OUR BUILT ENVIRONMENT

Ecosystem degradation and non-sustainable environmental practices are ongoing and pervasive problems that require innovation, determination and courage to envision solutions, ensure the survival of future generations, and revive the Earth's irreplaceable ecosystems. Various systems losses have already occurred over the last century including loss of agricultural space due to erosion, loss of greenspace due to expanding cities, collapsing fisheries, pollution of our fresh and marine waters, ozone depletion due to emissions from factories and cars, etc.

In many cases the continued degradation of our ecosystems is "exacerbated by the associated loss of the knowledge and understanding held by local communities" (Millennium Ecosystem Assessment, 2003). Fortunately, on a global level there are various groups like the United Nations and the International Institute for Sustainability that are trying to direct the public's attention to the damages that have and are presently occurring. At the community development level, innovative techniques are being developed to mitigate the problems that have been created or are created by human practices. In response to our built infrastructure, programs like Smart Growth, LEED, the Living Building Challenge, and Integrated Resource Management are challenging the norm and have developed the case that building for the environment increases ecosystem integrity and social well-being. The challenge with these innovative methods is that more often they are orientated towards new development and less so on the renovation of the currently built environment. Our communities continue to expand into areas of greenspace using these new techniques (and old design practices as well), but what remains are previously built structures that upon inception and construction did not incorporate goals to maintain ecosystem integrity and social well-being.

These communities are large areas of impermeable surfaces that do not allow water to infiltrate and ultimately have negatively impacted hydrological flows on the previously unaltered landscape. Infrastructure such as driveways, parking lots, homes, offices, schools, highways, and paved walkways do not allow for the percolation of water through the soil, and instead are designed to be impenetrable by water with a goal of getting water off the area as fast as possible. These impervious structures create large volumes of water that must be drained and sent to nearby watersheds to be then carried out to the ocean. During storm events, stormwater flows are directed to the stormwater system that routes volumes of water to the nearest water body (*i.e.,* streams, wetlands). The excessive volumes of water being discharged into these natural water bodies result in the scouring of streambeds and erosion of stream banks, thereby damaging and reducing the natural function of the ecosystem (*i.e.,* biodiversity, flood retention, groundwater recharge) that the natural water body occurs within. The volumes of water running off of this built infrastructure into receiving streams contains high levels of nutrients (*i.e.,* fertilizers), harmful bacteria, pollutants (*i.e.,* oil, gas, lead, heavy metals), and pesticides.

To address these issues of pollution and degradation of water bodies' stormwater, new techniques have developed to minimize flooding, erosion, and the amount of metals, nutrients, and bacteria that enter into water bodies are called Best Management Practices (BMPs). Such practices range from the proper use and application of fertilizers, and source reduction through site design or mitigation techniques through the preservation of vegetation along streams or water bodies. Other methods that can be applied are more structural such as engineered stormwater wetlands, sand filters, grassy swales, and rain gardens. Based upon the concept of urban reclamation and restoration, these practices can be applied to a functional engineered system to create an ecologically and socially functional learning environment.

The following paper will provide a perspective on what made Project Urban Rain Garden a success. This document does not advise on how to design and build a raingarden in a built urban environment. Project Urban Rain Garden team members decided to use experts in the design and construction process and therefore cannot document how these experts performed their activities. Furthermore, site characteristics and capital requirements dictate the size and type of any strategy undertaken. Most important to take from this model is that it based upon the foundation of educating, empowering, and inspiring a school and surrounding community on the importance of our currently built infrastructure and how urban areas can be redesigned and restored to be ecologically and socially functional.

WHAT IS A RAINGARDEN?

A rain garden is a landscaped area that is built in a low lying area in order to intercept and naturally filter storm water runoff. The garden is deigned with a depression or bowl like feature that is designed to temporarily hold water, allowing for the percolation of the water through to soils thereby recharging groundwater. Designed to mimic nature, the raingarden is an active component of the hydrological cycle.

An important occurrence in nature, rain replenishes water supplies, provides moisture for living resources and maintains flow levels of rivers, streams, wetlands and aquifers. Through the movement of water on the landscape by streams, wetlands, lakes, and the ocean, water continuously circulates on, above, and below the surface of the Earth. As the sun heats the Earth, water evaporates from these bodies of water. This water vapor travels on air currents to eventually condense into clouds when it reaches a cooler layer of the atmosphere. Eventually, enough condensation occurs to form precipitation and the water is released back to the Earth as snow, rain, or hail. Water that lands on the Earth's surface can flow directly into rivers, lakes and oceans, or it can seep into the ground. Some water infiltrates deep into the ground and replenishes underground reservoirs known as aquifers, while some remains close to the surface where it is absorbed by plants or seeps back into rivers, lakes and oceans. Through transpiration, plants release water through their leaves. Through evaporation, water bodies release water back into the atmosphere.

