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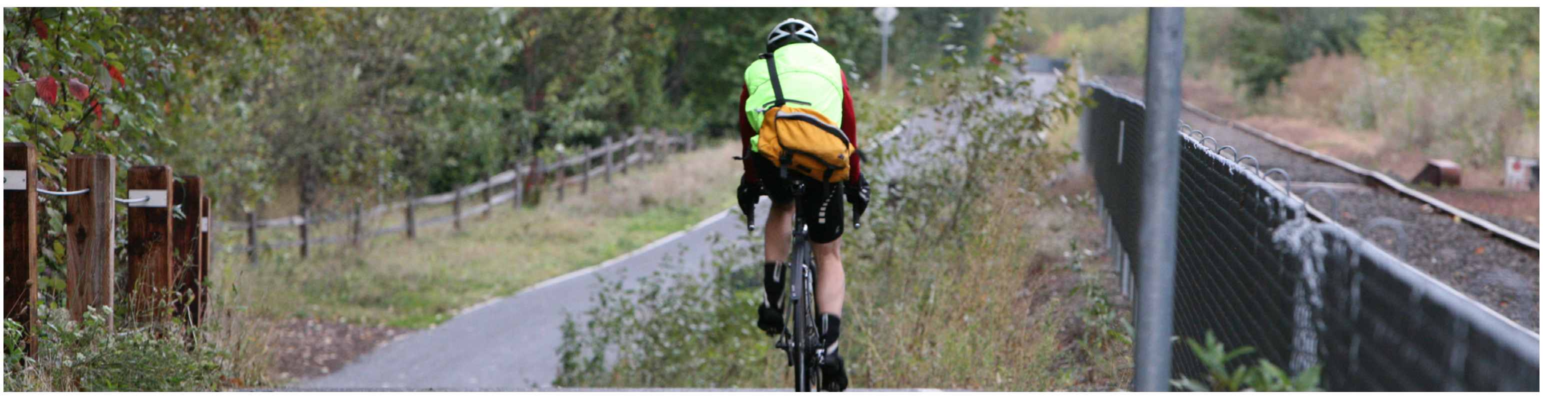

Green Cities

Sustainable Development in Springwater

1206 U of Oregon
Eugene, OR 97403

t 541.346.3582
f 541.346.3626

sci@uoregon.edu
sci.uoregon.edu

Matthew Cunha-Rigby, Architecture

Dr Robert F Young, Assistant Professor
Planning, Public Policy and Management

UNIVERSITY OF OREGON

SCI
Sustainable Cities Initiative

Buildings | Neighborhoods | Regions | Architecture | Planning | Landscape | Policy

Acknowledgements

This report is included as part of the University of Oregon's Sustainable Cities Initiative, with the initial 2009-2010 Sustainable Cities Year focusing on the City of Gresham, Oregon. The Green Cities team would like to extend appreciation to everyone involved in the project. Thank you to the City of Gresham, for their willingness to work towards a sustainable future. Their genuine interest in the Sustainable Cities Initiative will prove invaluable to realizing a more livable community. The assistance provided to the students by Janet Young and Jonathan Harker is especially appreciated. Their hard work made it possible for the course to address the specific needs of Springwater, while researching innovative methods for developing a sustainable community.

Thank you to the University of Oregon and the Sustainable Cities Initiative staff. The dedication of the entire SCI team and the Co-Directors of the Program - Nico Larco, Marc Schlossberg, and Robert Young – make the effort a successful venture into the practical application of academic research. Additional thanks are extended to the SCI Program Manager, Nick Fleury, for his role in administering the Sustainable Cities Initiative and in acting as the liaison between the University of Oregon and the City of Gresham.

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Without the cooperation of these individuals, the Sustianable Cities Initiative would not be where it is today.

SCI
Sustainable Cities Initiative

About SCI

Sustainable Cities Initiative (SCI) is a cross-disciplinary organization at the University of Oregon that seeks to promote education, service, public outreach and research on the development and design of sustainable cities.

Our work addresses sustainability issues across multiple scales, from the region down to the building, and emerges from the conviction that creating the sustainable city cannot happen within any single discipline. SCI is grounded in cross-discipline engagement as the key strategy for solving community sustainability issues. We serve as a catalyst for expanded research and teaching; market this expertise to scholars, policymakers, community leaders, and project partners; and work to create and sponsor academic courses and certificates. Our work connects student passion, faculty experience, and community need to produce innovative, tangible solutions for the creation of a sustainable society.

About SCY

The Sustainable Cities Year Initiative is a 'partnership' with one city in Oregon per year where a number of courses from across the University focus on assisting that city with their sustainability goals and projects. The Sustainable Cities Year faculty and students work with that city through a variety of studio projects and service learning programs to: 1) provide students with a real world project to investigate; 2) apply their training; and 3) provide real service and movement to a local city ready to transition to a more sustainable and accessible future.

About Gresham

With just over 100,000 people, Gresham is the fourth largest city in Oregon. It is bordered to the west by Portland, the largest city in the state. Gresham is home to the Mount Hood Jazz Festival and is known as "The City of Music". It is close in proximity to the Columbia Gorge National Scenic Area and Mount Hood, the highest point in Oregon. Gresham has a wide variety of neighborhoods including the Civic Center, known for its active transportation network, rapid transit connections and residential, commercial and retail mix.

SCI Co-Directors

Nico Larco, Assistant Professor of Architecture
Marc Schlossberg, Associate Professor of Community & Regional Planning
Robert Young, Assistant Professor of Community & Regional Planning

Nick Fleury, SCI Program Manager
Price Armstrong, SCI Research Assistant

Course Participants

Green Cities

Dr Robert Young, Assistant Professor, Community & Regional Planning
Nicolas Garcia, Graduate Teaching Fellow

Energy
Brandon Hern, Business Student
Jake Lamanna, Architecture Graduate
Javier Salas, Community & Regional Planning Graduate
Brooke Standifer, Business Graduate
Kristin Walker, Business Graduate

Mobility
Jeff Bolinger, Architecture Graduate
Andrew Crampton, Planning, Public Policy & Management Undergraduate
Jeff Knighton, Architecture Graduate
Briana Orr, Environmental Studies Undergraduate
Chris Roddy, Environmental Studies Graduate
Chris Ruderman, Public Policy and Management Graduate
Ted Sweeney Planning, Public Policy & Management Undergraduate

Natural Flows
Sam Callero, Environmental Studies Undergraduate
Dan Edleson-Stein, Architecture Graduate
Melanie Knapp, Environmental Studies Graduate
Kory Northrop, Environmental Studies Graduate
Homero Penteado, Landscape Architecture Graduate

Sustenance
Kira Benesh, Architecture Graduate
Matthew Cunha-Rigby, Architecture Graduate
Jessica Hampton, Not-For-Profit Graduate
Matthew Hart, Architecture Graduate
Krystan Menne, Architecture Graduate
Drew Serres, Environmental Studies Undergraduate

Waste
Taylor Bailey, Architecture Graduate
Phillip Bozarth-Dreher, Architecture Undergraduate
Edward Clark, Architecture Graduate
Andrew Cusack, Architecture Graduate
Nick Joelli, Planning, Public Policy & Management Undergraduate
Vivek Sarma, Architecture Student
Jessie Scott, Architecture Graduate
Hannah Wendel, Environmental Studies Undergraduate

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I. Executive Summary

The Green Cities Project focuses on providing the City of Gresham with a set of policy and plan recommendations for the Springwater Community. Springwater, a 1272-acre site on the southeast edge of the Portland Metro Area, was added to the Urban Growth Boundary (UGB) in 2002 and was the subject of the 2005 Springwater Community Plan. The Community Plan outlined a series of goals and land-use proposals for the area's future development, intending to bring economic development to east Multnomah County, to provide family-wage jobs and employment opportunity for the area, and to promote a livable, sustainable environment for future residents.

The work of Green Cities provides an alternate land-use proposal and development policy for the Springwater Community. This proposal aims to meet the goals of the 2005 Springwater Community Plan, while utilizing ecosystem services and sustainable development strategies to create a livable community. The Green Cities proposal approached development in Springwater by organizing research into five project teams, focusing on the site's Energy, Mobility, Sustenance, and Waste needs, while incorporating the site's Natural Flows into plan and policy development.

The research was conducted using site visits, in-class discussions, meetings with city officials, and group coordination charettes. Individual project teams used this information to organize their own research and develop policy and plan recommendations addressing their specific focus for the Springwater Community.

Community Visions

Each project team developed a vision and set of guidelines outlining their specific planning and policy proposals for the Springwater Community.

Energy:
The Green Cities Energy Plan focuses on meeting the needs of Springwater's residents using a locally owned utility system and a network of alternative and individual building generation technologies. These are supplemented by increases in energy efficiency measures and modifications to the building code that permit passive solar technologies.

Mobility:
The Green Cities Mobility Plan envisions a network of alternative, multi-modal, human-powered, local and regionally connected transportation options. The system creates an automobile free environment that centers on a walkable, well connected community.

Natural Flows:
Natural Flows are integrated into the community proposal, focusing on life flow, water flow, air temperature, and industrial wastes. Through the preservation and restoration of the site's characteristic flows, the plan utilizes ecosystem services, strengthening the relationship Springwater has to its environment, and creating a place humans and the natural environment can coexist with one another.

Sustenance:
Green Cities proposes a system of local food and water distribution, where the majority of food is produced on-site, the water supply is sourced locally, and the community is tied to the land. The system will create a stronger local economy, where money spent on food remains in Springwater. The food is fresh, organic, holds more nutritional value, and is of higher quality.

Waste:
The Waste Plan proposes a minimal waste community, where discarded organic material and other, inorganic items are composted, reused, recycled, or put to other uses. Residences, neighborhoods, and industries are all committed to reducing the waste stream. In the Eco-Industrial Park, one person or industry's waste becomes food for another.

Policy and Plan Recommendations

The vision for each research group developed into a set of proposals, plans, and guidelines from which the vision can be realized and implemented in Springwater. To ensure that each individual group's research and recommendations coalesce into a unified plan for the community, the Green Cities proposal is arranged into four development categories that encompass each group's work.

Land Development
Development in Springwater intends to support and maintain existing riparian and wildlife habitats and corridors. The corridors, primarily situated along Johnson Creek and its tributaries, will also maintain connections to other important habitat areas in Springwater, and will extend to corridors and areas outside the community. Existing vegetation should be retained where possible and become as much a part of the human landscape as it is a part of the natural landscape. This will help reduce the urban heat island effect and maintain air quality within the community. Agriculture is proposed to become a major part of the community and should be developed on lands that are not zoned for ecological or human uses. Most of the urban development is proposed along the existing transit corridor, between Telford Road and Highway 26. Neighborhoods can extend outside of this boundary, where they connect to the open space provided in the form of riparian corridors, agricultural areas, and parks.

Local, Non-Automotive, Regionally Connected Transit
A network of non-automotive transportation options, based on pedestrian, bicycle, and small electric vehicle travel, willl connect development within and outside of Springwater. Regional transit options will include an extension of the Portland Max line along Highway 26, a bicycle corridor along the Springwater Trail, and parking structures at the periphery of the community to serve those without alternative transit options. Within the community, bioshelter greenways are proposed to provide residents with a safe, pleasant path along which they can bike or walk. Cargo bikes, neighborhood electric vehicles, and pedi-cab services are expected to move people and goods when bicycle and pedestrian travel cannot suffice. The city should also incorporate good design principles that support a comfortable, walkable urban environment for people.

Decentralized Infrastructure
To reduce the impact the community has on the environment and to utilize local, renewable, and ecosystem services to support infrastructure needs, Springwater will need to decentralize its infrastructure network. This requires commitment to developing local sources of waste management; water supply, managment, and treatment; energy supply, generation, efficiency and code; and a food supply network.

The waste management system will consist of commercial, neighborhood, and residential scale composting of organic wastes, a local recycling center, and a resource reuse program. Water supply will be sourced through rainwater catchment, renewable groundwater extraction, efficiency, and water reuse. Wastewater and stormwater are to be treated using biological treatment methods, utiziling living machines, constructed wetlands, and bioswales to naturally filter water for reuse or return to the ecosystem. Energy will be managed though a local utility, which will oversee local scale renewable energy generation. Building and efficiency codes will ensure that energy use is conserved, and that natural energy from the sun will be used whenever possible. The food supply will be grown locally, with gardens located throughout the residential, neighborhood, and community areas, and local farms outside the town center. The food will be exchanged through a local distribution system, centered on a weekly farmers market, local community supported agriculture programs, and independed grocery stores.

The Eco-Industrial Park
The Eco-Industrial Park will comprise the industrial zone in Springwater. The Eco-Industrial approach will reduce the waste associated with industrial production and promote synergy between industrial and environmental needs. The park will be located between Highway 26 and Telford Road, easily accessible through local and regional transit. By removing parking and placing industrial parcels close together, industries can share resources and reduce the amount of land required for industrial development.

Future Study and Limitations

The Green Cities report focuses on general recommendations for the Springwater site. It is intended that the City of Gresham will use these recommendations to inform policy and plan decisions for the Springwater Community. However, if the recommendations are to implemented in future plans for the area, detailed, site-specific studies will need to be undertaken to ensure that they are viable, effective, and cost-effective solutions for the area.

Conclusion

Green Cities hopes to show that the proposed strategies, approaches, and technologies are an affordable, desirable, and feasible means of addressing future development demands within the area. Although the report can be considered as an alternative development proposal, the community it envisions reduces the impacts the community has on the environment, while making a livable community, and meeting the goals stated in the 2005 *Springwater Community Plan*. The City of Gresham can use these recommendations as a base for any future development proposals in Springwater, as guidelines for developing these proposals, and as marketing tools to promote development interest and excite public awareness.

II. Introduction

The Springwater District was added to the Portland Metro Urban Growth Boundary (UGB) in December 2002 in the interest of providing industrial land, economic development, and family wage jobs for eastern Multnomah County. The 1272 acre site is incorporated into the city limits of Gresham, Oregon, the fourth largest city in the state, with just over 100,000 people. Springwater lies along Gresham's southeast border, and straddles U.S. Route 26 as it travels between Portland and Sandy, Oregon.

The Springwater Community Plan was adopted in 2005, with the purpose of describing "how urbanization of the area should occur to meet the intent of the December 2002 UGB expansion." It emphasizes "economic development and livability in a sustainable environment." However, since its incorporation into the UGB, and since the approval of the Springwater Community Plan, the area has failed to see any development.

The Community Plan identifies six underlying goals for Springwater (see Existing Data and Reports). The absence of development allows Gresham the opportunity to re-envision its plan for the Springwater Community, while still meeting its intended goals. The city can align its goals with a sustainable vision for the district, by improving the quality of life in the community, and addressing ecological, cultural, political, institutional, social and economic components without leaving a burden on the future generations. Springwater has the opportunity to become an innovative community at the forefront of 21st Century urban development.

The Green Cities Project aims to address these issues by providing Gresham with a social, ecological, and sustainable framework upon which it can develop Springwater. Although the existing Springwater Community Plan is a fine example of traditional planning and development practice, Green Cities provides an alternative model for developing the urban center. It breaks from the standard, low density development approach that has proven to be unsustainable. The project looks to natural systems and ecosystem services to support the city's infrastructure needs, reducing the costs inhibiting Gresham's ability to develop Springwater. By providing a working relationship between the city and its surrounding environment, Springwater can ensure that the future health of its community, its environment, and its people are maintained.

This report is a synthesis of the work completed during the Green Cities Project. It merges the content from each individual student's work into a single document. In this process, much of the information has been distilled into the basic policy and plan recommendations for the Springwater area. This information includes the benefits and reasons for implementing many of the recommendations. However, in summarizing the content, the information does not include most of the technical research and detailed descriptions of how specific recommendations function (i.e. the process by which a living machine works and breaks down waste). The goal of this synthesis is to provide the City of Gresham with a framework from which it can develop policies and plans for the Springwater area.

III. Existing Data | Reports | Conditions

In November 2005, Gresham, Oregon adopted the Springwater Community Plan, which provides guidelines for following the intention of the December 2002 Portland Metro Urban Growth Boundary (UGB) expansion. The 2002 UGB Expansion added an additional 18,867 acres to the developable land within the UGB, most of which aims to provide space for housing units and job growth. It also offered "regional policies to support neighborhoods, protect industrial areas, and enhance town and regional centers." Figures 1 and 2 (page 10) detail the portion of the 2002 expansion that make up the Springwater area, which comprises approximately 1272 acres southeast of Gresham.

Prior to its introduction into the Portland UGB, the Springwater site was primarily for farm and agricultural use, however, the Portland Metro redesignated the site as a Regionally Significant Industrial Area (RSIA). To meet these intentions, the Springwater Community Plan focuses on developing industrial high tech campuses, attracting businesses that will bring family wage jobs to eastern Multnomah County, and providing a livable, sustainable environment for future residents.

Figure 3 on page 12 shows the plan district map and the designated zoning proposal developed for the Springwater Community Plan. It allocates 384 acres (30 percent) for industrial development, locating all of this land east of Johnson Creek, where flat topography and vehicular access to US Highway 26 make the area suitable to large scale commercial development. There are 106 acres (8 percent) given to commercial office development, focused between Johnson Creek and Hogan Road, at the southern portion of the Springwater site. Three residential districts are envisioned: 43 acres of townhouse development (3 percent), 99 acres of low density single family residential (8 percent), and 97 acres of very low density single family estate residential (8 percent). The plan hopes to incorporate a 23 acre mixed use Village Center (2 percent), which includes retail, office, residential, and services. It is located east of Hogan Road, within walking distance of the Springwater Trail, near the existing Persimmon Golf Course. An additional 7 acre neighborhood commercial site will be located west of Orient Drive, and two community parks will be developed, one of which is to be a neighborhood park in the Village Center, and the other is to be a trail system linking to the Springwater Trail. Vast infrastructure improvements are required to support envisioned community development, including the reorganization of the Springwater arterial, which aims to reconfigure Highway 26 with two crossings, a northern bridge and a southern interchange. The infrastructure proposals also includes planned water, wastewater, and stormwater development, and the enhancement of existing streams, flood plains, wetlands, riparian areas, and tree groves.

> "The Plan provides capacity for over 15,000 new jobs. This is accomplished through a mix of employment areas that maintains opportunities for large-scale industrial development while promoting flexibility to respond to market conditions and local land constraints. Residential areas are proposed in portions of Springwater that are not suitable for employment uses; these areas include a mix of housing from high-density attached housing units in an urban setting to large lot residential areas nestled at the foot of Hogan Butte. A Village Center will provide services for employees and residents and serve as a focal point for the community. A natural resource protection and enhancement program will protect water quality and habitat in Springwater, and will help maintain the scenic character of the region as development occurs. Finally, new infrastructure –

> including a new interchange on Highway 26 – will support the community's urbanization" (Springwater Community Plan, 2005).

The Springwater Community Plan identifies six underlying goals:

(1) Create a Community, both economically and sustainably,
(2) provide Economic Development with industrial land generating family wage jobs,
(3) foster Sustainability through encouraging businesses, industries, and homes to be built with and practice environmental stewardship,
(4) promote Livability, by providing a community with a high quality of life, which utilizes compact and sustainable urban development, a range of housing choices, walkable neighborhoods, access to open spaces and natural resources,
(5) a well planned Transportation system that promotes transit, walking, and cycling,
(6) to preserve, protect, and enhance natural areas and resources.

The Springwater site is currently characterized by rural residential uses, with a 2000 census of 298 households and 833 people. There are 437 tax lots existing within the site, including the Persimmon Golf Course and a few commercial buildings. The existing transportation system is dominated by fast moving arterials in a north-south direction, including US Highway 26, Hogan Road, and 242nd Avenue.. Public water, wastewater, and stormwater infrastructure is not yet developed, with current residents utilizing underground wells and subsurface disposal systems. The site contains environmentally sensitive habitat areas, such as the Western Buttes, Johnson Creek, ponded wetlands, springs, and seasonal drainages. Although the site does not have any developed parks, the Springwater Trail bisects the area along Johnson Creek.

The Green Cities Plan uses the development proposed in the Springwater Community Plan as a basis for its recommendations. The plan reorganizes the proposed zoning designations and redistributes it based around the site's existing infrastructure, the local environmental conditions, and the need for an area that can adapt and react to the requirements of a 21st century urban environment.

