NEWBURGH/NEW WINDSOR WATERSHEDS PROJECT

Final report on current conditions and proposed remediation actions for the Silver Stream watershed

Prepared for the New York State Department of Environmental Conservation by Students of Cornell University's College of Art Architecture and Planning as part of CRP 3072/5072: Environmental Planning Workshop

Silver Stream Team:

Ada Chan – Architecture. New Jersey. Collaborative design.

Aundrea Cruz – MRP.

Sage Magee – URS. Huntington Beach. Climate adaptive design.

Lilah Rosenfield – URS. Salt Lake City. Social and environmental justice.

Chris Tae Seo Lee – URS. Seoul. *R*eal estate development.

Yuncheng Wang – URS. Shanghai. *Green storm water i*nfrastructure development.

Course Instructor/Project Advisor:

George Frantz

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Introduction

The research, analysis, and recommendations presented in this report were completed by a project team composed of Cornell University students from the college of Architecture Art and Planning, as part of the Spring 2018 AAP curriculum workshop course (CRP 3072/5072: Land Use/Environmental Planning/ Urban Design Field Workshop). Our team engaged in work for the client, the NYS Department of Environmental Conservation. The work culminated in this final written report, which details research around the runoff sources that have contaminated the SIlver Stream watershed, which provides the City of Newburgh's public water supply. In addition, the report compiles possible techniques to mitigate urban rainwater runoff and suggests a few specific interventions for the Town of New Windsor. While the effort has been largely student led, the instructor advised the team on various aspects of project management, and monitors progress throughout the semester.

History

PFOS Contamination in Newburgh

The City of Newburgh is located in Orange County, New York, on the Hudson River. It is surrounded by the town of Newburgh and the Town of New Windsor. In 2014, the U.S Environmental Protection Agency (EPA) received reports of contamination of Newburgh's water supply. In compliance with the EPA Unregulated Contaminant Monitoring Rule (UCMR), the agency ordered that of the water supply be tested. From December 2013 to October 2014, the city identified four samples which contained between 140 and 170 Parts Per Trillion of perfluoroctanesulfonic acid (PFOS). These results were provided to the EPA and to the public in the Annual Water Quality Report.

PFOS is a commonly used man-made chemical in the production of paper, waxes, polishes, paints, varnishes, and cleaning products, and a fire suppressant. When released into the environment, however, it becomes a contaminant. PFOS has been shown to be toxic to living organisms—not only to humans but also to wildlife and vegetation. The EPA addressed the PFOS's severe health effects such as high cholesterol and adverse reproductive and developmental effects. In addition, it can also potentially cause cancer. Despite its short-term exposure, PFOS can persist for years in organisms and the environment and accumulates with additional exposure.

In 2017, the Department of Environmental Conservation(DEC) announced the storm water outfalls on the Steward Air National Guard Base were the main source of toxic PFOS in the region. Since 1990, firefighting foam concentrate used in exercises and equipment testing on the Steward Air National Guard has flowed through the Air Base rainwater collection system and out into the watershed. The contaminants eventually flowed into Lake Washington and downstream waters. Importantly, the Lake Washington is the Newburgh's primary reservoir that lies within the Quassaick Creek Watershed with a diversion from Silver Stream, directly influencing the city's water supply. According to the tested samples from EPA, the two properties above together have at least 20 outfalls releasing into the watershed for Newburgh's drinking water.

In response to the contamination, Newburgh received permission from New York City to temporarily tap the Catskill Aqueduct and use its water. Within months, the city and NYSDEP had finished construction on a state-of-art water filtration system that is able to remove the PFOS after it has been drawn from Lake Washington. This resolved the immediate water crisis, but problems for the watershed still remain.

Existing Conditions

Problem Areas and Positive Examples

While the PFOS contamination has been temporarily mitigated, the contamination of the Silver Stream has shown that the existing conditions within Silver Stream watershed must be critically reexamined. As we describe in this following section, water protection laws have not be effectively enforced or implanted in critical parts of the watershed. This problem is especially acute in the eastern corner of the watershed, mapped in *Fig 1* Below.

Figure 1: Overview map of Little Britain Road (Red) and Union Avenue (Blue)
Note Lake Washington to the East of Union Ave
Source: Google Earth

There is an immediate need for storm drains of road shoulder storm water management along Little Britain Road. The only places that have storm drains are the intersections with residential streets with drains. Little Britain Road is a long arterial road that adds a substantial amount of impermeable surface to Newburgh. Without adequate road drainage system, pavement failure, pavement distresses, and pavement deterioration can occur along Little Britain Road. Hence, a proper and efficient surface drainage system to enhance road quality and increase the lifespan of pavement.

Little Britain Road and Union Ave, in the western section of New Windsor and the Silverstream watershed, are storm water management focus areas. They demonstrate both poor and preferable storm water management practices for commercial lots.

Problem Areas:

Little Britain Road

Shown in red, most of Little Britain Road lacks curbs and lacks storm drains. In addition to the safety risk of water pooling and potentially causing hydroplaning for cars traveling at highway speeds, the unmanaged runoff from Little Britain deposits substantial pollution in the watershed. Since there is no filtration mechanism from runoff to the water supply, street pollutants are only filtered by the intermediary flora. This is inconsistent along the road and inadequate for effective storm water management.

It is possible that there is a limited amount of runoff collection in very simple detention basins and ditches along Little Britain. There are roadside cuts that are either drainage ditches or poorly maintained road shoulders. As a result, it is difficult to catalog these ambiguous features in any reliable or comprehensive way, and therefore they have not been taken into consideration for the purposes of this analysis.

Cafe Spice Distribution Center

A noteworthy example to illustrate the dangers that insufficient storm water management poses to the Silver Stream watershed is a spice distribution facility just east of Lake Washington.

Figure 2: Cafe Spice Truck at Distribution Center
677 Little Britain Road

Cafe Spice distribution center on Little Britain road is at the top of a small hill to the northwest of a pond. The parking lot is flat and appears to be without any drains, barriers, or on-site storm water management and consequentially parking lot runoff goes into the pond. In the event of an accident, there could be substantial quantities of spices draining into the pond and disrupt the natural balance of the water. Locations such as this should manage runoff on-site and prevent

Figure 3: Google Earth overview of Cafe Spice & Pond
Source: Google Earth

drainage into the pond. Diverted storm water that is captured onsite could drain to other retention infrastructure at the bottom of the hill which might be shared with nearby businesses.

Positive Examples

Union Avenue

Union Ave, highlighted in blue, is largely new construction and the road appears to have been repaired and renovated recently. This road is substantially wider than Little Britain Road and has storm drains down the extent of the road. Given how spacious it is, there is ample opportunity to divert some of the storm drain water into rain gardens or other green storm water management facilities.

Figure 4: Google Earth overview of The Reserve, facing east towards the runoff collection ponds and Brown's Pond

The Reserve

In addition to Union avenue, the Silver Stream watershed has instances of well-managed storm water. An excellent example of this is the "The Reserve" neighborhood on the southeastern tip of Brown's Pond. In this newer tract home development there is both collection and treatment of the storm water. In the neighborhood, there is a self-contained system of drains and a multi-stage series of filtration ponds adjacent to Brown's Pond. The exact nature of the drains and system isn't publicly available since The Reserve is a private community but after mapping the drains and outflows it appears to be similar to public projects.

