Creating a livable city through sustainable design

Downtown Seattle is built upon what used to be the forested hillsides and tidelands of the Puget Sound. The natural conditions allowed rainwater to collect and infiltrate the groundwater where it fell and there was little surface runoff.
Today the rainwater gets piped and transported for miles before it reaches the sound. Impervious buildings and streets have replaced the natural infiltration capacity of the soils and plants and the natural cycle of water has been altered.

Seattle in 1860.
Source: MOHAI

What are the means we can use to restore some of these natural processes to a dense historical urban neighborhood like Pioneer Square?

This project aims to explore and study conventional and unconventional methods of increasing sustainability and improving stormwater management, while at the same time add improved quality of life to the people that live and work in this area.

Reducing use of the wastewater system

The majority of the storm water in South Downtown is currently collected in a combined waste water system; this water is then led to the King County West Point Treatment plant where it is cleaned before it gets discharged to Elliott Bay.
To prevent sewer backups and overloading of the West Point Treatment plant during very intense or long periods of rain the City of Seattle and King County have installed CSO's (combined sewer overflows) in various parts of the city. The CSO's only operate when the regular system gets close to its capacity and they provide primary treatment and disinfection before the water is discharged into the recipient body of water such as Elliott Bay. Obviously this water is not as clean as the water going through the regular treatment plant.

Is it cost-effective to redirect part of this budget to create more localized storm water management within South Downtown?

If more stormwater is retained on site or within a neighborhood could it translate to less overloading of the conventional wastewater system during peak flow events?

While increased landscaping can increase ecological diversity and visual interest to the urban environment, can it also cost-effectively reduce the need for other costly adds to the wastewater system?

Study area:
South Washington Street and
Second Avenue South
in Pioneer Square

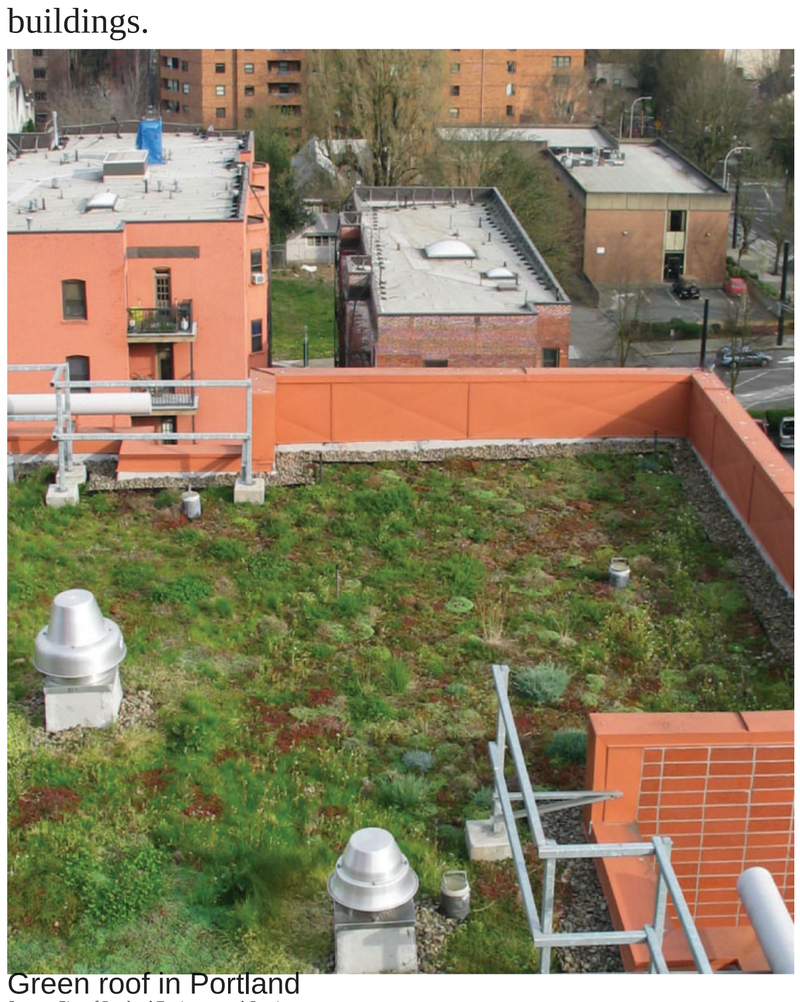
The demands on the overall wastewater system could be reduced by decreasing usage through the application of a wide range of strategies such as increased greening, stormwater retention and rainwater harvesting.

Increased Greening

Increased greening of the urban environment can be achieved in a variety of ways such as:

Green Roofs

Green roofs can retain 50% or more of the rainfall on a roof. They reduce heat island effects, and improve air quality. Green roofs also provide habitat for insects and birds and work as ecological links between open spaces.
Green roofs can be used in new development throughout South Downtown and can be retrofitted on existing buildings.



Green roof in Portland
Source: City of Portland Environmental Services

Street trees and landscaping

Increased greening through street trees, green walls and other landscaping captures more rainwater and provides improved habitat for both humans and wildlife, such as birds and insects.
Continuous street tree plantings provide a unifying character to streets and also improve airquality.

