Sustainable Street Renovation Project at Pacific Lutheran University

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May 13, 2004

Completed in Partial Fulfillment of the Environmental Studies Major
at Pacific Lutheran University

Abstract

College campuses across the country are the source of land development, resource use, and environmental degradation. They are also the source of much of the environmental education that takes place in our country. It is therefore the responsibility of college campuses to ensure that their behavior is in line with their teaching. A nationwide campus sustainability movement has sprung up to demand that colleges accept this responsibility. Pacific Lutheran University is an emerging leader in this movement, but lacks a strong project to establish this leadership. The project that I propose is to renovate a street on the PLU campus to demonstrate the many facets of sustainability. The main component of the project would be to create a more natural hydrology for the ground covered by and surrounding the street, including reduced flooding and groundwater recharge. In addition, the project would create a safer, pedestrian friendly, aesthetically pleasing strip that includes native vegetation for the benefit of local wildlife. The justification for this project is located in the ethic of sustainability, the writings of environmental activist, teacher, and green design advocate David Orr, and the favorable geological conditions of the PLU campus. The Street Edge Alternative Project in Seattle is used as an example of a sustainable street renovation completed in the Puget Sound region and serves to demonstrate the scope and potential of a PLU project. PLU must become a leader in the campus sustainability movement, and a street renovation project would be a formidable declaration of our leadership.

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Introduction

We live in a society obsessed with automobiles. Personal motorized vehicles are the prime form of transportation for the majority of citizens in our nation. Traffic counts all over the country continue to rise, and there doesn't seem to be an end to the proliferation of automobiles in sight. As long as cars continue to dominate the landscape, paved surfaces for them to travel on will also continue to criss-cross and subdivide the land.

The campus of Pacific Lutheran University is not immune to the dual phenomena of automobiles and paved surfaces; roads surround our campus and even pass through it, separating buildings, offices, and athletic facilities. While it is possible for a pedestrian to access much of campus without encountering a motorized vehicle, streets do make up an important part of our campus environment. Streets provide convenient access to buildings and other facilities, parking, and a thoroughfare by which to pass through campus on the way to other destinations. Streets form an important part of the campus infrastructure.

There are, however, some important consequences of streets and automobile traffic that must be considered. For the purpose of this project, I will consider the following detrimental qualities of street development: hydrological disturbance, pollution of ground and surface water, aesthetic degradation, decrease in pedestrian safety, and loss of wildlife habitat. Some of these consequences can be viewed as environmental degradation issues; others are clearly issues of safety, aesthetics, and community health. All of the consequences and costs of street development, however, impact the overall

sustainability of an area and should be addressed in a comprehensive and integrated manner.

A comprehensive approach to street development is beginning to emerge. Engineers, contractors, and public utilities are rethinking the way land is developed for vehicle use, striving to minimize the negative effects of such development. These projects require cooperation between landowners, land developers, and land users, thereby ultimately leading to projects that satisfy the needs of all interests and parties involved. This new philosophy of road building can be applied not only to new construction, but to renovations of existing roadways as well. In fact, because there is already such a vast infrastructure of roads throughout the country, sustainable street renovation projects are actually the most feasible option for truly mitigating the negative consequences of street development.

The shifting paradigm of street development and renovation is one tool within a larger national trend toward sustainability and low-impact development. This movement calls for a holistic, integrated approach to environmental and community health concerns that strives to minimize the impacts of human development while maintaining the quality of life that we have all come to expect. Colleges and universities throughout the country have taken up the sustainability movement, and PLU is no exception. In fact, certain groups within PLU have been aggressively pursuing sustainable initiatives for many years now. The social trends for sustainability are strong, specific project examples are available, and the time is ripe for change on campus.

In light of the broad social movement for sustainable communities and the more specific trend toward conscious, low-impact street development, I will make an argument

for the importance of a sustainable, low impact street renovation project on the PLU campus. I will utilize ethical arguments for sustainability, David Orr's writings on the particular importance of campus sustainability projects, geologic evidence, and a comparison to the SEA Street Project to show that a sustainable street renovation project is not only feasible, but the only responsible option for the PLU community.

Background

The impetus for a sustainable street renovation project at PLU is by no means an isolated one. It can be located within many other social phenomena, including the growing concept of sustainability, the nationwide sustainability movement on college campuses, and the specific actions and events that have taken place at PLU in relation to the sustainability movement. In addition, there is an important trend among land developers toward a set of techniques called Low-Impact Development (LID) that is gaining wider acceptance and use. A brief history of all of these phenomena is necessary in order to understand the motivation for and importance of a sustainable street renovation project.

