City of Renton Stormwater Greenfrastructure

- A INVENTORY OF CANDIDATE SITES TO PROTECT, ENHANCE, OR CREATE NEW GREEN STORMWATER INFRASTUCTURE

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Geography 582 GIS Data Management

Case for Green Stormwater Infrastructure (*Greenfrastructure*)

- Definition:

  Greenfrastructure means green stormwater infrastructure. It refers to stormwater systems or practices that use or mimic natural processes to infiltrate, filter, reuse, or facilitate the evapotranspiration of stormwater on site.

- Why Greenfrastructure: Preserving natural systems that inherently contribute to stormwater treatment reduces the need to build costly and hard engineered systems to replace their ecosystem services if they were lost to development; and

  For unavoidable losses, soft or bioengineered solutions can provide more effective stormwater treatment and generate a wider spectrum of ecosystem service benefits overall than hard engineered solutions.

Conflicting Municipal Stormwater Management Goals

- In the interest of public safety and property protection, convey surface water away from properties, roadways, and structures as quickly as possible to prevent backwater flooding and subsequent impairment to structures or harm to persons during and immediately following extreme storm events.

- In the interest of environmental protection and management, maintain, restore, or create storrmwater controls that help insure post development flow quantity, quality, and frequency to meet a predevelopment land cover type (e.g., historic condition) flows at specified storm recurrence interval design thresholds.

Environmental Issues Associated With Inadequately Treated Stormwater Runoff

- Excessive sediment in stormwater can fill in spaces between gravels in salmonid spawning beds, decreasing oxygen availability necessary for juvenile fry emergence and survival;
- Excess nutrients runoff loads can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Salmonids and other aquatic organisms can’t exist in water with low dissolved oxygen levels;
- Industrial and household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and heavy metals toxic to aquatic life;

Environmental Issues Associated With Inadequately Treated Stormwater Runoff (cont.)

- Stormwater runoff from roads and highways can carry oil, grease, and heavy metals such as copper that can adversely affect salmonid navigation and ability to avoid predation;
- Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting water polluted by stormwater runoff; and
- Flashy peak stormwater runoff can change the natural seasonal hydrographs of associated drainages to the extent of causing excessive channel degradations that over time accelerate the separation of streams from their floodplains and contribute to downstream bank erosion, flooding, and loss of property and human life.

Renton Stormwater File Geodatabase Datasets (vector)

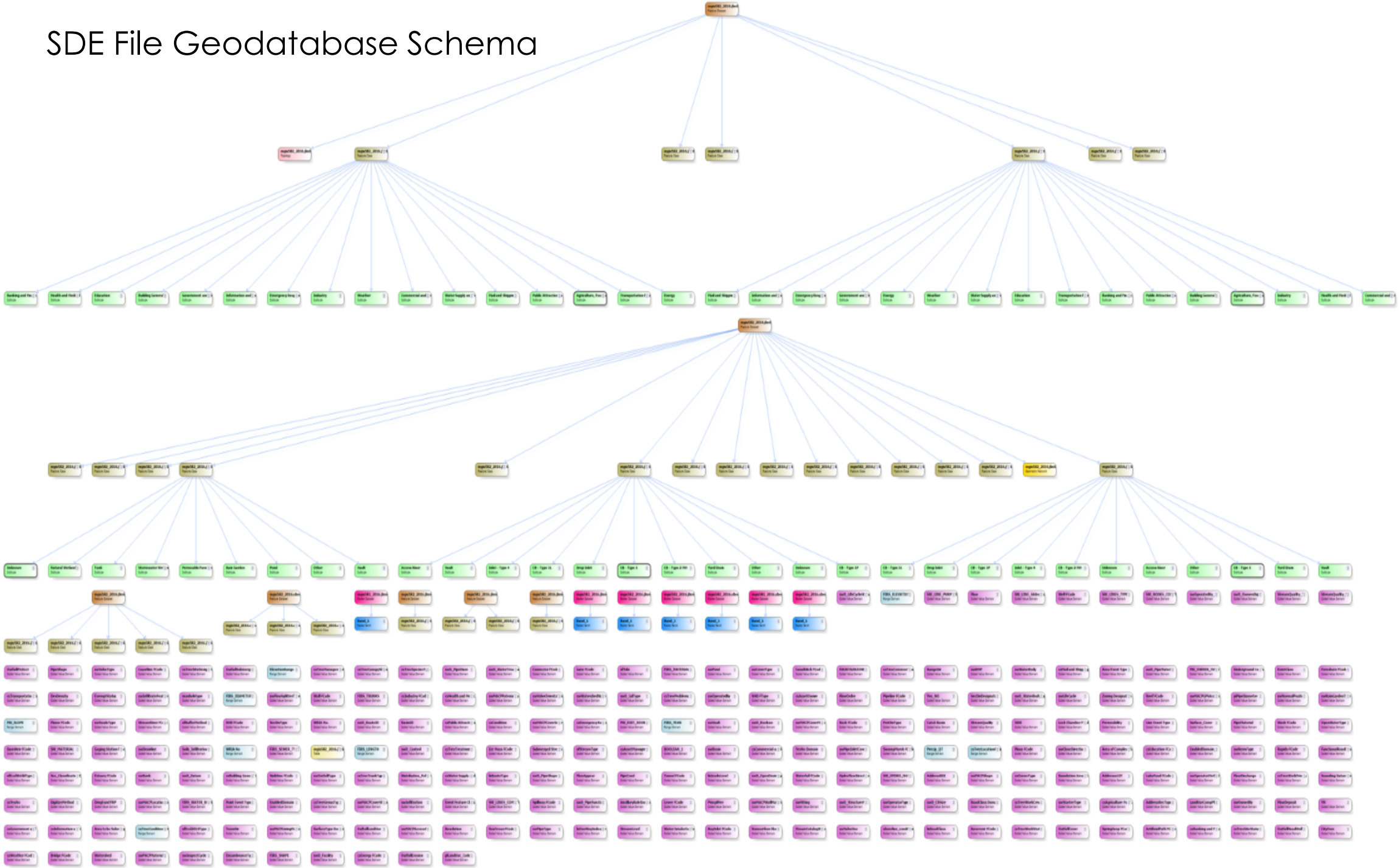
Feature Dataset	Feature Class	Description	Source
Boundary	Renton	City of Renton boundary (Incorp-orated and Unincorporated)	http://www5.kingcounty.gov/gisdataportal/
Hydrology	Renton_ Basin	Surface water basins, sub-basins, and catchments.	University of Washington gishub database connection
Hydrology	Waterways	Rivers and streams in Renton drainage basin area.	http://www5.kingcounty.gov/gisdataportal/
Hydrology	100-year Floodplain	The geographic extent of the 100-year (1%) flood recurrence interval	http://www5.kingcounty.gov/gisdataportal/
Hydrology	Isohyets	Isolines of mean annual precipitation	http://www.wsdot.wa.gov/mapsdata/geodatacatalog/default.htm
Hydrology	Wetlands	USFWS National Wetland Inventory	https://www.fws.gov/wetlands/nwi/
Conveyance	RSW_Pipes	City of Renton stormwater pipe network.	http://rentonwa.gov/government/default.aspx?id=29887

Feature Dataset	Feature Class	Description	Source
Conveyance	RSW_ Discharge	City of Renton stormwater pipe outfalls.	http://rentonwa.gov/government/default.aspx?id=29887
Conveyance	RSW_ OpenDrains	City of Renton stormwater open ditches.	http://rentonwa.gov/government/default.aspx?id=29887
Transportation	Streets	City of Renton Streets	http://www.wsdot.wa.gov/mapsdata/geodatacatalog/default.htm
Landuse	Landuse Types	Zoning and Property Use Types	http://rentonwa.gov/government/default.aspx?id=29887
Landuse	OpenSpace	Open undeveloped areas	http://rentonwa.gov/government/default.aspx?id=29887
Landuse	Parks	Multi-use parklands	http://rentonwa.gov/government/default.aspx?id=29887
Landuse	Candidate Stormwater Green Sites	Sites potentially available for green stormwater infrastructure	See workflow in part 3 of this Lab exercise.
Terrain	Elevation Contours	Isolines of equal elevations	https://gdg.sc.egov.usda.gov/GDGOrder.aspx
Terrain	Soils	NRCS SSURGO Soils Data	https://gdg.sc.egov.usda.gov/GDGOrder.aspx