Green walls on Capitol Hill Library

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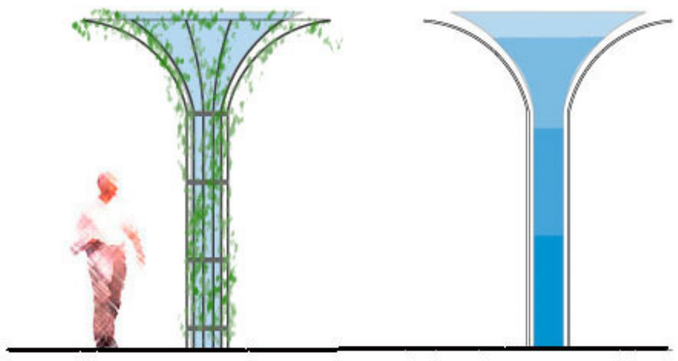
Urban Rain Trellises

Where the planting of trees is not feasible, such as on sidewalks on top of areaways or places where the space is limited, urban trellises could be installed. Although not comparable to a regular street tree these trellises add increased greening and cooling of streets in summertime. The columnar trellises are planted with vines and are self watering. The core of the trellis store rainwater, like a garden rain gauge but in a larger version. It has solar powered LED lighting incorporated into the rim, providing additional interest during evening and night time.
Vines such as grape, kiwi, hops and honeysuckle provide seasonal interest.



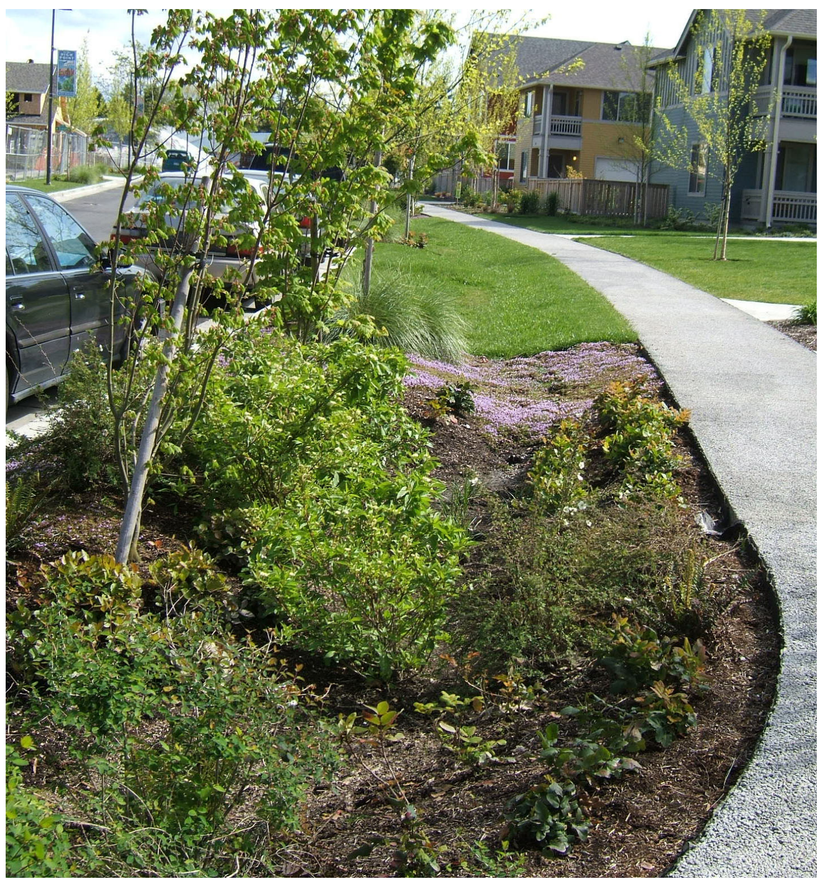
Urban rain trellises

Phytoremediation and retention

Phytoremediation is the process of cleaning water or soils with plants. This process can be achieved by collecting stormwater in bioswales and stormwater planters.
Retention of stormwater lessens peak flows to the wastewater system and provides opportunities for phytoremediation.

Bioswales

Bioswales are landscaped swales that are designed to remove silt and pollution from the stormwater. They consist of a swale drainage course with gently sloped sides and are filled with vegetation, compost and/or riprap. A bioswale is designed to maximize the time water spends in the swale, which aids the trapping of pollutants and silt.



Bioswales at High Point

Storm water planters

Stormwater planters serve the same function as bioswales in that they capture, slow, cleanse, and infiltrate stormwater. Because they are designed like a planter with walls the stormwater planter requires less area than a typical bioswale and can be incorporated into sidewalks with 12’ minimum width. The stormwater planter has well defined edges and does not conflict with other uses, this makes it suitable to the character of a dense urban environment. The stormwater is captured in a series of planters. Each planter uses plants such as Rush and Sedges for capturing pollutants.