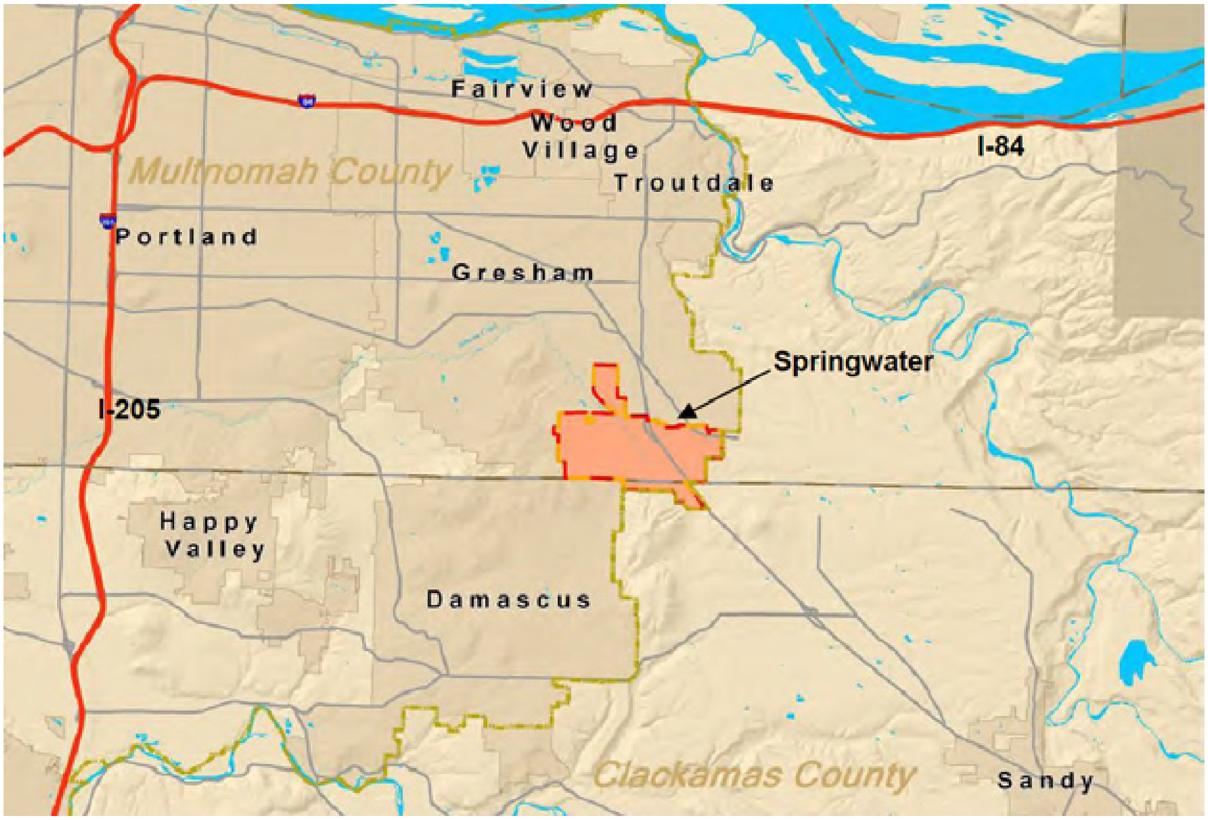


Fig. 1 - Springwater, Regional Context

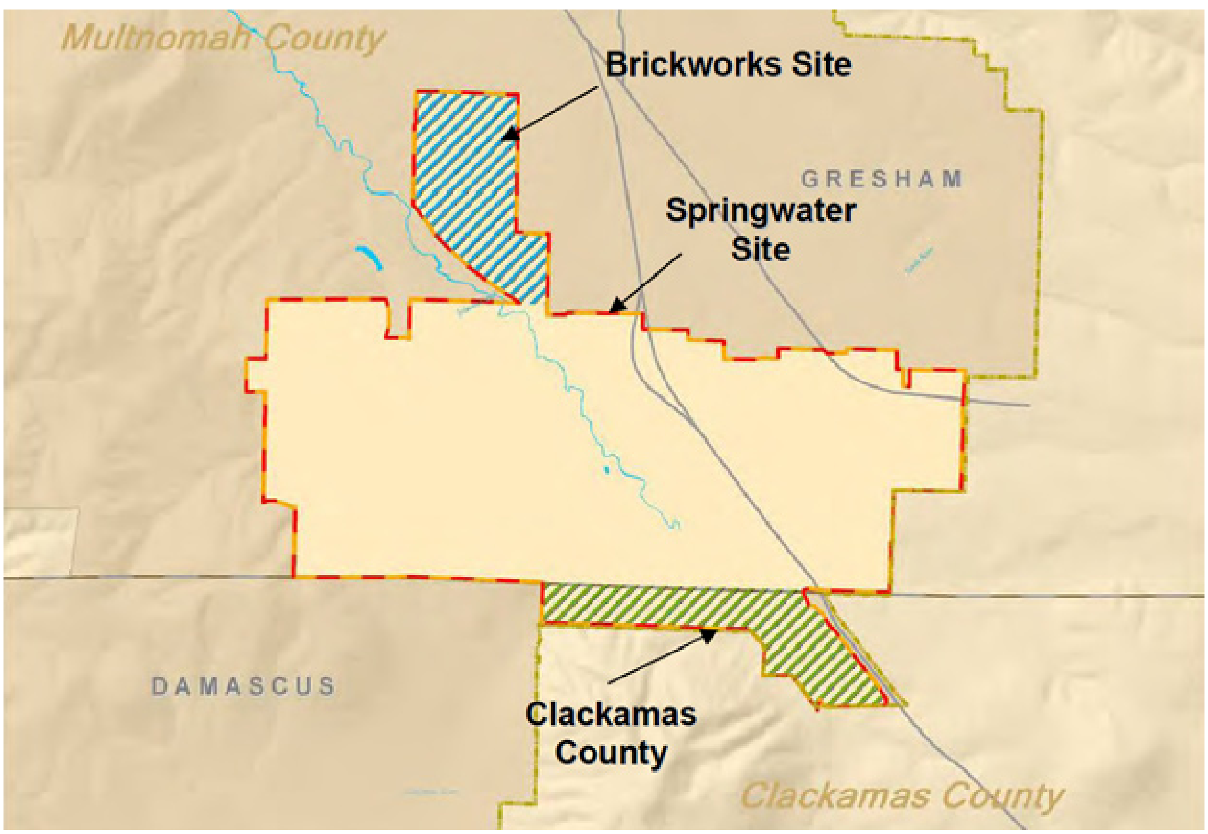
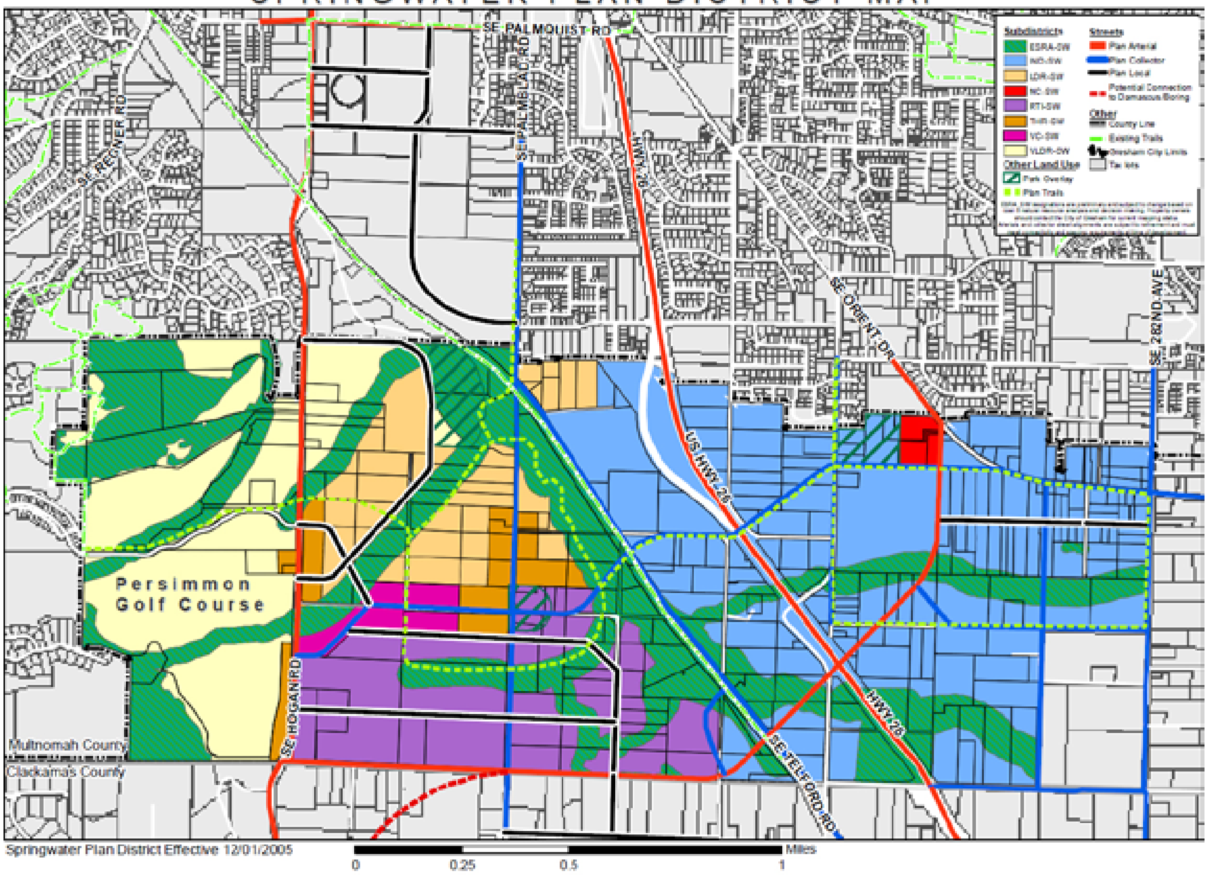


Fig. 2 - Springwater Planning Area

SPRINGWATER PLAN DISTRICT MAP



Subdistricts

	ESRA-SW	ECOLOGICALLY SENSITIVE RESTORATION AREA
	IND-SW	INDUSTRIAL AREA
	LDR-SW	LOW-DENSITY RESIDENTIAL
	NC-SW	NEIGHBORHOOD COMMERCIAL
	RTI-SW	INDUSTRIAL (OFFICE BUILDINGS)
	THR-SW	TOWNHOUSE RESIDENTIAL
	VC-SW	VILLAGE COMMERCIAL
	VLDR-SW	VERY LOW-DENSITY RESIDENTIAL

Other Land Use

- Park Overlay
- Plan Trails

Streets

- Plan Arterial
- Plan Collector
- Plan Local
- Potential Connection to Damascus/Boring

Other

- County Line
- Existing Trails
- Gresham City Limits
- Tax Lots

Fig. 3 - Springwater Plan District Map, 12/01/2005

IV. Methodology

The Green Cities Plan approaches development in the Springwater Community with the intent of using ecosystem services to support urban infrastructure. This approach aims to create a successful, sustainable community that meets the goals of the Springwater Community Plan. However, it differs from traditional planning practices in the process it takes to achieve these goals. Rather than relying on large, centralized infrastructure and conventional land development practices, the plan researches alternative methods and technologies to develop the area. The research attempts to show that the alternatives presented in the proposal are viable, cost-effective, and favorable to the community and the environment.

The class made an initial visit to Gresham and the Springwater area on Friday October 9, 2009. Officials with the City of Gresham gave the class an overview of the site, its history, the city's hope for future development, some of the site's difficulties in being developed, and insight into how eco-development could advance the site. Following this discussion, the class took a tour of Springwater and the surrounding area. The tour followed a map provided by Gresham, which directed students along the existing road network, with stops at significant sites within the boundary.

Following the site visit, students in the course divided into research groups, with each one focusing on a type of infrastructure, community need, or ecosystem study that pertains to sustainable development of Springwater. Each group focused their study within their individual research topics, developing a plan for the area that meets the needs of the community. This required weekly research and coordination meetings, where individuals in the groups would present their research, and the group would work together to develop a cohesive plan. To ensure that each of these groups' plans were not isolated from the other groups' plans, weekly all-group meetings and class presentations were held to allow for discussion and coordination.

To conduct research, the course groups utilized case study analyses, peer-reviewed journals, published reports and books, and other planning proposals relating to each focus. These were gathered using the resources available through the University of Oregon library system.

Jonathan Harker, a Senior Planner with the City of Gresham, visited the class midway through the term to listen to group presentations and provide comments and direction for the research and planning proposals. This provided additional insight into Gresham's expectations for the project, and allowed the groups to adjust their research as needed.

Each group presented their final research and plan proposals to the class during the final review on Monday, December 7, 2009. These proposals, which were of substantial length, have been broken down and arranged into the document presented in this proposal.

V. Community Visions

The following visions are organized according to each of the Green Cities research focuses, consisting of Energy, Mobility, Natural Flows, Sustenance, and Waste. Each focus is presented through an idealized vision for the community; the particular benefits, aspects, and implementation strategies of these visions will be expanded upon in the Policy, Plan and Design Recommendations for Springwater. Although these visions are organized individually, there is a significant amount of overlap between their disciplines, which will be addressed in the Policy, Plan and Design Recommendations.

Energy

The Green Cities Energy Plan focuses on meeting the needs of Springwater's residents using a locally owned utility system and a network of alternative and individual building generation technologies. These are supplemented by increases in energy efficiency measures and modifications to the building code that permit passive solar technologies.

The local utility is community owned, and decentralizes the transmission of power to the Springwater community. It reduces dependence on metro-wide utility companies, centralized distribution systems, and inefficient energy transmission, instead centering on a locally invested co-operative, where Springwater residents control their own energy decisions and share in the utility's success. The authority is in the hands of the community, and the responsibility is mutually shared.

Solar hot water heaters, photovoltaic panels, industrial solar applications utilize solar energy for community use, biomass utilizes the byproducts of organic decomposition for energy, and cogeneration simultaneously produces heat and power. These technologies are locally sources, and remove the ill effects and hazardous byproducts associated with fossil fuel use.

Fig. 4 - Example - Solar Energy House

A form-based building code emphasizes the built form in relation to its individual parcel of land. In Springwater, the application of the these codes will govern building orientation, with regards to solar access and cross ventilation, allowing for passive heating, cooling, and daylighting of the buildings. Efficient, insulated building technologies are highlighted, making the application of passive technologies entirely feasible. These will be applied at all development scales, from individual residences and neighborhoods, to industrial buildings and eco-industrial parks.

Finally, incentives will encourage the application of these technologies. They will make them affordable and attractive to residents, so that the community is not only environmentally responsible, but also socially connected and financially productive.

Mobility

The Green Cities Mobility Plan envisions a network of alternative, human-powered, and locally and regionally connected transportation options. The system creates an automobile free environment that centers on a walkable, well connected community.

Bioshelter greenways (Figure 5) will create safe, attractive, pleasant, and sheltered pedestrian corridors throughout the Springwater Community. The greenways will maintain human comfort throughout the year, utilizing passive technologies for heating in the winter, and ventilation practices in the summer. The sheltered greenways will grow food, and will be lined with gardens, producing a uniquely human experience. They will safely transport pedestrians throughout the community, leaving as little impact as possible on the local ecosystem.

Bicycles, human powered cargo vehicles, and small electric vehicles will travel around the community, reducing the need for costly infrastructure and privately owned automobiles. Local bicycle trails will connect throughout the community, allowing flow of both commuter and cargo

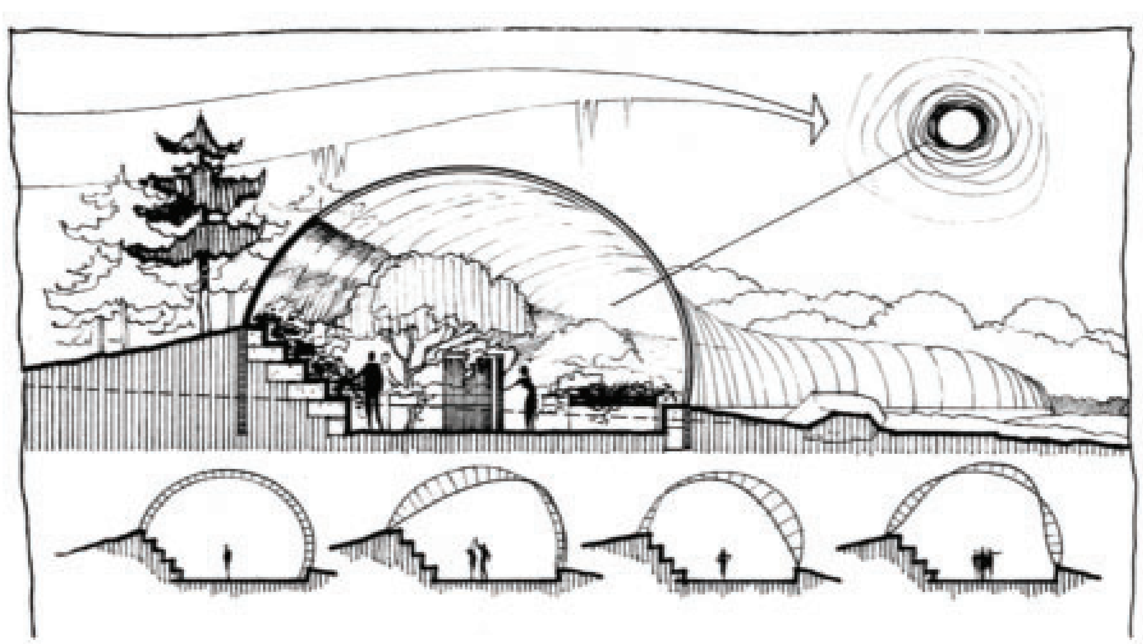


Fig. 5 - Bioshelter Greenway

bikes, while neighborhood electric vehicles will serve purposes where bicycle or pedestrian uses are inappropriate. A bike sharing program allows residents to choose when and how they would like to travel throughout Springwater, increasing the range of transportation options.

Automobile travel will be confined to the existing thoroughfares along US Highway 26 and Telford Road. The industrial corridor will be located between the two roads, and will accommodate the needs of the industrial complex without compromising the human powered network within Springwater. Small electric trucks will serve the industrial complex interior, reducing the amount of large vehicles entering the area.

Land bridges will span US Highway 26, facilitating safe, unimpeded travel between the eastern and western portions of the Springwater site. These landbridges will be attractive to residents, and will foster a variety of local plant species. They will double as wildlife corridors, promoting the flow of human and animal residents alike.

A trolley line will extend along the North-South axis of Springwater, stopping at major points within the community, and connecting to the existing Portland lightrail network. A bus rapid transit system will also link the community along the existing corridors of Telford Road and Highway 26. These provide an efficient means of travel between the Springwater and the rest of the metro area.

At the edges of the community, larger parking structures will be available for convenience of those residents who desire a private automobile. They will also serve other Portland Metro residents who are unable to utilize public transportation to access Springwater. These will allow for a greater flexibility of travel options, while maintaining the integrity and health of the Springwater community. They will be planted with green roofs and living walls, so that their stormwater impacts are mitigated, and so that they serve local environment as much as they do the local human population.

Natural Flows

The Green Cities Life Flows Plan integrates natural flows into its community proposal, focusing on life flow, water flow, air temperature, and industrial wastes. Through the preservation and restoration of the site's characteristic flows, the plan utilizes ecosystem services, while strengthening the relationship Springwater has to its environment, and creating a place where business will want to locate and people will want to live.

The local environment will become a place where both humans and native species can reside within its borders. The existing constraints to human and wildlife movement will be alleviated, so that a series of connected corridors and patches will maintain habitat connectivity. By creating and maintaining these habitat spaces, a healthy ecosystem can coexist with a healthy human environment.