Introduction to Sustainability

Sustainability is a simple concept to grasp: it can be defined as behavior and development that strives to provide for present human needs without compromising the ability of the biosphere or individual communities to continue to provide those needs into the foreseeable future. The concept of sustainability is ancient and has been embodied in the philosophies of many cultures. One example is the Native American philosophy that one should consider how one's actions will affect the seventh generation out.

However, the increase in the speed and capacity of development brought about by the industrial revolution has pushed the ideals of sustainability out of vogue. This has been the case for at least the past 200 years, and an ethic of sustainability continues to elude mainstream society. But the philosophy of sustainability, like many other trends in human knowledge, seems to work in cycles and has begun to invade human consciousness once again.

The modern sustainability movement has grown out of the environmental movement of the late 20th century. It has also grown beyond this mainstream environmental movement. While sustainability is grounded in concepts of ecological integrity and holistic earth-care, it expands on this base. Sustainability includes considerations of economic health, standard of living, community vibrancy, human safety, and healthy human relationships (also known as social justice). It is based first and foremost on the concept of interconnectedness. Human society cannot be separated from the rest of the animal world; human health cannot be separated from environmental health; social justice cannot be separated from environmental justice. Sustainability argues that we can protect and nurture the natural systems of our planet, while at the same time improve our quality of life as human beings and decrease the injustice that occurs in human relationships. This is the burgeoning paradigm that social progressives find ourselves immersed in, and it is spreading to all corners of society.

The Campus Sustainability Movement

One such corner in which sustainability has deep and growing roots is within colleges and universities. A milestone for sustainability within the institution of higher education was reached in 1990 when thirty-one university leaders and international

environmental experts representing fifteen countries from around the globe came together to author a statement on the commitment of colleges and universities to promote sustainability and ecological literacy. The conference convened for this purpose was held in Talloires, France, and is hence known as the Talloires Declaration. It outlines the concerns of the university leaders regarding many aspects of environmental and social degradation, and ends with a list of 10 actions that the signatories agree to perform. Since 1990, the Talloires Declaration has been signed by over 300 colleges and universities in over 40 countries and continues to demonstrate the growing interest and commitment to sustainability among institutions of higher education (ULSF website).

Other networks have sprung up to address sustainability in higher education. One such organization is University Leaders for a Sustainable Future (ULSF), which is the secretariat for the Talloires Declaration. This organization strives to "make sustainability a major focus of teaching, research, operations and outreach at colleges and universities worldwide" (ULSF website). Their concept of sustainability requires that a higher education institution's activities be ecologically sound, socially just, and economically viable. University Leaders for a Sustainable Future believes that colleges and universities must demonstrate sustainability through curriculum, research, and operations (ULSF website).

Another organization focused on sustainability in higher education is Second Nature, a group whose mission is "Education for Sustainability". Second Nature was founded in 1993 to bring about "the change in society that is vital to the success and livelihood of every current and future living being: a change for a just and sustainable future" (Second Nature website). Second Nature, like ULSF, is dedicated to integrating

sustainability into the practice and teaching of colleges and universities. Another college sustainability organization in partnership with Second Nature is the Education for Sustainability Western Network, which "is a professional association of individuals, institutions, nonprofits and businesses interested in integrating sustainability into higher education in the West" (EFS West website). EFS Western Network focuses on providing a forum for collaboration between leaders of sustainability at individual institutions of higher learning. They accomplish this through training, workshops, conferences, research support, publishing opportunities, and funding (EFS West website). These growing organizations, and many others, are increasing awareness of sustainability at college campuses around the world.

History of Sustainability at PLU

One such campus is Pacific Lutheran University. An organized effort for sustainability on campus is a fairly recent development, but PLU is quickly establishing itself as a regional leader in the campus sustainability movement. The real push for sustainability on campus began in the spring of 2002, when English and Environmental Studies Professor Charles Bergman and Vice President of Finance and Operations Sheri Tonn formed the Campus Sustainability Committee. In order to integrate the efforts for sustainability across campus, faculty, administrators, staff, and students were all invited to join the committee. It was decided early on that the committee would strive to integrate concepts of sustainability throughout the curriculum, research, and operations of the campus. The group also agreed to focus on water sustainability in light of the prime importance of water and the many opportunities for improvement on campus. The committee receives no funding for curricular or operations projects from the university,

and therefore decided to apply for a grant from The Russell Family Foundation for a "Collaborative Campus Effort on Sustainability With a Water Focus." The grant was approved in the fall of 2002, and the committee began making serious plans for water sustainability.