Figure 5: A view one one of the reserve's detention ponds from Reserve Run Rd. Note the Mt. Ariy Rd Causeway across Brown's Pond in the background.

Summary of Existing Conditions

Taking a broader view of the properties within the watershed, it is clear that new laws regarding storm water management have made a substantial impact on the built environment and improved storm water capacity. However, since most of the real estate in Newburgh and New Windsor was constructed before these requirements went into effect, there is still a substantial amount of the town in need of better storm water management practices.

In addition to implementing an effective drainage system, the town should engage in annual evaluation of drainage systems. Maintenance is a crucial part of managing roads, and the drainage network should be considered part of the road system. Drainage system improvement and maintenance should be town priority, as it can effectively reduce the cost of pavement maintenance.

In general, immediate implementation of storm water management along Little Britain Road is needed. It can improve the quality of the road and reduce its vulnerability to water.

Comparable Interventions

Constructing an effective storm water management system for Little Britain is an intensive project that will require thoughtful and creative consideration of the various costs and benefits of potential interventions. Municipalities around the country and the world have faced similar problems and come up with a variety of solutions. The project team analyzed various storm water management precedents in cities and towns worldwide, and suggests some combination of the following management techniques, scaled to fit the needs of the Village of New Windsor.

Intervention Types

This study examines various green infrastructure techniques that have been used to protect watersheds like Silver Stream from contamination. These techniques can be categorized as hard or soft engineering. Soft engineering uses biological and geographic features that either occur in the watershed naturally or that have been engineered to mimic natural conditions. Hard engineering uses solutions to

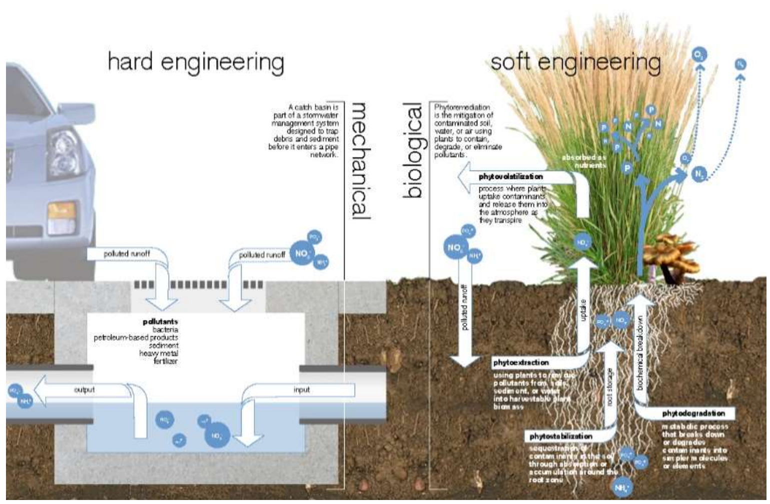


Figure 6: Hard and soft engineering
Source: Low Impact Development: A Design Manual for Urban Areas

armor the watershed with fixed elements. This study gives the communities within the Silver Stream watershed a better idea of the various solutions available for creating a cleaner environment.

Hard Engineering

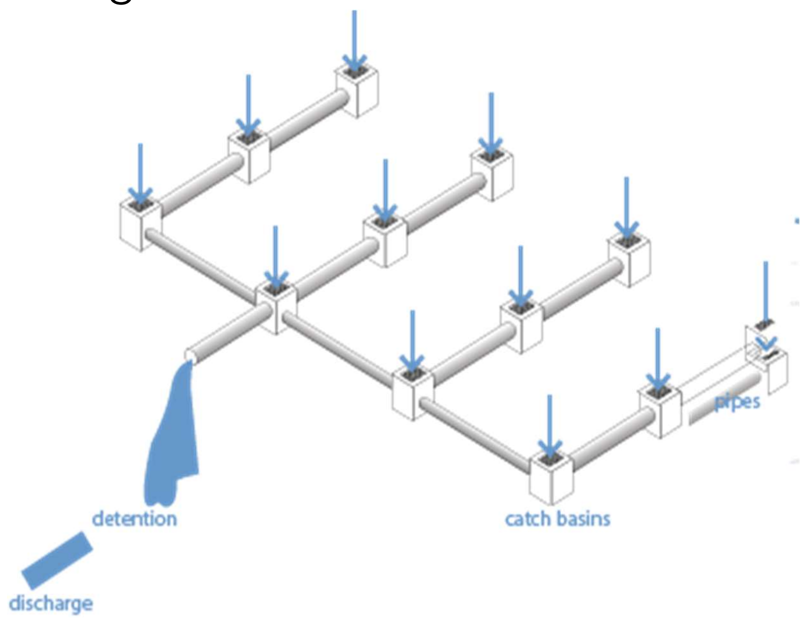


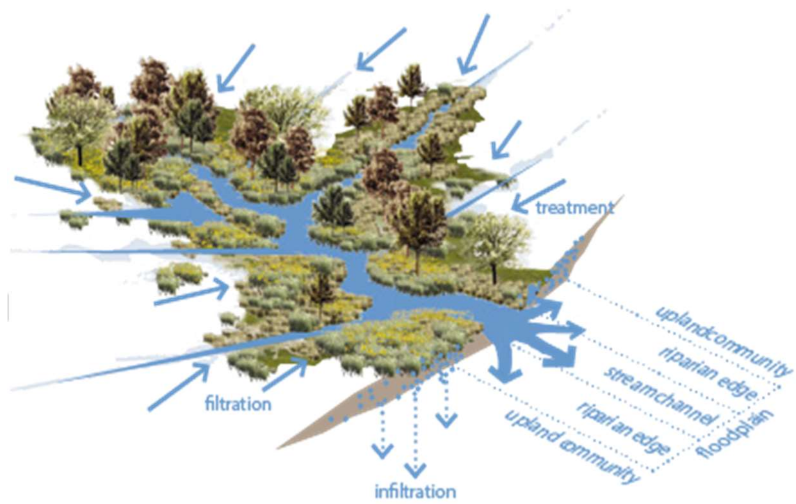
Figure 7: Conventional Hard Engineering
Source: Low Impact Development: A Design Manual for Urban Areas

Hard engineering is typically based on a piping system which transfers storm water runoff from the focus site to a location where it can be stored, detained, or discharged with a

Figure 8: Types of Hard Engineering
Source: Low Impact Development: A Design Manual for Urban Areas

smaller ecological impact. These infrastructure channels move runoff through pipes, catchment basins, curbs and gutters

Soft Engineering



Soft engineering utilizes Low Impact Development (LID) as a storm water management approach and favors ecological solutions. It remediates polluted runoff through a network of distributed treatment landscapes. Runoff flows to a location where vegetation treats pollutants.