A community-wide water management plan will be implemented, which will maintain the health of the local watershed, remove harmful stormwater impacts, and reduce community water use through efficiency and reuse measures. Johnson Creek will flow unimpeded, maintaining important habitat connectivity and hydrological functions. Stormwater runoff is treated using

Fig. 6 - Wildlife Corridor

natural filtration, reducing the strain on local water systems, and removing conventional chemical treatment methods. Green street design is applied to the urban network, creating a relationship between attractive human environments and healthy natural environments.

Natural vegetation is maintained throughout the site, mitigating the impacts of the urban heat island effect. Existing tree canopies reduce heat gain and shade buildings from solar exposure, reduce air infiltration, provide wind breaks for urban spaces, provide pollution barriers from industrial sources, and increase stormwater retention. They are traded on the carbon market, providing the community with valuable economic inputs, while utilizing them for decreased energy and infrastructure costs.

An Eco-Industrial Park will integrate business practices that close the industrial waste loop. Each industrial waste stream will become material for other industrial inputs, reducing the raw material required to maintain industrial processes, and removing the waste emitted by the process. In this system, waste becomes food, and the local ecosystem remains healthy, functioning, and free of risk.

Sustenance

The Green Cities Sustenance Plan proposes a system of local food and water distribution, where the majority of food is produced on-site, the water supply is sourced locally, and the community is tied to the land. The system will create a stronger local economy, where money spent on food remains in Springwater. The food is fresh, organic, holds more nutritional value, and is of higher quality.

Development within the community occurs according to the placement of developed areas in Springwater, to the local environmental needs, and to the location of higher quality soils within the Springwater boundary. Natural processes are maintained, so that agricultural production remains organic, free from the use of chemicals and pesticides, and in contact with seasonal variations.

Fig. 7 - Community Gardens

A local food distribution network sustains the community. Individual, neighborhood, and allotment gardens are organized throughout the area, allowing residents to grow their own food. Rooftop and vertical gardening strategies utilize built space for additional food production. Community Supported Agriculture (CSA) programs are available, and a local farmer's market is organized, allowing residents to obtain their food directly from the local farmers. Local restaurants, a local food co-op, neighborhood grocery stores, and a food court within the Eco-Industrial park provide fresh and prepared food at all times and from local ingredients.

Edible landscaping transforms streets, yards, and parks into areas of beauty and bounty. Residents can walk throughout the community, stopping to pick fresh fruit and produce at their leisure.

The water supply is decentralized, and local technologies, such as rainwater harvesting and groundwater wells, provide water from its source. Water efficiency measures are implemented, reducing the amount of water the community uses and needs. Water management measures regulate and appropriate water for the needs of both the human community and for the local ecosystem.

Waste

The Green Cities Waste Plan proposes a minimal waste community, where discarded organic material and other, inorganic items are composted, reused, recycled, or put to other uses. Residences, neighborhoods, and industries alike, are all committed to reducing the waste stream. As in the Eco-Industrial Park, one person or industry's waste becomes food for another, ending the cradle to grave approach (see Figure A2, page 70).

Composting takes place within each individual residence, and at each neighborhood cluster. Bins are provided to residents as incentive to compost their waste, providing food for individual gardens or for the local agricultural regions. Neighborhood composting systems are available when individual bins reach capacity, and regular waste collection is limited to individual

Fig. 8 - Living Machine

neighborhoods, reducing waste collection costs, and limiting the amount of material entering the landfill. Industrial composting systems are based in a centralized facility, located adjacent to each industrial park. The facility receives compostable industrial waste, processes it, and sends it to local farms as organic fertilizer (see Figure A3, page 71).

The community manages a central resource dissemination center, available to residents, who can bring unwanted, non-compostable items for reuse. The center redirects the waste to alternative uses, whether by sale or donation, so that their life cycle continues infinitely.

Biological waste treatment facilities filter wastewater, reducing the infrastructure needed to carry the waste to a central treatment plant. The wastewater is filtered using natural methods, either in the form of a living machine, applied at a building scale, or in constructed wetlands, which are applied at a neighborhood or industrial scale. The constructed wetlands also function as habitat, or as recreational elements within the community's outdoor network.

Biogas and Biomass energy generation uses any byproducts of the composting and biological waste treatment processes to create energy. Biogas/Biomass generation supplies energy on site, reducing transmission infrastructure, and eliminating much of the community's carbon footprint.

The Eco-Industrial Park provides space for businesses that create reusable, refillable, and/or compostable products. The waste stream that leaves the facility is either food for another industry, or it is a non-toxic byproduct that enters the community wide biological waste treatment system. These industries will also utilize recycled products as material for their own production. The entire system eliminates many pollutants, and allows industry, nature, and community to exist aside one another (see Figure A4, page 71).

VI. Policy and Plan Recommendations

The Green Cities Plan organizes the community visions into a set of policy, plan, and design recommendations for the Springwater Community. The recommendations are arranged into four components: (1) Land Development, (2) Local, Non-Automotive, Regionally Connected Transit, (3) Decentralized Infrastructure, and (4) the Eco-Industrial Park.

Together, each piece of the recommendation makes up the community plan. It is the cooperation between each of these pieces that creates an idealized community towards which the City of Gresham can develop Springwater. Although the recommendations are included as part of an overall plan, the individual elements can be implemented in phases.

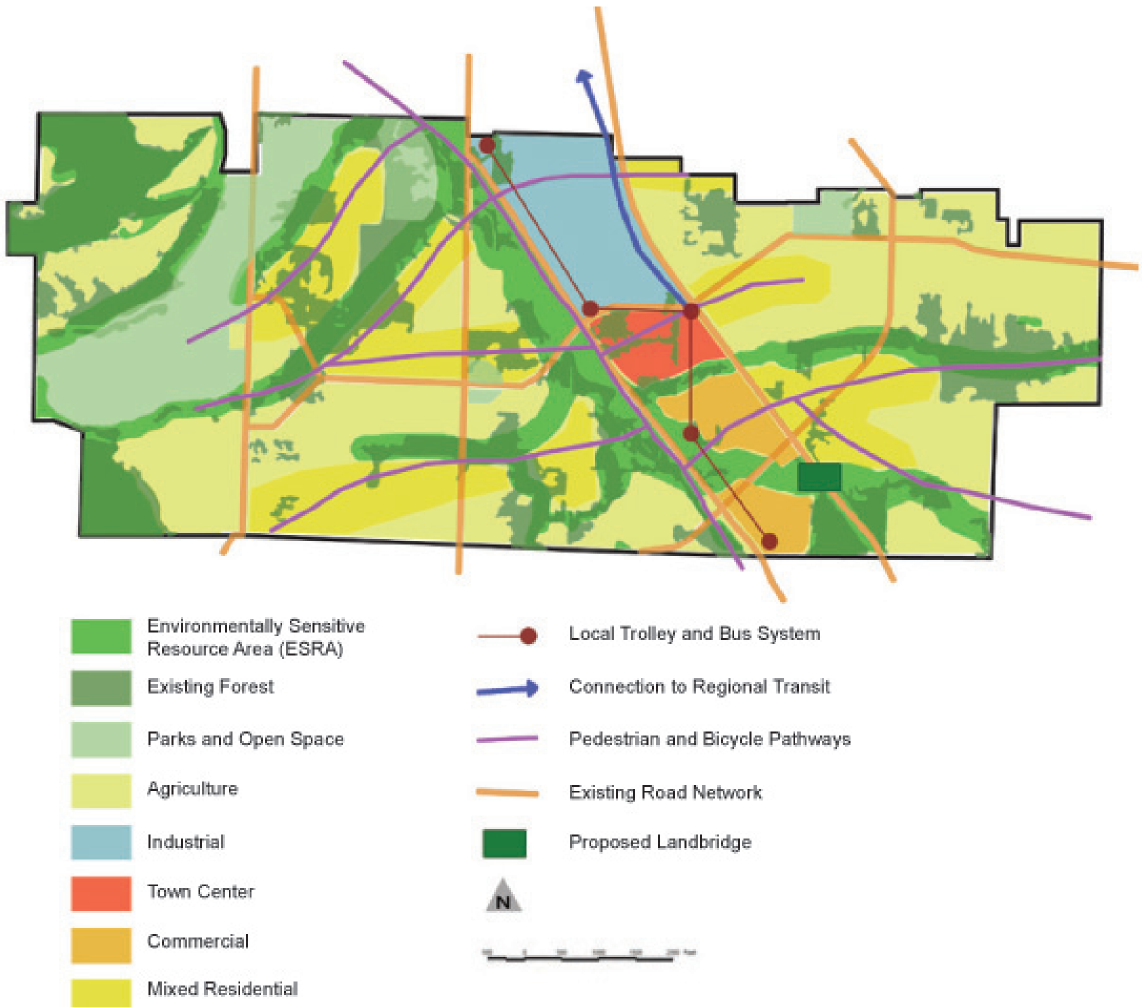


Fig. 9 - Green Cities Development Plan - Springwater

Land Development

A land development pattern that maintains existing landscape features and element flows, while recognizing human needs, is proposed for the Springwater Community. The pattern will allow the site's natural elements to coexist with its human habitation. By balancing the needs of each group, Springwater will create a community in which the urban and natural environments are no longer disparate pieces, but elements of a working ecosystem. Springwater's development should occur in a way that minimizes its impact on the environment, respects and replenishes the natural capital of the land, and creates a place that is more livable and welcoming to humans.

Habitats and Corridors

The Springwater area includes a range of ecological features, including more than four miles of tributary streams and riparian habitat. Johnson Creek, the major riparian corridor transecting the community, is a highly polluted tributary of the Willamette River. The Department of Environmental Quality (DEQ) considers Johnson Creek as a limited quality stream, and development within Springwater should aim to restore the watershed to its original health. This includes, but is not limited to, remediation of contaminated sites, control and mitigation of stormwater runoff, removal and reduction of harmful chemicals and fertilizers, and conservation of critical habitat areas.

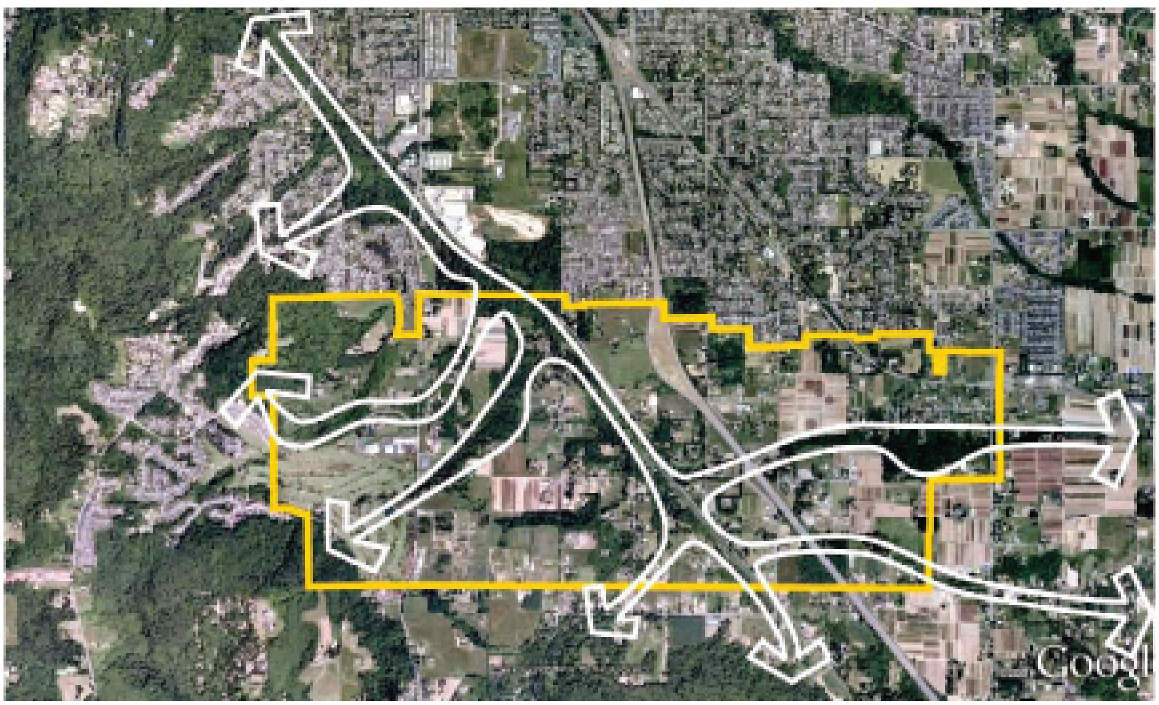


Fig. 10 - Riparian Corridors - Local Tributaries

Johnson Creek and its tributary streams, including Hogan Creek, Botefuhr Creek, Brigman Creek, and McNutt Creek, are designated as Environmentally Sensitive Restoration Areas (ESRA) within the Springwater Community Plan. With the exception of the Hogan Creek corridor, which consists of early to mid successional forest, these areas consist of mixed deciduous and conifer forests. The streams are integral habitats and movement corridors for local wildlife. They present opportunities to maintain and restore ecological health by accommodating various flows of life, including terrestrial, aquatic, and migratory species. Although the relatively undeveloped nature of the site maintains local connectivity, the overall area connectivity is compromised by larger transportation corridors, primarily US Highway 26, and the possibility of new urban development. Figures 10 and 11 highlight the important movement corridors that are integrated into the Green Cities Plan. By proposing to preserve these corridors in the form of ESRA and Parks and Open Space designations, the plan provides a relatively continuous path for wildlife to move throughout the area (see Green Cities Plan, Figure 9, page 20).

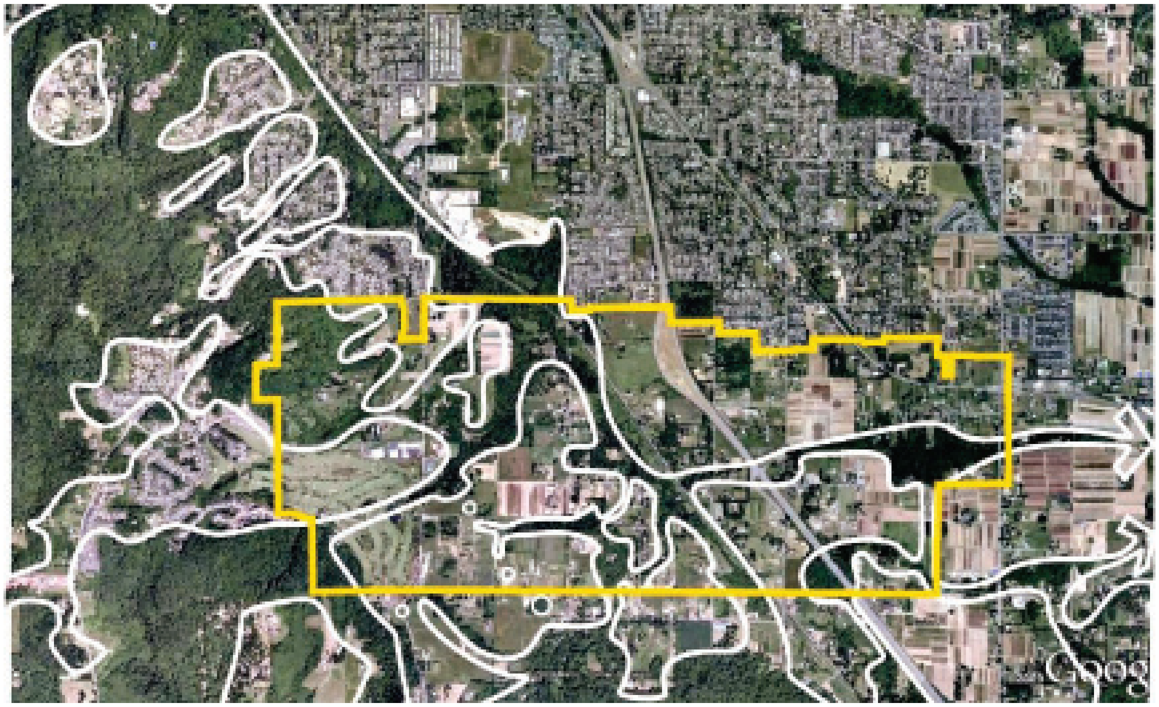


Fig. 11 - Critical Corridor and Patch Connectivity

However, these corridors should be included as a piece of a total plan to improve habitat in Springwater, and cannot be the sole attempt to accommodate wildlife. They should be of appropriate width, depending on the species the corridor hopes to accommodate, and should be in close proximity to other, isolated habitat patches located throughout the area. Rooftop gardens should be developed on buildings within the industrial park to expand the available habitat to developed areas. These gardens can become habitat patches within the city, providing stepping stones for migratory and resident birds.

The following design principles, based on Richard Forman's principles of landscape ecology (Forman, 1996), should be considered to alleviate the impacts of human development and strengthen the natural ecosystems within Springwater.

- Continuity of Stream Corridors: Maintain aquatic habitat conditions and terrestrial connectivity.
- Wider and Denser Corridors: Protects water quality and improves habitats.
- Stepping Stones: A row of small habitat patches provides intermediate connectivity for interior species between larger patches. (Note: the distance between patches is determined by the ability of the targeted species to see each patch).
- Patch Distance: Patches closer to the main habitat will be recolonized faster than patches that are isolated.
- Habitat Grouping: Smaller patches grouped together function as a larger habitat.

The following guidelines are based on Forman's principles, and should be referenced to improve and maintain the ecological functionality of the Springwater area.

- Adopt Native Species
- Provide conditions for succession
- Maintain and/or provide functional connectivity along the entire length of the corridor
- Provide a high quality corridor for native species, especially those that present and most sensitive to development and change
- Restore, where possible, the links between corridors and interior habitats
- Create and protect wetlands, grasslands, and meadows
- Enhance vegetation on banks of creeks; give preference to native plant species
- Create rooftop habitats

Using these principles and guidelines, the Springwater Plan developed a series of plans that can be implemented to improve corridor connectivity. Figure 12 shows the location of these plans within the community.

1. Daylight Hogan Creek and restore riparian vegetation around site
2. Protect headwaters of Brigman Creek and connect to the habitat patch on the southwest.
3. Protect headwaters of McNuff Creek and connect via stepping stones to Brigman Creek
4. Widen Johnson Creek Corridor
5. Revegetate McNuff Creek
6. Revegetate the North Fork of Johnson Creek at the underpass and revegetate the creek banks
7. Revegetate Johnson Creek
8. Revegetate the North Fork of Johnson Creek
9. Develop an underpass for Johnson Creek and revegetate the creek banks
10. Protect, maintain and improve small patches for habitat
11. Provide rooftop habitat for birds in the form of stepping stones.

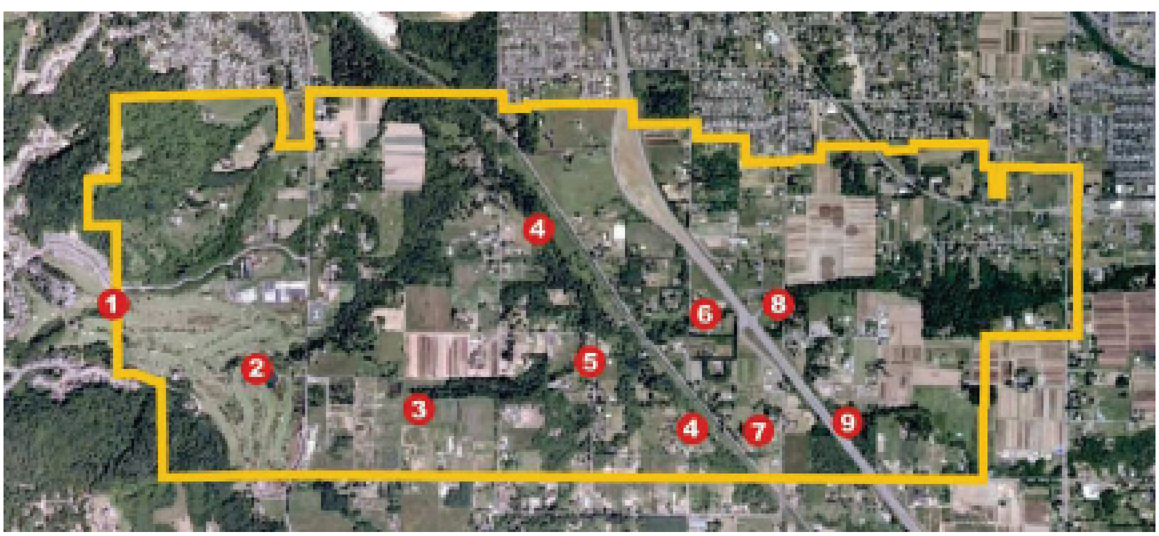


Fig. 12 - Habitat Restoratin Recommendations

Fig. 13 - Trans-Canada Highway Overpass (Land-Bridge)

Additionally, to achieve a continuous habitat corridor throughout the site without disturbing the regional transit along Highway 26, the Springwater Plan recommends that a large land bridge, measuring 0.75 miles in the north-south direction, and 0.20 miles in the east-west direction, be constructed over Highway 26, facilitating the movement of both humans and wildlife. This should be located at the southern end of the site, in close proximity to Johnson Creek, and within an established ESRA. The bridge will help relieve some of the ecological fragmentation created by the highway. This should be supplemented with a series of underpasses along Highway 26, predominantly located along stream crossings, and supporting the movement of small mammals, fish, and other riparian species.