In a typical rain garden, plants are chosen for their ability to withstand large amounts of water, are low maintenance and are able to adapt to local weather conditions. Rain gardens can be installed in a variety of soil types from clays to sands and can range in size. Rain gardens can be installed in a small corner of a lawn, alongside a road, used as a median in a parking lot, or in the case of Project Urban Raingarden, a courtyard of an elementary school. The size and design of the rain garden will depend on the local climate, the location, and hydrology of the landscape and soils.

Rain gardens remove pollutants using physical, chemical and biological mechanisms such as absorption, plant uptake, filtration, sedimentation and microbial action.[1] A process known as absorption is a chemical process that removes heavy metals by using the charged particles within the soil to attract and bind to the metals. Since the absorptive capacity of the soil is finite, it is important that rain gardens are continually mulched to help replenish this capacity. Microbes are found in the shallow root zone areas of rain gardens and break down the organic material from decaying plant material. Microbes will also eat harmful pathogens that may occur within the soil. These pathogens can be destroyed through exposure to sunlight and in dry conditions; therefore it is imperative that rain gardens are designed to filter water and dry out quickly.

The composting of dead plant material back into the garden is important as well for the dying vegetation releases various nutrients back into the system. The process of decomposition of the dying material by microbes within the soil release nitrogen and phosphorous back into the soil so that growing plants can reuse these nutrients.

Sedimentation and filtration are both important aspects of a rain garden, for these processes remove soil particles, litter, and other debris from water. The degree to how much a rain garden performs these actions is based upon its location, size and design. Sedimentation occurs in a system when water is slowed down by vegetation. A vegetation buffer slows the water down and energy from the water is dissipated, thereby enabling suspended particles to settle to the bottom of the rain garden. Filtration occurs when the vegetation mass captures some of the particles being carried by the water as water passes through. Rain gardens can be very effective devices for removing sediments if they are maintained on a regular basis. Rain gardens also reduce mosquito breeding and eliminate pests by valuable habitat for birds, butterflies, and beneficial insects.

[1] Designing rain gardens

PROJECT URBAN RAIN GARDEN

Project Urban Rain Garden was a Leadership Victoria class of 2006/07 Community Action Project, carried out by the team *Today's Stewards for Tomorrow* in partnership with Victoria West Elementary School. Each year, participants in Leadership Victoria form small teams that partner with a community organization to conceptualize and deliver a project of benefit to the community, a Community Action Project. The end result is that the community agency and its constituents benefit at the same time that Leadership Victoria participants develop collaborative community leadership skills and capacity.

For their project, *Today's Stewards for Tomorrow* (TSFT) chose to focus on educating youth about environmental sustainability and engaging them in sustainable solutions. To do this, they partnered with Victoria West elementary school to build a native plant rain garden in what was previously a 300 square meter concrete courtyard at the school. The main goal of the project was to find a way to connect children with natural eco-systems while making an impact on stormwater management issues.

PROJECT URBAN RAIN GARDEN MODEL RATIONALE

Ecosystem degradation and non-sustainable environmental practices are ongoing and pervasive problems that require innovation, determination and courage to envision solutions that will ensure the survival of future generations and the revival of the Earth's irreplaceable ecosystems. Being that children are our future leaders, it is imperative that we provide them the skills, knowledge and resources early in their lives that will allow them to develop new methods to combat the damage that has occurred within all ecosystems.

Speaking to children about the various issues and concerns regarding ecosystem degradation can be complex and overwhelming for both the children and teachers. In addition, children are not usually aware or in contact with degrading ecosystems and thus do not see this troubling problem. This disconnection limits children's understanding of the problem as well as their ability to develop solutions. A rain garden bridges that gap for students. An outdoor, hands-on classroom engages different methods of learning than traditional, indoor classrooms. In an outdoor classroom, children are provided the opportunities to learn about ecosystems. Furthermore, various studies on adults have shown that such school gardens enable parents to participate as well, and gain a new understanding of the purpose and usefulness of gardens.[2][3]

In order to truly facilitate learning and ownership, it was imperative that the children participate in the project from the very beginning. Not only did the participation in the creation and design of the rain garden foster enthusiasm, enhance self esteem, and increase relationship skills amongst students, it provided a medium for the students to be creative, identify and link their own personal cultures to the garden. Studies have shown that the most successful school gardens are those that include the children throughout the entire project, from design to construction.