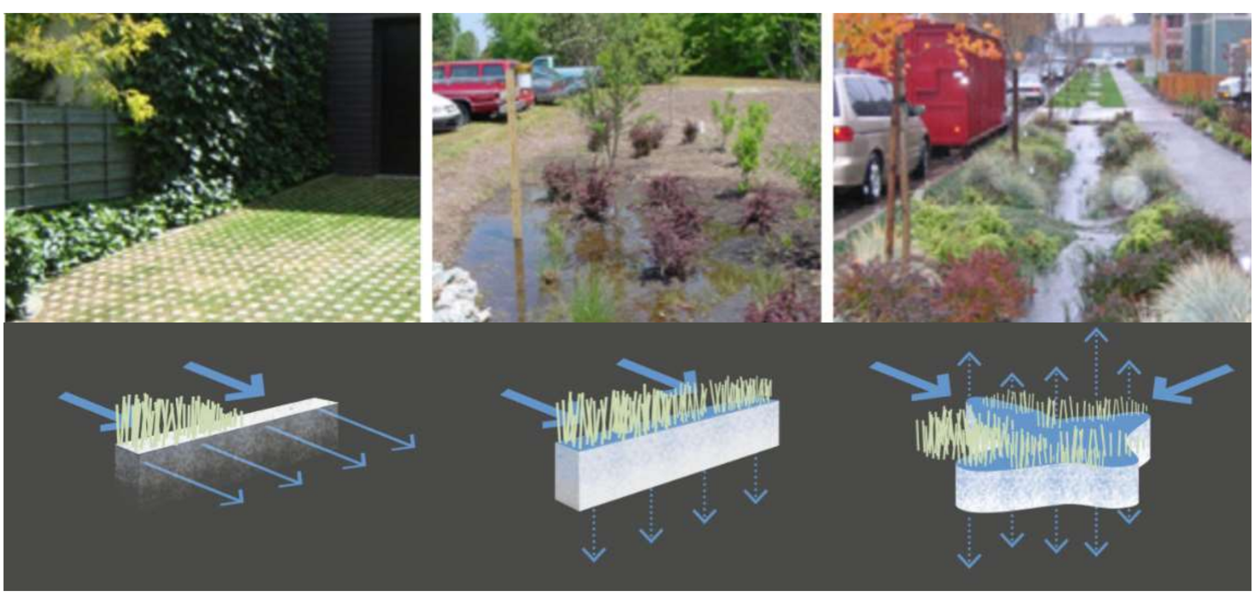


Figure 9: Types of Soft Engineering
Source: Source: Low Impact Development: A Design Manual for Urban Areas

American Storm water Precedents

Biofiltration

Biofiltration is the use of plants and other natural systems to reduce pollution in a water system.

Figure 10: Bioswales
Source: CalTrans; http://bit.ly/silverfigC5

Biostrips

Biofiltration Strips, also known as vegetated buffer strips, are vegetated sections of land over which storm water flows as sheet.

Bioswales

Biofiltration Swales are vegetated channels that receive and direct the concentrated flow of storm water.

Figure 11: For the Ala Wai Watershed Storm water BMPs on Oahu Project, median areas between the freeway off ramps, were converted into bioswales. The bioswales consist of an under drain system, which includes a perforated drain pipe and engineered soils that provide filtering. Above this, native vegetation was planted to slow and filter storm water as it first enters the bioswales. Additionally, the design includes an outfall structure that forces storm water to pond in the median allowing more time for infiltration into the under drain or evaporation.

Source: Hawaii Storm water Project/Hawaii Department of Transportation; http://bit.ly/silverfigC6

Rain gardens

Rain gardens capture runoff from street and parking stalls along main roads and can divert storm water away from sewers and bodies of water

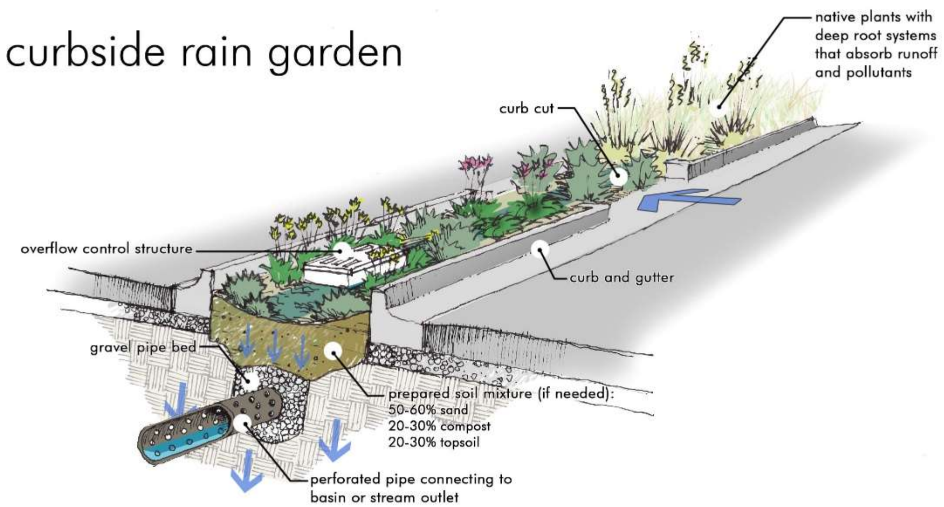


Figure 12: Illustration of a curbside rain garden
Source: http://www.saveitlancaster.com/local-projects/sidewalks/

Curbside Rain garden

Curbside rain gardens require only limited intervention but can significantly improve storm water retention and filtration for a street or neighborhood.

Figure 13: New Seasons Market in Portland, Oregon, installed a ring of interconnected storm water swales. Three storm water planters within a 6-foot planting strip between the sidewalk and street curb slows and filters runoff from Division Street.

Source: City of Portland: http://bit.ly/silverfigC8

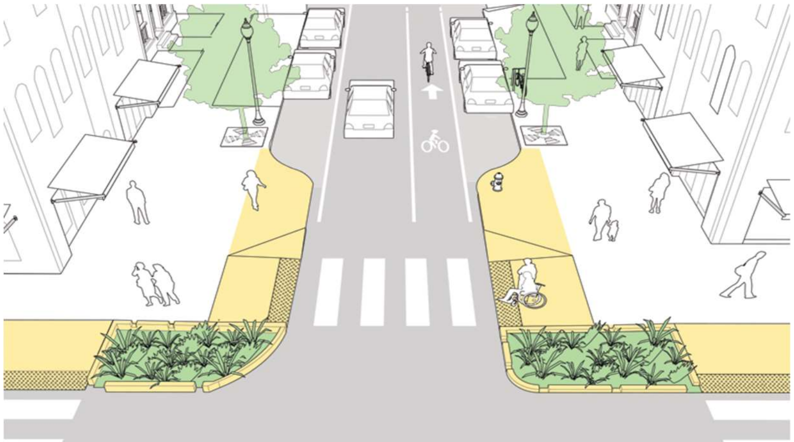


Figure 14: Illustration of a curbside extention rain garden
Source: National Association of City Transportation Officials; http://bit.ly/silverfigC9

Curbside Extension Rain garden

Curb extensions are a more significant intervention but come with addition benefits; a curbside extension increases the overall visibility of pedestrians by aligning them with the parking lane and reducing the crossing distance for pedestrians. These safety measures can be a greater streetscape asset with rain gardens.

