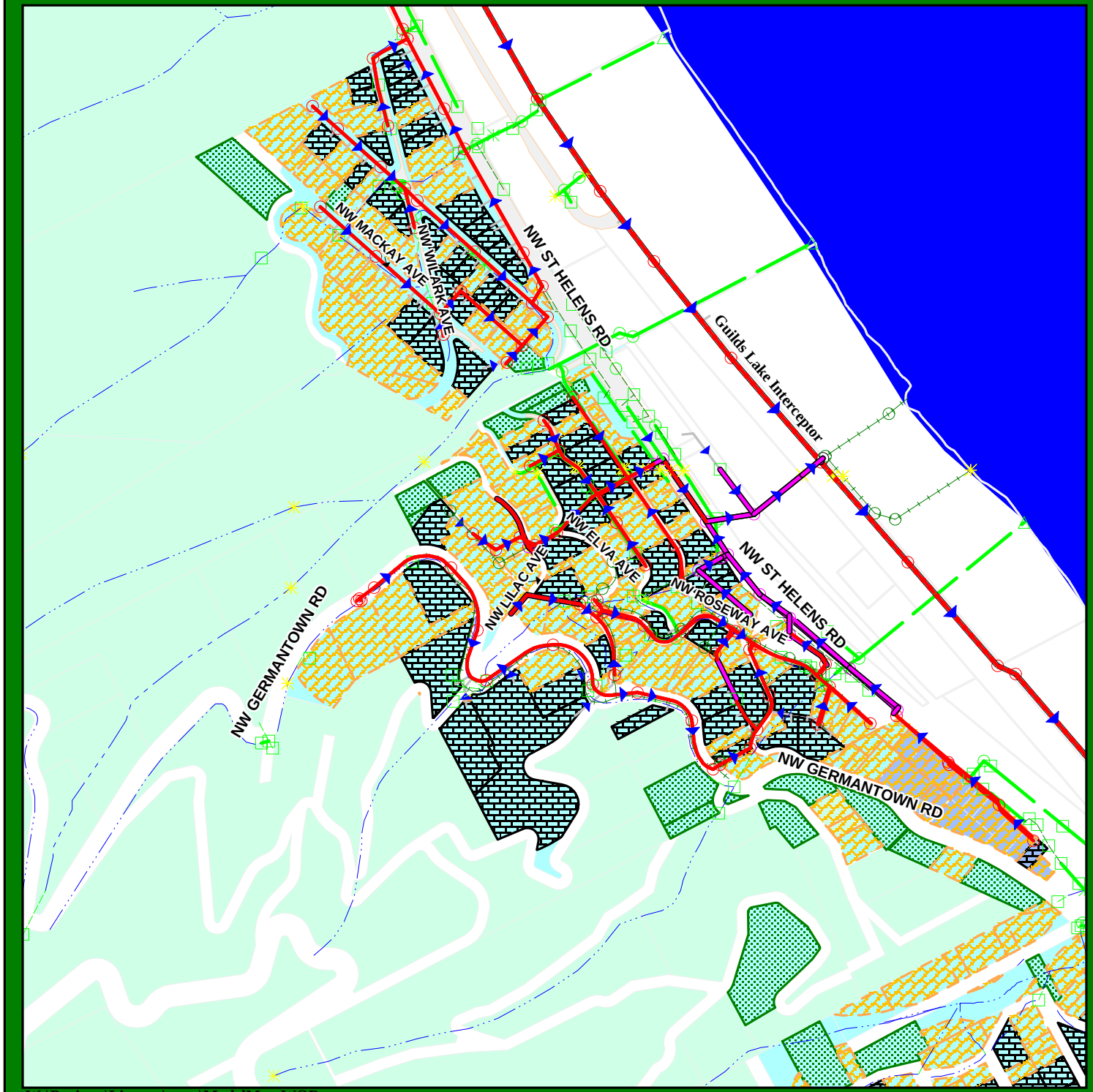

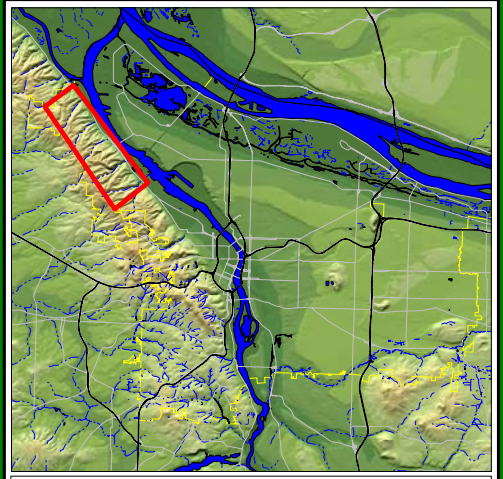

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subset_taxlots by GenEX

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POS
SFR

0 500 FEET

0 0.05 0.10 MILES

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W E
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Linnton Area Modeling Evaluation
Waldemere-Glen Harbor Neighborhood