One of the key components of the grant was to bring David Orr to PLU to present an Earth Day lecture on sustainability in higher education. David Orr is a recognized leader in the campus sustainability movement whom I will discuss in greater detail later. He delivered a well-attended and informative lecture. Another component of the grant was to organize a workshop in June 2003, during which 25 faculty, staff, and students learned about global and local water issues, as well as set priorities for action on campus regarding water issues. The major goal of this workshop was to develop a list of water sustainability projects to guide the future work of the campus sustainability committee. One project that was identified and given high priority was a sustainable, low impact street renovation project.

A third component of the grant provided funding for a Campus Water Sustainability Fellowship for the summer of 2003. I was chosen as the Fellow, and completed research on stormwater management, low impact development, funding possibilities, and general water sustainability. I also worked with the list of campus water sustainability projects developed at the workshop, creating a synopsis for each project and determining which projects had the highest priority. I focused some research on the sustainable street renovation project identified at the workshop. The idea for this Capstone Paper is a result of the Water Sustainability Workshop and the research I completed as the Campus Water Sustainability Fellow.

Another important component of the grant was to send representatives from PLU to Greening of the Campus V, a biannual conference at Ball State University in Indiana that brings together leaders in campus sustainability from all over the world. PLU professor Rose McKenney and I presented a paper titled, "Building a Model of Water Sustainability by Integrating Operations, Research, and Curriculum." This conference was instrumental in allowing members of the campus sustainability committee to share information about the sustainability work going on at PLU, as well as learn from the projects being developed and implemented at other institutions.

The campus sustainability committee recently applied for and received a renewal on the initial grant from The Russell Family Foundation. A second workshop is being planned for summer 2004, two new sustainability fellows are being chosen, and committee members are making plans to attend the first major sustainability and higher education conference in the western U.S. and Canada in October 2004. The sustainability movement at PLU continues to grow and evolve, and this paper is one part of the effort to make sustainability a reality on the PLU campus.

Introduction to Low Impact Development

An important component of a sustainable street renovation will be to improve the stormwater management in the vicinity of the street. One strategy for addressing these issues is low-impact development (LID), a newly emerging form of stormwater management. The Puget Sound Action Team defines LID as "an ecologically friendly approach to land development and stormwater management designed to reduce impacts on watershed hydrology and aquatic resources" (LID brochure). It uses native vegetation, landscaping, and small-scale hydrologic controls to capture, treat, and

infiltrate stormwater. LID helps to maintain the volume and rate of runoff from a site, as well as natural stream flow patterns. LID requires that each site be examined in relation to its hydrologic function in the watershed (LID brochure). Basically, it requires a holistic, systems approach to dealing with stormwater.

There are four common LID practices for managing stormwater. The first is called disconnectivity, which involves directing runoff to vegetated areas, thereby reducing the volume and temperature of runoff and recharging groundwater. A second strategy is called bioretention, in which landscaping is designed so that specific soils and plants filter and store runoff while promoting groundwater recharge. A third technique is to use permeable pavements, including blocks, pavers, asphalts, and concretes. These surfaces allow water to infiltrate to special gravel and soil that filters and slowly releases water back into the ground. The fourth practice involves building open swales, which are grassy/vegetated areas at the edges of parking lots that receive runoff, infiltrate, and treat for pollutants (LID brochure). Ideally, a sustainable street renovation project at PLU would integrate all of these techniques.

Finally, low-impact development can be summarized as such: Natural, pre-developed watersheds achieve a balance between overland stormwater flows, infiltration, storage, and evapotranspiration. LID strategies apply site and building development techniques designed to maintain this natural balance through soil, native vegetative cover, and by assessing sensitive areas and drainage characteristics of the site and watershed (SEA Street website).

Methods

My argument for a sustainable street renovation project at PLU has four components. These four components include a discussion of the ethical norm of sustainability, a summary of David Orr's writings on campus sustainability, an analysis of the geologic conditions of the street area to be renovated, and a comparison to a similar street renovation project completed in the Puget Sound region. Each of these components will provide a vital piece of my argument, and the cumulative result will be a holistic approach to sustainability at PLU, and specifically a sustainable street renovation project.