Figure 15: Sustainable Jersey awarded the City of Hoboken a Sustainable Jersey Small Grant for rain garden curb extensions. Rain garden curb extensions will help New Jersey reach set sustainability goals of alleviating flooding by capturing stormwater runoff and further promoting walking through safer pedestrian crossings

Source: City of Hoboken; http://bit.ly/silverfigC10

Proposed Site Intervention

Reconstruction of Stewart Citgo Gas Station

1069 Little Britain Rd,

New Windsor, NY 12553

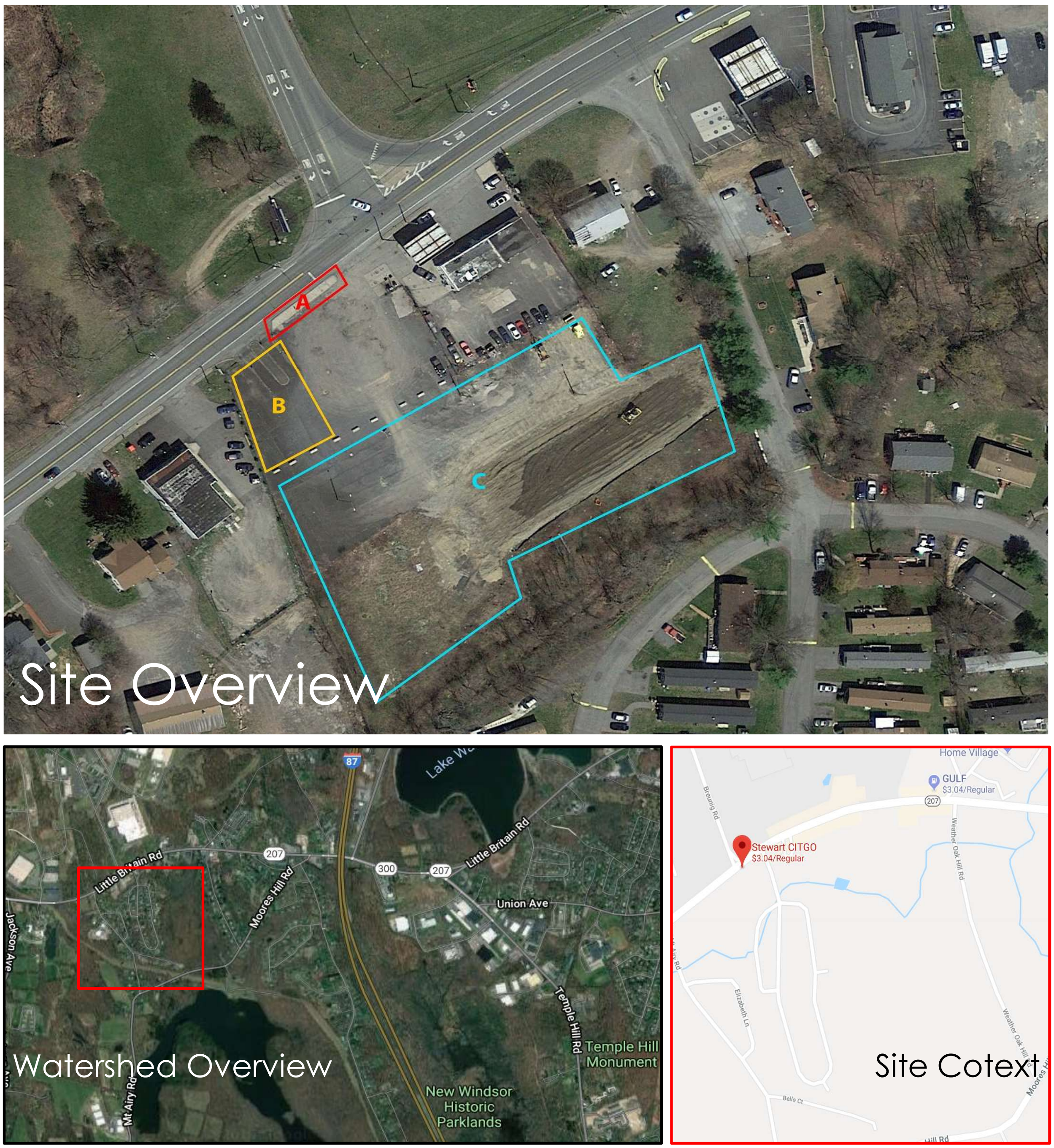


Figure 16: Site Overview and Context
Source: Google Maps

Introduction and Site Conditions

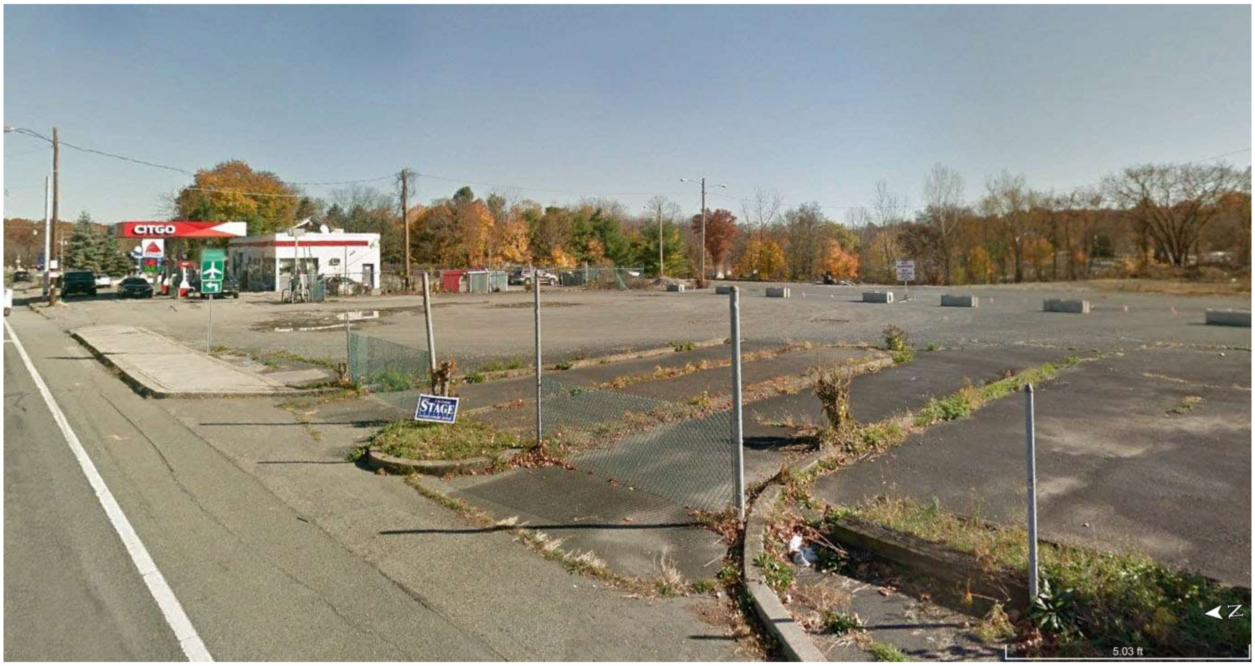


Figure 17: The site as it exists today, viewed from Little Britain Road

The Stewart Citgo Gas Station is located off of Little Britain Road, North of Browns Pond. It has stood there for over two decades as a gas station, the property barren, and largely devoid of vegetation. Heavy metals and toxic chemicals are constant concerns with parking lots and gas station making this site a prime candidate for storm water filtration systems. Storm water management is necessary on this site because of its proximity to a culvert (on the west side of the site) which directs a natural stream into Browns Pond. Water retention and filtration on the site can be used by both the gas station and the housing development southeast of the gas station.

Along the west boundary of the site, the topography naturally slopes to a small stream that feeds into the Silver Stream Reservoir. Behind the gas station, there is an unpaved patch of dirt compacted by heavy vehicle traffic but currently remains un occupied. The majority of the site is paved but only two thirds of the site appears to be actively used. Curbing near the street is minimal and is completely paved in concrete.