Renton Stormwater File Geodatabase Datasets (raster)

Raster	Coverage	Description	Source
DEMd_Clip	Renton Basins	Elevation (feet)	https://gdg.sc.egov.usda.gov/GDGOrder.aspx
HillSha_Rent1_Clip	Renton Basins	Hillshade View	https://gdg.sc.egov.usda.gov/GDGOrder.aspx
Slope_Renton1	Renton Basins	Percent Slope	https://gdg.sc.egov.usda.gov/GDGOrder.aspx
maprecip_Clip2	Renton Basins	Mean Annual Rainfall	http://www.wsdot.wa.gov/mapsdata/geodatacatalog/default.htm

SDE File Geodatabase Schema



Vector Data Coordinate Systems and Horizontal Datum

NAD_1983_HARN_StatePlane_Washington_North_FIPS_4601_Feet

Projection:
Lambert_Conformal_Conic
Geographic Coordinate System:
GCS_North_American_1983_HARN
Datum: D_North_American_1983_HARN
Spheroid: GRS_1980

Raster Data Horizontal and Vertical Datums

- North American Datum (horizontal)of 1983 (NAD 83).
- North American Vertical Datum of 1988 (NAVD 88).
- National Elevation Data (NED) at a resolution of 1/3 arc-second (about 10-meters).
- Scientists and resource managers use NED data for global change research, hydrologic modeling, resource monitoring, mapping and visualization, and many other applications.

Research Question

- Which datasets are needed to locate geographically the areas of opportunity and constraint for protecting existing and / or developing new stormwater “greenfrastructure” in Renton, Washington and what is an effective geoprocessing workflow that will help to discern those locations from the data?

Renton SDE File Geodatabase

ArcCatalog - Database Connections\Renton_SWI.geog.uw.edu.sde\mgis582_2016.jlm62.HillSha_Rent1_Clip

File Edit View Go Geoprocessing Customize Windows Help

Database Connections\Renton_SWI.geog.uw.edu.sde\mgis582_2016.jlm62.HillSha_Rent1_Clip

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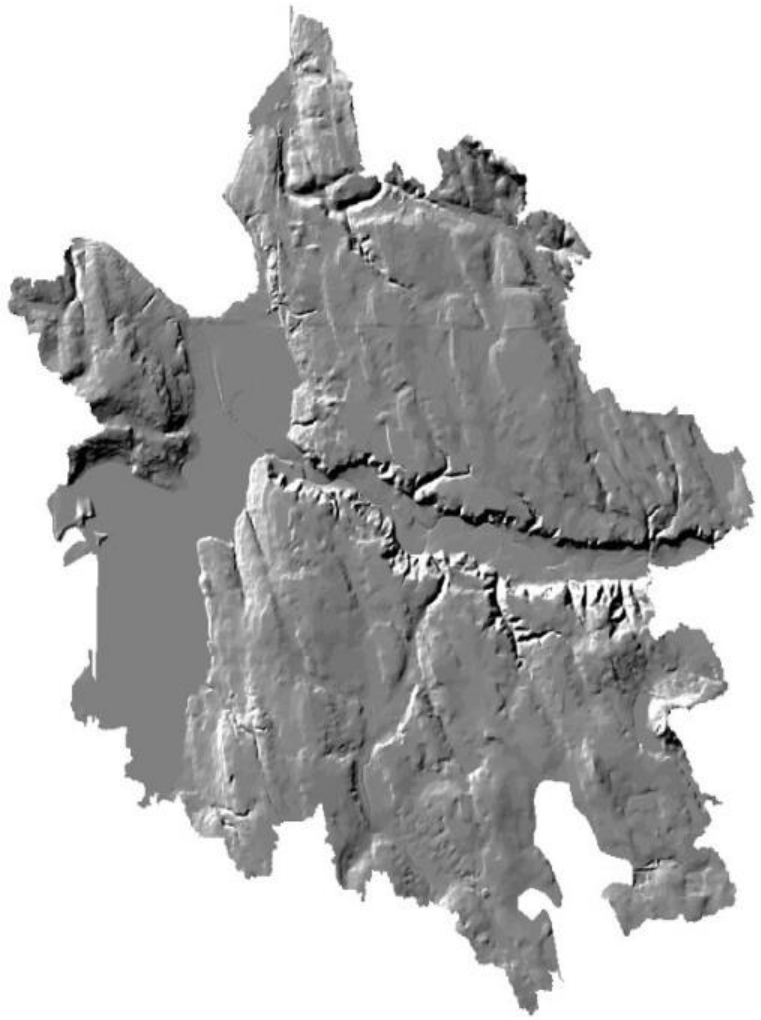