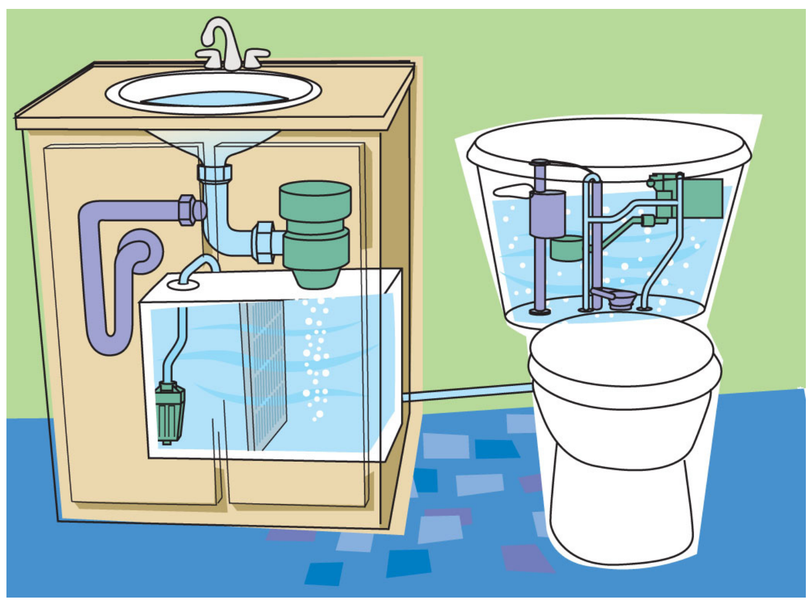
Stormwater planters in Portland

Reducing potable water use

In the northwest we are fortunate to have a good supply of freshwater, still it is not an unlimited resource and it is good to reduce our water consumption.
Water conservation can be achieved through simple measures such as running a washing machine and dishwasher only when they are full and limiting time in the shower. More water saving ideas can be found at:
http://www.wateruseitwisely.com/index.shtml
There are more fundamental changes we can do in how we use and reuse potable water, this include grey water reuse and rainwater harvesting.

Grey water reuse

Greywater is wastewater generated by household processes such as washing dishes, laundry and bathing. Existing buildings can be retrofitted to reuse greywater for toilet flushing and new development can include water saving techniques. Water storage can be provided on rooftops or underground.



Greywater reused to flush toilets

(Source: Watersaver technologies)

Rainwater harvesting

Rainwater can also be reused for irrigating trees and landscaped areas in Pioneer Square and can be stored on rooftops or underground in storage tanks.

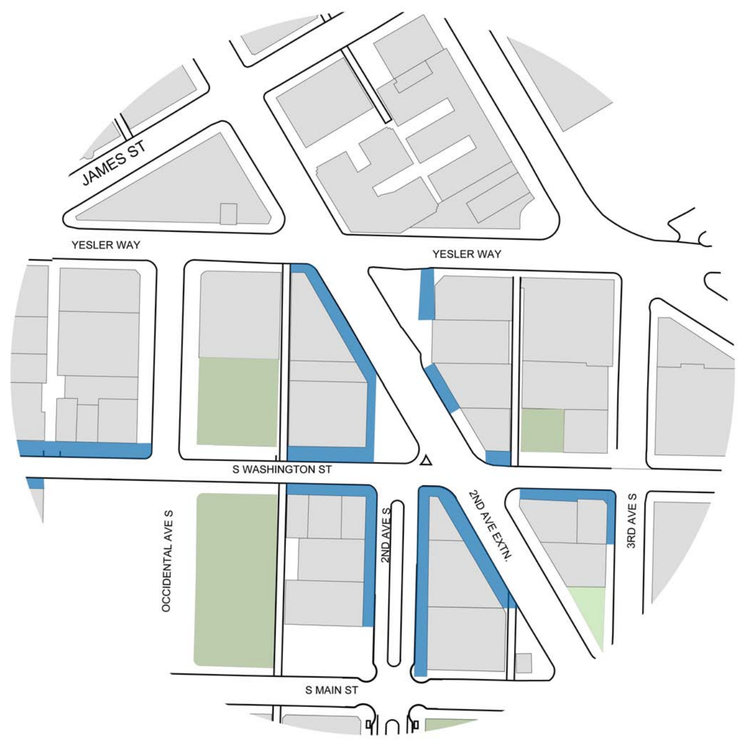
Using rooftops for water storage

Water towers such as the one on the Washington Shoe Building, used to be a common sight in Pioneer Square. They served their respective buildings with potable water from the city’s water system.
Modern water towers can be installed to store rainwater and greywater for reuse within the buildings.