Proposed Interventions

Our interventions include three systems in multiple locations on the site to maximize the effectiveness of storm water management. In the map above (Fig. 11) interventions systems could be installed on the north, west and southern ends of the site.

Intervention A

The first recommended intervention for this site is to modify a number of the roadside curbs into rain gardens. Given the curb's proximity to a main road, the plantings should be short native grasses that minimize maintenance. These roadside rain gardens will help filter out the heavy metals and pollutants especially prominent in heavy traffic areas.

Figure 18: Permeable Pavers
Source: http://bit.ly/silverfigD2

Intervention B

The paved western corner of the gas station has minimal traffic. Our second recommendation is to repave this portion of the lot using porous asphalt or turf block pavers that can support vegetation while providing enough stability for vehicles when needed. Part of the asphalt paving will be replaced with these alternative paving methods which will reduce instant runoff into the stream, which will reduce flooding. In addition, water that does enter the stream will be cleaner.

Figure 19: Bioswale
Source: http://bit.ly/silverfigD3

Intervention C

The rear portion of the lot is a large, packed-dirt surface, We propose that the city work with the owners to develop part of this lot into a bioswale. This intervention would not only filter pollutants but retain and treat the water running off the site. Additionally, this bioswale could help treat pollutants running off the neighborhood development just behind the gas station.

Summary of Interventions

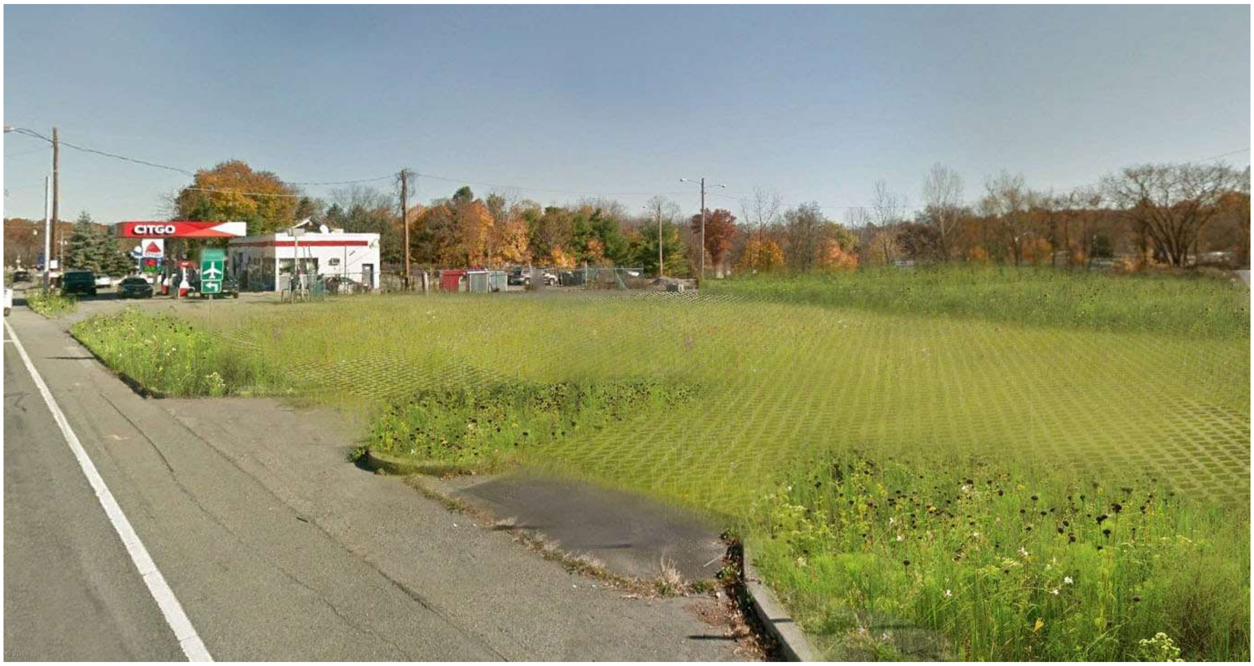


Figure 20: A rendering of the proposed interventions on the site

These interventions are proactive measures to improve the future quality of the environment and water supply. There is a limited amount of remediation these systems provide as certain chemicals, though filtered out of the water will remain in the vegetation and soil until it is manually removed through maintenance of the system or left over decades to slowly decompose (if possible). While these systems attempt to maximize the natural processes of vegetation, a certain amount of maintenance is required to ensure proper plant growth such as the removal of litter of pollutants that have accumulated.

Conclusion

The Silver Stream watershed, the primary water source for the City of Newburgh, New York, presents significant challenges as well as significant opportunities. In addition to ongoing perfluoroctanesulfonic acid (PFOS) contamination from firefighting activities on Steward Air National Guard Base, there are several roads adjacent to Silver Stream which were constructer before effective roadside storm water treatment was considered best practice. Nevertheless, we feel confident that by creatively adapting both hard and soft storm water management techniques from around the country, the town of New Windsor can work with the NYSDEC to mitigate the negative effects of storm water runoff, and ensure a clean environment for both town residents, and surrounding communities.

Appendix: Maps

In the course of preparing this report, the team assembled a number of maps using data from a variety of sources. The full collection of data is available upon request, but the following maps effectively represent much of the information we have assembled.