PROJECT URBAN RAIN GARDEN GOALS

Goal 1: This project will enable teachers to bring to light various environmental issues and foster an interactive learning environment to teach children the concepts of the environment. Ecosystem degradation is an issue that affects us all; storm water management is one piece of this larger issue that demands to be addressed.

Goal 2: The rain garden will provide an alternative to the most common methods of learning in that it is a tactile and kinesthetic learning environment where students can learn through a hands-on approach,

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[2] Lekies, Kristi S., Marcia Eames-Sheavly, Kimberly J. Wong, and Anne Ceccarini. 2006. Children's Garden Consultants: A New Model of Engaging Youth to Inform Garden Design and Programming. HortTechnology 16(1): 139-142.

[3] Heffernan, M. (1994). The Children's Garden Project at River Farm. *Children's Environments.* 11(3): 221-231.)

actively exploring the physical world around them. The garden not only becomes a learning tool, but a play environment as well.

Goal 3: Participation in the creation and design of the rain garden will foster enthusiasm, enhance self-esteem, and increase relationship skills amongst students. The use of artwork will provide a medium for the students to be creative, and to identify and link their own personal cultures to the garden.

Goal 4: The rain garden will teach and inspire the surrounding community to have an understanding, respect, and love for natural systems. This rain garden will serve as a conversational piece and continual learning environment that will inspire the community to undertake other sustainability orientated projects.

Goal 5: Building a rain garden demonstrates that there are progressive, achievable solutions available to address storm water management. This project breaks down some of the obstacles other schools and communities may face in implementing similar actions, by providing a replicable and workable model to be disseminated in various formats, including a website.

HOW DOES PROJECT URBAN RAIN GARDEN WORK?

Project Urban Rain Garden is the reclamation of a paved 300 square meter urban playground at Victoria-West Elementary. The rain garden was designed to take stormwater from an overhead walkway (approximately 250 square meters) and discharge the water into the catchment area.

Water exits the roof structure to fall through a metal sculpture into a 15" wide x 2" deep pea gravel channel and is then carried through the main portion of the garden by this channel. The depth of the sandy loam soil ranged from 36" to 60" deep (depending on the area within the garden) with a naturally occurring marine clay substrate underling these sandy loan soils. The sandy loam soil allows for an approximate percolation rate of 2-4" of water per hour. Beneath the soil is a 24" wide x 10" deep channel dug into the clay. The channel is lined and covered with filter fabric. Within this underground filter lined channel is a clean ¾" clear drain rock and a 4" perforated pipe that is connected to a catchbasin at the end of the garden. The installation of the ¾" clear drain rock and the perforated pipe is to ensure soils drain properly and does not become overly saturated.

Any amount of water that filters through the entire soil bed will be cleaned and will remain in the trench until enough clean water fills it. Once the trench has filled with enough clean water, the water will be carried to the catchbasin and discharged into the storm sewer. The raingarden is designed to handle a 1 in year 5-year storm event. Upon the occurrence of a larger storm event, waters will soak into the soils and the remainder will be carried to the catchbasin by the pea gravel channel. The channel and the plants within the garden will prevent erosion from occurring and perform filtering and sedimentation before the water enters the storm drain.

To ensure proper and effective drainage the garden is raised by cement wall at the discharge point and slopes down through the garden. To ensure that the plants establish themselves and survive the first few years, an underground drip irrigation system was installed. This system uses very little water, and ensures that the water applied to the plants does not evaporate. The native plants were chosen for their ability to withstand large amounts of water, their low maintenance requirements and their capabilities to adapt to local weather conditions.

THE MODEL

The following model will not provide design specifications and calculations to build a rain garden (links to sources will be provided in Appendix C). The purpose of the model outlined is to provide a perspective on what made Project Urban Rain Garden a success.