A discussion of ethics is useful in this paper because it will provide the larger framework for discussing the importance of tangible, sustainable renovations of the PLU infrastructure. Ethics can be thought of as rules of conduct for human and community behavior. Part of my argument is that PLU, like society as a whole, has heretofore failed to behave appropriately in regard to designing an environmentally-friendly, aesthetically pleasing street environment. One sustainable street renovation project cannot undo decades of haphazard development, and the particular project I will suggest is simply an example of the direction that the PLU community needs to head. But by outlining the ethical guidelines for future renovation and development, I will put forth the vision that will eventually lead to a sustainable campus, integrated to ensure maximum individual, community, and environmental health.

Narrowing my focus to colleges and universities, I will summarize the writings of David Orr. Orr is the recognized leader on issues of campus sustainability. He is a Professor and Chair of Environmental Studies at Oberlin College in Oberlin, Ohio, and

oversees the Adam Joseph Lewis Environmental Studies Center, an outstanding example of green building design that he spearheaded. Orr travels all over the country, delivering lectures at dozens of colleges about sustainability. He focuses specifically on how sustainability can be applied on college campuses, but also in society as a whole. To this end, he has written three books focused on integrating sustainability into all aspects of the institution of higher education: *Ecological Literacy: Education and the Transition to a Postmodern World, Earth in Mind: On Education, Environment, and the Human Prospect*, and *The Nature of Design: Ecology, Culture, and Human Intention*. These three books will form the core of my literary analysis. I will outline Orr's vision for campus sustainability and connect it to the ethical norm of sustainability. This portion of the paper will continue to provide the context for the street renovation project, although at a more specific level.

The next component of my paper will be a geologic analysis of the PLU campus, with special attention being paid to the area adjacent to the proposed street to be renovated. This analysis will focus on the soil type, flooding danger, high water table, bedrock depth, and slope of the area, in order to gain an understanding of the drainage capacity. All of this information will help to establish the feasibility of the street renovation project to manage and treat stormwater.

The final element of my argument will be a presentation of the Street Edge Alternatives (SEA) Project conducted by the Seattle Public Utilities. This project is the model for the proposed street renovation project at PLU. The SEA Street Project was completed in the spring of 2000, and the Department of Civil and Environmental Engineering at the University of Washington has conducted a study of the project, titled

"Hydrologic Monitoring of the Seattle Ultra-Urban Stormwater Management Projects". Using the goals, methods, descriptions, and analysis of the SEA Street Project, I will make a specific argument for the feasibility of the street renovation project at PLU as an initial component to an overall greening of the campus.

In summary, I will begin with an overarching description and ethical analysis of sustainability in order to establish the impetus for a sustainable street renovation project. Then I will narrow my argument to the importance of encouraging sustainability on college campuses using the writings of David Orr. Next, I will get even more specific with a geologic analysis of the land directly underneath and directly adjacent to the proposed street. Finally, I will conclude with a case study of a successful street renovation project on a similar street in the Puget Sound area.

Ethical Norm of Sustainability

One context in which to locate the ethical norm of sustainability is within the Christian tradition. Focusing on a Christian perspective of and argument for environmental stewardship is especially relevant in the discussion about moving PLU toward sustainability. PLU is deeply rooted in and committed to its Christian heritage, which makes it irresponsible for PLU to ignore the sustainability argument that arises out of Christian environmental ethics.

The starting point for environmental ethics in this tradition is love (Martin-Schramm, Stivers 34). Love is part of a relationship with God, in which the individual receives love, lets it work within the self, and only then moves on to action inspired by that love (34). So love must originate in one's faith in God, and then spread to the relationship one has with oneself, others, and nature.

Love in the Christian tradition gives rise to the concept of justice, or more importantly in the realm of environmental ethics, ecological justice. The norm of justice requires human beings to uplift the concept of fairness in relations with each other, non-human animals, and ecosystems (Martin-Schramm, Stivers 37). It is important not to separate the concept of justice from love, because love provides the personal context for all considerations of justice, and prevents decision making from becoming simply a matter of balancing interests (37). Love explicitly connects to justice in that it requires the recognition of the needs of others, or in other words, the recognition of unfairness in social or ecological relationships. Love also allows us to judge this unfairness, and requires that we take up the cause of injustice and work to create harmony.