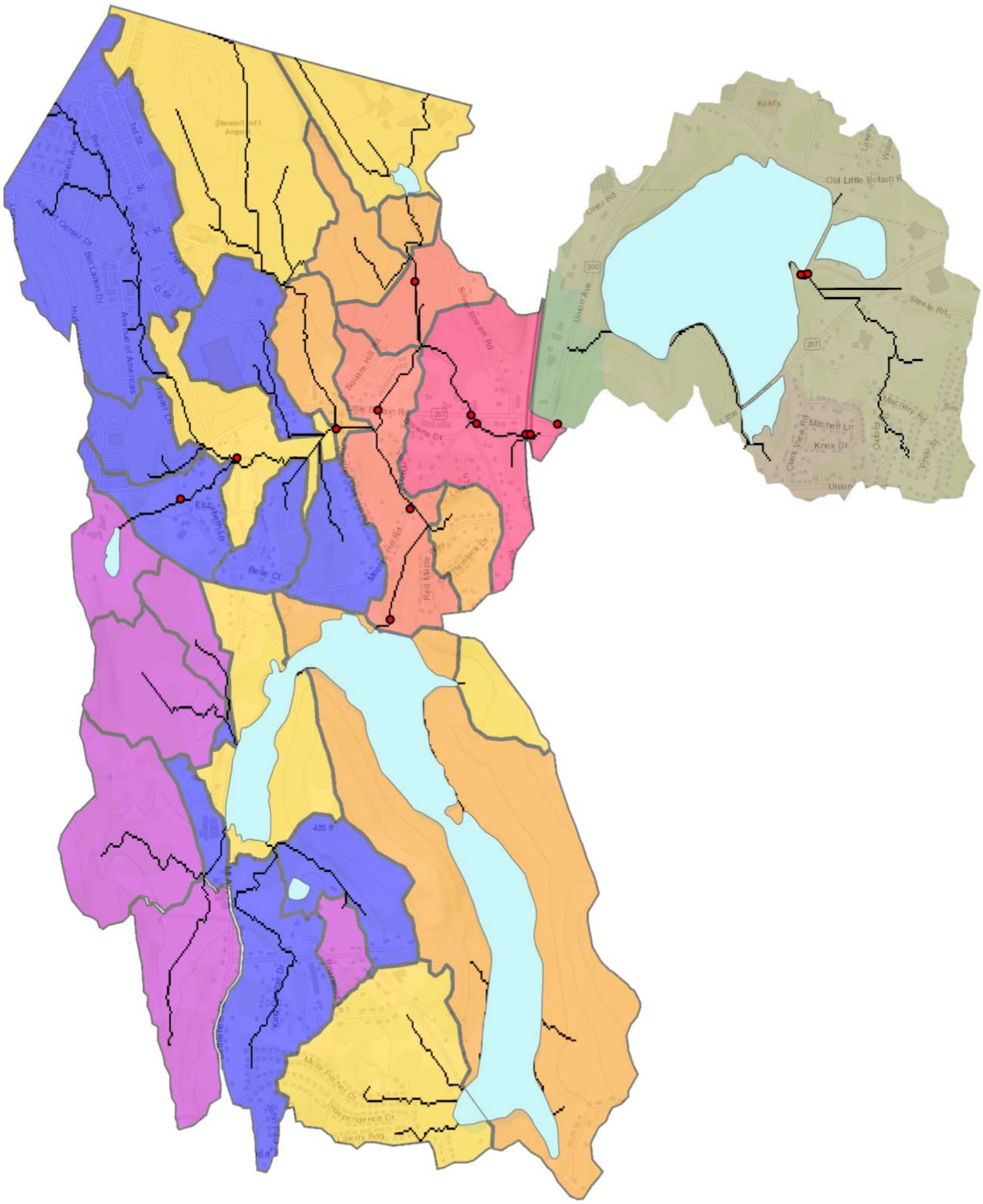
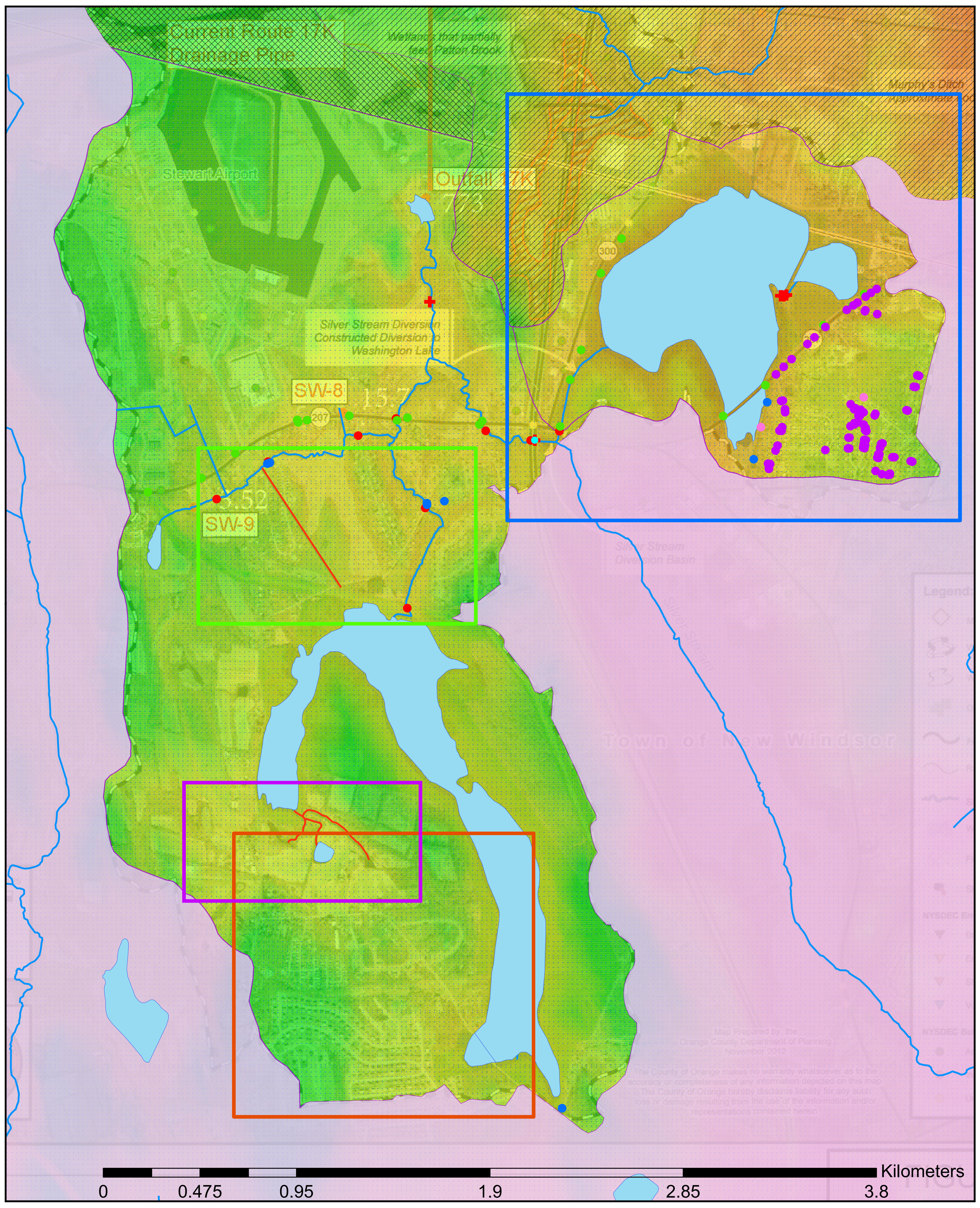