A key component of Project Urban Rain Garden was the development of an integrated design team at the outset. An integrated design team should consist of a professional landscape architect, and a civil engineer

both familiar with BMP stormwater techniques. A contractor (or project manager familiar with construction techniques) is key to the design team. The contractor will be able to identify what is possible before any construction activities occur saving time and money. Furthermore, the design team should consist of key stakeholders. In the case of Project Urban Rain Garden, the principal, key teachers from the school, a member of CUPE, the school district labor board, parent's advisory council (PAC), and the local community organization all had representation at the design meetings. The importance of these individuals is that the garden at the school would have champions of the garden, for the children will eventually leave the school. It is important to recognize the expertise of the group and where the expertise lacks at the beginning of the formation of the team. Furthermore, it is important to identify which stakeholders that may not have been included in the original team. Not engaging specific community groups may in-fact create greater problems and grievances during or after construction has occurred.

The purpose of an integrated design team is that it provides a medium for all interested parties to have a discussion and brainstorming session on what could be and what will be built. In the long run, an integrated design team will save money, patience, and time. With more traditional project teams, key stakeholders are separate from one another, having very little interaction and communication with one another resulting in miss-communication, cost and time over-runs, and more importantly a designing the project during construction rain garden because key individuals during the design phase where not included.

Rules of engagement should be identified and agreed upon by the team. Decisions will have to be made and it should be decided early on how decisions should be made (*i.e.,* one person, group vote, collaboration, etc). Furthermore, the role of individual who chairs the meetings and who takes minutes should be established. The individual taking minutes should be the person who also liaisons between the integrated team, setting up meetings, providing minutes, updates, etc. The size and style of the garden will determine what sort of funding is required. An individual(s) should be identified and placed in-charge of developing funding, keeping an up-to-date record of funds acquired, amounts spent, and what is available. Proposal writers may have to approach various businesses for price estimates on items or services required.

Funding is the first and foremost item to begin work on. The success of the team was in their capacity to identify funders immediately and approach such persons in charge, thereby improving the chance of acquiring funds. A preliminary project proposal was written for Project Urban Rain Garden identifying the goals, timeline, and estimated costs of the project. (see Appendix A for proposal). Individuals who are experienced with proposal writing should be placed in charge of this area. A timeline is equally important for the team to develop as well. Gannt charts are a useful for this type of project and are commonly used in construction activities for they illustrate the start and finish dates of various activities within a project. These are known as terminal and summary elements. The strength of a Gannt chart is in its capacity to show the dependency (or relationships) between activities within a project. Furthermore, Gannt charts can show current schedule activities using percent complete shaded and a vertical line noted today's date.

Engaging the outside community is key to ensuring that a project will be not only successful, but will have a lasting effect. The difficulty in engaging the community or having a communities input on the design team is almost impossible since design teams should be small. In order to educate, empower, inspire a community, an external interactive activity (or activities) may bridge the gap and identify what the community desires. Case in point, the Project Urban Raingarden team wanted children attending the school to provide input on the design of the rain garden.

To help the children understand the greater purpose of the rain garden, members of the team went to the school and spoke to the children about sustainability, watershed pollution and how a rain garden works. This discussion included an interactive watershed model where students had the chance to see and to recreate the cycle of pollutants (such as motor oil, pesticides and fertilizers) being picked up by storm water and running into the surrounding waterways. To integrate the students attending the school into the design process and begin the formation of ownership and pride, the grade 4/5 students then conducted a survey of the school population about what they would like to see in a rain garden. These results were then tabulated by these students and presented to the design team.

To help the school and surrounding community visualize and celebrate this project, on June 4th, 2007, a local artist facilitated a day where all 220 students took part in painting a 50'x50' painting of their rain garden. On June 8, 2007 the students, along with guests from the community, gathered in the concrete courtyard that would become the rain garden to unveil this painting. The ceremony included rain garden themed student artwork, poetry and compositions, as well as a *Rain Garden Unity* song, written by a member of the Vic West Elementary staff and sung by all the students of the school.

Construction commenced during the summer of 2007 and was completed before school began in September 2007. To further engage the students, on October 12th, 2007 each of the school's 220 students learned about planting and native plants. Each student was then offered the opportunity to plant one of the plants in the rain garden. Older students partnered with younger ones to help them in the process. Many parents and other members of the community also chose to volunteer and participate in this learning and planting day. To empower the children, a rain garden opening celebration day commenced on October 26th, 2007, enabling Victoria-West Elementary leadership students to provide rain garden tours, as well as participate in a recognition ceremony for the great number of sponsors and community members involved in making the project a success.

Since the opening of the garden, classes have now been taught in the courtyard to facilitate learning in various disciplines such as Math (*i.e.,* counting plants), English (*i.e.,* children writing poetry about the garden), Science (*i.e.,* how plants grow, take in nutrients, hydrological cycle), Art, and Music.