From the ethic of ecological justice can be identified four norms: sustainability, sufficiency, participation, and solidarity (Martin-Schramm, Stivers 37). I believe that the norm of sustainability is most applicable to the argument for a street renovation project at PLU, and I will therefore focus my discussion on that norm. However, the other three norms can also shed light on the far-reaching implications and importance of a street renovation project. In order to understand these norms, it is important to be aware of the sources from which they are drawn. I will begin by listing these sources, followed by a brief description of sufficiency, participation, and solidarity, and then move into a more lengthy discussion of the ethical norm of sustainability.

There are five major sources of ethical norms in the Christian tradition. The first and most important source is the Bible (Martin-Schramm, Stivers 35). The Bible is by no means a perfect source; different ethical interpretations emerge from the Bible due to the presence of different authors writing in different settings and timeframes. But the Bible

does have themes that run throughout, such as the importance of love and its expression through the ideal of justice. Theology, or the interpretation and study of religious texts and ideas, is the second source of ethical norms (36). For example, understanding God as the harbinger of love and justice encourages Christians to seek out these concepts in their relationships in order to know God better. The historical traditions of the Church constitute the third source (36). This involves identifying trends in Christian thought and action, such as the emphasis on the poor. The fourth source is the church in its many forms (36). This source represents the variety by which ethical guidelines are defined, such as through pronouncements, rules, organizations, or community education. The fifth source includes other religious and ethical traditions (36). Many other traditions have made important insights about the environment, and it is important to note that these insights can be embraced by and integrated into the Christian tradition.

The ethical norm of sufficiency involves one's responsibility to share in the bounty of creation. It repudiates unlimited consumption and hoarding, and instead promotes the satisfaction of basic needs and the principle of equity. And of course, sufficiency extends to all living things, not just human beings (Martin-Schramm, Stivers 40). The norm of participation requires human beings to consider the impacts of our decisions on all living things. In the case of oppressed human beings, their voices should be heard and incorporated into decision-making. For those who have no discernible voice (all other species), we must speak up in their interest (42). The norm of solidarity is focused first and foremost on the principle of interdependence. This principle can be applied to the relation between the individual human being and the social good, the rich

and the poor, the powerful and the powerless, and human beings and non-human species. This norm emphasizes the communal, rather than individualistic, nature of life (44).

Sustainability, as mentioned earlier, is the "long-range supply of sufficient resources to meet basic human needs and the preservation of intact natural communities" (Martin-Schramm, Stivers 38). In essence, sustainability is focused on the future, and on future generations in particular. Sustainability requires that all of our decisions in the present take into account the needs of the future, for human beings, non-human species, and the earth as a dynamic, living system. It emphasizes the responsibility inherited by each generation to leave things at least as good as, or better than, they were when we found them (39). This principle is not difficult, and can be applied at the micro level quite easily.

For example, when I was in high school, my marching band would travel to competitions and sleep on the gym floors of other high schools. Being rambunctious high school students released into the world without our parents, we could make quite a mess. But before we left the next morning, we made sure to pick up all the garbage on the gym floor, even that which was there before we arrived. We also swept the floor with a big dust mop, if we could find one. In these simple actions (enforced by our director, of course), a bunch of high school students were demonstrating a concern for the future; we knew that others would be coming after us and that they would enjoy and appreciate a clean space.

Similarly, we the human species must more readily acknowledge that others will be coming after us (future generations), and that they will want a clean space to occupy (the earth). In my high school example, we did not know who would be coming after us,

but we still felt a kinship with and responsibility to them, probably because we assumed it would be another marching band just like ours, a group of people to whom we could relate and to whom we felt connected. As we consider future human generations and global sustainability, our relationship to the "others" who will come after us is much more intimate; the "others" are our children, new human life, the one form of life that we humans have no trouble propagating, even to the detriment of other forms. The consideration of global societal sustainability for the benefit of future human generations is a macro level issue, and obviously more difficult to achieve than simply sweeping up our messes. It is not impossible, however, and I will next consider two visions for a sustainable future.

One such vision is elucidated by author Robert L. Stivers in the book *The Sustainable Society: Ethics and Economic Growth*. In this book, Stivers works around two basic questions: 1) Are present forms of growth, particularly rising population, the increasing pressure on resources, and the pervasive spread of pollution desirable?, and 2) Can these forms of growth continue much longer (Stivers 18)? Stivers performs a thorough analysis of the impetus for economic growth, the costs and benefits of growth, the desirability of growth, and the limits to growth. He also raises three ethical issues. Distribution talks about inequalities in the supposed prosperity brought about by growth, and is related to the norm of sufficiency (112). A second issue is who should pay for the costs of growth, and the third issue involves the trade off between liberty and coercion in maintaining quality of life (136). Finally, Stivers puts forth his vision for a sustainable society, which will require three things. First, it will require an equilibrium economy in which forces of increase and decrease of population and capital are balanced (187). The

second requirement is a globally oriented political system (194), and the third is a new worldview centered on an appreciation of nature (199). Stivers' vision is rooted in the Christian hope that God's love will see us through this transition.