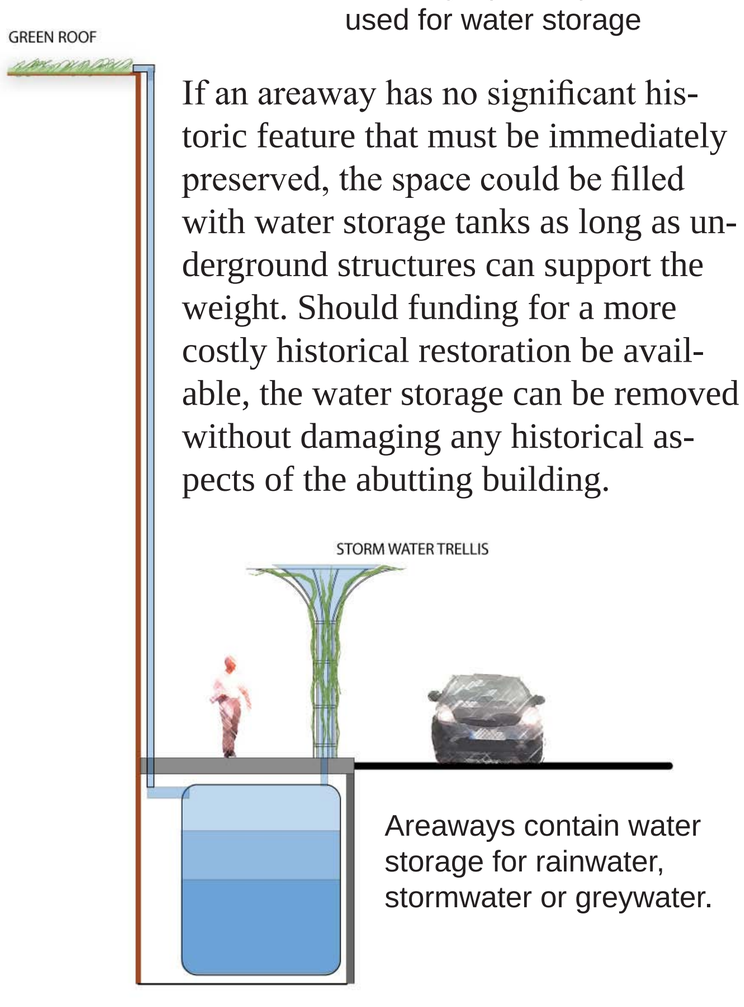
Historical water storage on rooftop

Using areaways for water storage

Areaways are usable, hollow areas, generally in the street right-of-way, below the sidewalk and between the building foundation and the street wall. The street wall holds back the earth below the road surface and provides support for the sidewalk between the street and the building walls.
Areaways are prevalent throughout Pioneer Square, some of them are part of the underground tour but most of them are unused. The unused areaways may present a unique opportunity to store and retain water, whether it is stormwater, rainwater or greywater.
There are more than 100 areaways in the Pioneer Square District. One areaway can be up to 300’ long, 12’ wide and 10’ high. This represents 36’000 cubic feet/1300 cubic yards/ 260 thousand gallons of storing capacity.
For comparison the average person uses about 80-100 gallons of water per day.
(*http://ga.water.usgs.gov/edu/qahome.html#HDR3)



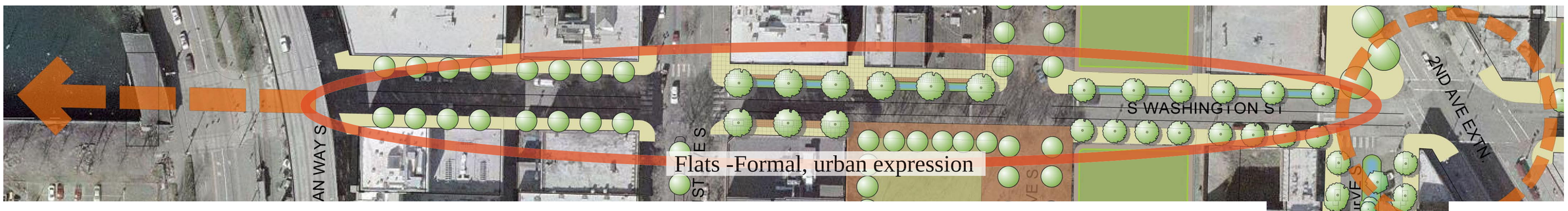
Areaways (in blue) could be used for water storage



If an areaway has no significant historic feature that must be immediately preserved, the space could be filled with water storage tanks as long as underground structures can support the weight. Should funding for a more costly historical restoration be available, the water storage can be removed without damaging any historical aspects of the abutting building.

Areaways contain water storage for rainwater, stormwater or greywater.

South Washington Street from Second Avenue to Kobe Terrace/ I-5



South Washington Street from Second Avenue to the waterfront

Green Streets in South Downtown

Green Streets are designed to emphasize pedestrian amenities and landscaping in areas that have dense residential uses. The purpose is to enhance pedestrian circulation and create open space opportunities in residential areas lacking adequate public open space.

Future plans for South Downtown includes higher residential use but there is limited space for new parks. By designating new green streets in this area the city can meet some of the open space needs of future residents.

South Washington Street and 2nd Avenue S. are not yet designated as Green Streets but they fulfill many of the location criteria set forth by the City of Seattle for green streets.

Proposed Green Streets in Pioneer Square/ International District

The following are concepts on how 2nd Ave South and South Washington Street could become more attractive and enjoyable for pedestrians and at the same time be an important part of a localized stormwater management program.

South Washington Street- The Cycle of Water

Washington street is an east/west street with an elevation change of 60' from Kobe Park to the Colman Dock Ferry Terminal. There are great views to Mount Rainier and to Elliott Bay. The street runs through the Japantown and Pioneer Square neighborhoods and ends at the Waterfront, connecting the uplands to the shoreline.

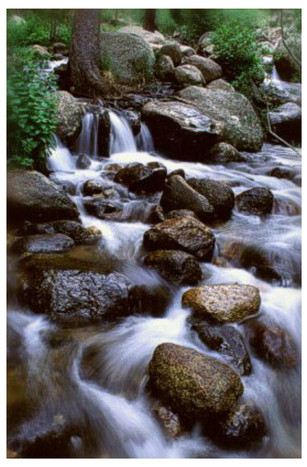
View of Puget Sound from Washington Street

The current character along the street varies. Beginning with a steep hill with residential feel in the most eastern part, the street continues through a redevelopment zone that currently consists mainly of surface parking lots. At 4th Avenue, Washington Street enters the Pioneer Square area with century old distinctive brick buildings.