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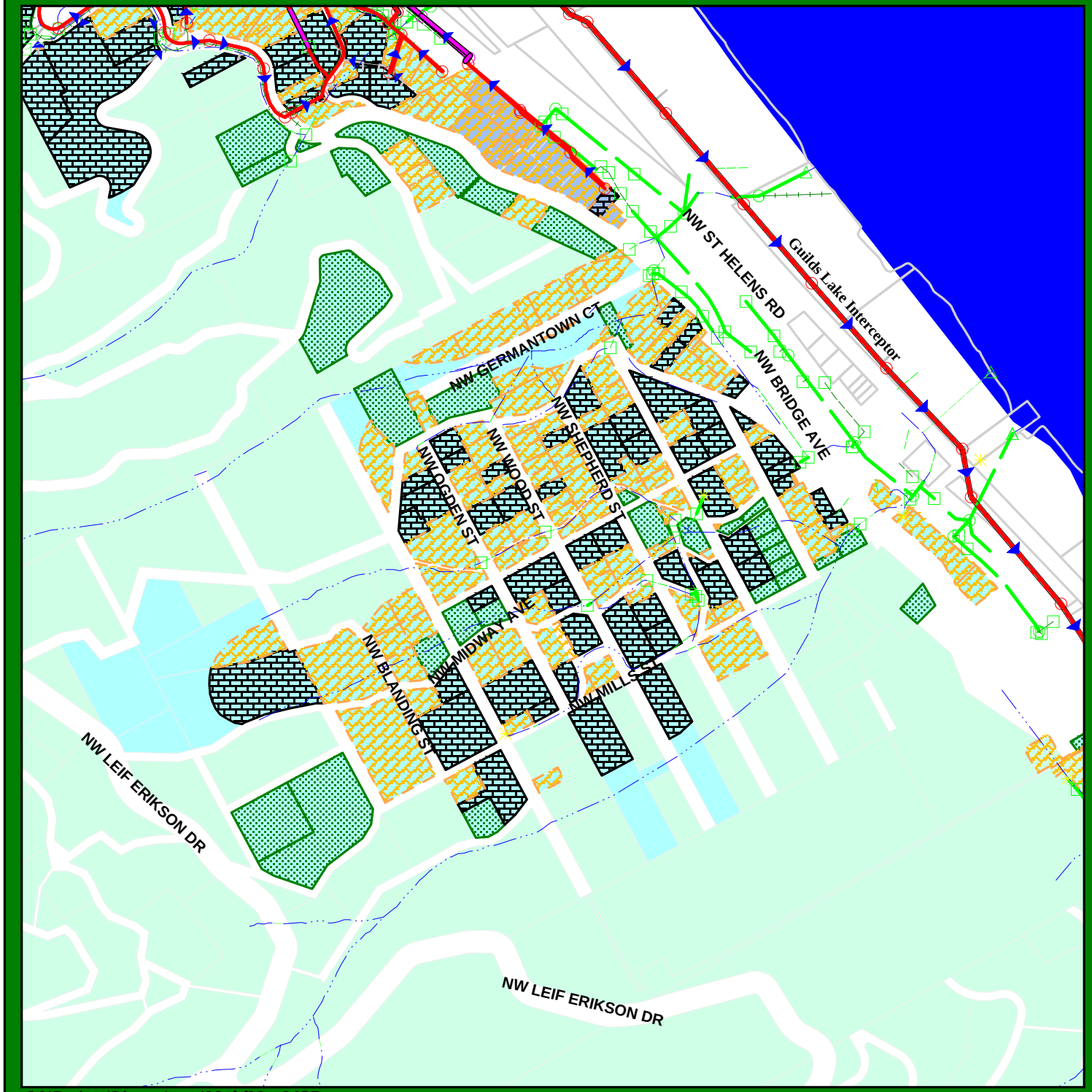

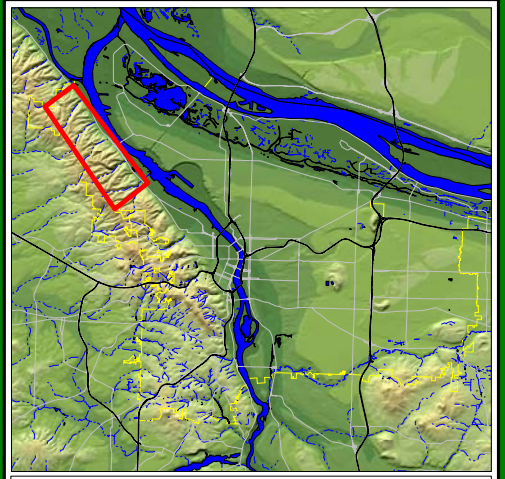

Sanitary Sewer
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Stormwater
Developed Lots (refinedeveloptls.shp)
Total Capacity to Develop (refinezonecap.shp)
City or Metro Owned Convert to Open Space
Pump Stations