Preview: Geography

SDE Raster Dataset selected

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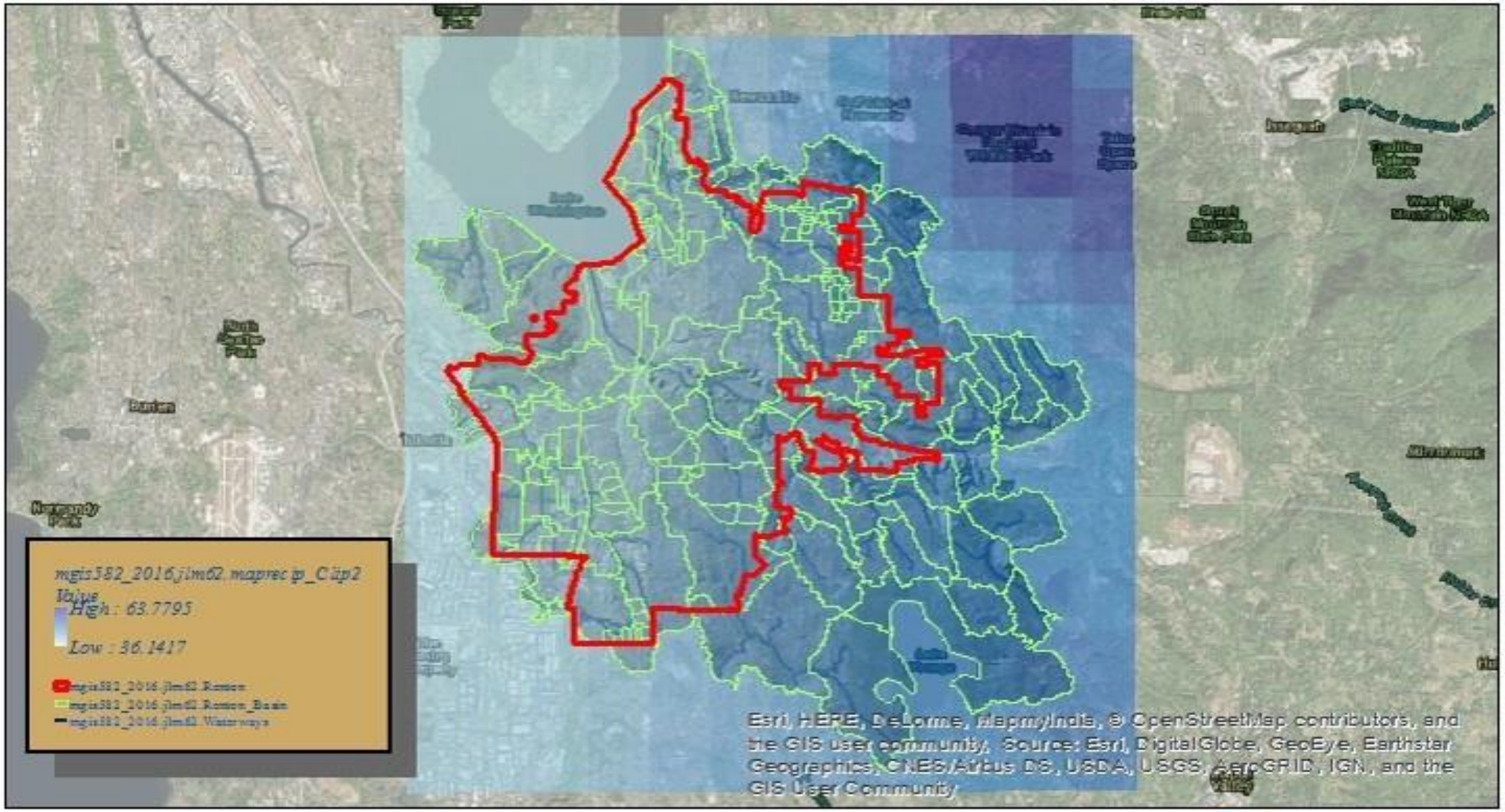
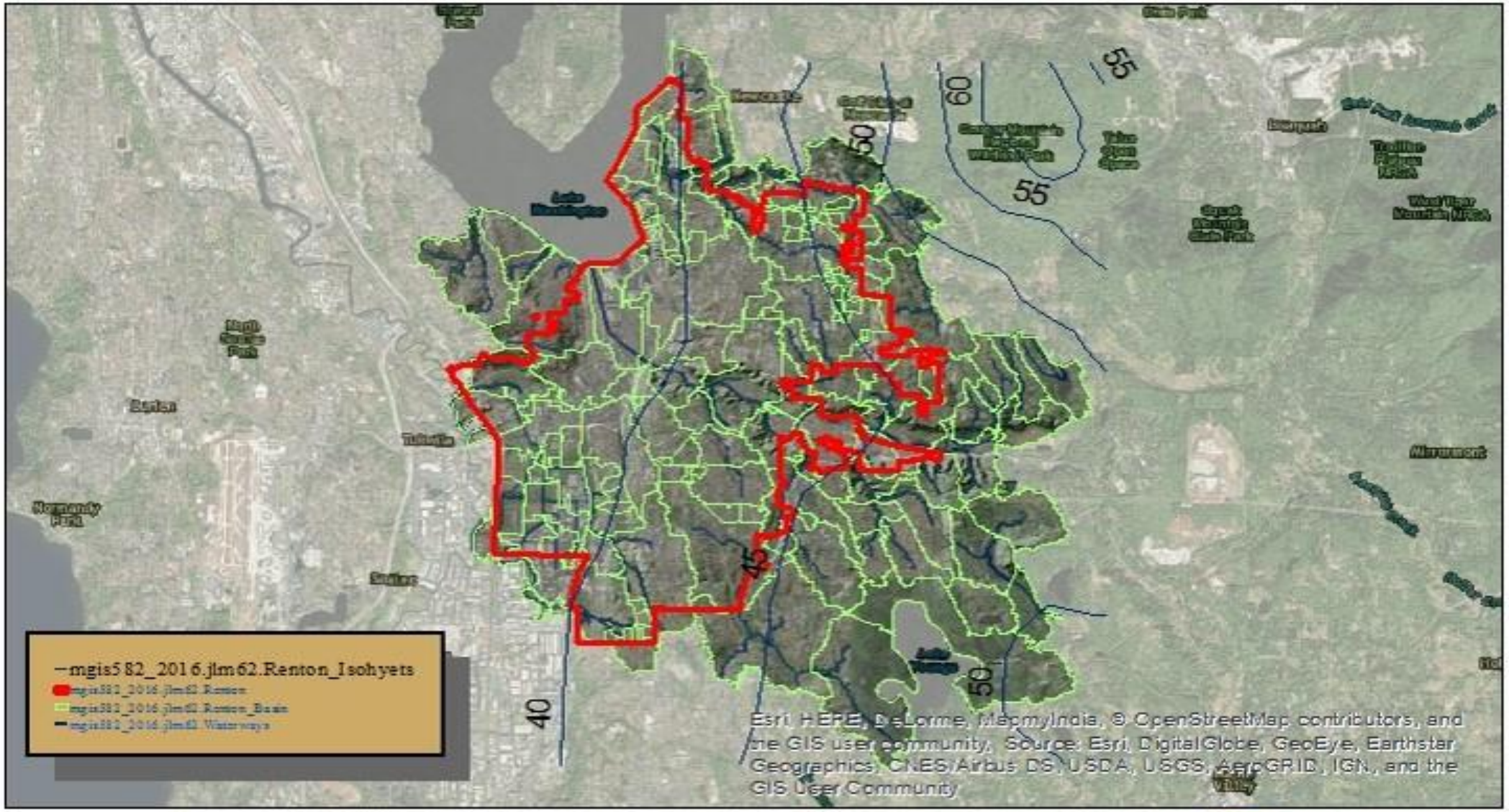
Renton Drainage Basins Area Mean Annual Precipitation (inches)



Map by John Marshall and Kelly O'Bennick - November 23, 2016
Source: Varied Data Cited in Report

Renton Drainage Basins Area Mean Annual Precipitation (inches)

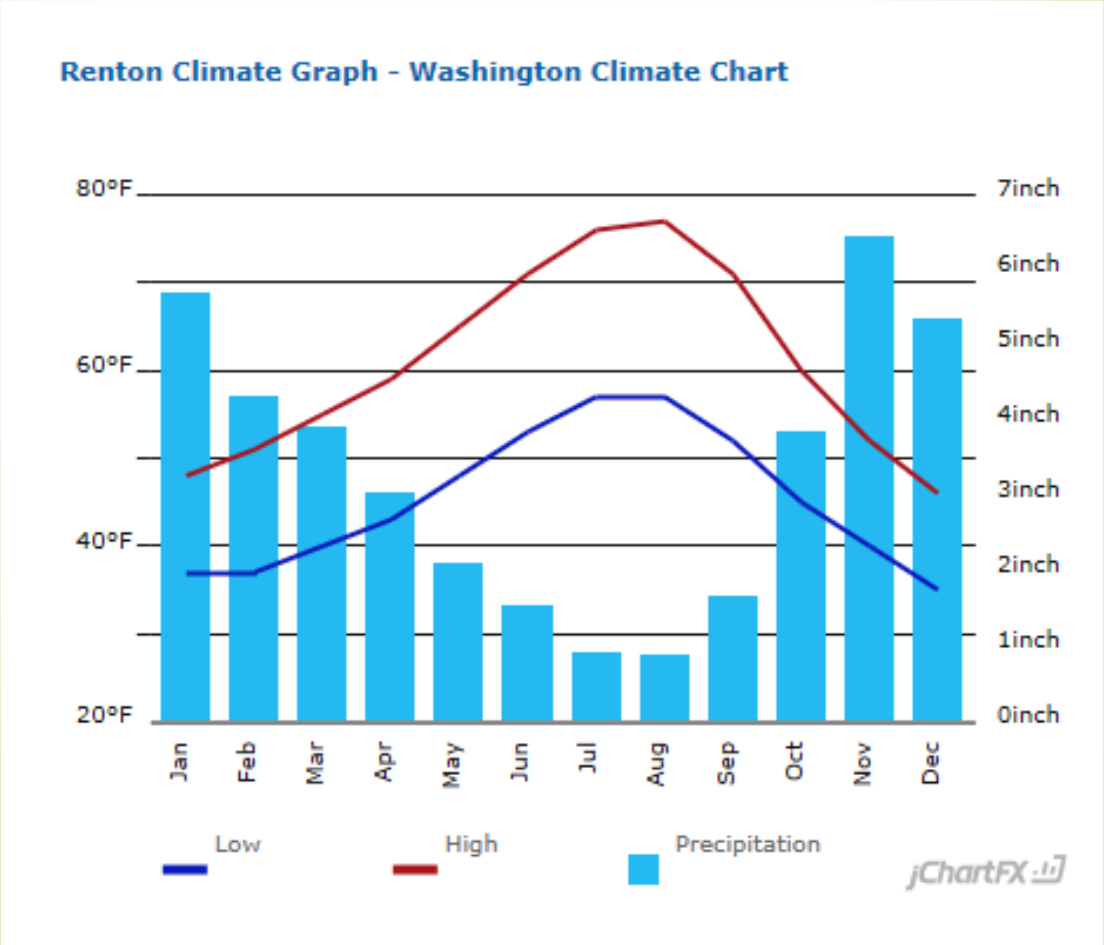


Map by John Marshall and Kelly O'Bennick - November 23, 2016
Source: Varied Data Cited in Report