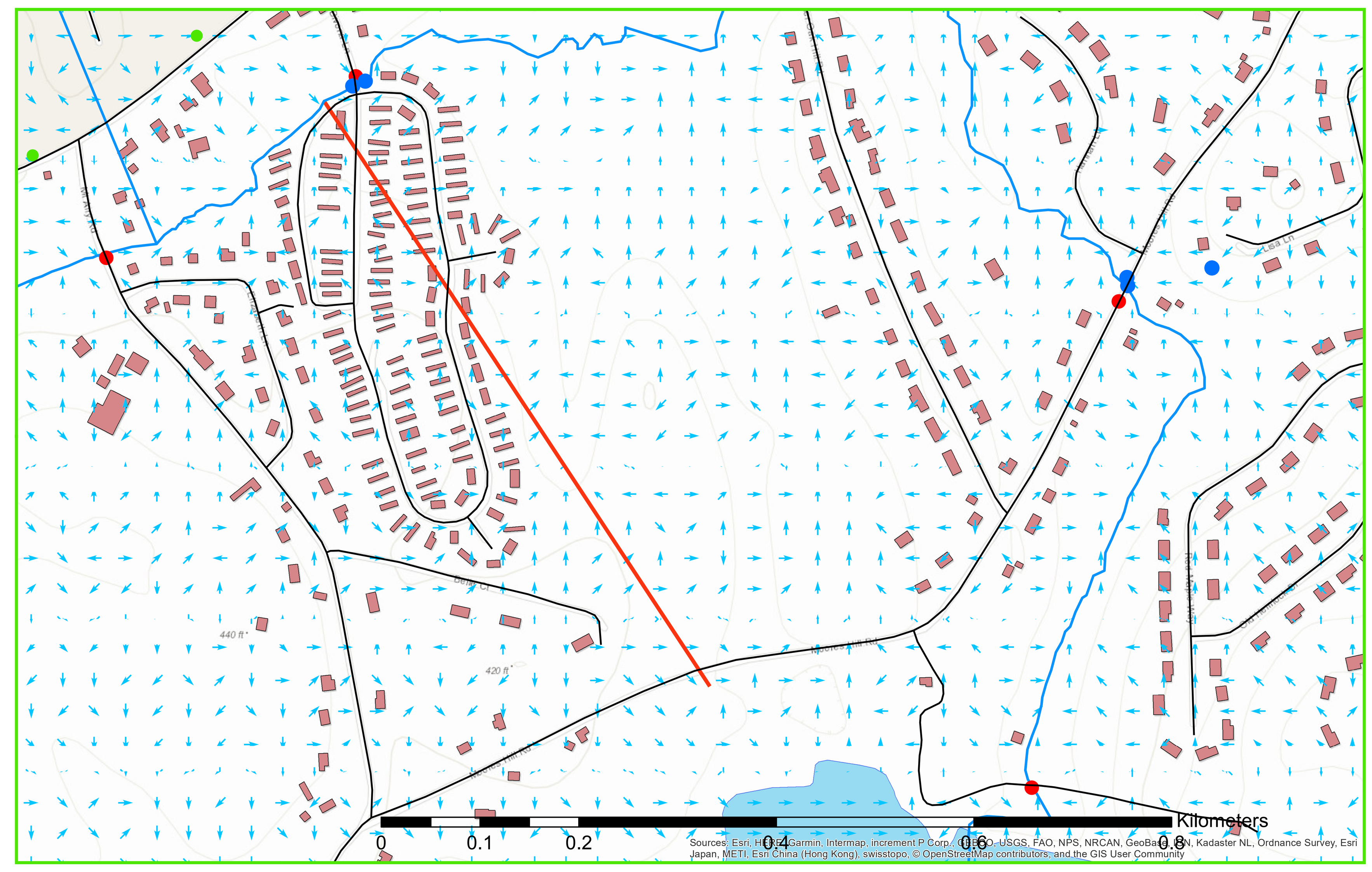
Figure 21: This Map is a Representation of Subwatersheds Within the focus area, and also provides a decent representation of the project team's area of interest. Cooler colors represent areas further upstream from the divertion point towards lake washington.