These areas will also allow for human recreation opportunities. By retaining corridors and developing parks and open space, Springwater will become an area where the surrounding environment contributes to the human environment, making it a more desirable and livable community.

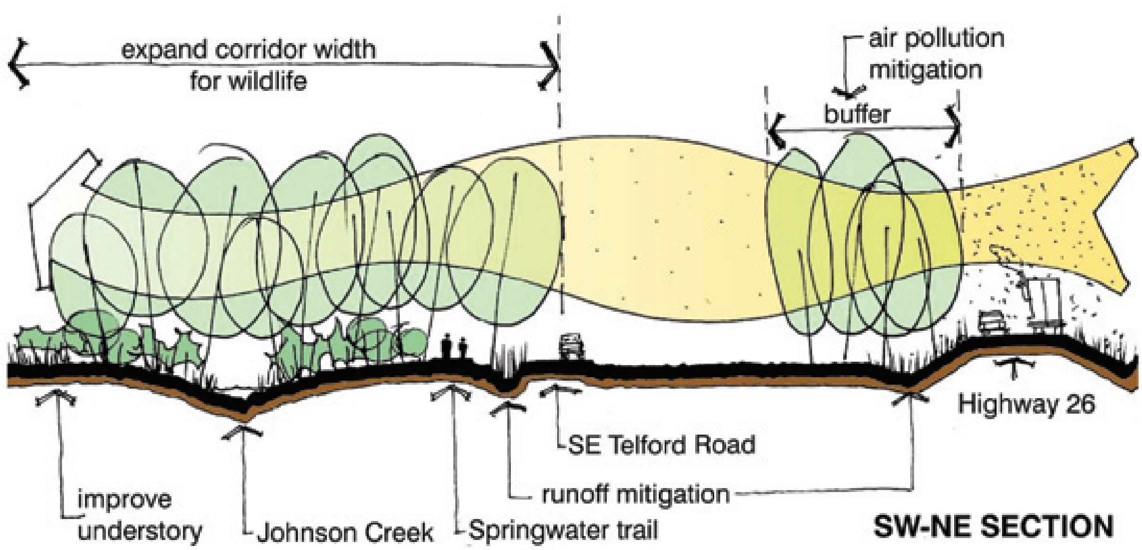


Fig. 14 - Section through Springwater

Existing Vegetation

Approximately 27 percent, or 392 acres, of Springwater's area is covered with trees. These areas provide critical habitats for local wildlife, and they help to maintain corridors throughout site. However, in addition to these ecological benefits, existing tree canopy holds significant benefits for the human environment: visually, climatically, and economically.

The Urban Heat Island (UHI) effect is a phenomena where urban regions routinely have temperatures measuring 6-8 degrees warmer than surrounding rural regions (Stone, 2001). This largely results from the replacement of natural vegetation with impervious surfaces such as asphalt, concrete, roofs, and walls, which have a higher capacity for retaining and emitting heat (Wu, 2009). By retaining existing vegetation, the effects of the UHI can be mitigated. This substantially reduces the costs associated with cooling buildings. For example,

- Between 1985 and 2001, the tree canopy in San Antonio, Texas was reduced by 22 percent, resulting in a loss of summer energy services totaling $17.7 million (American Forests, 2009).
- In Portland, Oregon, homes located adjacent to mature trees realized significant energy savings. Those with two 25 foot tall trees along the western façade experienced a 36 percent reduction in cooling costs, compared to a typical Portland residence (McPherson, 2002).
- Trees adjacent to buildings act as windbreaks, and are found to reduce air infiltration into homes by as much 50 percent, which results in an annual heating savings of 25 percent (McPherson, 2002).

At the urban scale, deciduous trees help to shade urban spaces during the summer months, when their canopy is full, and they help to heat spaces in the winter, by allowing sunlight to pass through.

Tree canopies also help mitigate the impacts of stormwater runoff and urban air pollution. Mature trees, in particular, are especially valuable, and it is important that they are maintained, as they remove up to 70 times as many pollutants from the atmosphere as younger and smaller trees (McPherson, 1997).

- In Palm Beach County, Florida, approximately 17 percent of the tree canopy was lost between 2004 and 2006 as a result of hurricanes. This resulted in a loss of $157 million in stormwater retention capacity, $12 million in annual air pollution removal, and an increase of 2-4 percent of 8 major water pollutants (Kollin, 2009).
- In the Puget Sound region, the existing canopy is projected to decrease stormwater runoff by 2.9 billion cubic feet annually, resulting in a net value of $5.9 billion (McPherson, 2002).
- In Springwater, the current tree canopy removes 32,000 pounds of air pollutants annually. This translates into an annual savings of $74,000 through air pollutant removal.

Trees can also be used as a financial asset. When carbon is traded on open market, one metric ton of carbon sells for $3 in the United States and for $35 in Europe. As the U.S. market continues to grow, more value is given to the carbon that is traded, and the market becomes more valuable. Assuming the U.S. market eventually reaches that of Europe, the existing canopy in Springwater has the potential to earn more than $900,000 annually. Additionally, GASB 34 is a federal tax law that introduces the potential to count trees as a municipal asset when assessing taxes, allowing Springwater to count its existing canopy as a municipal asset.

The existing vegetation is also an important component of the human experience. The presence of green space in urban areas provides psychological and physical benefits to humans, improves human health, and increase productivity. In addition to making urban spaces more thermally comfortable, it provides areas for recreation and relaxation. This makes the community more enjoyable, and more valuable. One study showed that parks and open space contributed to increasing proximate property values, which, with an increase in property taxes, covered the municipal investment into the space (Nicholls, 2004). In Portland, Oregon, properties located within 200 feet of a public park experienced an increase in value of 3 percent; properties located within 1500 feet an increase in value of up to 2 percent; and for properties located more than 1500 feet from a public park, the increases in value are negligible (Nicholls, 2004). Depending on the type of open space the property is adjacent to, researchers found that the increase in property value in Portland can range as high as 15.7 percent (Been, 2008).

Tree sensitive design guidelines should be integrated into the local building code to ensure that these benefits are realized. This includes the preservation of existing tree canopy, the placement of new trees within urban area, and the design of landscape elements.

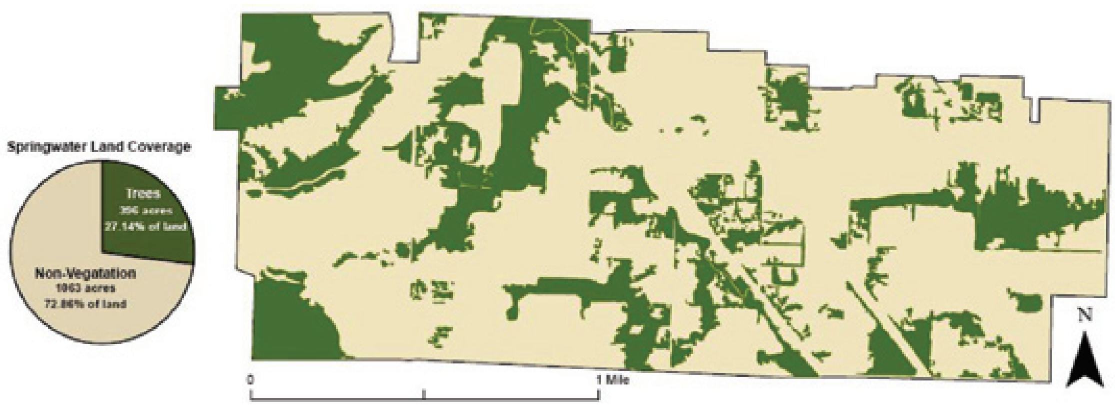


Fig. 15 - Existing Land Coverage

Agriculture

Each soil type within the community is suitable for agricultural development (see Fig. A7, Appendix, page 73). The majority of the soils consist of loams, which are an ideal combination of sand, silt, and clay, that maximize potential crop variety and development (USDA, 2009). The main issue confronting agricultural development in Springwater is the relatively poor drainage throughout the site. This issue can be addressed by planting and rotating crops that are suited to poorly drained sites, and through the use of raised beds.

Ideally, Springwater will be able to grow enough produce to support as many individuals as possible. However, the area's acreage cannot support the entire population: assuming a vegan diet requiring 0.528 acres/person, 2,409 individuals can be supported; assuming a vegetarian diet requiring 1.584 acres/person, 803 individuals can be supported; and assuming an omnivorous diet requiring 2.64 acres/person, 482 individuals can be supported (Avery, 2009). These values are unrealistic, as only a portion of the site can be devoted to agriculture. However, by devoting as much of the site to agriculture as is feasible given the community's other needs, there will be more local produce available to each person, and more money in the local economy (refer to Decentralized Infrastructure, Sustenance).

Agricultural development in Springwater will need to be balanced with other needs. Although it is important that the community is able to use the land for food production, it is equally important that other land uses be accommodated. This includes land that is critical towards maintaining habitat area and overall habitat connectivity, land for urban development, land for transportation, and land for recreation. The remaining available acreage can be devoted to agricultural use, although areas that have the potential to adversely impact riparian systems should be avoided.

Urban Development

Other portions of the site will be utilized for urban development. To ensure that appropriate amounts of land are provided for habitat, agriculture, transportation, and open space, sprawling suburban development is deemphasized and a more compact, community oriented development is proposed.

The industrial sites will be located between Telford Road and Highway 26, maximizing their proximity to regional transit, reducing their impact on outlying areas, and creating a centralized industrial park. The town center and commercial developments will also be located between Telford Road and Highway 26, making their locations central to and accessible within the local community. Finally, residential areas are arranged in cluster and node developments, with smaller neighborhood clusters arranged around a central node. This allows the residential clusters to share resources within their local neighborhood, as well as utilizing community resources available within each node. These areas are within close proximity to the central district, allowing for ease of transportation, while maintaining desired separation distances.

Each of the residential areas should be located within 1,500 feet of public open space. This will ensure that every property is in a desirable location, and that each property will see an increase in property value. In Portland, Oregon, researchers found that urban parks had a significant impact on mean housing values, where homes located within 1500 feet of open space experienced an increase in values ranging from 1.8 percent to 15.7 percent, depending on the type of open space the parcel is located adjacent to (Been, 2008). This will also increase the city's property tax revenue, providing additional funds for other necessary expenditures.

Local, Non-Automotive, Regionally Connected Transit

The Green Cities Plan proposes a network of alternative transportation methods that are both locally and regionally connected. It emphasizes human scale modes of movement and deemphasizes automobile use. This allows the Springwater community to change the dynamics of its land use patterns and accommodate a community oriented development that is conducive towards pedestrian, bicycle, and public transportation modes.

A shift away from private automobile use holds many benefits, both for the individual and the community. Smart Growth America maintains that efficient development decisions save taxpayers money, making it possible for households to depend less on transportation. Metro areas with healthy, compact, centralized cities, alternative transportation networks, and vibrant centers and neighborhoods have stronger overall economies (Smart Growth America, 2009).

- In Portland, Oregon, the average individual that rides transit and utilizes alternative transportation saves an average of $9,581/year, or $798/month (American Public Transportation Association, 2010).
- By shifting from driving to walking, average savings of 25 cents per vehicle mile traveled (VMT) is realized, with the savings increasing to 50 cents per VMT under urban conditions (Litman, 2009).
- Many of these savings remain in the local economy, rather than entering externalized markets. Of the $1.1 billion that Portlanders save by using alternative transit, $800 million, or 72 percent, remains in the local economy (Cortright, 2007).
- At the municipal level, developments that incorporate bicycling and walking infrastructure in proximity with public transportation can reduce fiscal outlays towards roads and other infrastructure expansion by 25 percent (Rogoff, 2009).
- Alternative transportation also produces significant returns on public investment. In Portland, Oregon, an initial investment of $73 million on a streetcar led to private investment totaling $2.3 billion within two blocks of the line (GGLO, 2009). Alternative transit investments increase neighboring property values between 5 and 20 percent (GGLO, 2009). Every $1 invested in public transit results in $31 dollars of private investment within the surrounding community.
- This form of investment also produces significantly more jobs than does traditional roadway infrastructure. For example, every billion dollars spent on public transportation produced 16,419 job-months, whereas the same billion dollars spent on highway infrastructure only produced 8,781 job-months (Barry, 2010).

Alternative transportation also significantly reduces health problems attributed to autocentric development, which encourages a sedentary lifestyle dependent on the automobile (Southworth, 2005). “Analysis reveals a statistically significant association between improved walkability (in communities) and more walking and cycling activity, lower body mass index (BMI), and lower hypertension; people living in more walkable neighborhoods are more likely to walk for at least 10 minutes daily are less likely to be obese than those living in less walkable areas, regardless of age, income, or gender (Litman, 2009).

- In Portland, Oregon, “households in pedestrian friendly neighborhoods make over three times as many transit trips and nearly four times as many walk and bicycle trips as households located in neighborhoods with poor pedestrian environments” (RITA National Transporation Library, 1993).
- The health issues associated with obesity cost Americans $76 billion every year (GGLO, 2009). By encouraging a more active lifestyle, alternative transit can reduce these costs and promote a healthier community.

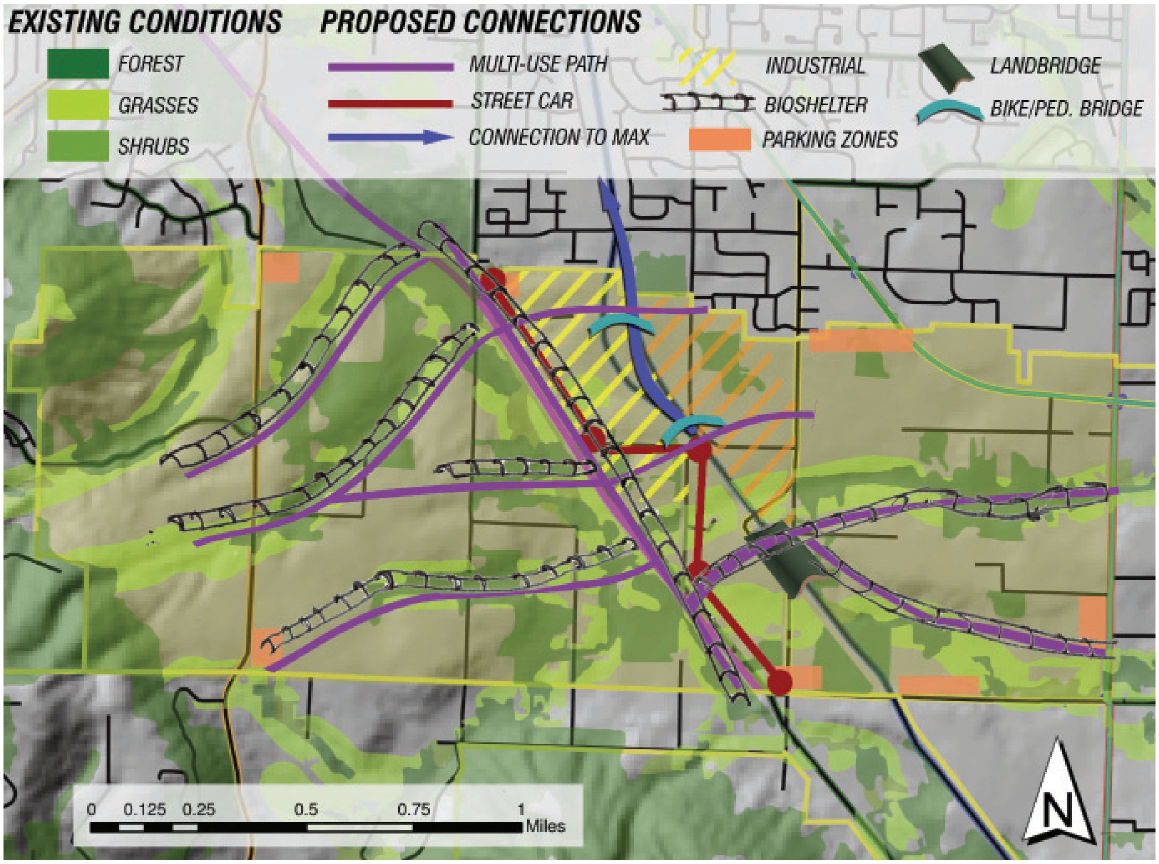


Fig. 16 - Green Cities Mobility Plan

The Green Cities Plan aims to address these issues by developing a transit plan for the community. This plan removes the automobile as a means of transit, and focuses on developing safe, enjoyable, and active means of transit throughout the community.

Local, Non-Automotive, Regionally Connected Transit			
Regional Mobility	Planning for Parking	Walkability	Appropriate Vehicles
• Extend TriMet Max Blue Line to Springwater • Local Trolley System • Bus Rapid Transit	• Perimeter Parking Zones located adjacent to alternative modes of transit	• Bioshelter Greenways • Connected, Safe, Comfortable, Walkable Streets/Districts	• Bicycles • Bike-Sharing Program • Neighborhood Electric Vehicles

Regional Mobility

A mass transit system will accommodate cross-community and regional transit needs. This system will connect Springwater to the rest of the Portland Metro region using public transportation, rather than a network of highways supporting private automobile use.

Fig. 17 - San Diego Trolley System

Fig. 18 - Curitiba Bus Rapid Transit

The community will connect to Gresham and Portland via an extension to the existing TriMet Max Blue Line, which currently runs between Gresham and Hillsboro. This extension will follow Highway 26, and will terminate in the Springwater Community at the intersection of Highway 26 and SE Callister Road.

A local trolley will run north-south between Telford Road and Highway 26, making 5 stops in the area. The line will start north of Rugg Road, and will end at the intersection of Highway 252 and Telford Road. The first stop, moving from the northern end of the site to the south, will be along Telford Road at the north entrance to the industrial park. The second stop will be at the southern end of the industrial park, where it intersects with SE Callister Road. The third stop will be a transfer station to the light rail line that connects to Gresham and Portland, and will be located at the intersection of Highway 26 and SE Callister Road. The fourth stop will be along Telford Road, to the east of the land bridge crossing Highway 26. The fifth and final stop will be at the southern end of the site, where Telford Road intersects with Highway 252, and connects with the Portland area regional bike loop. The initial costs of the system are relatively high, but can be alleviated through ridership fees and low operating costs.

The trolley system can be supplemented by a local bus transit service that utilizes the existing roadway network along Telford Road and Highway 26. This bus line will connect to existing bus transit routes in the Portland area, providing an additional, affordable and efficient means for metro residents to reach Springwater, and for local residents to move throughout the metro area. Bus services will cost considerably less than a trolley system, totaling approximately 25 to 50 percent of the cost. However, when Bus Rapid Transit is utilized, where existing arterials and separate lanes are dedicated to bus transit, costs can be as little as 1/50th of the total (International Energy Agency, 2005). Although bus transit systems have higher operations costs, higher pollutant emissions, slower speeds, and lower reliability than trolley systems, they are an effective alternative, when the costs of developing a trolley cannot be justified. The city of Curitiba, Brazil, is lauded for its public bus system, which has proven extremely successful in reducing automobile usage, urban traffic problems, fuel consumption, and pollutant emissions. It is estimated that Curitiba's Bus Rapid Transit System reduced annual automobile usage by 27 million trips, resulting in a per capita fuel consumption that is 30 percent lower than other Brazilian cities (Goodman, 2007).