Renton Annual Precipitation and Temperature

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F:	48	51	55	59	65	71
Average low in °F:	37	37	40	43	48	53
Av. precipitation in inch:	5.71	4.33	3.94	3.07	2.13	1.57
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-

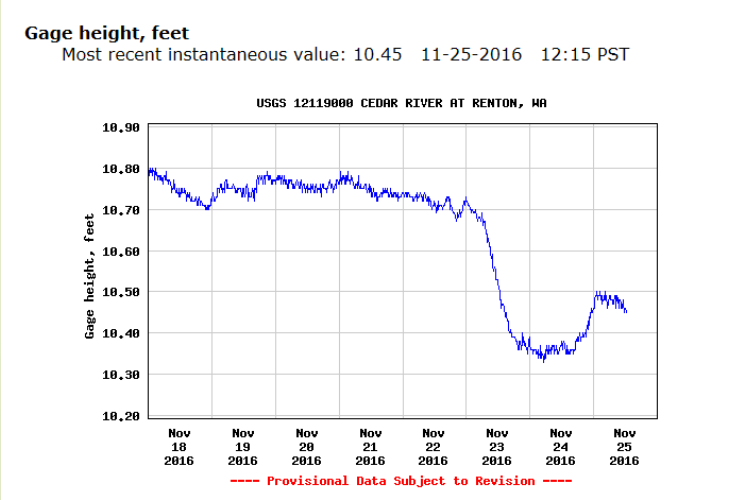
	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F:	76	77	71	60	52	46
Average low in °F:	57	57	52	45	40	35
Av. precipitation in inch:	0.94	0.91	1.69	3.86	6.46	5.39

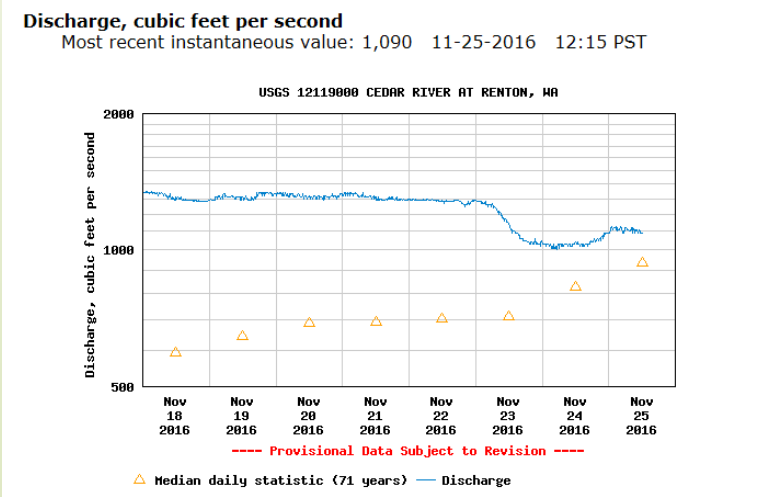


Source: http://www.usclimatedata.com/climate/renton/washington/united-states/uswa0824

USGS Renton Cedar River Gaging Station Data

(47.482348, - 122.202875)