The street continues to the waterfront passing the Viaduct and crossing Alaskan Way. It ends at the historical Washington Street Boat Landing structure.

The proposed design for Washington Street contains a series of design expressions that reflects the cycle of water.

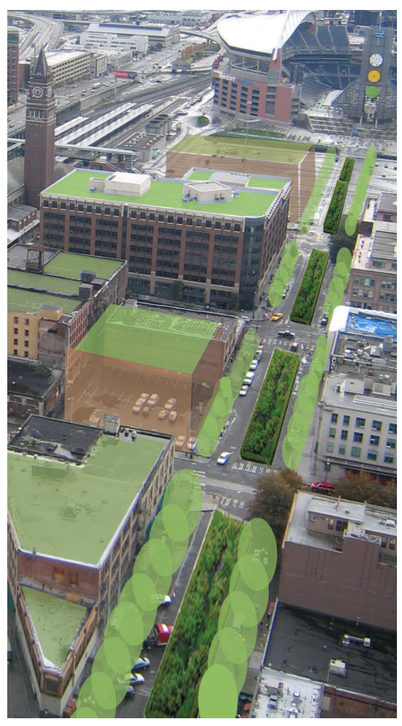
The upper, eastern part of Washington Street displays the natural flow of water as it moves down the hillside in a natural/abstract version of a mountain stream.



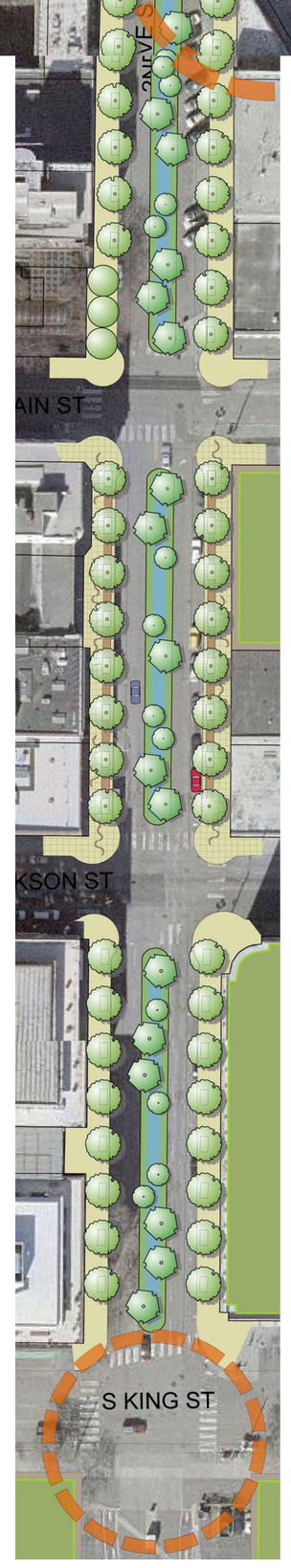
Natural and man made flow of water

The lower, western part of Washington Street features formal stormwater planters where feasible. Since many of the sidewalks along this stretch are built on top of areaways urban rain trellises take the place of street trees.

Existing Conditions-
View from Smith Tower



Future Green Street?



Second Avenue from
Yesler Way to
South King Street

2nd Ave South- Connecting Landmarks

2nd Avenue between Yesler Street and South King Street connects two prominent Seattle landmarks: the Smith Tower and Qwest Field. Buildings lining the street are a mix of historic brick buildings and new structures.

SDOT classifies 2nd Avenue as a minor arterial because it carries high volumes of traffic on game days. It is also a designated local transit street and serves as a stop for the Metro bus layovers. The area is going through some major changes with new housing being planned for several lots in the vicinity. These are all factors that need to be taken into consideration in further development of 2nd Avenue as a Green Street.

The proposed bioswale on 2nd Avenue collects water from surrounding streets and roof tops. A formal low hedge borders the swale that features elements of 19th century garden design that reflects the historical, urban character of Pioneer Square.