Newburgh Info Map

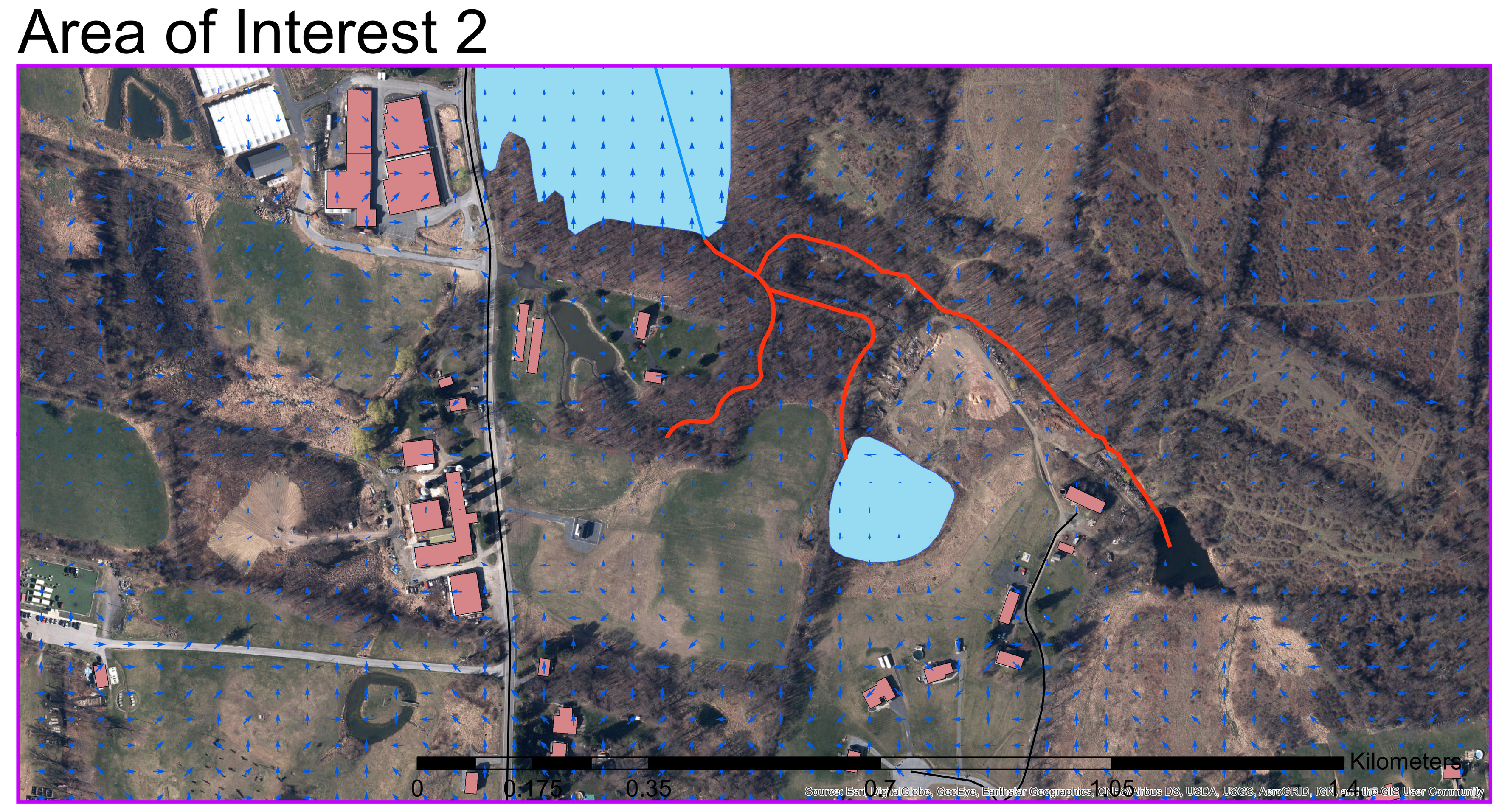
Overview



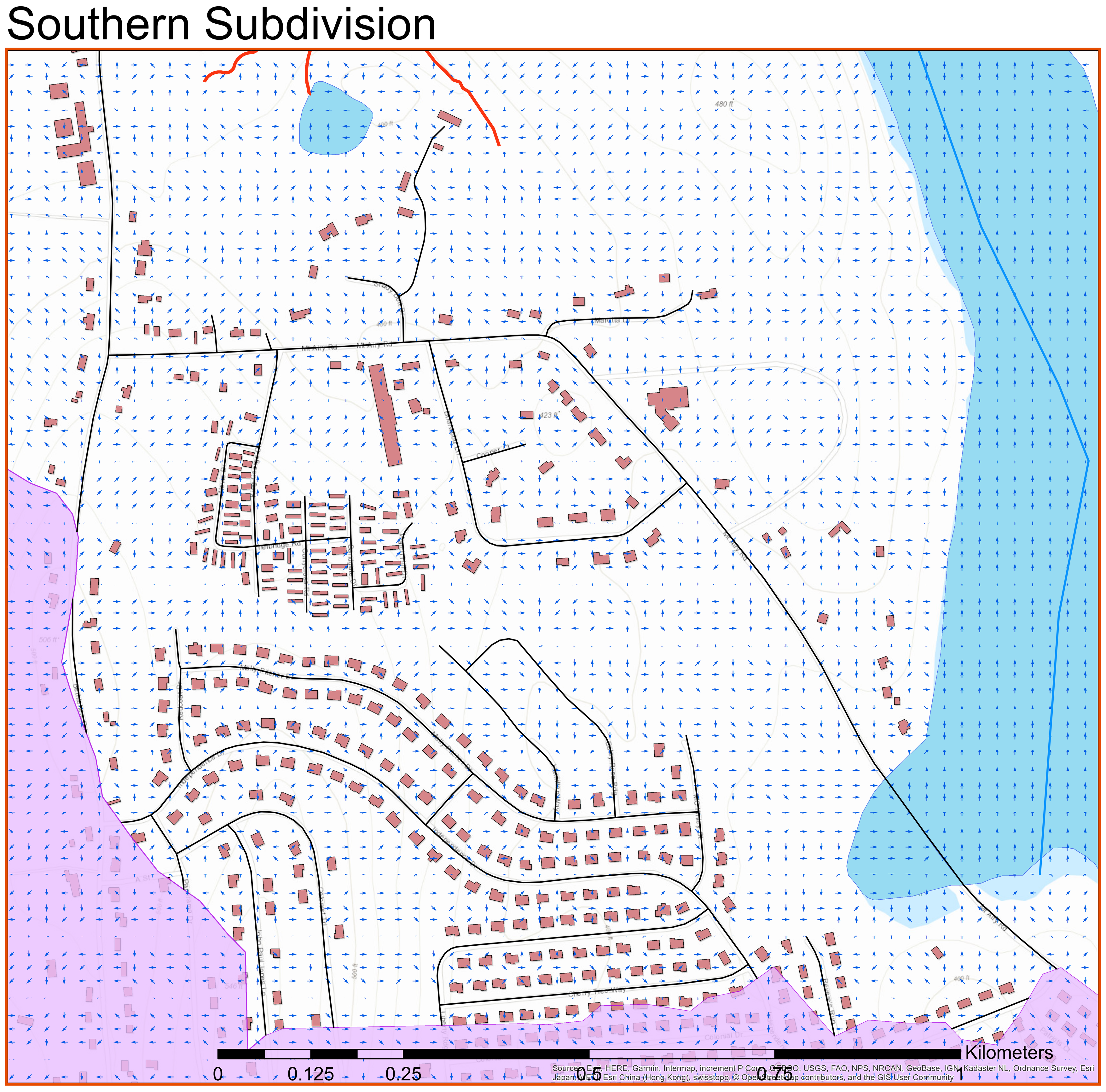
Area of Interest 1



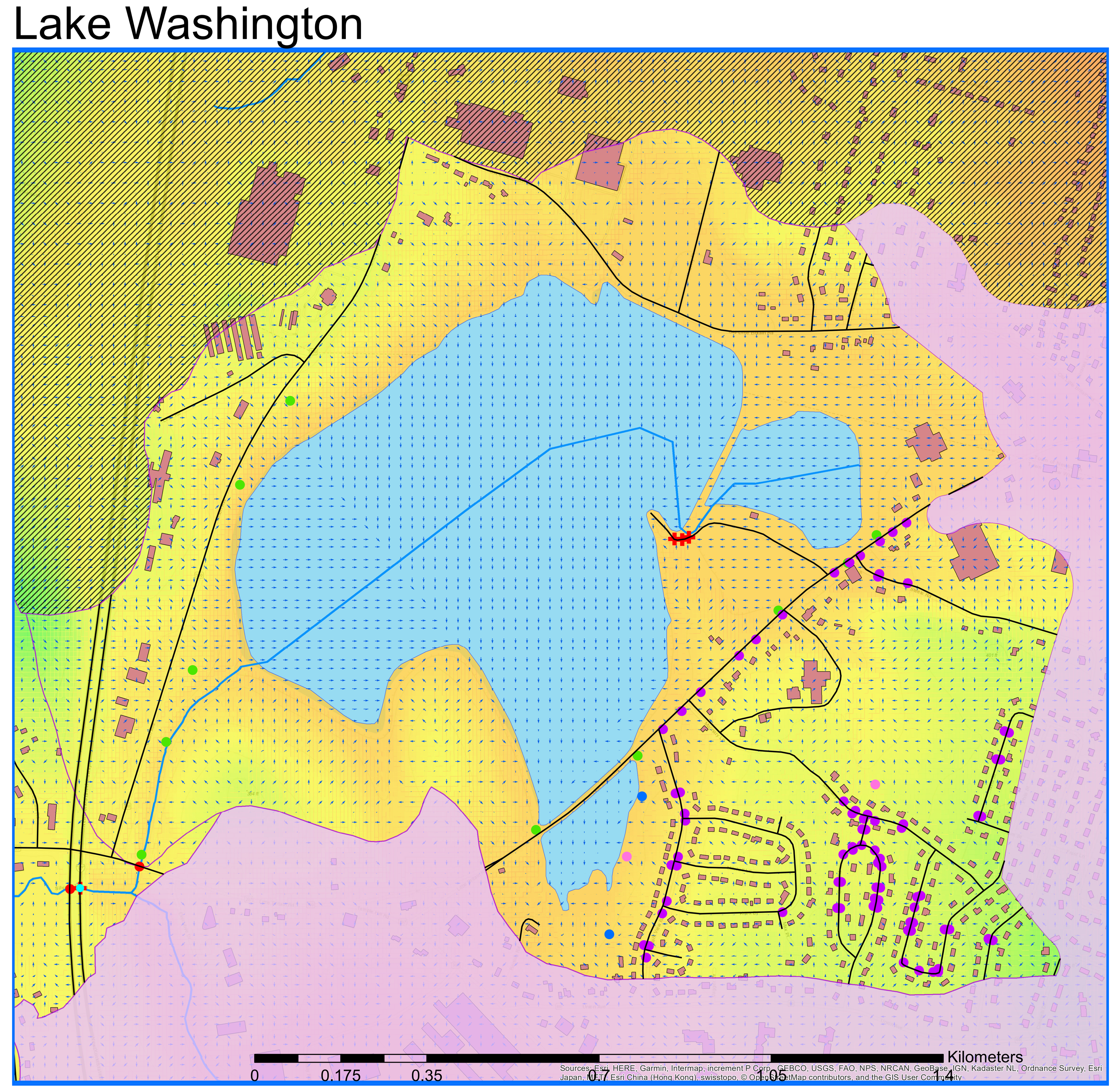
Area of Interest 2



Southern Subdivision



Lake Washington



Legend

Areas
- Primary Focus Area
- Focus Watershed (Excluded)
- Patton Brook
- Out of Focus Area

- Lakes & Ponds
- Primary Streams
- Streams of Interest
- Flow Direction Vector

- TS Culverts
- Created Outfalls
- Windsor Outfalls
- DOT Outfalls
- Known Other Culverts
- Unkown Culverts

Elevation Heatmap

Value
- High : 467.864
- Low : -0.773