In order to share this experience and create a replicable model for other schools, a web site was developed (www.urbanraingarden.ca) outlining the project and partners associated. This being one possible solution to stormwater issues, Project Urban Rain Garden, in concert with prescribed school curriculum, now provides teachers with a medium to demonstrate and teach sustainability principles, thereby enabling students to explore issues of sustainability, eco-system degradation, and showcasing how they can make a positive contribution to environmental improvement

APPENDIX A:
PROJECT URBAN RAIN GARDEN PROPOSAL

Today's Stewards For Tomorrow - Project Proposal
Project Urban Rain Garden

Applying Organization:	Leadership Victoria: Today's Stewards For Tomorrow
Address:	Suite 306 - 620 View Street
City & Province:	Victoria, BC
Postal Code:	V8W 1J6
Phone:	250-386-2269
Fax:	250-386-2279
Contact Person:	Daniel Hegg
E-mail:	hegg.daniel@gmail.com

Mission Statement and Brief History of Leadership Victoria:

Leadership Victoria is a program that supports the development and growth of local leaders to ensure that the future well being of the local community is sustained.

Developed in the Fall of 2000, spearheaded by Volunteer Victoria, Leadership Victoria's mission is to develop well-informed leaders who are passionately engaged in building a vibrant community in Victoria, British Columbia. The vision is to see community leadership capacity greatly expanded across all sectors, while program graduates, embodying the values of integrity, accountability, inclusiveness, and diversity, step up to be in leadership positions throughout Victoria.

The 2006/2007 Leadership Victoria class consists of 24 aspiring community leaders. Participants are broken down into smaller groups to carry out a Community Action Project. *Today's Stewards for Tomorrow* is one of these groups and is made up of 6 participants.

> "These small group activities serve as a laboratory for exploring leadership styles and skills and examining the development of teams. Each group develops a consensus on a project and prepares a plan in the Fall. In the Spring, once that plan has been reviewed by their peers and approved, the plan is implemented and completed by June.
>
> ...[the] projects demonstrate to the larger community that small groups of enthusiastic people can make a difference in that community in a short period of time. A community investment in Leadership Victoria has immediate pay back. The program emphasizes practical experience and exposes participants to current regional issues as a context for skill building."[4]

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4 Leadership Victoria website: http://www.leadershipvictoria.ca/what.htm

Today's Stewards for Tomorrow (TSFT) Team Members:

Acacia Ashton:	Sales Representative, Wille Dodge Chrysler
Anna Russo;	Communications Coordinator, Victoria Community Council
Daniel Hegg:	Graduate Student / Intern, Aqua-Tex Scientific Consulting
Karen Wallis:	Coordinator of Volunteers, Saanich Police
Lisa Oghma:	Senior Financial Planning Analyst, Ministry of Community Services
Louise Carlow:	Manager Corporate Communications, Greater Victoria Harbour Authority

As participants in this year's Leadership Victoria program, our team – *Today's Stewards for Tomorrow* – is focused on the issues of environmental sustainability facing our community.

Our group's vision is to inspire today's children to be stewards for tomorrow. Our mission is to inform, inspire and empower young environmental stewards by partnering with a local school community to develop an educational and interactive rain garden.

This project is called Project Urban Rain Garden

Website: www.urbanraingarden.ca

Project Information

Project Title: Project Urban Rain Garden

What is Project Urban Rain Garden?

Project Urban Rain Garden is an interactive outdoor classroom, to be built on the grounds of Victoria West (Vic West) Elementary School.

It will provide students with the opportunity to explore issues of sustainability, eco-system degradation, and how they can make a positive contribution to environmental improvement. A rain garden is built in a low area in order to intercept and naturally filter storm water runoff.

In a typical rain garden, plants are chosen for their ability to withstand large amounts of water, are low maintenance and are able to adapt to local weather conditions. As one possible solution to water pollution issues, the Vic West rain garden, in concert with prescribed school curriculum, will provide teachers with a medium to demonstrate and teach sustainability principles.

Vic West Elementary, located near Banfield Park in the municipality of Victoria West, is part of a vibrant, active community. The area has greatly benefited from the Victoria West Community Association, who have enhanced the area with community gardens and local markets. Recent construction in Victoria West has encompassed unique modern designs and demonstrated innovative sustainable development practices.