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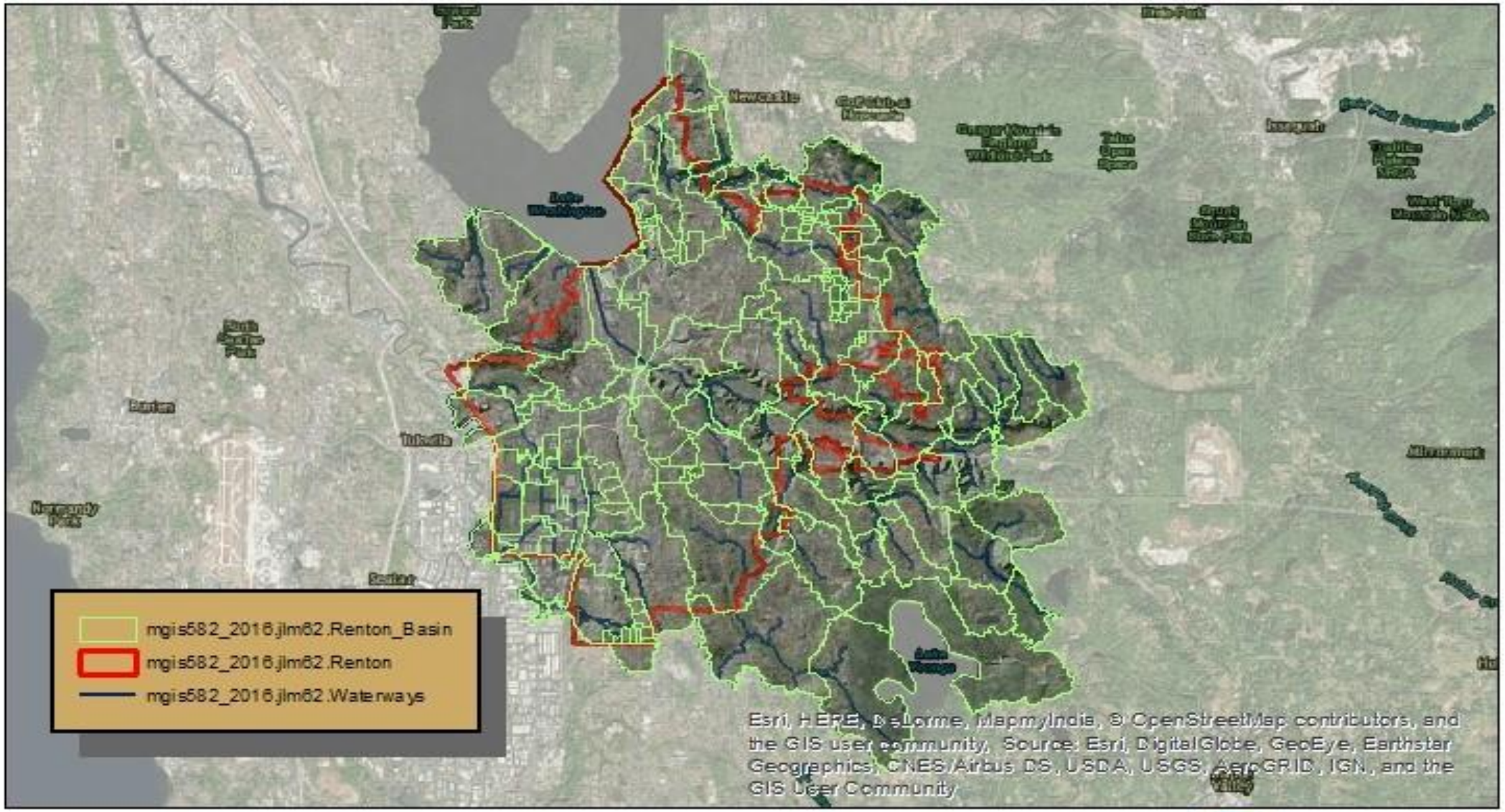
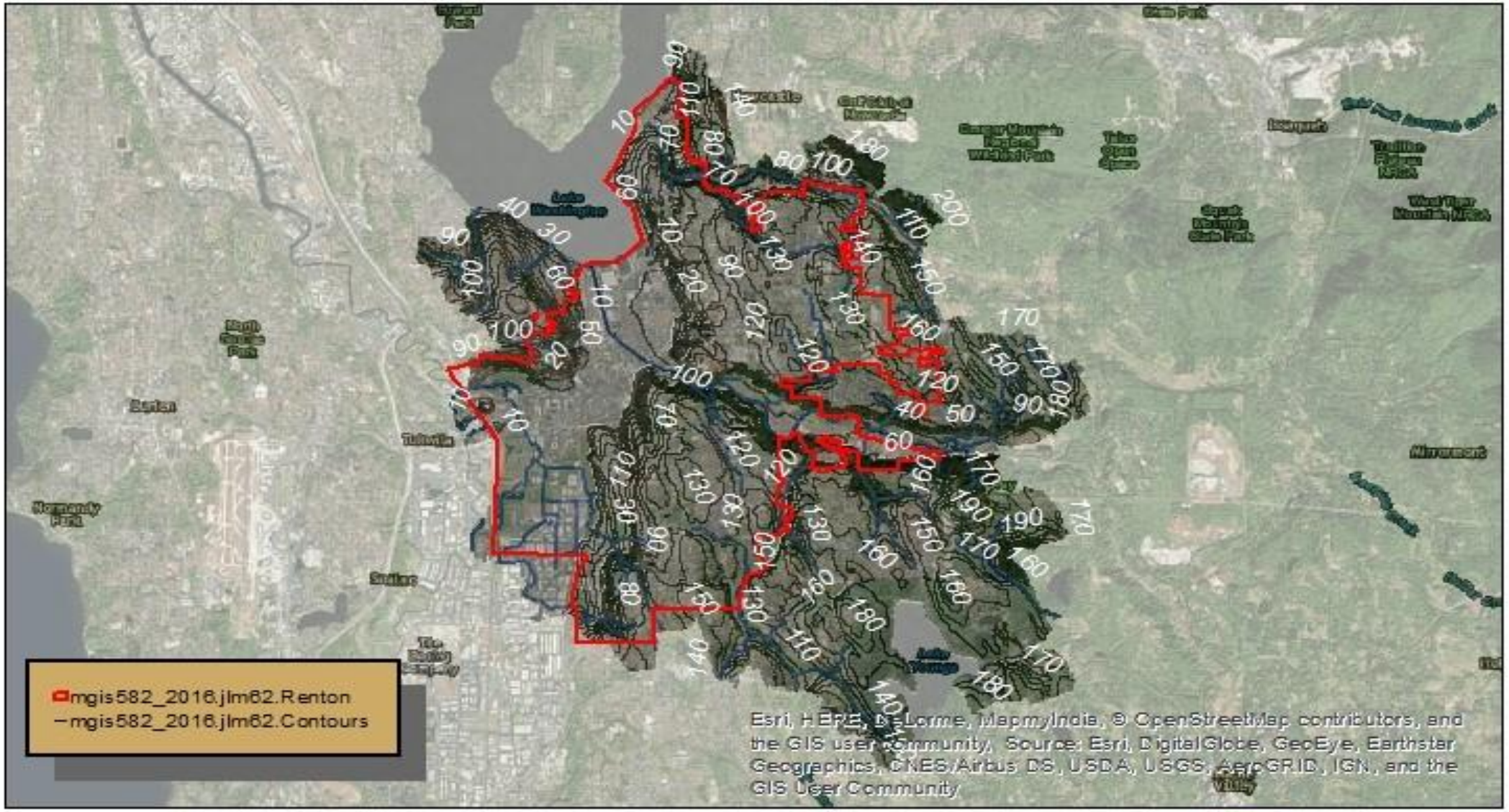
Renton Drainage Basins and Waterways



Map by John Marshall and Kelly O'Bennick - November 23, 2016
Source: Varied Data Cited in Report

Renton Drainage Basins Area Elevations (feet)



Map by John Marshall and Kelly O'Bennick - November 23, 2016
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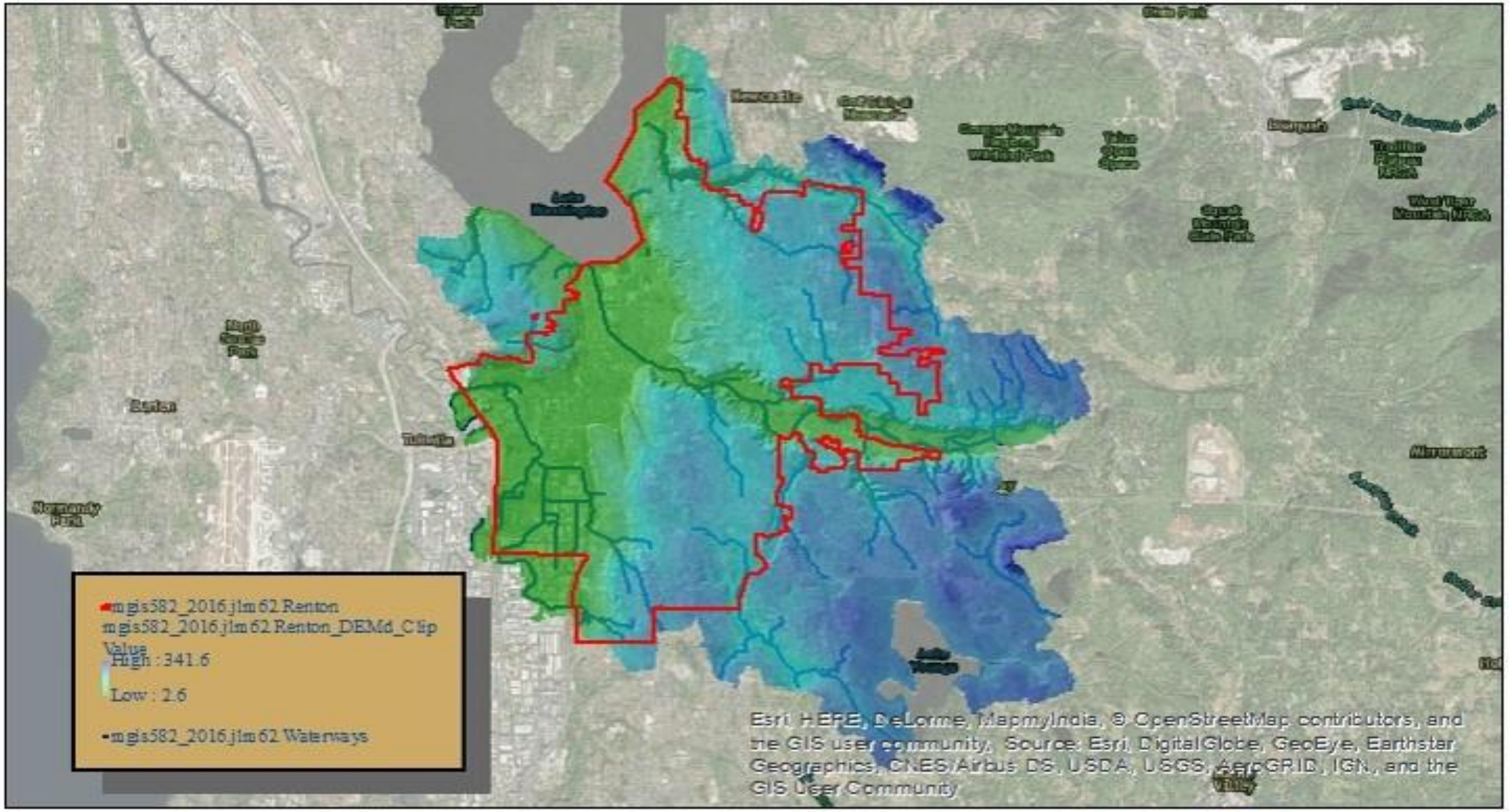
Renton Drainage Basins Area Elevations (feet)