Another vision is that put forth by John B. Cobb, Jr. in *Sustainability: Economics, Ecology, and Justice*. Cobb argues that the key to a sustainable society is maintaining the quality of life that human beings, at least in developed countries, have come to expect (Cobb 35). This, he says, is the only way to get people to comply. The steps toward sustainability are efficiency, followed by the elimination of fossil fuels as our primary source of energy (36). Other components include decentralization and a critique of free trade. Another requirement is that we move beyond anthropocentrism to respect the integrity of all creation (82). Cobb concludes by offering one vision of hope, in which humans work with the Spirit to create a world where life and love can flourish (125).

I have offered two interpretations of the steps necessary to create a sustainable world. Many other visions for a sustainable future have emerged from the discipline of ethics. I will turn next, however, to a discussion of David Orr's vision of campus sustainability, which is not explicitly rooted in the Christian conception of ethics that I have heretofore discussed, but is quite relevant nonetheless.

David Orr's Vision of Campus Sustainability

David Orr, as I mentioned previously, is the leading expert and visionary in the field of campus sustainability. He proposes a comprehensive plan for achieving sustainability, both within the institution of higher education and in society as a whole. Orr has proposed his vision primarily in the form of three books, each of which I will summarize in order to draw out the core of Orr's argument. My next step in this section

will be to connect Orr's broad vision to the very specific street renovation project at the heart of this paper.

Orr's oldest book, *Ecological Literacy: Education and the Transition to a Postmodern World*, was published in 1992. In this book, Orr talks about the crisis of sustainability, which he believes goes beyond just natural resource depletion and pollution to include a crisis of the human spirit. Orr believes that our society lacks a story that connects us to the earth in any meaningful way (4). He goes on to give a standard definition of a sustainable society as one that satisfies its needs without jeopardizing the prospect of future generations (23). But he goes farther, breaking it down to technological and ecological sustainability, only the latter of which has true potential to solve the crisis (24). Orr's solution in this book relies on overhauling our system of higher education to equip students to live well in their place and know their local landscape (99). He also believes that it is of vital importance for college campuses to operate in sustainable ways as a form of pedagogy (103). The significance of this book in relation to PLU is wrapped up in this last point. Improving the sustainability of the campus water infrastructure would be an important teaching tool, specifically in Environmental Studies courses, but also on a campus-wide scale. Any improvements to campus water sustainability would need to be highly publicized and integrated into campus curriculum.

Orr's second major work is *Earth in Mind: On Education, Environment, and the Human Prospect*. In this book, Orr once again takes on our country's institutions of higher education. He outlines six principles for rethinking education: 1) all education is environmental education, 2) education is for building your person, 3) responsibility for

knowledge/technology, 4) understand effect of actions on real communities, 5) examples over words, and 6) learning style is as important as content (12). In chapter 7 of this book, Orr makes some interesting comments about water. He says that "the wise use of water is quite possibly the truest indicator of human intelligence…" (54). He also argues that water should be a part of every school curriculum as mythology, history, politics, culture, and society (58). He goes on to make the bold claim that water should be the keystone in the science of ecological design. In connecting sustainability back to campus operations, Orr says that water and water purification should be built into the design and landscape of educational institutions (58). Orr obviously recognizes the primacy of water in issues of sustainability. He also gives a detailed critique of building design, and offers suggestions on what we could potentially learn from the buildings we occupy if they were designed ecologically. The connections between this book and PLU are explicit: water must be a part of our curriculum and a consideration in the design of our infrastructure.