Vic West students will participate in all stages of the project, from the design stage to planting the garden. In addition, a local artist will work with the class to develop artwork that will become a permanent part of the garden. Emphasis will be placed on working with grade 4 and 5 classes, to encourage them to become “stewards” of the garden, leading them to develop a sense of ownership and pride for their school and their garden. Intermediate students will be engaged as “buddies” to the elementary students. As the student stewards advance through the school, they will then teach the younger learners the concept and purpose of the garden, passing on the stewarding role to the next generation of students. Ownership, pride and enthusiasm in their garden is sustained and nurtured, ensuring that this celebration of the environment continues over the years. The rain garden will also be a community gathering place and a play area for students where they, as well as the plants, may grow.

Why is Project Urban Rain Garden Important?

Water running off properties and streets into receiving streams via the storm drains contains pollutants such as oil, gas, lead, heavy metals, and pesticides, thus making the issue of storm water quality and quantity discharging into natural streams important.

Excessive flows during storm events can result in scouring of stream beds and erosion of banks. Ecosystem degradation and non-sustainable environmental practices are ongoing and pervasive problems that require innovation, determination and courage to envision solutions that will ensure the survival of future generations and the revival of the Earth’s irreplaceable ecosystems.

Various eco-system losses have occurred over the last century including loss of agricultural space due to erosion, loss of green space due to expanding cities, collapsing fisheries, pollution of our fresh and marine waters, ozone depletion due to emissions from factories and cars, etc. In

many cases such degradation is "exacerbated by the associated loss of the knowledge and understanding held by local communities."[5]

Children are not usually aware or in contact with degrading ecosystems and thus do not see this troubling problem. This disconnection limits children's understanding of the problem as well as their ability to problem solve. A rain garden bridges that gap for students.

An outdoor, hands-on classroom engages different methods of learning than a traditional, indoor classroom and provides an invaluable opportunity to learn about ecosystems. Since children are our future leaders, it is imperative that we provide them the skills, knowledge and resources early in their lives that will allow them to develop new methods to combat the damage that has occurred within all ecosystems.

What Will This Project Accomplish?

The outcome of this project is the reclamation of a paved urban playground into a rain garden that will act as an outdoor classroom, community gathering area, and inspiration for other schools and communities.

In order to achieve this, we have identified five goals:

Goal 1**:** This project will enable teachers to bring to light various environmental issues and foster an interactive learning environment to teach children the concepts of the environment. Ecosystem degradation is an issue that affects us all; storm water management is one piece of this larger issue that demands to be addressed.
Goal 2: The rain garden will provide an alternative to the most common methods of learning in that it is a tactile/kinesthetic learning environment where students can learn through a hands-on approach, actively exploring the physical world around them. The garden not only becomes a learning tool, but a play environment as well.
Goal 3: Participation in the creation and design of the rain garden will foster enthusiasm, enhance self esteem, and increase relationship skills amongst students. The use of artwork will provide a medium for the students to be creative, and to identify and link their own personal cultures to the garden.
Goal 4: The rain garden will teach and inspire the surrounding community to have an understanding, respect, and love for natural systems. This rain garden will serve as a conversational piece and continual learning environment that will inspire the community to undertake other sustainability orientated projects.
Goal 5: Building a rain garden demonstrates that there are progressive, achievable solutions available to address storm water management. This project breaks down some of the obstacles other schools and communities may face in implementing similar actions, by providing a replicable and workable model to be disseminated in various formats, including a website.

5 Synopsis of the *Millennium Ecosystem Assessment 2003*

Other Community Partners

In addition to Vic West Elementary School, many individuals and organizations in the community will collaborate with our group to realize this project.

- A Design Team has been formed that consists of LeFrank Landscape Architecture Ltd, Civil Engineer Neil Neate, a C.U.P.E. representative, a school district 61 representative, Vic West principal Brent De Nat, vice-principal Maryanne Trofimuk, teacher Lindsay Hinds, Parent's Advisory Council representative Patty Parkhouse, plus three members of the TSFT team.
- As well, other organizations including the Vic West Parent Advisory Committee, Vic West Community Association and Dockside Green have expressed interest in collaborating on the project.
- The Design Team will partner with the Grade 4/5 classes of Vic West Elementary School. Students will be involved in all aspects of the project, from planning, design and implementation to maintenance of the garden. Each year, the Grade 4/5 students will be the stewards of the garden, passing their knowledge on to the next year's group of students. Our team's goal is to meaningfully engage the students in decision-making aspects of the project. With the building of the rain garden, and through the sharing of power and responsibility, our team hopes to contribute to the growth of competent, committed, reflective, and caring young people.