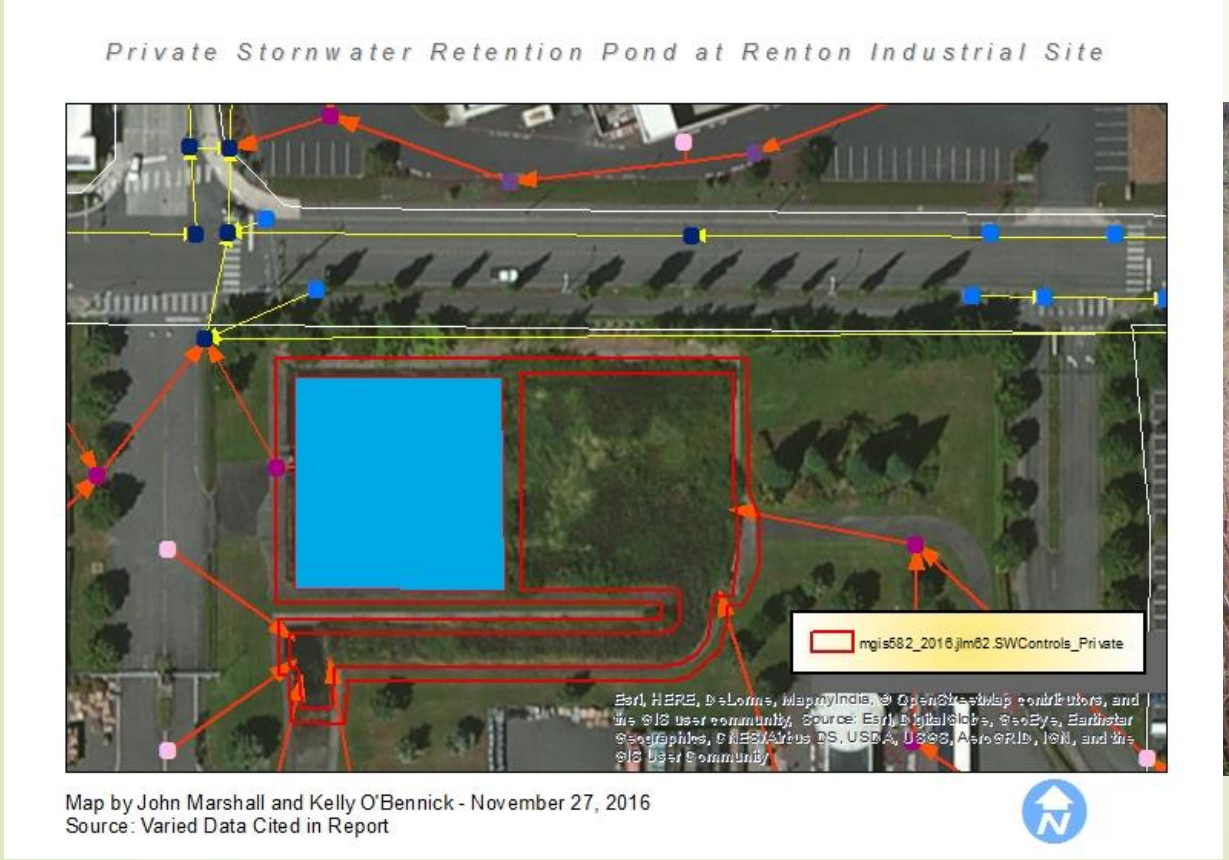


Map by John Marshall and Kelly O'Bennick - November 23, 2016
Source: Varied Data Cited in Report

Example of Renton Public (Yellow) and Private (Red) Stormwater Pipe System Near South Shore of Lake Washington

Map by John Marshall and Kelly O'Bennick - November 23, 2016
Source: Varied Data Cited in Report