Orr's most recent book is *The Nature of Design: Ecology, Culture, and Human Intention*. In this work, Orr is operating on the premise that we as global society need to redesign our communities from the bottom up to be sustainable rather than rely on supposed green technology (11). He begins with a discussion of the barriers to this community transformation, including our culture's obsession with fast knowledge acquisition, speedy communication, degraded language, and technology. In regards to the speed of the modern world, Orr makes an interesting analogy with the flow of water. He talks about the ecological impacts of increased water velocity and how the increase in water velocity in our urban watersheds is the result of thoughtless urban development (49). Orr goes on to discuss the politics of instituting ecological design, and concludes

with an essay stressing the vital importance of creating a world in which children are safe and free to learn and become the leaders in the revitalization of our communities. Orr's conception of ecological design provides a framework for restructuring PLU's relationship with water. Ultimately, it informs us that we must shift the values of our campus community in order to achieve true sustainability.

David Orr makes many arguments for campus sustainability, but I think that the most profound argument he makes regards the pedagogical value of campus operations. A sustainable street renovation project would create an outdoor learning laboratory for Environmental Studies classes. Students could study all aspects of the project, from the landscape design to the hydrologic monitoring. Using this local laboratory would educate students about the importance of living well in their place; it would give every student a real world example that connects their actions with environmental impacts and teaches them simple strategies for minimizing those impacts. A sustainable street would provide significant learning opportunities.

Geologic Analysis of 124th Street Area

In order for a low-impact street renovation project on the PLU campus to be successful, the area of campus to be renovated must possess a few favorable geologic characteristics. The characteristics that I will look at are soil type, flooding danger, high water table, bedrock depth, and the slope of the area to be renovated. These characteristics are important because they are a few indicators that tell us how well stormwater will infiltrate and disperse as it flows through the low-impact street system. Stormwater management is a major component of the street renovation project, and the

geology of the area is the most important thing to consider when designing a stormwater management project.

The bulk of the geologic evidence for the street renovation project comes from the *Soil Survey of Pierce County Area, Washington*. This guide allowed me to locate the PLU campus on one of many maps of the Pierce County Area. The particular map I used showed a 4 by 3 mile area including most of the Parkland area. Once I located the PLU campus, I determined what soil type was prevalent on campus. I then looked up this soil type on the numerous tables in the *Soil Survey* to determine the qualities of the PLU soil and underlying geology, specifically with regard to the flow of water.

The PLU campus, with the exception of the old Clover Creek bed, is designated as Spanaway gravelly sandy loam (Soil Survey 78). Some areas of campus, such as athletic fields, may have been filled in for leveling purposes, but Spanaway gravelly sandy loam is characteristic of most of campus. In order to more clearly explain what this soil classification means, I will break down each component of the name. The Spanaway association designates a general soil type that underlies the communities of Lakewood, Parkland, Spanaway, and Roy, and was formed in glacial outwash on uplands (4). The soil is defined as gravelly because it contains 15 to 50 percent rounded or angular rock fragments that are up to 3 inches in diameter (66). A sandy soil class indicates that the soil is 85 percent or more sand and not more than 10 percent clay (67). Finally, loam is "soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles" (66). As you may notice, two of these classifications clash: a sandy soil must have 85 percent or more sand while a loam must have 52 percent or less sand. Placing the loam classification last indicates that this is the

primary classification, and the sandy designation shows that the ratio of sand in this particular soil is towards the upper end of the "less than 52 percent sand" requirement for loam.

Next, I will describe some of the qualities of this soil that make it appropriate for a low-impact street renovation project. The Spanaway gravelly sandy loam that underlies the PLU campus is defined as "somewhat excessively drained" (34). This means that water is removed from the soil rapidly (65). This type of drainage occurs in this soil because of the large amount of gravelly particles and sand, which create a highly permeable substance. Part of the low-impact street renovation project would be to create multiple, small scale bioswales along the roadway that would absorb the stormwater runoff from the roadway and the surrounding area. The "somewhat excessively drained" soil found throughout campus will adequately accommodate the stormwater runoff from the street surface and allow it to permeate to the groundwater without fear of flooding.

The drainage of the soil relates to other factors, including flooding, high water table, and depth to bedrock. Flooding is "the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides" (Soil Survey 49). It is important to note that water standing for short periods after precipitation events is not considered flooding. Flooding is rated based on the frequency, duration, and time of year that flooding is likely to occur. The susceptibility of an area to flooding is determined based on an examination of the soil profile to look for signs of flooding, local information about floodwater levels in the area, and information that relates the position of each soil on the landscape to historic floods (49). The flooding frequency of the Spanaway

gravelly sandy loam that underlies campus is “none” (125). Subsequently, the duration of flooding and likely time of year of flooding are not applicable.