Implementation Plan

Community Stakeholders:
The TSFT team has successfully engaged local businesses, community groups, municipal and federal funders to provide resources for excavation, mulch, soil augmentation and plants. We will continue to identify and approach other stakeholders to ensure a broad array of interests are addressed, and to enhance community involvement in the area.

Provincial Jurisdictions:
In the document *Environmental Concepts in the Classroom,* BC's Ministry of Education suggests that teachers introduce the study of environmental concepts in all subject areas and in all classroom settings, while emphasizing "direct experience, responsible action, complex systems, consequences of actions, aesthetic appreciation and environmental ethic."[6]

School District Involvement
The design plans, developed by the rain garden Design Team, will be agreed upon in principal, and official architectural and engineering plans will be signed off by School District 61 officials, leaving the final design and plant selection up to the students.

Furthermore, the TSFT design team will work on developing a general yearly maintenance plan with school officials, maintenance staff, students and the local community representatives.

Student Involvement
Grade 4/5 teachers Maryanne Trofimuk (teacher and vice principal), and Lindsay Hinds will use educational tools developed from the document *Environmental Concepts in the Classroom,* as well as seek council from experts (Capital Regional District, Aqua-Tex Scientific Consulting, etc) in the areas of ecology, biology and storm-water management with the rain garden as the case study.

6 *Environmental Concepts in the Classroom*: http://www.bced.gov.bc.ca/environment_ed/

Once students and teachers understand the purpose and reasoning for the garden, TSFT team members and Deborah LeFrank Architects will then discuss the variety of rain garden design options and criteria available to the students. Teachers will facilitate the brainstorming and development of the class' final design.

An additional component of the learning will be facilitated by a local artist who will work with the children and develop art that will remain in the garden.

The TSFT team will work with the Parent's Advisory Council to develop plans for an open house and celebration on-site in June (ideally to coincide with National Environmental Week). The purpose of the open house will be to showcase the signed drawings, to share with the local community the progress made to date, and to promote the project and the benefits of a rain garden to the community. The design of the garden will be painted on the area of school ground that will eventually house the garden. Various media will be approached to help with the celebration. Corporate sponsors, community partners and friends of the garden will be recognized in a manner appropriate to their level of support.

Demolition will occur prior to the school opening in September 2007. Planting will occur during class times (to be determined by the teachers) and will be part of classroom learning.

Following Up for a Successful Implementation:
During the year after construction the TSFT team will have quarterly discussions with the teachers to see how effective the garden is functioning as a rain garden and as an educational tool. These discussions will be documented and analyzed with a set of recommendations being forwarded to the school to ensure additional success.

Providing a Model:
In order to share our experiences and create a replicable model for other schools, TSFT members are designing a website outlining our experiences, our successes and best management practices. This website will be maintained by the children, creating a technology link between the Vic West classroom and other classrooms worldwide.

Conclusion

It is our hope that Project Urban Rain Garden will be a model that will be replicated by other schools, groups and individuals, helping to inspire people to take action, learn about environmental sustainability and eco-systems, and contribute to the improvement of the environment**.**

APPENDIX B:
PICTURES OF THE PROJECT SITE AND ACTIVITIES

The courtyard, Spring 2007, pre construction

TSFT members give interactive lesson and have discussions with Grade 4s and 5s about watershed pollution. May 2007

TSFT members, with construction professionals, pulling up and recycling concrete to prepare the courtyard for construction of the Rain Garden - August 2007

Painting day: TSFT members, all Vic West students, parents, community volunteers and local artist Robert Cerins painted a canvas of what they hoped the rain garden would look like – June 8, 2007

Planting day: All Vic West elementary students, TSFT members, parents, community volunteers and landscape architect Deborah LeFrank spent the day planting all the plants in the rain garden – Oct 12, 2007

Official Opening of the rain garden happened with a ceremony on October 26th, 2007. Students wrote poems, shared their thoughts on the rain garden, thanked those involved, and sang their own rain garden song, "The Rain Garden Unity Song"

APPENDIX C:
RAIN GARDEN DESIGN AND CONSTRUCTION INFORMATION/LINKS

Lot Considerations[7]
- ensure that the rain garden is constructed entirely within lot boundaries
- maintain a minimum of 2 feet between rain garden and property lines
- if one lot's rain garden is planned to treat cross-lot drainage, a surface easement must be provided and no more than 2 lots' drainage can be involved
- to maintain typical use of the property, locate rain gardens near the perimeters and edges of the lots, away from traveled areas
- private rain gardens cannot be located in public right of ways without first obtaining permission from the Department of Public Works and Transportation