Example of Existing Stormwater Detention Facility

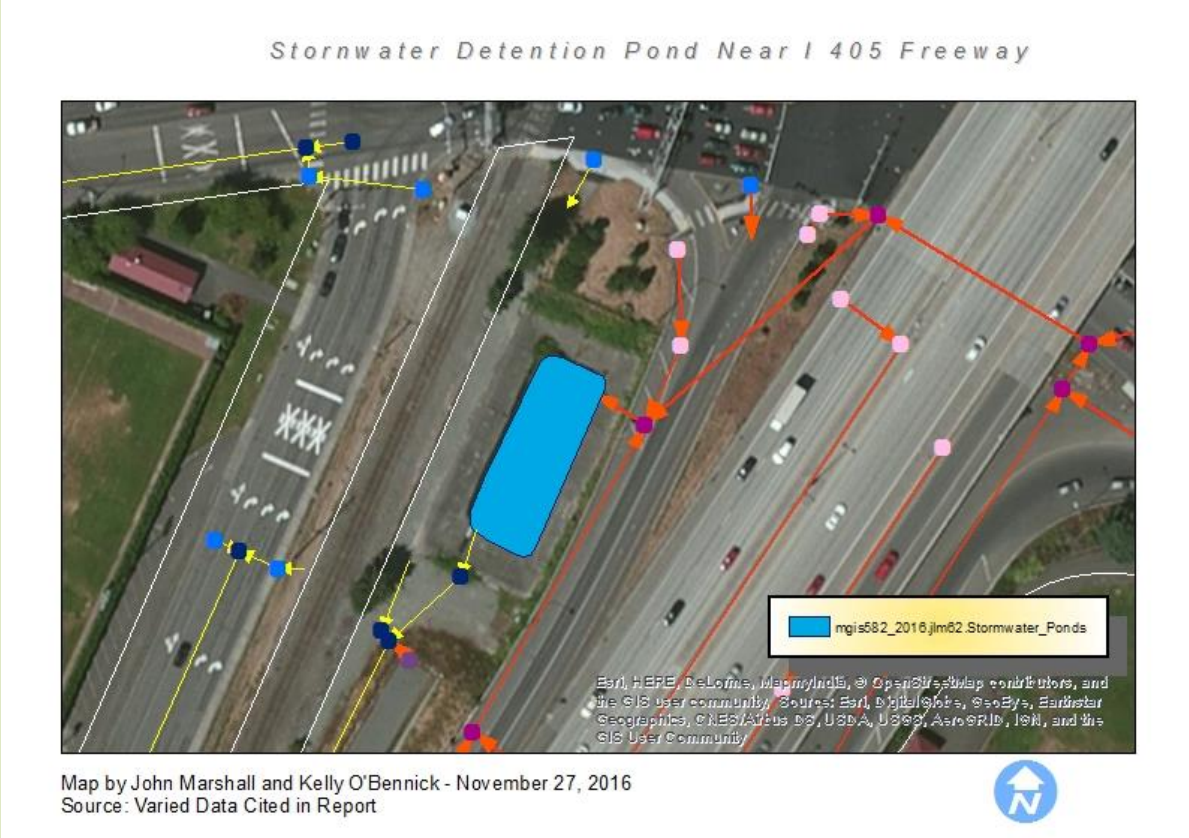


47.495285, -122.197991

Example of Existing Stormwater Detention Facility

47.495342, -122.194065

Example of Existing Stormwater Detention Facility



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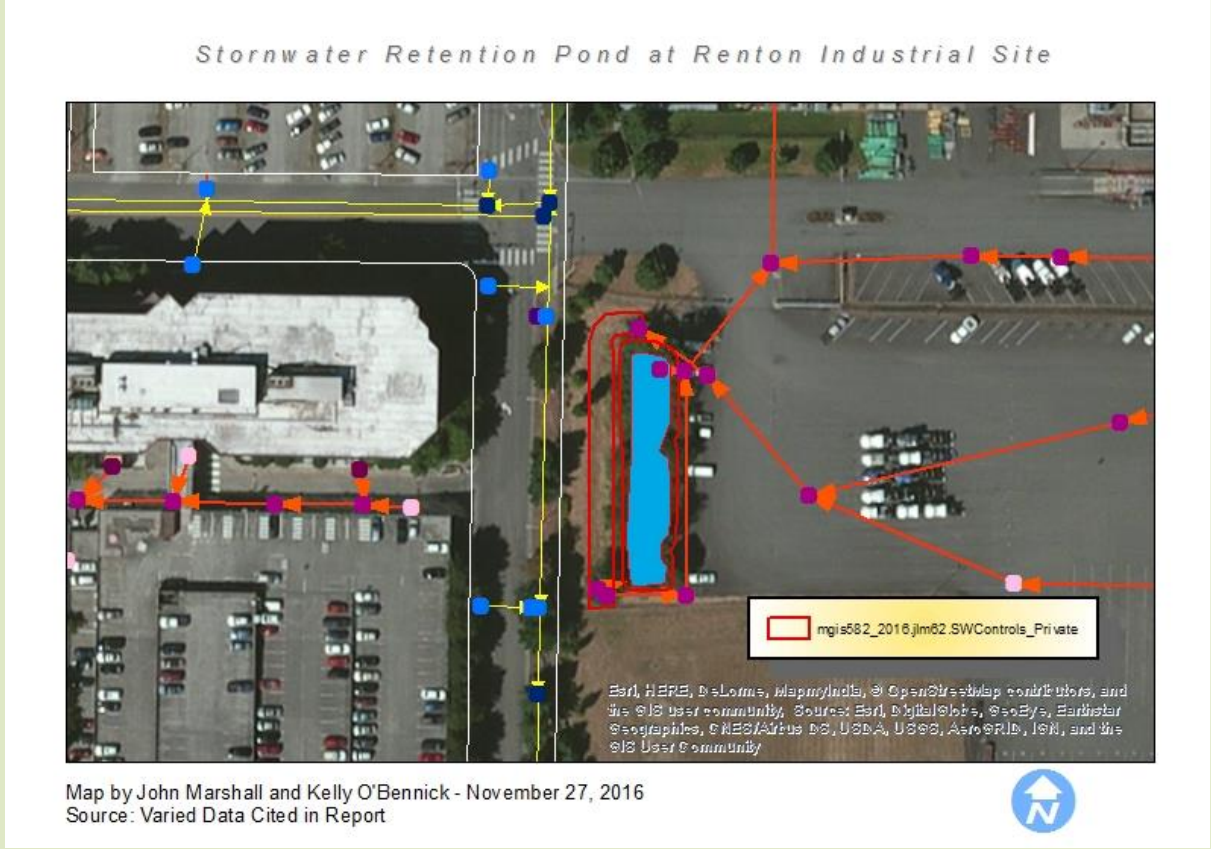
Example of Existing Stormwater Detention Facility



47.491694, -122.200046

Representation Work Flow Alternative 1

Step 1. Select by location parcels within 100-feet of a public stormwater pipe.

Step 2. Of the selected parcels select the parcels with centroid inside an open space feature.

Step 3. Export selected parcels to first intermediate open space proximate to stormwater pipe infrastructure feature class;

Step 4. Select by location parcels within 100-feet of a public stormwater pipe;

Step 5. Of the selected parcels select the parcels with centroid inside a park feature;

Step 6. Export selected parcels to second intermediate park proximate to stormwater pipe infrastructure feature class;

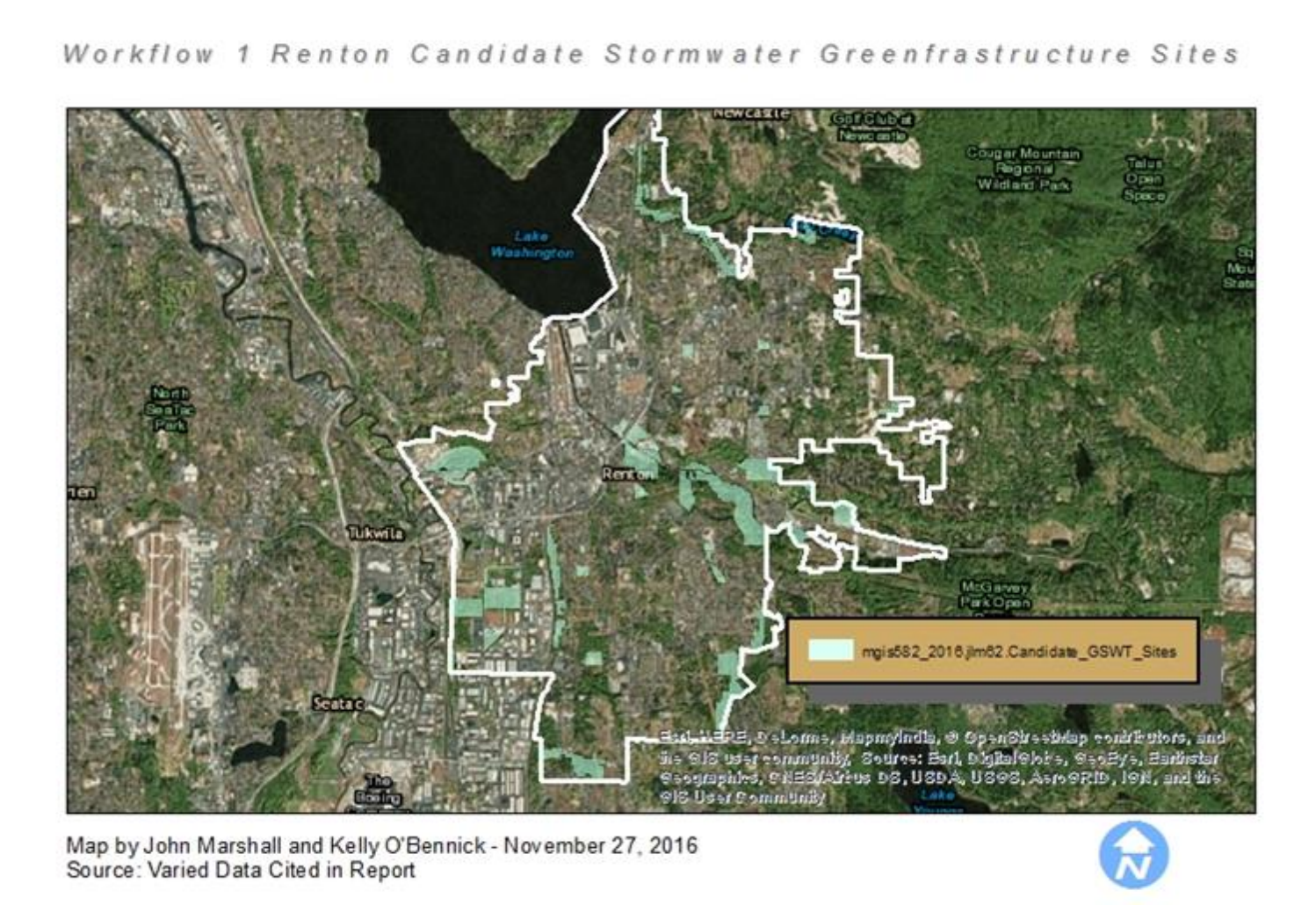
Step 7. Merge the two intermediate feature classes to create third single intermediate feature class

Step 8. Select by attribute parcels in City of Renton, King County, or State of Washington ownership.

Step 9. Export selected parcels to final feature class representing candidate sites for the protection of existing or creation of new stormwater green infrastructure.

Results Alternative 1

NumberSites	Acres	MaxSize (acres)	MajSize (acres)
277	1,524.5	52.5	< 1.0



Representation Work Flow Alternative 2

Step 1. Select by location parcels within 50-feet of a private stormwater pipe.