Planning for Parking

Although Springwater is to be a car-free community, it will need to maintain important connections to other auto-dependent communities throughout the Portland Metro area. A parking plan will need to be implemented to meet the needs of these outlying communities, where public transportation may be unavailable. This plan suggests that parking zones be designated at the northern, western, and southern entrances to the site. These zones will primarily be larger parking structures, so that amount of surface roads and parking are minimized, while providing a minimum amount of parking to the community. This allows flexibility to residents that wish to own an automobile and to commuters that must utilize one.

The parking structures will be located on the periphery, where they will abut sheltered walkways, pedi-cab stations, bike share stations, and neighborhood electric vehicle (NEV) stations, so that movement through the site from these areas will be both convenient and enjoyable. The parking garages will incorporate solar and rainwater collection, and green roofs, so that the land they cover will generate electricity, capture resources, and provide habitat for local birds. The costs of utilizing the parking structures will be higher than considered normal, discouraging auto usage, and providing funding to cover the costs of the garages and other municipal investments, such as the trolley.

The city of Freiburg, Germany developed a ‘car-free’ community on its outskirts, much in the same way Gresham can with its Springwater district. The community, Vauban, allows auto ownership and parking at its edge, where residents have the opportunity to purchase a space for $40,000 dollars, and allowing those who wish to own car to do so. As a result, 70 percent of the families in Vauban do not own a car, and another 57 percent of families sold their car to move there (Rosenthal, 2009).

Fig. 19 - Vauban, Germany

Fig. 20 - Vauban, Germany

Walkability

Walkability is the extent to which the built environment supports and encourages walking. It does so by providing for pedestrian comfort and safety, by connecting people to a variety of destinations requiring little time and effort, and by offering visually interesting paths throughout the community (Southworth, 2005). By proposing compact, centrally located mixed-use development, the Green Cities Plan arranges a variety of destinations within a 10-15 minute walk from one another. Each destination will be connected to one another through safe, comfortable, pathways that offer the pedestrian a variety of choices by which their destination can be reached.

Neighborhood and urban development will be planned and designed to encourage pedestrian use. To do so, meaningful destinations (Duany, 2001) will be arranged throughout the community, which could include parks, retail districts, public buildings, community centers, or areas that accommodate special events. These destinations will need to be woven throughout the community, so that they are not isolated from the individuals who wish to utilize them. They will also need to be connected by streets that are both safe and comfortable. Although the absence of automobiles within the community will help to create a sense of safety, streets will also need to be visible and well-lit. The architectural enclosure, or ratio of the adjacent building heights to street width, should be scaled to a person, be comfortable, and range between 1:1.1 and 1:2.5 in the vertical to horizontal ratio (Jacobs, 1995). These streets should also be visually attractive, and include pieces of the following qualities, which are commonly found in highly regarded, pedestrian friendly streets: (1) Trees, (2) Beginnings and Endings, (3) Many Buildings Rather than few; Diversity, (4) Special Design Features: Details, (5) Places, (6) Accessibility, (7) Density, (8) Diversity, (9) Length, (10) Slope, (11) Parking (Bicycle), (12) Contrast, and (13) Time (Jacobs, 1995). Zoning codes should be revised to permit a variety of uses to exist adjacent to one another. Design requirements should also mandate that streets be developed so that they are conducive to, and enjoyed by, pedestrian travelers.

Bioshelter Greenways will connect the residential nodes to the industrial, commercial, and town center areas. The Bioshelter Greenways comprise one portion of the footpath network within Springwater, which will enrich and enliven the pedestrian experience. Each path's surface quality, slope, continuity, congestion, legibility, weather cover, and safety are significant

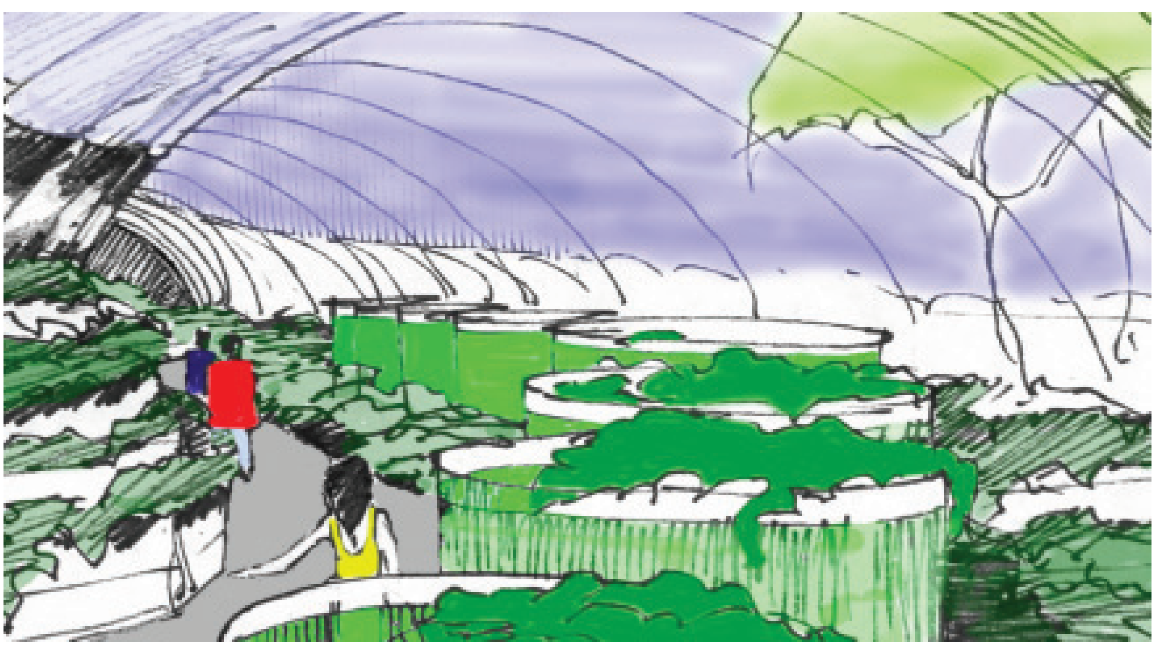


Fig. 21 - Bioshelter Greenway, Interior

factors in the shelter's design. They maximize the aesthetical experience of walking, while serving the needs of the pathway network and the greater community. These will follow the drainage contours of the landscape, allowing for movement of both people and resources. The greenways are enclosed walkways, acting as warm paths in the winter, and shaded paths in the summer. They should be at least 60 feet wide, enough to accommodate bicycle and pedestrian traffic, small electric vehicles, and gardening beds for food production, composting, and heat generation. The exterior will be clad with solar panels and rainwater harvesting technologies, so that energy is generated from a renewable source and water is captured on-site. Additionally, the greenways provide shelter from adverse weather conditions, they offer mobility options for disadvantaged residents, they provide a network of properly maintained paths, and they provide space for appropriate vehicle transit.

Recreational paths will allow for pedestrian travel and enjoyment. Whereas community streets and bioshelter greenways will connect the residential and commercial areas together, these paths will provide Springwater residents the opportunity to relax, exercise, or commune with nature. The proposed system of parks and open space, constructed wetlands, and riparian corridors will be added to the existing trail network in the area, which includes the Springwater Corridor and Johnson Creek Trail.

Appropriate Vehicles

Bicycles, human powered cargo vehicles, and small electric vehicles comprise private vehicular transit within Springwater. These modes of transit will each utilize an extensive, connected network of multi-use paths throughout the community. The paths are narrower and more compact than traditional roads, saving expenditure on infrastructure and maintenance costs, while allocating more land for other uses.

To utilize this network, each resident will have a bicycle available to them. Those who are unable to operate bicycles can utilize Neighborhood Electric Vehicles (NEV's) and Pedi-Cabs, or they can share the path network with cyclists and pedestrians. Although it is not necessary for each individual to own a bicycle, given the local proximity between the industrial, commercial, and

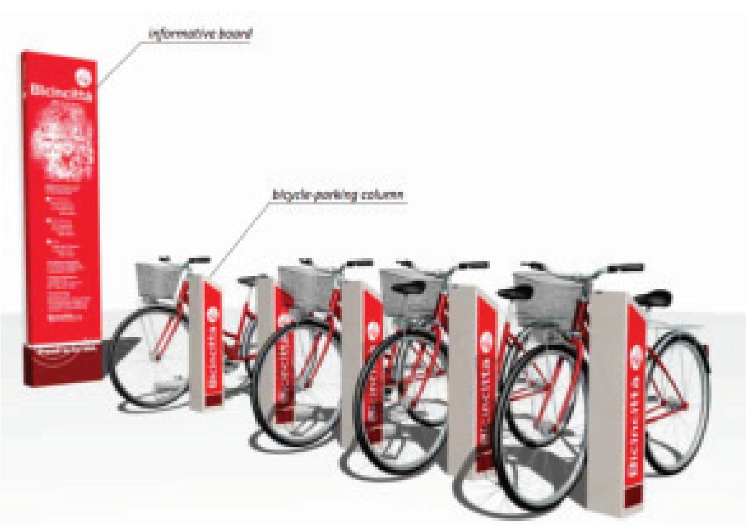


Fig. 22 - Bicycle Share Station

Fig. 23 - Cargo Bike

residential districts, bicycles will provide the freedom, ease, and quickness traditionally attributed to automobiles. Businesses and commercial districts will be fronted with bike carousels, rather than auto parking, which will provide safe and secure bicycle parking options throughout the community.

- Portland, Oregon instituted bike carousels in select areas throughout the city, and found that in the space normally serving 2 auto parking spaces, parking for 25 bicycles can be supported (Press, 2008). Surrounding businesses are in favor of the replacement, with more parking available to customers, and more opportunity to attract business.
- According the City of Gresham code, each bicycle space measures 2.5 feet wide by 6 feet in length, compared to a standard automobile space measuring 9 feet wide by 18.5 feet long, resulting in a 90% reduction in the amount of land required to support each unit of parking (City of Gresham Development Code, 2009).

Fig. 24 - Bicycle Parking, Copenhagen, Denmark

Fig. 25 - Neighborhood Electric Vehicle (NEV)

Fig. 26 - Pedestrian Land Bridge, Florida

For residents, visitors, and employees who do not own a bicycle and need to utilize one, a widespread bike-sharing program will be a convenient, effective means of distributing bikes for short-term use. Cities throughout Europe, including Copenhagen, Denmark, have found these bicycle sharing programs to be extremely effective, and cities throughout the United States, including Washington D.C., are beginning to implement similar programs. In Springwater, these will be placed at each public transit stop, and at the major entrances to the community, so that they are readily available, and easily returned. These programs will also supply cargo bikes for individuals who need to move goods within the community. In the event that this is not possible, whether someone is physically unable to do so themselves, or whether they do not have the available time, a courier service will employ riders to transport goods. In Portland, Oregon, some smaller businesses have found it profitable to use cargo bikes instead of automobiles for delivery purposes (Preusch, 2009).

Neighborhood Electric Vehicles (NEV) can serve the community at times when either walking or bicycle use is inappropriate. The infrastructure investment required to create a functional NEV system is a fraction of the cost compared to standard vehicles (Brayer, 2006). These vehicles are commonly used at many airports and amusement parks, are small and light enough to operate on the multi-use paths, and require minimal energy inputs that can be met using renewable energy sources. A regular shuttle service utilizing NEV's can be developed to move people quickly and efficiently around the site.

Three bridges are proposed to cross Highway 26, allowing unimpeded access between each end of the Springwater site. One of the bridges will be the large, land bridge proposed at the southern end of the site, adjacent to Johnson Creek. The other two will be located to the north of SE Callister Road, where they will connect development to the east of Highway 26 with the industrial park. These bridges will allow residents to cross the highway safely and quickly, using all means of transit available within the community.

Decentralized Infrastructure

The economic benefits for decentralizing infrastructure are substantial. Low-Impact development integrating human uses with the natural environment has shown to be less costly than traditional site development.

- A 2007 EPA study compared development costs associated with projects using green infrastructure with those of traditional development, and found that they yielded savings ranging from 15 to 80 percent of total costs (Chau, 2009).
- In Albuquerque, New Mexico, expenditures on infrastructure serving new housing was 22 times more expensive for sprawling developments than it was for infill development (GGLO, 2009).
- Well-planned compact growth consumes 45 percent less land and costs 25 percent less for roads, 20 percent less for utilities, and 5 percent less for schools, than does sprawling development. (GGLO, 2009).
- The infrastructure costs for traditional, low-density developments are estimated to be an average of $90,000 for each home (GGLO, 2009).
- By following Smart Growth principles for development, cities can save anywhere

between $5,000 and $70,000 per unit on infrastructure, and an additional $500 to $10,000 per unit on annual maintenance costs (GGLO, 2009).

The Green Cities Plan proposes to decentralize infrastructure for its waste management, energy supply, water supply, and food supply systems. Instead of large, costly, centralized distribution networks, the community will maintain a series of smaller, localized resource networks, located within each developmental scale.

Waste Management

Waste management will occur across multiple scales, in each of the residential, commercial, and industrial settings. Whereas traditional waste management infrastructure requires a fleet of waste vehicles, transfer facilities, and landfills, which are all expensive, resource intensive, and highly polluting, Springwater will utilize small and large scale composting and recycling facilities, in an attempt to reach zero waste.

- In Clark County, Washington, 18 percent of the residential waste stream headed to landfills is compostable organic waste, not including yard debris (Brook, 2003).
- In Oregon, 29 percent of the commercial waste stream consists of food products.
- By managing waste through recycling facilities, rather than in traditional landfills, 10 times as many jobs are created for every 10,000 tons of waste generated (Ecocyle, 2007). This will also reduce the amount of land that is required for landfills, removing environmental issues associated with waste storage. The minimum amount of transportation and processing this system requires will reduce other additional costs, including vehicle purchase and maintenance, road maintenance, pollutant emissions, fuel costs, and waste disposal.

Household organic wastes will be processed at each residence using backyard composting, which recycles a substantial portion of the waste stream before it leaves the site. An additional waste collection station will be provided within each residential cluster; featuring a pair of larger compost piles that will require little maintenance, and will be available for community use. This composted material can be used to sustain local food production. To ensure that backyard composting is practiced, Springwater should mandate the use of compost bins, similar to Cedar Grove Composting in Seattle, Washington, and should provide these to residents at a subsidized cost.

Fig. 27 - Traditional Landfill

Fig. 28 - Backyard Composting

Household wastes that are unable to be composted will be placed at a central recycling station within each neighborhood node, eliminating the need for curbside collection at each residence. These wastes will be taken to Central Dissemination Center, where reusable materials holding remaining value can be removed and sold for additional use. This center is also available to local residents to drop off unwanted, but reusable items. Wastes that are delivered to the center and deemed inappropriate for reuse will be recycled into their material elements, at site

Fig. 29 - Central Dissemination Center (Recycling)

within the industrial park, where the recyclables can be used as source material for industrial production.

Wastes from the industrial and commercial areas of Springwater will also institute a composting and recycling system, similar to the residential areas, although at a slightly larger scale. Ideally, each site will maintain its own composting and recycling system, however, in the event that logistics do not accommodate these individual systems, a centralized facility within each area will be available. Recyclables will be sorted at the same industrial park facility as residential waste, and the compost will be distributed to local farms throughout the community.

Fees for the collection of non-compostable waste should be based on a sliding scale, so that it incentivizes composting, and make it a conscious choice for residents and businesses to work towards a zero waste community.

Water

A decentralized water system addresses the community's needs for water supply, stormwater management, and wastewater treatment through local, small scale methods. These methods provide inexpensive collection, treatment, and dispersion measures that are both effective and ecologically beneficial. Water management goals will improve the health of the existing stream system, capture and filter water on-site, reuse wastewater, and decrease overall water use.

Many municipalities rely on user fees and property taxes to fund public infrastructure, however, when the costs for trunk lines, local lines, and treatments facilities are totaled, user fees are insufficient to cover the life-cycle costs (Najafi, 2007). On average, American households spend approximately $523 each year on water and wastewater charges, covering consumption, conveyance, maintenance, and processing (US Environmental Protection Agency, 2009). This equals a total cost of approximately $4 billion dollars every year across the United States, and an energy use equaling 3 percent of the United States' total consumption (US Environmental Protection Agency, 2009). In California, 10 percent of all water conveyed for urban areas is unaccounted for, as a result of inefficiencies and aging infrastructure (California Department of Water Resources, 1998). For Springwater, the development of traditional wastewater infrastructure (collection and conveyance) is estimated to cost $26.7 million if it is to meet the community's expected demand (Springwater Community Plan, 2005). These costs can be drastically reduced through decentralization of the infrastructure.

A decentralized system can be approached through varying installations of (1) stormwater management and rainwater harvesting, (2) water conservation, (3) water reclamation and reuse, (4) energy management, (5) nutrient recovery, and (6) source separation (Daigger, 2009).

Water Supply

Water supply will be met using a combination of rainwater catchment systems, individual and municipal wells, and wastewater reuse. These technologies will be supplemented by increases in water efficient technologies and municipal policy.

Fig. 30 - Centralized Water Treatment Facility

Fig. 31 - Decentralized Rainwater Cistern

The average American household uses an average of 350 gallons of water per day (Mayer, 1999), equal to approximately 69.3 gallons per person (Vickers, 2001). Assuming Springwater reaches its target population of 16,000 residents, residential water use will require upwards of 1.1 million gallons each day. If the Persimmon Country Club requires the same amount of water as the average American golf course, it will require an additional 312,000 gallons each day, and 115 million gallons every year (Deford, 2008). This alone is equal to 10 percent of all water falling on the Springwater area during a standard year.

In order to ensure that the local community, the local ecosystem, and downstream populations receive adequate amounts of water, regulatory measures will be required to make efficiency standards mandatory. These regulations should be written so that certain types of fixtures, water uses, and irrigation methods are acceptable by municipals standards, and that inefficient technologies and practices are abandoned. These should be implemented at each development scale, from residential o agricultural usage. This is more effective and less expensive than constructing new infrastructure to meet increased demand.

- Although many people see the environmental needs for water as competing with the needs of humans, they fail to see the “benefits to mankind of functioning ecosystems, including natural resources (e.g. fish, timber and medicines), hydrological functions (e.g. flood protection and water quality improvement) and support of biodiversity. Water for ecosystems should thus be seen as water indirectly for people (Wallace, 2003).
- In the Regional Municipality of Durham, Ontario, estimates indicate that it would cost approximately $125 million for new infrastructure to provide the equivalent supply of water as will be made available by implementing a 10-year water efficiency plan, costing only about $17.2 million. (Brandes, 2006)
- In Oregon, approximately 85 percent of water demand is for agriculture, and this is expected to increase by 13 percent by 2050 (Zaitz, 2009). By applying microirrigation methods, such as drip systems, water use efficiency can increase to 95 percent, compared to the 40-80 percent efficiency achieved by sprinkler and gravity fed systems. (Vickers, 2001).

Residents, local businesses, and local industries should be educated on proper water conservation strategies. Additional regulatory measures will also need to be implemented. Metering and submetering devices are the most common, and should be installed to monitor water usage. Alternative price structures can also be applied to water and sewer fees, where users pay an increasingly higher rate once their usage passes an established threshold.

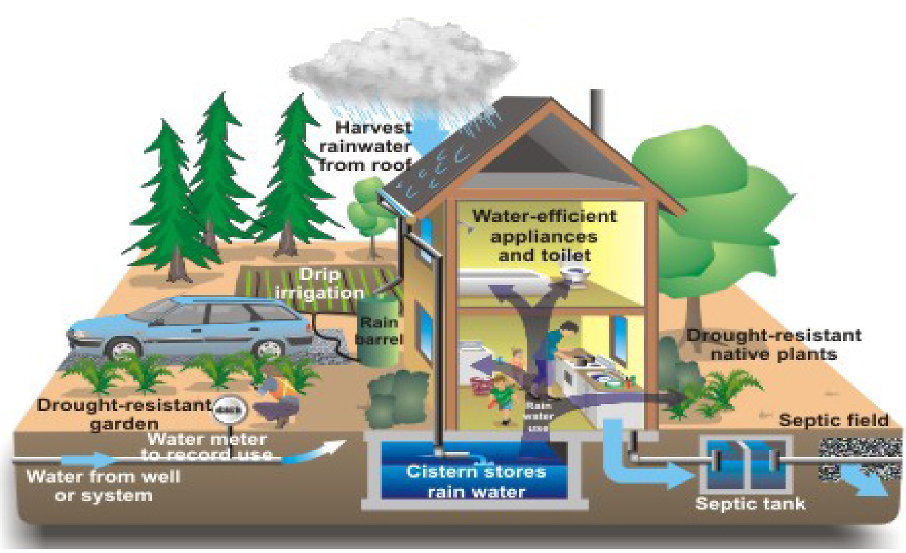


Fig. 32 - Residential Water Supply Systems

Wastewater can be reused on-site. It will be available for community use following its purification in the Biological Wastewater Treatment systems. This water is adequate for potable use, although current codes do not allow this for to happen. Until current codes are modified, the treated water can only be used for irrigation and other, non-potable uses.