subset_taxlots by GenEX

- COM
- IND
- MFR
- POS
- SFR

0 200 400 FEET

0 0.025 0.05 MILES

N W E S

Linnton Area Modeling Evaluation
Whitwood Court Neighborhood

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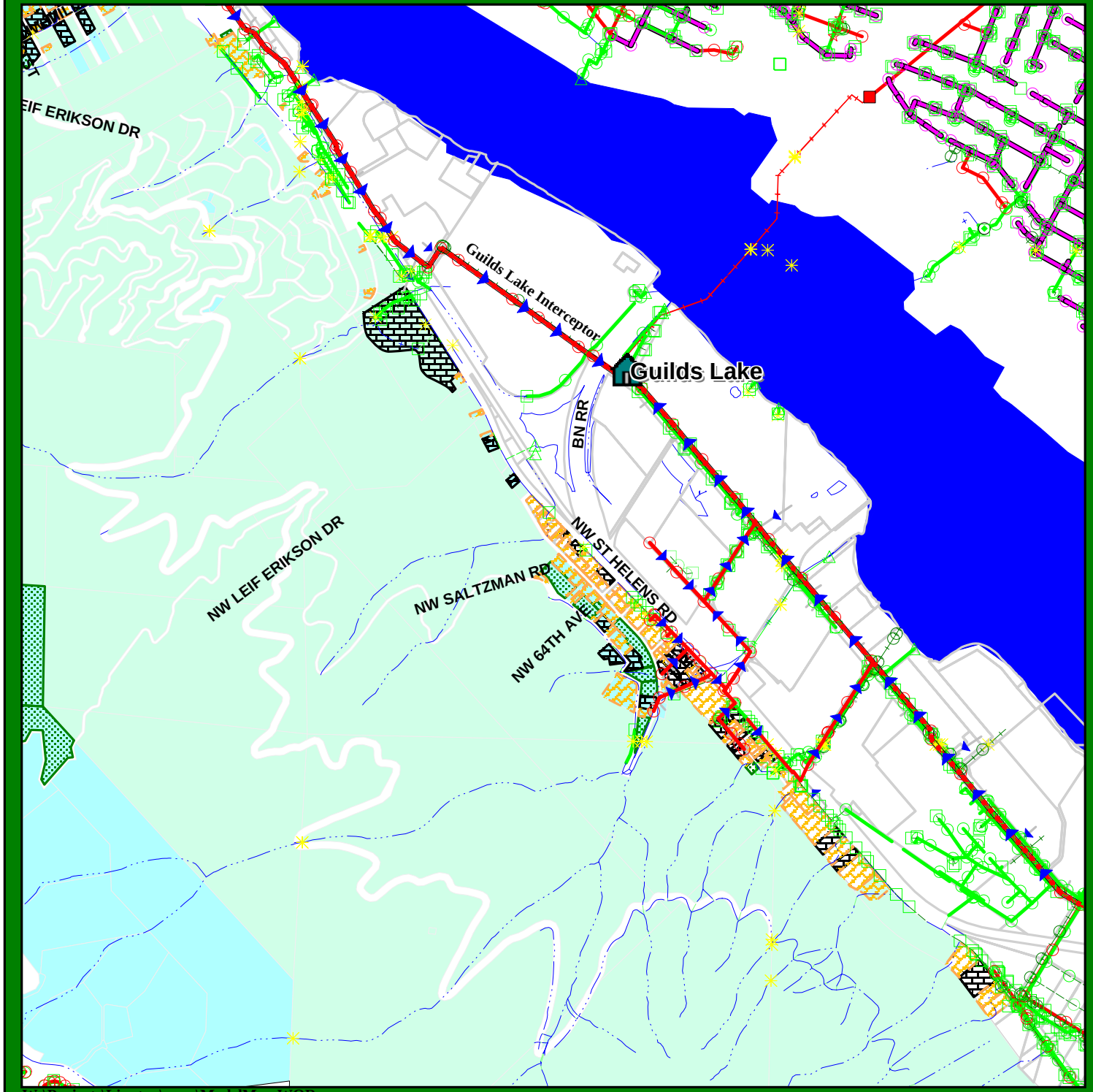

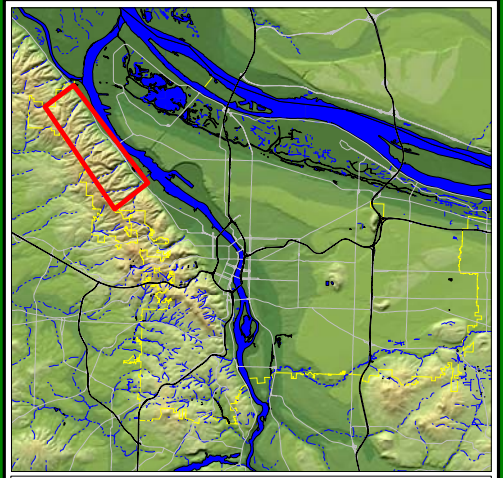

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subset_taxlots by GenEX

COM
IND
MFR
POS
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0 500 1000 1500 FEET

0 0.10 0.20 0.30 MILES

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Linnton Area Modeling Evaluation
Fairmont Village Neighborhood

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