Formal Bioswale in Portland
Design: Murase Associates

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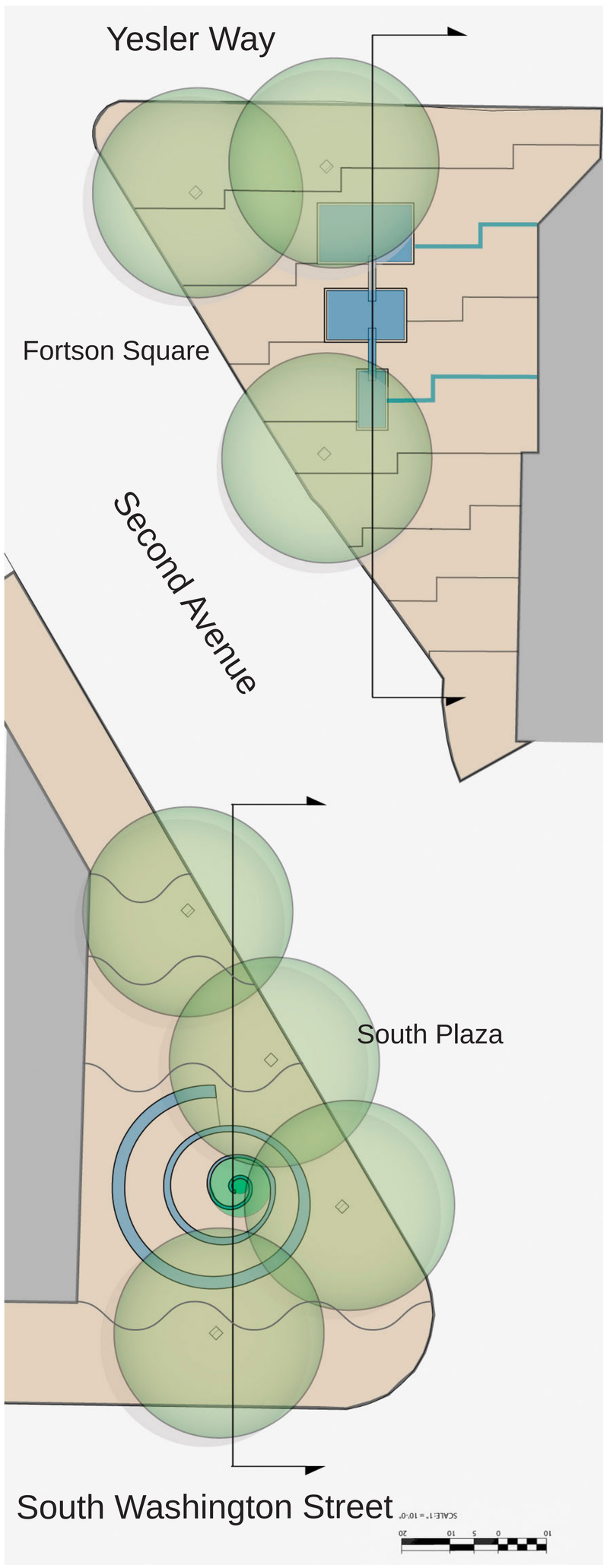
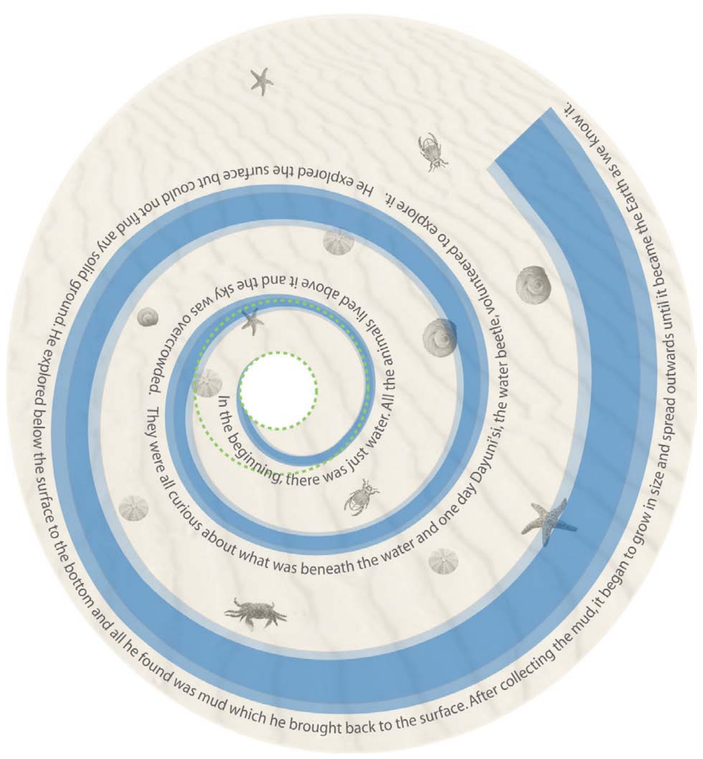
Intersection of Washington Street and Second Ave South.

The meeting of the two proposed green streets is emphasized through increased greening and two pedestrian plazas celebrating water.
The plazas, one either side of 2nd Avenue exemplify two different design approaches to urban storm-water-feature design.
South Plaza draws its inspiration from the pre-development conditions of the area while Fortson Square reflects the man made geometry of the buildings and streets that surrounds it.