Groundwater will be utilized through a combination of individual and municipally owned wells. Individual wells will be located on each developed parcel, serving the needs of that individual property. As development density and required separation distances increase, larger community wells serving a number of households or users will be developed. These require co-ownership among its users, who are responsible for operating and maintaining them. Municipally owned wells will serve areas where individual and community wells cannot adequately meet demand or where physical site characteristics are unfavorable towards well development. Each of these should be monitored to ensure that amount of withdrawal does not exceed the rate of replenishment.

Storage ponds can also be a part of the supply chain. They can act as either a backup system in times of low supply, as additional storage during unusually large precipitation events, or as a part of the normal supply system. The ponds should be located adjacent to existing riparian areas and within the network of constructed wetlands. They can also be placed within each development district as a means of supplying fluid for fire suppression. In these applications, the ponds are integrated as landscape features for the use and enjoyment of the local residents.

Water towers are another method of storing water for future use. The advantage of water towers, compared to other types of water storage, is the use of gravity to feed pressurized water. These are ideal for the industrial and commercial districts of Springwater, where large amounts of pressurized water will be required for fire suppression.

Rainwater catchment will make up the largest portion of the water supply. Given that 88 percent of the area's rainfall occurs during the winter months, rainwater catchment systems can capture and store the water for use during the dry, summer season. Two types of catchment systems are recommended for Springwater: rain barrels and rainwater cisterns. A combination of these systems will be arranged throughout each development area, with rain barrels serving individual parcel needs, and cisterns serving both individual parcels and neighborhood groups. Rain barrels are above ground catchment devices that are smaller than cisterns, usually holding around 55 gallons of water. They are most appropriate for providing a non-potable water supply. Cisterns are large rainwater collection tanks that can be placed either above or below ground, in combination with a filtration system. They can be integrated into individual building design, collecting rainwater that falls on roof surfaces, or they can be integrated as a part of local neighborhood infrastructure.

- Epler Hall, a building on the Portland State University campus, reduces its annual demand for municipally treated potable water by 110,660 gallons through the use of rainwater harvesting systems. (Portland Bureau of Planning and Sustainability, 2009).
- Assuming a total building footprint area of 1,625,000 square feet in Springwater's industrial park (refer to the Eco-Industrial Park recommendations), over 36.5 million

gallons of rainwater can be captured from the industrial buildings every year using rainwater collection techniques.

Community assistance for rainwater harvesting systems can be provided by the Community Working Group (CWG) proposed in the Springwater Community Plan. CWG will be tasked with supporting individuals and industries to successfully implement and maintain rainwater harvesting and water delivery systems. These methods should be mandated by local laws, so that each building employs a catchment system appropriate to their specific size and usage.

Fig. 33 - Curb Cuts for Managing Stormwater

Stormwater Management

Integrated total water management practices are planned to mitigate stormwater runoff in Springwater. These practices decrease the costs of infrastructural development for removing stormwater, they improve stormwater quality before it reaches local waterways, and they provide greater biodiversity and aesthetic beauty within the community.

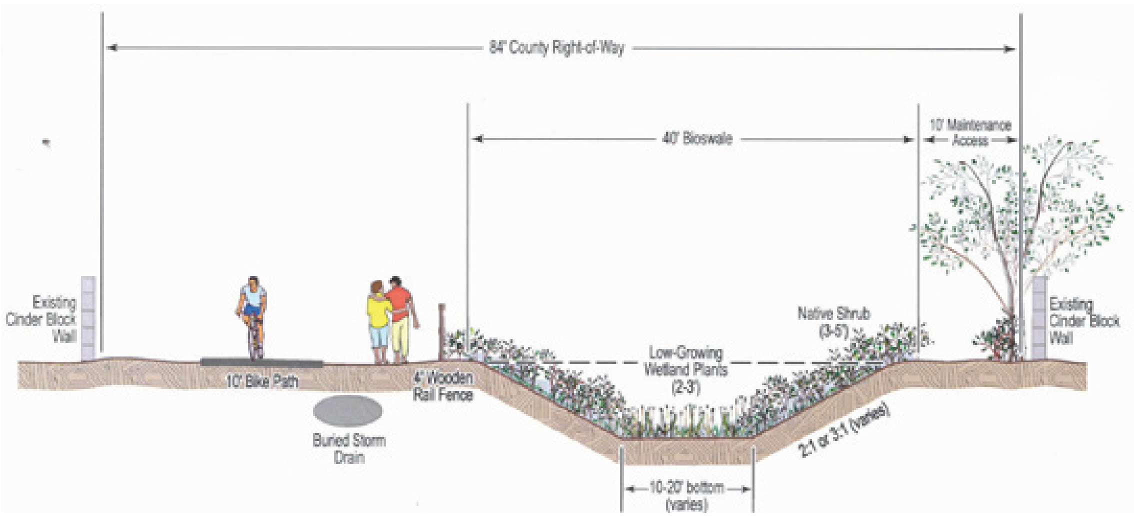


Fig. 34 - Bioswale Section

Stormwater management practices include permeable pavements and surfaces, and landscaped planting, which includes green roofs, bioswales, constructed wetlands and streetscapes. Each of these techniques retains water on-site, reducing the rate of stormwater flow, and allowing it to naturally infiltrate and filter through the landscape. Any stormwater that is unable to be retained on-site will be directed into vegetated swales and constructed wetlands, where it can be filtered for community use or return to local streams. Curb cuts will be utilized within the street network to ensure that stormwater flows into these systems.

Vegetated swales, micro dams, and constructed wetlands can store the water for release at a controlled rate. Green roofs can absorb water on buildings, while increasing thermal performance, extending roof permanence, and creating habitat areas. Trees and other vegetation within landscaped areas help to decrease erosion and improve soil quality. Wetlands can buffer agricultural, industrial, and developed areas, receiving and filtering contaminated runoff before it impacts the local ecosystem.

- Portland, Oregon's Green Street program features low impact development measures from which Portland can reduce total stormwater volume by 60 percent, reduce peak stormwater flows by as much as 85 percent, and decrease pollution in runoff by up to 90 percent (Struck, 2009).
- Estimates based on 10 percent green-roof coverage suggest that greenroofs can reduce the overall regional runoff by about 2.7 percent, and the individual building runoff by 54 percent (Mentens, 2005).
- One study of a 68 acre golf course at Purdue University found that constructed wetlands reduced 11 of the 17 pollutants in the water leaving the course (Kohler, 2004).

These strategies will be implemented throughout Springwater. By interweaving stormwater management with the urban environment, as appropriate within each of the development areas, the ecology and livability of the entire community will be enhanced.

Wastewater Treatment

The Green Cities Plan recommends a network of Biological Wastewater Treatment (BWT) systems, including living machines and constructed wetlands, which will be constructed throughout the community, serving all scales of development. These systems will need to be supported by policy measures that allow waste technologies to be utilized and by improvements in efficiency and conservation awareness.

BWT systems use natural and ecological processes within a staged filtration process to remove solid wastes and restore water quality. Water exiting the system is treated beyond a tertiary treatment standards, and can be safely discharged into local water systems. It can be used for irrigation, household purposes, including cleaning, washing, and consumption, and it can be used in the creation and restoration of habitat areas.

The Living Machine is the most common form of Biological Wastewater Treatment. These will be developed within each residential cluster. Wastewater and sewage from individual houses and facilities will channel into a central living machine serving each node, where anaerobic and

Fig. 35 - Constructed Wetland

aerobic process will break down the waste. Byproducts of the living machine can be used to support other components of the community plan: gases emitted during this process can be used to generate energy, the remaining sludge and slurry can be removed for use as fertilizer, and liquid effluent will be reused as greywater. Living machines are cost effective up 80,000 gallons/day, compared to traditional treatment methods (Todd, 2003). A living machine of this size could accommodate the daily wastewater discharges for 250 homes, which is well above the scale of the neighborhood cluster development.

Water that leaves the living machine and is not reused on site will flow through a series of constructed wetlands. Each wetland will treat the wastewater of 100 households. They will also serve the industrial and commercial areas, and will be sized to accommodate the appropriate wastewater flows from those uses. The wetlands will be dispersed throughout the community, minimizing the amount of hard infrastructure, and requiring only a minimum amount to transport water between the living machines and constructed wetlands. Constructed wetlands also filter stormwater runoff, and can produce harvestable byproducts, such as biomass for energy, fertilizer for agriculture, and water for community.

Constructed wetlands hold a number of advantages over traditional infrastructure.

- Costs to construct and maintain wetlands are low
- Energy requirements are minimal, as natural processes treat and move the water
- Low-Maintenance requirements can be serviced by unskilled laborers
- Allows flexibility to respond to variations in loading rates and capacities

Within the industrial and commercial development areas, wetlands will serve nodes of sites consisting of 3-10 units per system depending on the waste outputs. Industries that produce wastes requiring specific remediation treatments will be grouped together, allowing wetland systems that are designed to meet specific treatment objectives. This reduces the risks associated with mixing and transporting untreated waste streams.

The wetlands arrangement will provide public green spaces and transportation corridors for recreation and mobility, connecting different areas of the community with one another using open space. These areas can be opportunities that enhance wildlife habitat and create natural corridors for wildlife.

Energy

Energy is currently supplied using large, central power plants that transmit power across long distances. This requires an extensive a network of transmission lines that are costly and inefficient. Anywhere between 3 and 10 percent of energy is lost during this transmission (Morris, 2001), and the cost to transmit the energy can be as high as 150 percent of the production cost (National Renewable Energy Laboratory, 1999). Only a small percentage of this energy is produced using alternative energy sources, which results in a large amount of carbon emissions into the atmosphere.

To reduce these problems, the Green Cities Plan recommends that Springwater decentralize its energy supply. This will allow the community to become energy independent, free from the fluctuations of public market, and free of the large scale power outages and blackouts attributed to increased demand and natural weather events. This will require that Springwater (1) use building codes and development standards that require passive technologies and energy efficiencies in building construction, (2) utilize alternative energy generation technologies across all scales, and (3) develop its own locally owned utility company (see Figure A6, page 72).

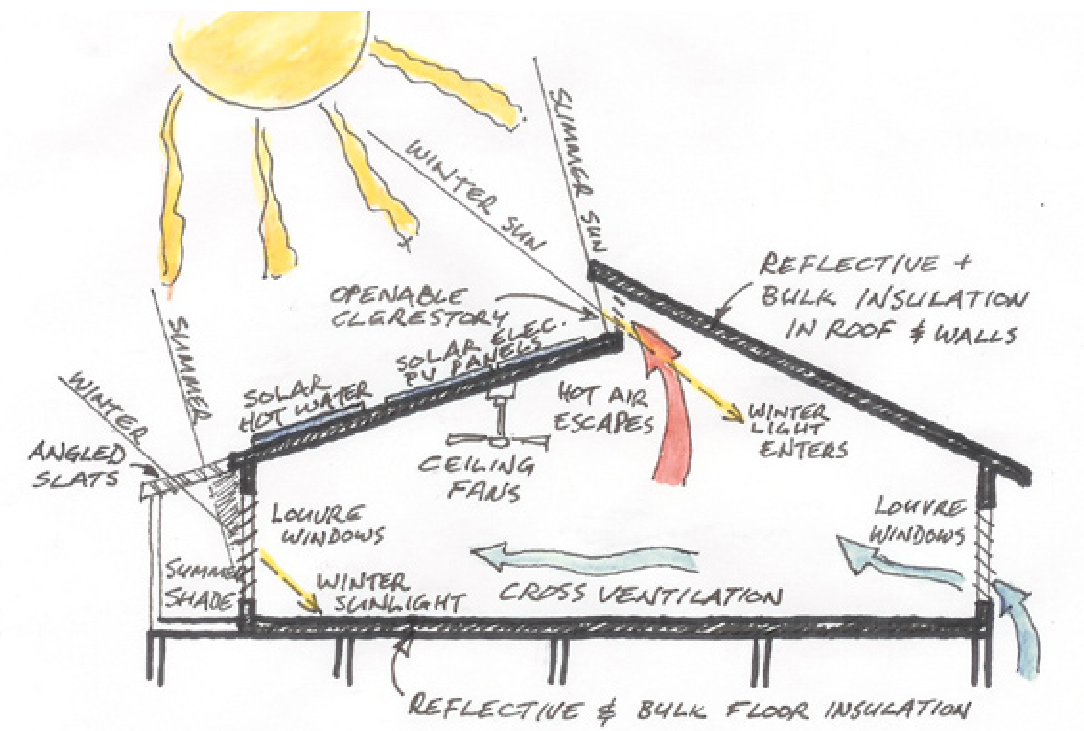


Fig. 36 - Passive Building Design

Form Based Codes and Passive Technologies

Buildings can drastically reduce the amount of energy they require for heating, cooling, and lighting by utilizing passive technologies. These technologies require an initial investment on the part of the building owner, after which they incur very little in additional costs and maintenance.

Buildings will need to be arranged so that they optimize their solar orientation and maximize their access to incident solar radiation. This requires that the street network be organized in pattern that places building parcels along a north-south axis, providing full southern exposure to each site. It allows each building the opportunity to maximize its potential to utilize passive technologies for heating, cooling, and lighting the building. These technologies could include solar gain, thermal mass, and trombe walls for heating; cross and stack ventilation, night flushing, evaporative cooling, and shading for cooling; and daylighting for lighting.

Energy efficient building construction should also be utilized. These include highly insulated envelopes with minimal thermal bridging, appropriate window to wall ratios, exterior shading devices, and proper orientation. These techniques improve the thermal performance of the building envelope, increasing occupant comfort, and expanding the opportunity for passive technologies to be effective. Buildings should also be adaptable, so that they can easily accommodate new uses, without requiring significant demolition, reducing the energy and waste produced in the construction process.

Local building codes and zoning laws will need to require these technologies to be implemented within every new building in Springwater. Older structures that are expected to remain should be retrofit to meet these energy standards. Incentives may also need to be provided to encourage energy efficient development. One alternative code structure is a Form Based Code. This places emphasis on the building form, rather than land use. Typically, form based codes are utilized to achieve a specific aesthetic, but they can also mandate the size, shape, and orientation of buildings in respect to their surroundings. LEED (Leadership in Energy and Environmental Design), PassivHaus, and other green building standards should also be required, so that buildings are both energy efficient, comfortable, and environmentally responsive.

Fig. 37 - Commercial Solar Application

Alternative Energy Generation

Three main forms of alternative energy generation will be implemented in Springwater: solar harvesting, biomass/biogas, and cogeneration. Solar harvesting technologies are proposed in each of the development districts, with the size of development dependent on the scale of its application. Biomas/Biogas and Cogeneration technologies will be applied where they are available, usually adjacent to the biological waste treatment systems. Although they are not emphasized in the Green Cities Plan, other renewable energy technologies, i.e. geothermal, wind and waste heat recovery can supplement the solar, biomass and cogeneration systems.

Annually, "buildings in the United States consume 39 percent of America's energy and 68 percent of its electricity. Buildings emit 38 percent of the carbon dioxide (the primary greenhouse gas associated with climate change), 49 percent of the sulfur dioxide, and 25 percent of the nitrogen oxides found in the air. The vast majority of this energy is produced from nonrenewable, fossil fuel resources." (FOOTNOTE). By removing fossil fuel based generation as a source of building energy systems, an enormous impact can be achieved towards the mitigation of future greenhouse gas emissions, the reduction of airborne pollutants, and the end of environmentally destructive extraction methods.

The average American home has the potential to capture more than 14,000 kWh of solar energy every year using its roof surface. (US Department of Commerce, 2009) Photovoltaic (PV) panels can be used to capture this energy, and the amount they receive is dependent upon the efficiencies of the installed panels. As panel efficiencies increase, more power can be harvested using solar technologies. They can be integrated with green roofs, providing shade for plants, and cooling for buildings. PV panels also offer utilities a way to maximize the productive capacity of their service area without major cost investment. Excess energy produced by the solar arrays can be transferred to the local utility, where they can extend renewable energy to other areas of the community. Solar water heaters are also recommended for each building within the community, as they can reduce residential energy demand by 11 percent. (Greener Choices, 2009). Although solar energy technologies incur higher initial costs, cities such as Austin, Texas, have found that a combination of policy and incentives can alleviate a utility's need to make costly large scale investments.

Biomass and Biogas technologies consume organic matter, including municipal solid and gas wastes, such as the byproducts created in biological waste treatment systems, to create energy. These technologies are considered carbon neutral, as they cause no net increase to the amount of carbon in the atmosphere. Currently, about 3 percent of all energy generated in the United States and 10 percent of all energy generated in Oregon is from biomass. (Oregon Department of Energy, 2009). Biomass boilers supply energy at low costs to users. Each boiler's steam output contains 60-85 percent of the potential energy in biomass fuel, which can be improved to an average of 85 percent when used with cogeneration systems. In the United States, it is feasible to capture and use over a third of the biomass and biogas potential of landfills (Biomass, 2009). For Springwater, biomass (biological matter) and biogas can be sourced through waste management methods, such as byproducts of composting; through wastewater treatment, such as the byproducts created by living machines and constructed wetlands; and through contracting local landfills, like the Allied Waste Landfill, to supply landfill waste for energy generation.

Cogeneration (Combined Heat and Power) technologies can maximize the efficiency of direct combustion systems by providing both energy and heat. These systems capture the wasted heat and reuse it for residential and industrial uses, rather than emitting it into the atmosphere. By using waste heat recover technology, cogeneration systems typically achieve total system efficiencies of 60-80 percent for producing electricity and thermal energy (US Environmental Protection Agency, 2007). These efficiency gains improve the economics of using biomass fuels by requiring less material per unit of energy output. Cogeneration systems will be combined with Biomass facilities throughout Springwater.

Fig. 38 - Biomass Energy Source

The Springwater Utility

A local energy cooperative, such as the Kauai Island Cooperative, will be established to store, distribute, and maintain energy throughout the community. The utility will be responsible for ensuring that energy is available to every resident, acting as a redundant system to the network of individual, alternative generation systems. It will also manage larger energy generation facilities, such as industrial solar power arrays and biomass generators.

Excess energy produced throughout Springwater can be purchased by the local utility, and distributed to local users that are unable to provide for their own energy needs. The local energy cooperative will provide jobs and economic benefits to the community, rather than sending them elsewhere at the advantage of large energy corporations. It will also play a significant role in the community, providing educational programs geared towards conservation and other energy efficient practices.

The following steps should be taken to establish a local energy cooperative: (1) decentralize capacity, (2) transfer authority, and (3) transfer responsibility.

1. Decentralize capacity - Springwater will need to form its own legal utility district in accordance with state and local laws, and it will need to be ready to take power within a reasonable period of time.
2. Transfer authority - The cooperative should be tasked to produce energy and provide it for its members. Each of its customers will partially own the utility, ensuring profits are either reinvested in community infrastructure or redistributed evenly amongst local residents.
3. Transfer Responsibility - To maximize clean and renewable energy usage, the cooperative will need to (1) set an increasing quota for renewable energy, (2) establish a public benefits fund for renewable and highly efficient power sources, (3) enact pollution portfolio standards, and (4) substitute property taxes for pollution taxes.

Food Supply

A 2001 study by USDA Economic Research Services showed that 12 percent of vegetables consumed in America were produced elsewhere and that the typical American meal, on average, contains ingredients from at least 5 countries (US Department of Agriculture, 2003). Food is traveling longer distances to reach the consumer, an average of 1,500 miles for each item (US Department of Agriculture, 2003), increasing the time between harvest and consumption, and reducing nutritional quality.