House Considerations
- if using on a lot with a basement, make sure that
- there is a minimum 25 foot setback from the home's foundation
- the rain garden's invert is lower than the proposed basement floor elevation
- the rain garden is located downgrade from the home

Slope
- if greater than 15%, technique not recommended or use a weep-garden design

Groundwater
- depth below the facility invert at least 2'

Plants
- must be able to tolerate
- expected pollutant loadings
- highly variable soil moisture conditions
- ponding water fluctuations
- cannot be an invasive species
- the use of native species is recommended
- minimum recommended caliper size for trees is 1"
- a minimum of 3 species of trees and 3 species of shrubs is recommended to insure diversity
- avoid species that require regular maintenance

Drainage Area
- limited to less than 2 to 3 acres
- preferably less than 1 acre

Surface Overflow
- typically not a design problem in residential settings due to
- small drainage areas
- surrounding grass provides a naturally safe, non-erosive surface for overflow
- design is off-line, already utilizing an overland flow path

Ponding Depth
- maximum 6" recommended for soils with an infiltration rate of at least 2"/hr
- maximum 3 to 4" recommended for soils with low infiltration rates or high hydraulic loadings (combine with a smaller drainage area)
- ponding depth may be increased if using sandy soils and underdrains to increase filtration
- any pooled water should be drawn down within 4-6 hours after a storm event
- do not plan a rain garden where wooded areas must be cleared to

Underdrain
- *required for all rain gardens in residential areas*
- build with a cleanout well that is accessible by the homeowner
- do not locate within the groundwater zone of saturation
- must have a hydraulic capacity greater than the planting soil infiltration rate
- may outfall to a suitable location such as a common space area, stream valley, drainage swale, roadside open-section, or existing enclosed drainage system

Soil
- homogeneous mix of
- 50% construction sand
- 20-30% topsoil with less than 5% maximum clay content
- 20-30% organic leaf compost
- pH between 5.5 and 6.5
- recommended minimum depth of 2 to 2.5 feet without large tree plantings
- recommended depth of 4 to 4.5 feet with large trees
- soil infiltration rate should exceed 1.5"/hr

Pollutant Concerns
- common homeowner pollutants include lawn fertilizers and driveway oils
- for the primary pollutants of concern, (nitrogen and phosphorus), the removal efficiency increases with depth suggesting that deeper cells reaching approximately 2 to 3 feet should be used.

Mulch
- maximum 2 to 3 inches deep
- should be fresh, not aged
- apply uniformly, do not pile around the base of trees

[7] Adapted from *The Bioretention Manual*, Prince George's County Department of Environmental Resources Programs and Planning Division, Maryland, 2001.

	make room for the facility	• do NOT use grass clippings

RAIN GARDEN DESIGN AND CONSTRUCTION WEB LINKS

For more information on BMPs see the Stormwater Management Manual for Western Washington: http://www.ecy.wa.gov/programs/wq/stormwater/manual.html.

homeowners. University of Wisconsin Extension: Madison, WI. Available at http://learningstore.uwex.edu/Rain gardens-A-How-to-Manual-for-Homeowners-P372C82.aspx

Barr Engineering Company. 2001. *"Infiltration Systems: On-lot Infiltration" in Minnesota Urban Small Sites BMP Manual.* Metropolitan Council Environmental Services: St. Paul, Minnesota. Available at www.metrocouncil.org/environment/Watershed/BMP/CH3_STInfilOnLot.pdf

Canada Mortgage and Housing. 2004. *Rain Gardens: Improve Stormwater Management in Your Yard.* CMHC: Ottawa. http://www.cmhc-schl.gc.ca/en/co/maho/la/la_005.cfm

Cozetto, Karen. May 2001. "Rain Gardens" in *Conscious Choice.* Available at www.consciouschoice.com

Royal Botanical Gardens. Resources on invasive plants relevant across Canada. Available at www.rbg.ca

Stromme, Lorrie. May 2001. "Plotting to Infiltrate? Try Rain Gardens" in *Yard and Garden News.* Available at the University of Minnesota Extension Service website http://www.extension.umn.edu/yardandgarden/YGLNews/YGLN-May0101.html