Stormwater feature inspired by the Moon snail

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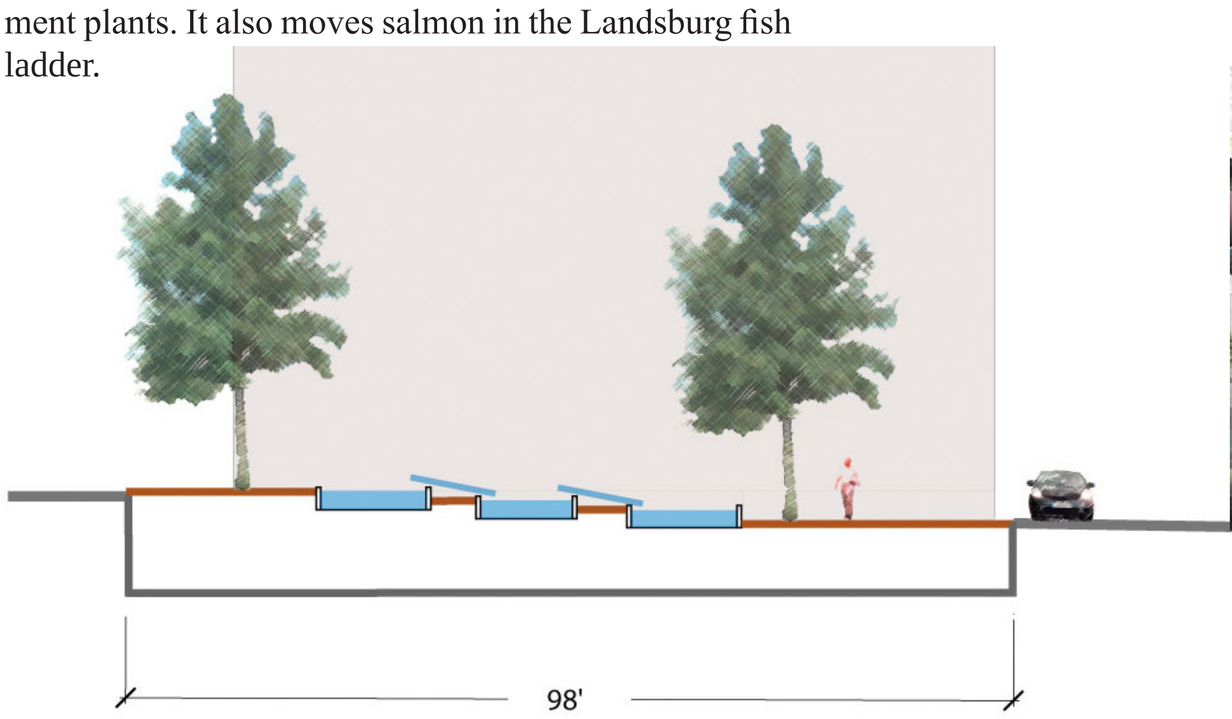
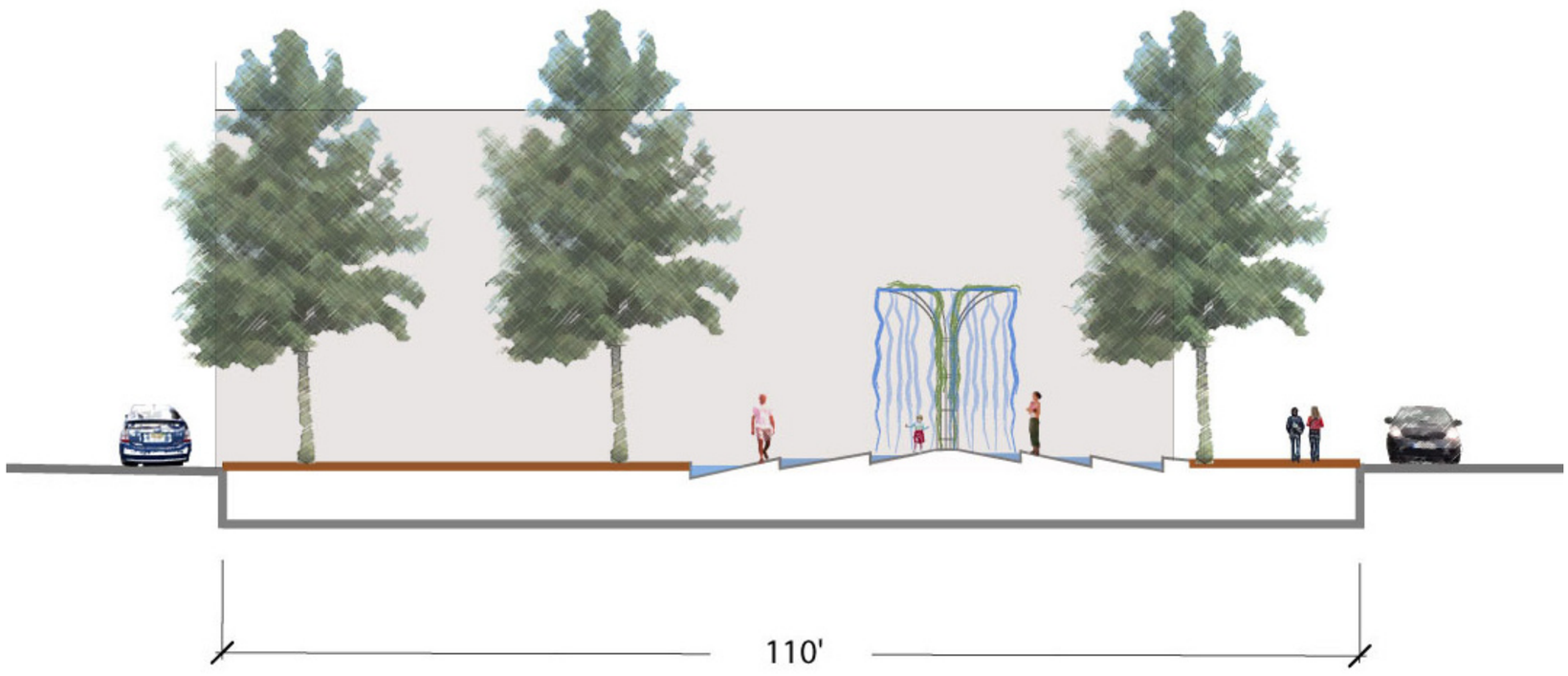
Fortson Square

Humans have been directing the course of water since they started irrigating farmland.
Fortson square tells the story of a ground breaking technical invention that simplified the vertical movement of water. Archimedes Screw was invented over 2000 year ago and is still used for moving water in high quantities in places such as hydro electric dams and sewage treatment plants. It also moves salmon in the Landsburg fish ladder.