A local food production system reduces the transportation distances, greenhouse gas emissions, and pollutants produced by the industrial food network; it provides fresh, higher nutrition produce to the consumer, and it supports the local economy.

- Food production accounts for 16 percent of all fossil fuel use in the United States, resulting in 7.7 percent of all greenhouse gas emissions (US Environmental Protection Agency, 1999). Only 20 percent of this figure is used to produce food, whereas the other 80 percent is used to process, transport, refrigerate, and prepare it (Hill, 2008).
- One study showed that locally owned businesses produced 70 percent more activity within the local economy than non-local businesses, and that 68 percent of this money remained in the community, compared to 43 percent for purchases at a non-local business (Hillary, 2008).
- In Santa Barbara County, research found that for every dollar spent at a locally owned business, 45 percent stayed in the community, compared to 15 percent at non-local businesses (Hoffman, 2010).

The Springwater Plan proposes a community based, local food production network that operates at three scales: (1) Garden to Table, (2) Field to Direct Supplier to Table, and (3) Field to Indirect Supplier to Indirect Seller to Table. This will provide the Springwater community with a production system that limits off-site food production and emphasizes local and sustainable agriculture. The Green Cities Plan recommends that on-site food production be supplemented by other sustainably operated farms and dairies within a 50-mile radius of the site. By supplementing food produced within the community with organic food distributed by local farms, Springwater will strengthen its local agroeconomy, connect residents with growers, provide a healthier diet, and contribute to overall ecological health.

Fig. 39 - Community Gardening

Level 1: Garden to Table

The first priority for distributing food within Springwater is the most direct: from garden to table. This is food that is produced on-site and within the local community. It includes individual and community gardens, rooftop gardens, vertical agriculture, small scale animal husbandry, and edible landscapes (see Figure A5, page 72, for organization diagram).

Individual gardens are private lots located on each residential parcel, where residents can grow their own produce within the comfort of their own home. Two types of community gardens will be incorporated into Springwater: allotment gardens and neighborhood gardens. Allotment gardens are distinct plots of land that are rented out to individual families for their own cultivation. These will be centrally located within the residential cluster, allowing each resident to have direct access to the garden. Neighborhood gardens are large parcels of land that are collectively cultivated by a group of people who share both the responsibility and the harvest. The Neighborhood Garden Association of Philadelphia helps to organize, maintain and run these gardens on behalf of the local community. In Springwater, the neighborhood gardens can be located in the industrial and residential zones. Community greenhouses will also be built to ensure that produce can be grown throughout the year. These will utilize passive solar technologies, reducing their energy consumption, and will be located within each community garden.

Rooftop gardens and vertical agriculture will utilize the community's building stock for food production. The rooftop gardens will be located atop the buildings in the industrial and

Fig. 40 - Rooftop Gardening

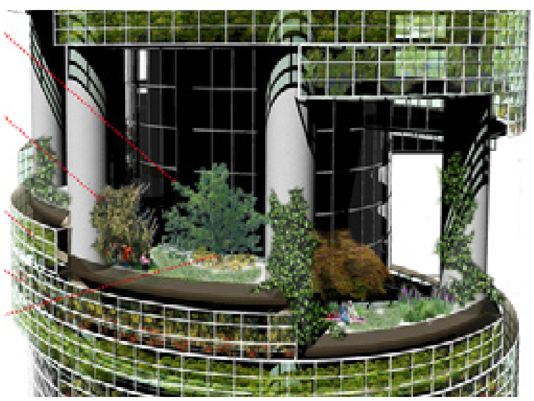


Fig. 41 - Vertical Gardening

Fig. 42 - Chicken Tractor

commercial districts, allowing food to be produced on an otherwise unproductive roofscape, and increasing each building's thermal performance. Vertical agriculture will developed on the water towers within the industrial and commercial districts, using architectural innovation to expand the amount of land available for food production. Additional agricultural towers may be developed as land use permits. These towers will house ground floor retail spaces, many of which will become small markets for distributing food produced within the area.

Small scale animal husbandry will support the local gardens. This includes the use of chickens, bees, and aquaculture. Chickens lay an average of 5 eggs each week, which is sufficient to feed a family owning a flock of at least 3 chickens. They also provide natural pest control, consume food wastes, and provide manure for fertilizer. Bottomless, movable enclosures known as chicken tractors allow the chickens 'free range' to graze on perspective garden sites, while containing them within a desired area. Bees provide honey for residents to consume, while helping to sustain plant diversity by pollinating fruits, berries, nuts and vegetables, which maintains the natural ecological cycle. Aquaculture allows fish to be raised on-site within small, solar tanks that can be used to regulate the interior temperature of buildings through the absorption of solar energy. As local city laws do not currently allow animal husbandry, they will need to be revised to allow it and other local food production techniques.

Edible landscaping will be integrated into the community through the placement of food bearing trees and plants, such as apple trees, cherry trees, or blackberry bushes. By providing a landscape that produces edible material, Springwater can transform many of its unproductive lawns and ornamental gardens into areas of food production.

Level II: Field to Direct Supplier to Table

As the amount of available land within Springwater is insufficient to meet the community's sustenance needs, direct source suppliers, in the form of local farmers, will be needed to grow and distribute additional food for the population. Residents will purchase their food directly from the farmers via farmers markets, Community Supported Agriculture programs, and market gardens. This brings the food to the consumer quickly and affordably (Gaudette, 2007).

The proposed Springwater Farmer's Market will operate on Wednesday afternoons, so that it does not compete with the existing Gresham Farmer's Market, which operates on Saturday

Fig. 43 - Local Farmers Market

mornings. This provides several small scale markets in the area, improving the availability and accessibility of local food to all neighborhoods. The farmers market will operate year-round, outdoors during the summer months and indoors during the winter months. It should be located on the periphery of the Eco-Industrial Park, where access to the market is available using all modes of transportation; and delivery, loading, and set-up of the farmers market is accessible and convenient.

CSA programs are an additional option for Springwater residents to obtain locally grown produce. In exchange for an annual investment in the farm, residents receive a weekly distribution of fresh, local, and seasonal produce, eggs, dairy, or meat. Local farmers, both within and outside the Springwater boundary, can offer these programs to residents. These will cooperate with the two nearby organic farms that already operate CSA programs (Bumblebee Farms and Dancing Roots Farm). These programs are ideal for residents who do not have the time or do not wish to grow their own food.

Market gardens are small scale production sites that produce a wide variety of crops, with the intention of serving the needs of local residents, businesses, and restaurants. These can be arranged throughout the industrial, commercial, and residential areas, allowing the transfer of local food to individuals and families working and living in the area.

Level III: Field to Indirect Supplier to Indirect Seller to Table

Indirect sellers will provide a daily supply of food to local residents, as farmers markets and CSA programs only operate once a week, and individual garden yields are often unreliable. A local green grocer, in the form of a local food cooperative will meet this demand. By providing Springwater with its own food co-op, residents and workers will be able to shop locally, ensuring their food dollars remain in the local economy. The co-op will be run by the community, making

Fig. 44 - CSA Shares

it possible to offer lower prices, and work-trade opportunities for low income families. The co-op is expected to be at the center of community events, not only providing a local food supply, but also a series of educational food, nutrition, and cooking classes.

The Eco-Industrial Park

A major element within the Green Cities Plan will be the Eco-Industrial Park (EIP). The park will consist of businesses cooperating together and with the local community in an effort to reduce pollution, to reduce waste, to increase economic gains, and to improve environmental health. It will market itself towards environmentally conscious industries through its innovative and clean methods of industrial production. By cooperating with one another, the industries in the EIP will use organic and chemical wastes from the community as raw material, will recycle industrial wastes from cooperating businesses in the industrial process, and will utilize material waste as a commodity.

By encouraging development of an Eco-Industrial Park, Springwater will realize benefits for:

1. Business
    - Decreased costs and increased revenues
    - Shared services, rather than individualized infrastructure development
    - Reduced burden from regulation
    - Increased market competitiveness
2. Community
    - Improved environmental health
    - Increased employment opportunity
    - Economic and environmental coexistence
3. Government
    - Increased tax revenues
    - Reduced enforcement burden
    - Reduced costs of environmental remediation
    - Reduced demand for municipal infrastructure
4. Environment
    - Reduced demand for finite resources
    - Decreased local and global pollution
    - Increase in renewable energy and material
    - Renewal and protection of natural systems

In order to realize these benefits, the EIP will need to accommodate two types of industry; those with a technological metabolism and those with a biological metabolism. Industries utilizing technological metabolism produce high input products that are leased to consumers for their useful lifetime, and then returned to the manufacturer upon the end of their lifecycle; whereas industries utilizing biological metabolism produce products that are made from natural materials and naturally decompose upon the end of their lifecycle. These types of industries remove waste as a byproduct of the industrial process, utilize traditional waste as a raw material, and contribute to the economic success of the eco-industrial model.

Organic waste and other recyclables that are unable to be reused in the industrial process will be processed at a central management site within the industrial zone, where it will be reused as compost. Sewage and other wastewater will be treated using on-site bioremediation, including living machines and constructed wetlands, which will safely return water for other industrial uses or for remittance into the local hydrological regime. Greenhouse gas emissions are kept to a minimum, using development standards for energy efficient and passive technologies, tax incentives, and development subsidies.

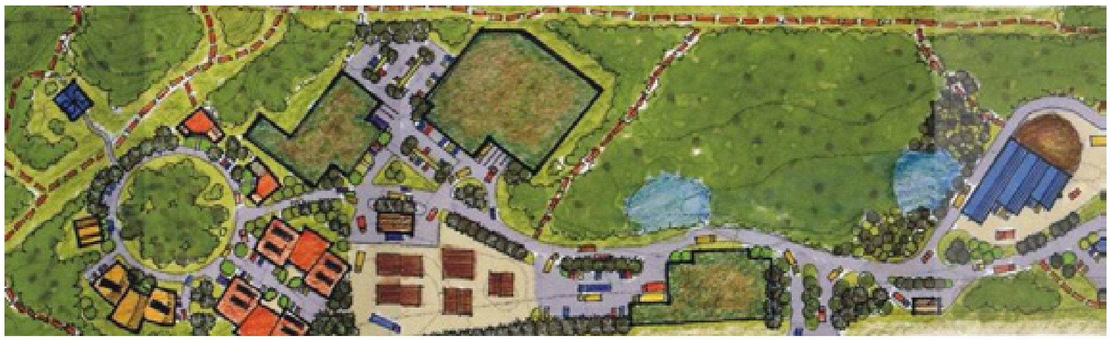


Fig. 45 - Proposed Eco-Industrial Park , Canada

The Eco-Industrial Park will become a central element within the larger industrial zone. Under the proposed land development plan, this zone will lie between Telford Road and US Highway 26, extending from the northern boundary of the Springwater site to a half-mile south of the boundary. This area consists of 41 acres of developable land for industrial use. Although this area is reduced from the original Springwater Community plan by 87.5 percent, the loss in development opportunity is negligible, as the parcels are reduced in size and the need for parking is eliminated.

The zone is divided into 125 average sized industrial sites, measuring 70' x 205', and totaling 14,350 square feet each. This allocates approximately 52 percent of the land in the industrial zone for development, and orients the building sites along the southern exposure. Assuming a four story commercial structure is developed on each site, the total developable floor area for the industrial zone is 6,500,000 square feet. This includes many benefits:

- By providing nono-automotive transportation and access to the site, the parking requirements are removed, which, based on the current Gresham City Code, require between 3.0 -3.8 parking spaces per 1000 gross square feet of floor area for Research and Development facilities (City of Gresham Development Code, 2009). Using a factor of 300 square feet per parking space (University of Colorado Environmental Center, 2002), this removes between 134-170 acres of land that would need to be developed as parking.
- The removal of surface parking alone reduces the stormwater runoff by at least 151 million gallons each year, assuming an annual precipitation between 37.4 and 44.9 inches. Additional land can be preserved by reducing requirements for access roads and loading docks.
- The layout of the industrial parcels is arranged in 5 site north-south rows, requiring only 1.5 linear miles of roadway.

A Common Distribution Center (CDC) will service the industries in the park. This will be located at the northwest corner of Highway 26 and SE Callister Road, where it can easily access Highway 26 and the Portland Metro area. The CDC will receive all inbound and outbound freight for the industrial zone and the Eco-Industrial Park, given the density of the development compared to traditional industrial zones. In addition to the industrial park, the CDC will supply the commercial and agricultural industries within Springwater.

Access to the industrial zone will be available across a range of transportation options. Motorized access will utilize US Highway 26, and will serve the distribution network for the industries. The main interchange for the Common Distribution Center will be at the intersection of Highway 26 and SE Callister Road, where zero emission fleet vehicles will enter and leave the site. Private automobile access from outlying districts will use the industrial district parking garage at the border of Springwater and Gresham, where alternative transit will move workers to their individual business sites. The zone will also be connected to the Springwater transportation network, including stops along the Trolley and Bus Rapid Transit lines, the bicycle corridor network, and the pedestrian pathways.

Within the Eco-Industrial Park, services will support the local food movement. A small-scale food processing plant will support drying, canning, and freezing of excess fruits and vegetables produced throughout Springwater. This will support year-round sustenance, while providing educational opportunities for the local community. A food court will provide space for a variety of food carts, and will serve as the primary location for a weekly farmers market and Community Supported Agriculture (CSA) distribution. An outdoor park and covered pavilion will provide additional space for local vendors, who will supply industrial park employees with fresh, nutritious food, while supporting independent food businesses.

A regional Eco-Industrial Park is also an option for Springwater. This will allow the industries in Springwater to connect with other environmentally sensitive businesses throughout the Portland Metro area, increasing the positive impacts Springwater has on its surrounding communities and environments.

VII. Future Study | Limitations

Although the research covers a wide range of plan recommendations and their implementation strategies for the Springwater area, the Green Cities Plan has its limitations, and future study will be required to transition it from a theoretical plan into a working, actionable proposal.

The course conducted research and developed plan recommendations for the Springwater site using the information it had available for the site. This included the existing infrastructure, the existing landscape, the proposed Springwater Community Plan, the projects intended goals; however given the limited scope of this information, there will be some discrepancies between the Green Cities recommendations and the actual conditions that lend themselves to certain types of development. Additionally, this project is a synthesis of the detailed reports produced in the course, and as a result, does not include much of the technical information within the recommendations. The recommendations are presented in this synthesis, and it is expected that further research will need to done on behalf of the reader to inform them of the actual processes that make these recommendations viable.

This will require that professional consultants be contracted to perform the appropriate analyses to allow any future planning recommendations to address the specific nature of the site. As an example, ecologists should determine the needs required to protect and preserve the local ecosystem and the attributes necessary to make it successful. Traffic engineers will need to determine the expected amount of bicycles, pedestrians, neighborhood electric vehicles, and other non-automotive travel within the site, so that multi-use pathways are designed and sized appropriately. These will need to coordinate with the plans developed by planners and urban designers for the location and form of compact, urban environments, so that adequate space and proper locations for the pathways are provided.

Additionally, a revised plan will need to address specific intentions for different parts of the site. Regarding the local ecology, which habitats and corridors are the most important to maintain to achieve the desired level of protection and preservation? What species will these habitats support, and how will their preservation support these species needs? At the residential level, what type of communities does Springwater hope to provide? How are these reflective of the needs of the targeted demographic, while still maintaining the values and intentions of the Springwater Community? These questions will need to be addressed through the development of the plan if it is to successfully meet its goals and the needs of the community.

For each of the plan recommendations, cost analyses and estimates will be need to be provided to ensure that each part of the plan is economically feasible. Although the research provided many of the fiscal benefits achieved by alternative forms of development, many of these examples are specific to other locales, and the costs cannot be directly applied to Springwater.

As it currently exists, the local zoning and building codes do not permit many of the plan recommendations. These are based on traditional planning practices, and are not conducive towards alternative development. The community will need to perform a code analysis, based on which of the plan recommendations it hopes to implement, and evaluate whether the local codes allow for the development. If not, will the community be willing to amend the codes to allow emerging, sustainable technologies? In many instances, the code will need to be rewritten or amended if Springwater hopes to implement many of the proposed recommendations.

Given the scope of this proposal, there are additional alternatives that can be applied to Springwater that are not included as a part of this document. As these innovative policies and technologies emerge, they can be looked at and applied to Springwater.

Finally, the Green Cities Plan recognizes that the plan will probably be implemented in phases. To ensure that the final plan for Springwater maintains its goals and objectives, the elements should be prioritized, and those that are crucial to sustaining the underlying structure and direction should be emphasized and implemented as appropriate. This will ensure that Springwater can meet its intended goals and become a successful, sustainable community.

VIII. Conclusion

By providing the preceding research and documentation describing alternative development plans for the Springwater Community, Green Cities hopes to show that the proposed strategies, approaches, and technologies are an affordable, desirable, and feasible means of addressing future development demands within the area. The City of Gresham can use these recommendations as a base for any future development proposals in Springwater, as guidelines for developing these proposals, and as marketing tools to promote development interest and excite public awareness.

As stated in the proposal, the Springwater Community Plan lists six underlying goals that Gresham would like to achieve through development of Springwater. These goals will still be met using the recommendations in the Green Cities Plan, will not reduce the quality of life residents expect or that cities hope to provide, and in most instances will enhance the goals compared to traditional planning.

The following statements provide a brief overview of the way in which the Green Cities Plan meets the Springwater Community Plan's stated goals. The actual methods through which these are achieved are outlined in the preceding Community Visions and Policy, Plan and Design Recommendations.

1. Create a community, both economically and sustainably

By planning a community that utilizes ecosystem services, blends ecology, land management, and development into a single plan, and promotes livable, human scaled neighborhoods, Springwater will reduce its initial infrastructural investment, its annual municipal operating costs, and create a more valuable, profitable community. The impacts on the environment will be minimal, maintaining a mutually beneficial, working relationship between the community and its environment.

2. Provide economic development with industrial land generating family wage jobs

Springwater's allocation of a significant amount of land for industrial development will provide incentives for many different types of industry to relocate to the area, creating jobs and resources for the local community. By reducing the amount of land the area requires in infrastructure and support, the community can distribute land to other uses or environmental causes, while still maintaining the desired level of employment opportunity.

3. Foster sustainability through encouraging businesses, industries, and homes to be built with and practice environmental stewardship

By reducing centralized infrastructure and expanding upon existing building codes, Springwater will instead provide ecosystem services, green building practices, and environmental sensitivity, which allow its businesses, industries, and residents the opportunity to practice the environmental stewardship their values embrace.

4. Promote livability, by providing a community with a high quality of life, which utilizes compact and sustainable urban development, a range of housing choices, walkable neighborhoods, access to open spaces and natural resources

By reducing the amount of land required for development and providing land to support integral human and ecological needs, the community can develop in a pattern that increases access to open spaces and recreation, that creates compact, connected, walkable urban and residential areas, and provides a variety of spaces in which residents can choose to live. This will create a community that is more livable and sustainable.

5. A well planned transportation system that promotes transit, walking, and cycling

A non-automotive transportation system provides greater variety in the amount of mobility choices residents and businesses can utilize, while removing the adverse impacts automobile use has on a community and its people. This network provides additional land for community use, improves human health, and reduces infrastructure costs, while creating a community that is conducive to a livable and sustainable development.

6. To preserve, protect, and enhance natural areas and resources.

By preserving important landscape and ecological areas within the site, and by planning a community that supports ecosystem needs and interaction with the local environment, natural areas and resources will be preserved and protected while the community's relationship and access to these spaces will be enhanced.

Although the Springwater Community Plan provides the framework for the community to achieve these goals, the alternative presented in this paper is equally viable. However, the alternative must be embraced by the local planning agency and the local community, so that the necessary support is behind its implementation. This requires that the community look beyond the initial obstacles with an eye towards a better, more livable and sustainable future. By implementing an alternative vision for the community, such as that outlined in the Green Cities Plan, Springwater can become a model for other cities and future developments throughout the world.