Step 2.Of the selected parcels select the parcels with centroid inside an open space feature.

Step 3.Export selected parcels to first intermediate open space proximate to stormwater pipe infrastructure feature class;

Step 4.Select by location parcels within 50-feet of a private stormwater pipe;

Step 5. Of the selected parcels select the parcels with centroid inside a park feature;

Step 6.Export selected parcels to second intermediate park proximate to stormwater pipe infrastructure feature class;

Step 7.Merge the two intermediate feature classes to create third single intermediate feature class

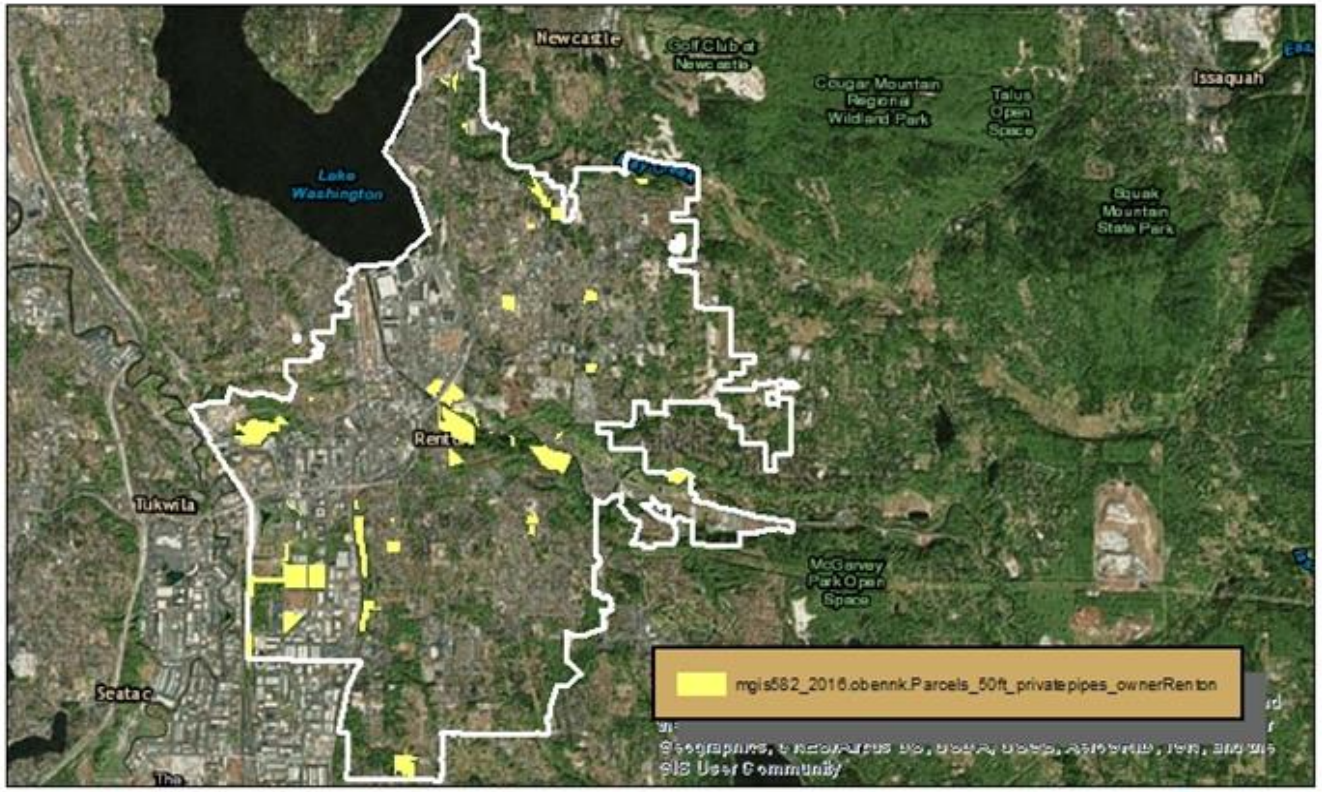
Step 8.Select by attribute parcels in City of Renton ownership.

Step 9.Export selected parcels to final feature class representing candidate sites for the protection of existing or creation of new stormwater green infrastructure.

Results Alternative 2

NumberSites	Acres	MaxSize (acres)	MajSize (acres)
119	753.1	44.1	<.5

Workflow 2 Renton Candidate Stormwater Greenfrastructure Sites



Map by John Marshall and Kelly O'Bennick - November 27, 2016
Source: Varied Data Cited in Report

Comparisons of the Alternatives
Renton Black River Area

Workflow 1 Renton Black River Area Candidate Stormwater Greenfrastructure Sites

Map by John Marshall and Kelly O'Bennick - November 27, 2016
Source: Varied Data Cited in Report

Workflow 2 Renton Black River Area Candidate Stormwater Greenfrastructure Sites

Map by John Marshall and Kelly O'Bennick - November 27, 2016
Source: Varied Data Cited in Report

Comparisons of the Alternatives
Renton Maplewood Area

Workflow 1 Renton Maplewood Area Candidate Stormwater Greenfrastructure Sites

Map by John Marshall and Kelly O'Bennick - November 27, 2016
Source: Varied Data Cited in Report

Workflow 2 Renton Maplewood Area Candidate Stormwater Greenfrastructure Sites

Map by John Marshall and Kelly O'Bennick - November 27, 2016
Source: Varied Data Cited in Report

Comparisons of the Alternatives
Renton Panther Creek Area

Workflow 1 Renton Panther Creek Area Candidate Stormwater Greenfrastructure Sites

Map by John Marshall and Kelly O'Bennick - November 27, 2016
Source: Varied Data Cited in Report

Workflow 2 Renton Panther Creek Area Candidate Stormwater Greenfrastructure Sites

Map by John Marshall and Kelly O'Bennick - November 27, 2016
Source: Varied Data Cited in Report

Challenges and Lessons Learned

- Understanding working in a SDE environment.
- Misunderstanding of LiDAR data of versions 1st return or the last return.
- Schema locks.
- Difficulty working within the concept of Geodesign.
- Communication, we used emails but we did a lot better with phone calls.
- Remember to Breathe, don't get ahead of yourself.

Conclusion

- In this project on a municipalities level, we were able to determine some opportunities for candidate green storm water Infrastructure for both public and private pipes within the city of Renton. This is the 1st draft inventory, we didn't not want to prematurely exclude any GWI opportunities, our next steps would be using more landscape variables to refine our search to find more green storm water infrastructure opportunities.
- 2 alternative workflows based on stormwater pipeline proximity to publicly owned parkland & open space were designed to select and represent a list of potential candidate stormwater greenfrastructure sites in the City of Renton.

  Alternative 1 inventory list of 277 candidate publicly owned sites covering over 1,500-acres.

  Alternative 2 inventory list of 119 candidate sites owned by the City of Renton covering over 750-acres.

  - Limited search and selection criteria were used and there was no attempt to classify candidate sites by their relative fitness matches with specific stormwater control types.
- There may be opportunities for upgrading some or all of these facilities to be in better conformance with modern green stormwater infrastructure design and performance.

Future Considerations

- End of the year 2016- Most of the Municipalities in King County will go into Phase 2 of the storm water permits. Any new development and redevelopment in those cities will be required to meet a higher bar for installing green stormwater infrastructure controls to off-set the adverse effects of their development
- Regulatory programs tend to target a "no-net-loss" ideology using project-by-project concepts of pre-development and post-development. To achieve some benchmark of historical recovery for a region like the Puget Sound, government grant programs will likely be required to fund protection of existing and development of new green stormwater infrastructure above and beyond that which is required in the NPDES Stormwater regulatory program. Inventories like those generated in this report are more likely to be used to help facilitate broader grant programs such as these.

QUESTIONS?

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