A series of stepping pools collects roof runoff and takes advantage of the ~ 5' elevation change at Fortson Square. These pools are connected by narrow runnels and Archimedes screws. Water slowly trickles down the runnels while the Archimedes screws can be operated by passersby to move the water upward between the pools without little effort.



Archimedes Screw
www.wittemuseum.org



South plaza –
Moon snail stormwater feature

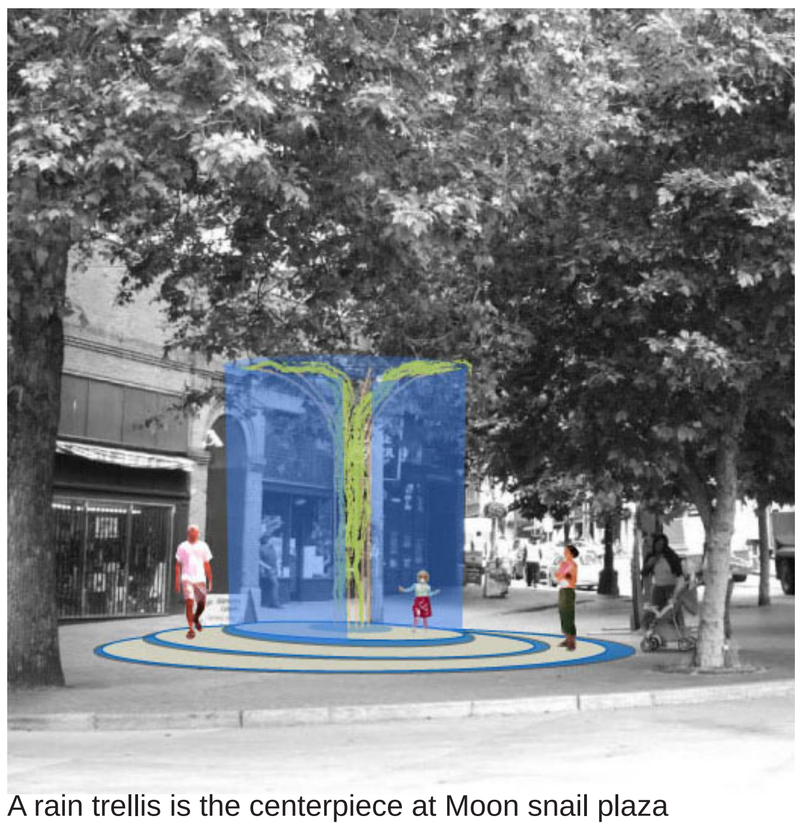
Not very long ago, most of South Downtown was muddy tidelands inhabited by invertebrates and mollusks. Moon snail Plaza brings predevelopment conditions of the area to the attention of pedestrians by interpretive design components that tell the story of what was here before the settlers started filling in the tidelands.

A storm water feature inspired by the moon snail daylights stormwater that has been collected off roofs and sidewalks. The shell of the Moon snail shape consists of a spiraling wedge shaped water runnel that fills up with water when it rains. The surface has imprints of creatures that are found in tidelands like crabs and snails and tells the story of creation from a Native American perspective. Text could be imprinted along the sides of the spiral, encouraging people to move into the spiral.

Spirits exist wherever there is life. Water is alive. The river is alive, the rocks on a river bed, the sand along the banks of a river. Everything that's contained in a river has life and because it has life, it also has spirit. I have repeated that several times. If it has life, it also has spirit. My people also know this. When they are sent for spiritual help, they know that if they are successful, they will be recognized by the spirits that are part of the water, a part of the rocks, a part of the movement, a part of anything that lives and breathes with the water.
-Vi Hilbert, Upper Skagit Indian Tribe

Close up of stormwater feature with water runnels and imprints of tideland creatures.

A rain trellis centerpiece stores water and feeds the moon snail water feature. At times of intense rainfalls the rain trellis will get filled to its capacity. Water then spills over the top of the trellis creating a water pavilion with the walls being a sheet of water. The trellis has vines growing on it and the rim has fiber optic blue lighting.



A rain trellis is the centerpiece at Moon snail plaza

A sustainable South Downtown.

What are the means we can use to restore natural processes and increase sustainability in a dense historical urban neighborhood like Pioneer Square? The intent of this project has been to address the various forms of water in the city and how we can look at stormwater as a resource rather than a problem.
The strategies and designs explored and presented in this project are unconventional by today's standards but they represent a new approach to how we can use and reuse water in the city in a more sustainable way. The ideas are conceptual and are meant for further discussion and development.

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