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Figure 44: CSA Shares. *Great Country Farms.* <http://www.greatcountryfarms.com/pictures/CSA/.cache/CSA%20box%202.JPG-small.jpg>

Figure 45: Proposed Eco-Industrial Park, Canada. *Eco-Industrial Solutions, Ltd.* <http://www.ecoindustrial.ca/Images/hinton_plan.jpg>

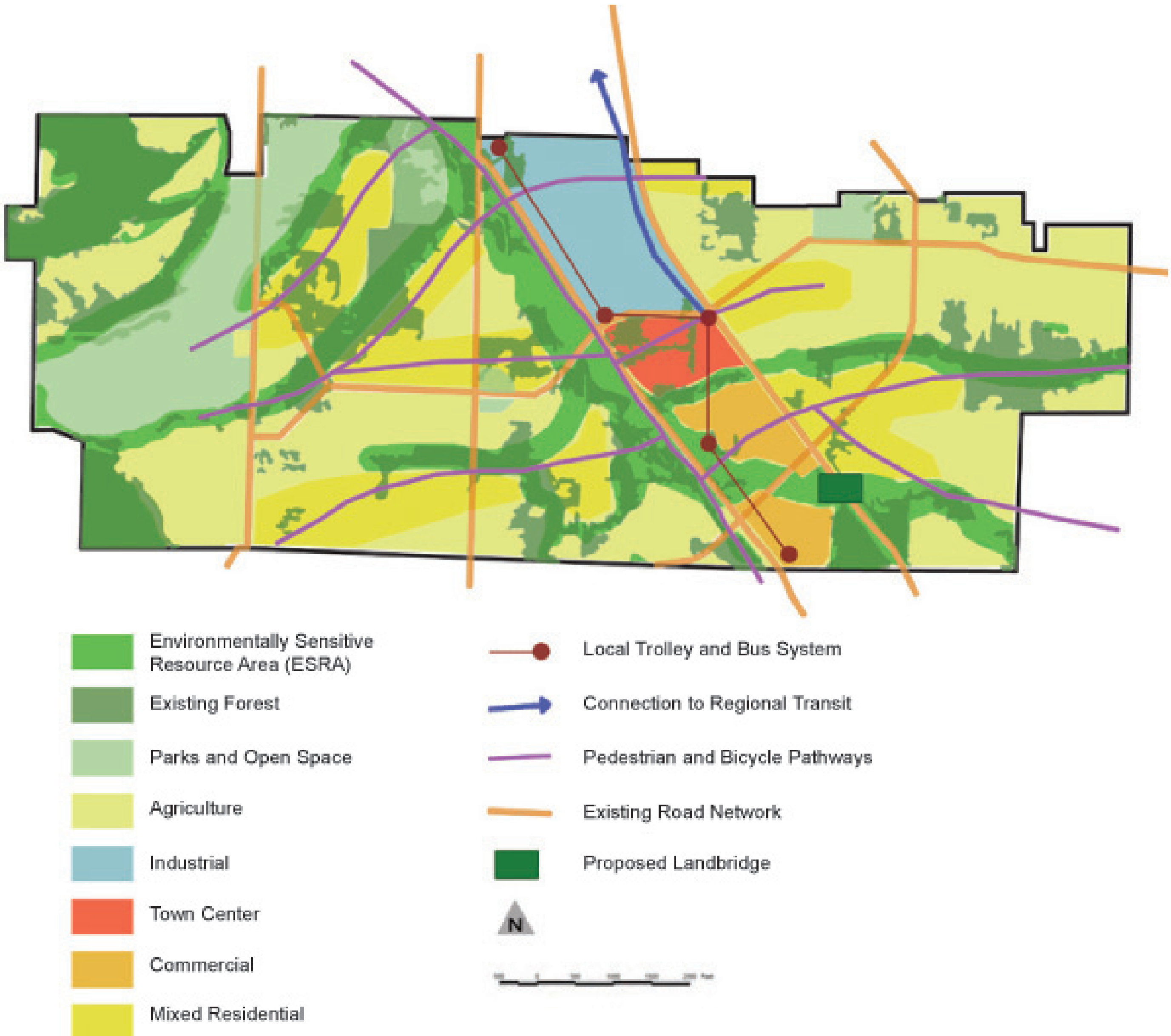

Fig. A1 - Green Cities Development Plan - Springwater

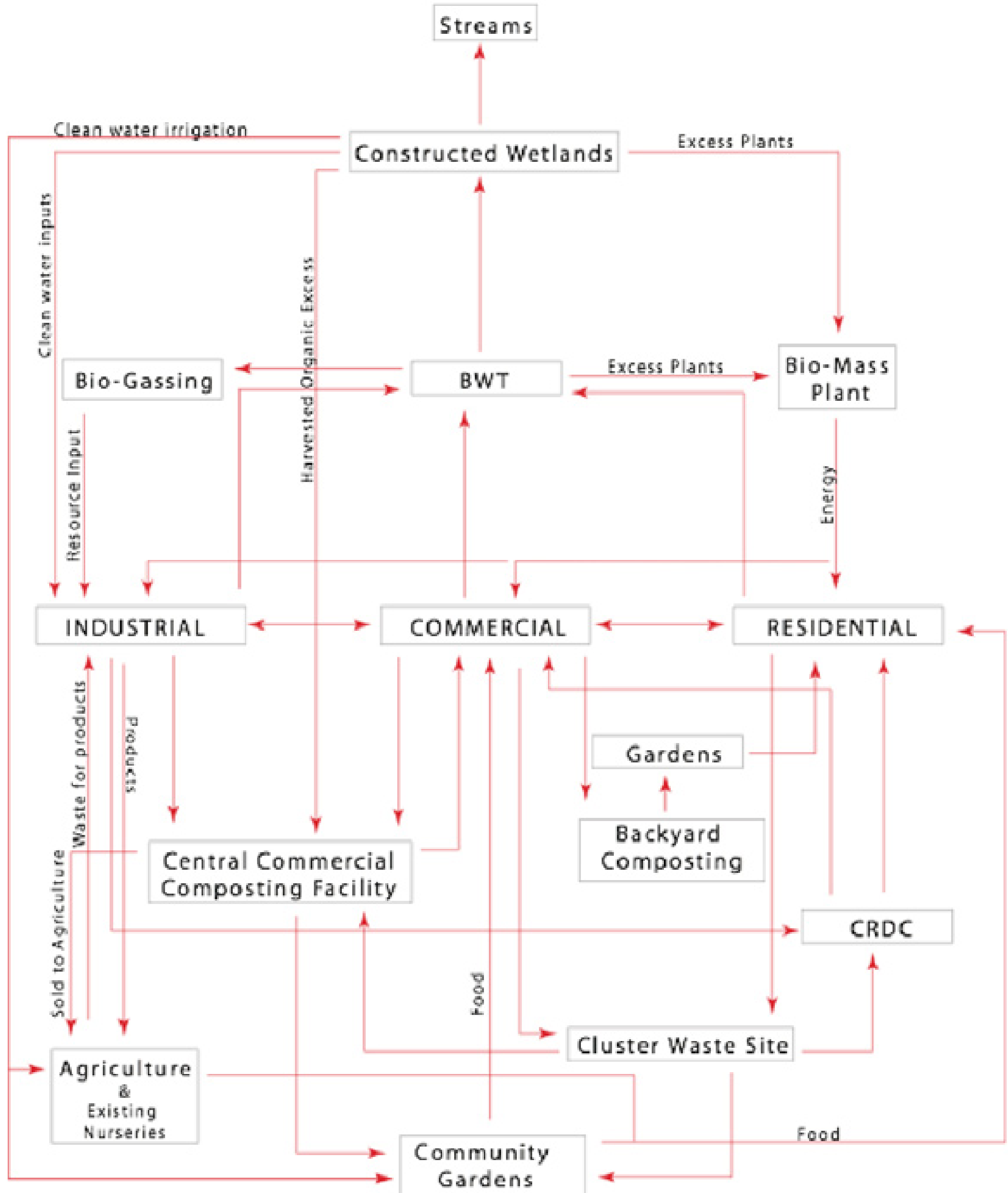

Fig. A2 - Proposed Waste Stream Flow

Fig. A3 - Proposed Neighborhood Organization

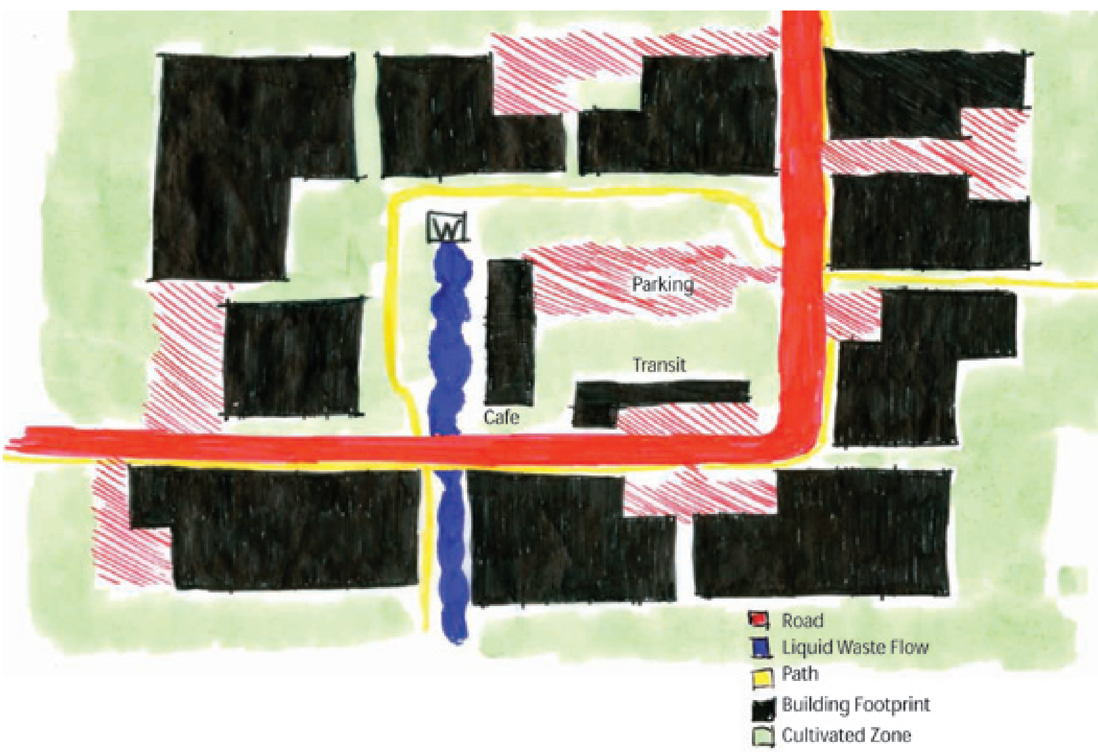

Fig. A4 - Proposed Industrial Waste Organization

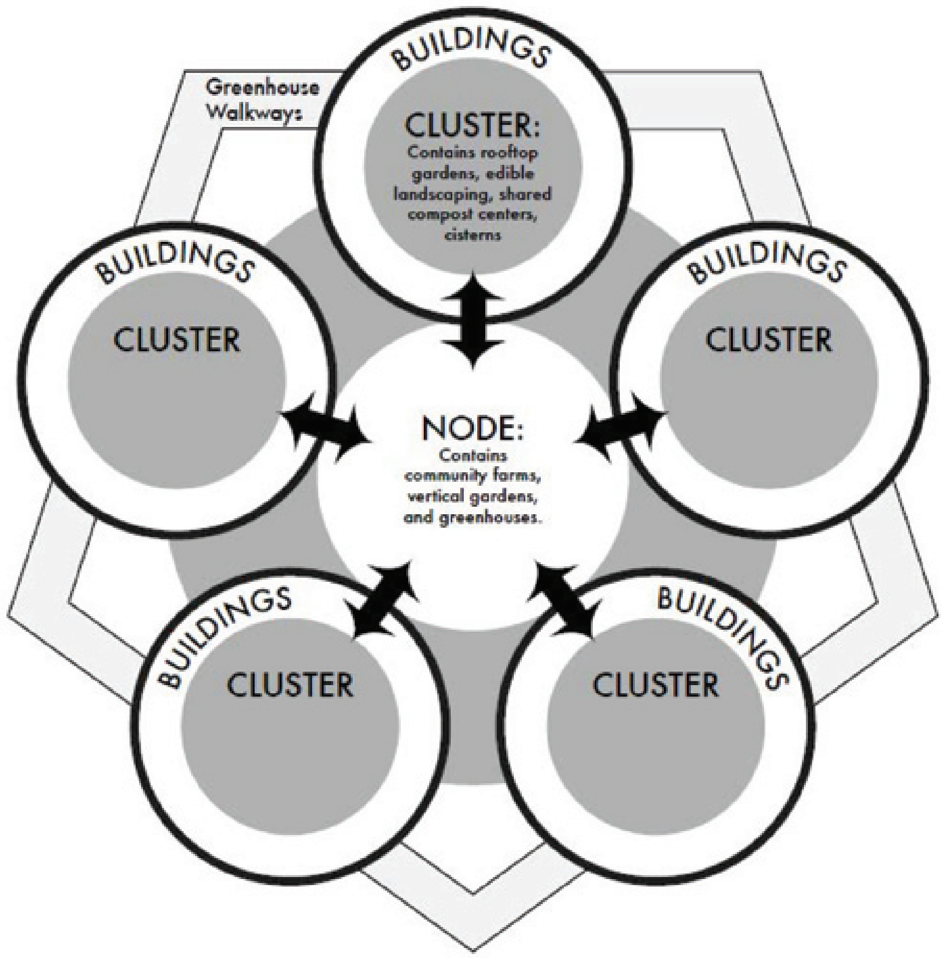

Fig. A5 - Neighborhood Cluster and Node Relationship, Sustenance

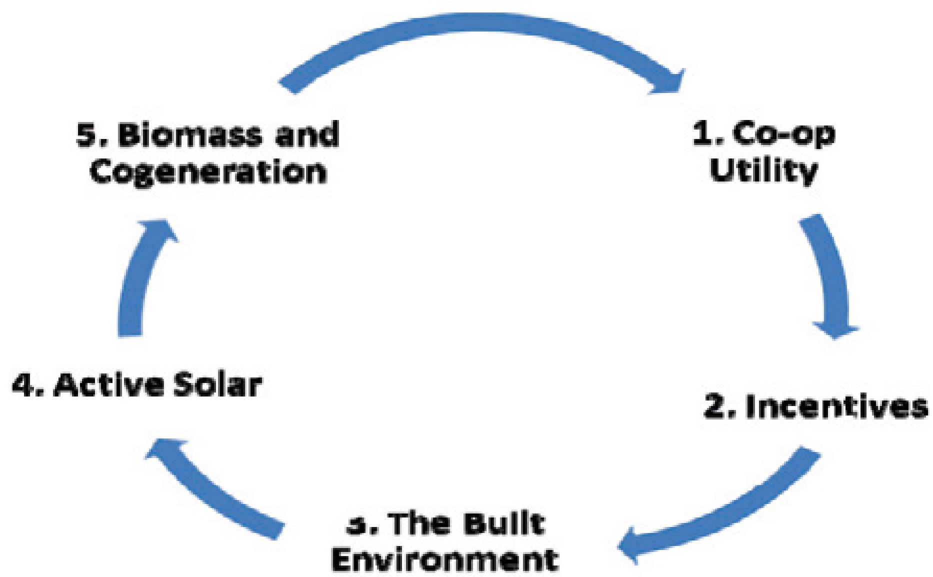

Fig. A6 - Energy Generation Policy

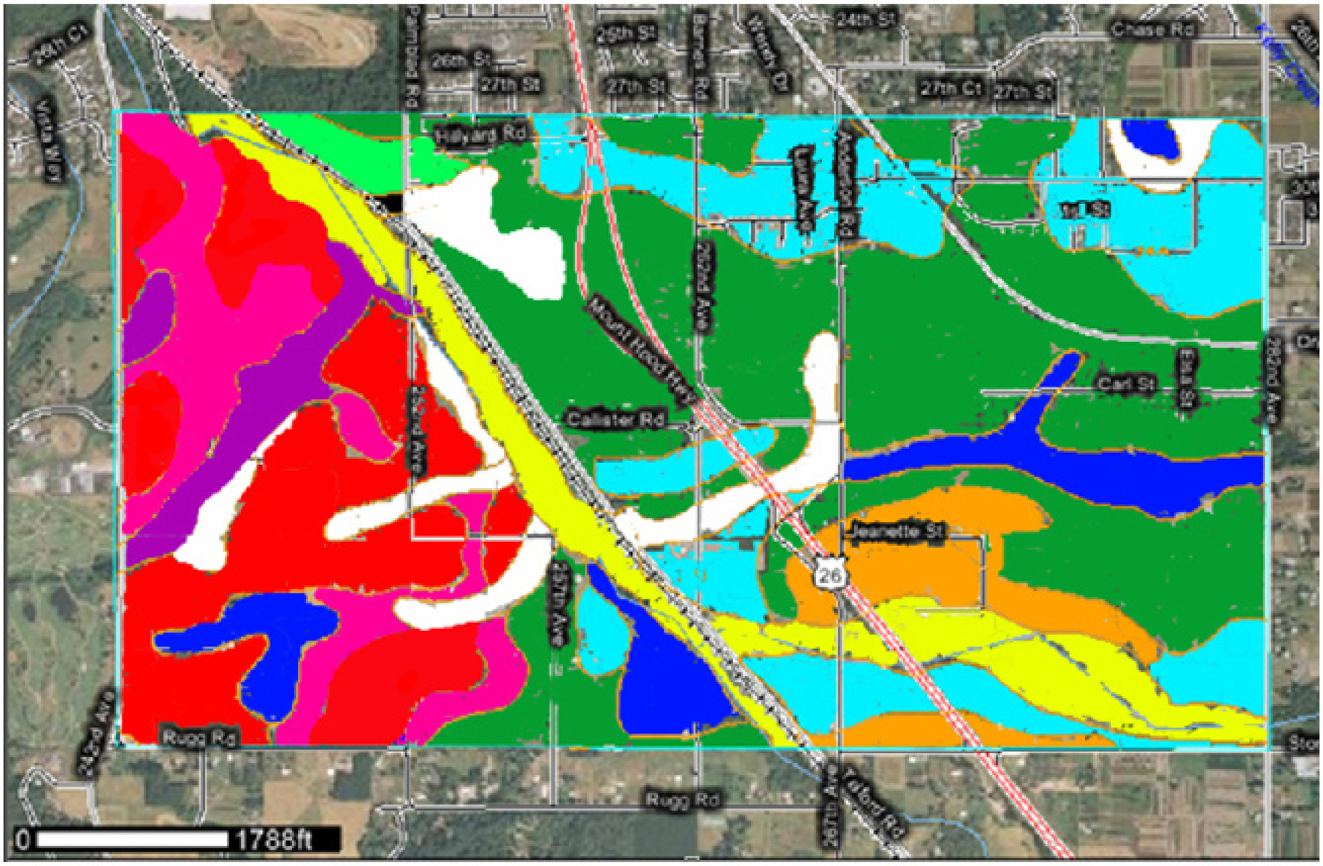

Fig A7 - Soils Map,

Red - 7B, Pink - 7C, Purple - 7D, Gold - 10B, Turquoise - 34A, Dark Green - 34B, Light Green - 34C, Yellow - 55, Blue - 57, White - Unknown

Soil Type Breakdown

1. 7B (Red) Cascade silt loam, 3 to 8 percent slopes, somewhat poorly drained.
2. 7C (Pink) Cascade silt loam, 8 to 15 percent slopes, somewhat poorly drained
3. 7D (Purple) Cascade silt loam, 15 to 30 percent slopes, somewhat poorly drained
4. 10B (Gold) Cornelius silt loam, 3 to 8 percent slopes, moderately well drained
5. 34A (Turquoise) Powell silt loam, 0 to 3 percent slopes, somewhat poorly drained
6. 34B (Dark Green) Powell silt loam, 3 to 8 percent slopes, somewhat poorly drained
7. 34C (Light Green) Powell silt loam, 8 to 15 percent slopes, somewhat poorly drained
8. 55 (Yellow) Wapato silt loam, : 0 to 3 percent, poorly drained
9. 57 (Blue) Wollent silt loam, 0 to 3 percent, poorly drained