High water table is defined as the “highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years” (Soil Survey 49). In other words, the high water table is the depth one has to dig below the surface to find soil saturated with water during the wettest time of the year. The Spanaway gravelly sandy loam found on campus has a high water table of greater than 6 feet (125), which means that even during the wettest season of the year, water infiltrates the soil quickly and enters the water table without saturating the soil. This characteristic of the campus soil makes it very favorable for managing the stormwater from the sustainable street renovation project.

Another important factor in the ability of the landscape to handle stormwater is the depth to bedrock. This measurement indicates how far below the surface one must dig to find an impermeable surface (Soil Survey 49). A shallow depth to bedrock could indicate that water will backup during a storm event and cause surface flooding. A deeper depth to bedrock means that there is more space for the water to collect and flow into the water table before it backs up to the surface and causes flooding. The depth to bedrock for campus is greater than 60 inches (125), which is a sufficient depth to ensure that flooding will not occur for most storm events. Once again, this factor indicates that the geologic conditions on campus are favorable for the sustainable street renovation project.

The final geologic factor that I will consider is the slope of the area. The slope of the area indicates how surface water will flow during a storm event. A flat slope means

that the water will puddle where it falls and drain into the soil. As the degree of slope increases, the degree to which the water will flow on the surface before it puddles and drains increases. The Spanaway gravelly sandy loam on campus has slopes that range from 0 to 6 percent, with short and steep slopes in places (Soil Survey 34). This can be observed well on campus, where we have a mostly level landscape with a short and steep hill separating upper and lower campus. The particular site of the street renovation project is level, which will allow the project to be designed so that stormwater from the roadway can be directed to bioswales on both sides of the road. This will provide more surface area for the infiltration of stormwater, which is another beneficial characteristic of campus geology in relation to a sustainable street renovation project.

There are many geologic factors related to the ability of a landscape to absorb stormwater. I have considered the soil type, the flooding characteristics, the high water table, the depth to bedrock, and the slope of the area to be renovated. All of these factors indicate that the area to be renovated possesses highly favorable geologic conditions with regard to stormwater management. Based on this preliminary analysis, a sustainable street renovation project on campus is geologically feasible.

SEA Street Project

In my Environmental Methods of Investigation class in the Spring Semester of 2003, I was exposed to before and after pictures of a street renovation project in Seattle. The pictures were part of a Powerpoint presentation about low-impact development and I was absolutely stunned by the amazing results that the before and after pictures demonstrated. I did some further investigation into the project, and was a major proponent of including it on the list of potential Campus Water Sustainability Projects

produced at the Water Sustainability Workshop on campus in June 2003. This project in Seattle is the inspiration for a sustainable street renovation at PLU, and will serve as the model for my description of the PLU project. Therefore, it is vital to discuss the history of the Seattle project, as well as a discussion of the components of the project and the monitoring studies that have been completed.

The Street Edge Alternatives Project (SEA Streets) is an integrated program being administered by the Seattle Public Utilities. The project is "designed to provide drainage that more closely mimics the natural landscape prior to development than traditional piped systems" (SEA Streets website). It accomplishes this objective by constructing alternative mean of controlling and treating surface water run-off from residential streets. The real impetus for this project was a need to protect urban creek ecosystems, although it is also seen as an opportunity to create sustainable neighborhoods and encourage community stewardship (Seattle Public Utilities 1). A long list of project objectives was created, and includes the following:

1) decrease peak flow rates of surface runoff;
2) minimize impervious area (experiment with "pervious" surfaces);
3) innovative street-edge treatment to allow ground water infiltration, if possible;
4) document effects of alternative design through research studies;
5) minimize maintenance requirements through proper design and resident stewardship;
6) provide complete street improvements including a sidewalk on at least one side, trees and landscaping, driveway adjustments, parking and street realignment as needed to create a traffic calming design;

7) change the existing paradigm that curb/gutter/sidewalk system is necessary in residential areas;
8) increase urban "green cover" (Seattle Public Utilities 1).

In addition, the project design team established a list of design objectives specific to the roadway, which includes 1) provide a sidewalk on at least on side of the block, 2) accommodate drainage system needs, 3) provide a street that reduces the speed and discourages through traffic, 4) provide driveway and walkway adjustments to equal access that currently exists, and 5) provide on street parking that will address resident needs and project goals (Seattle Public Utilites 5). Both lists of objectives provided important guidance in the completion of the street renovation project.

The initial, experimental site that was chosen was 2nd Avenue Northwest between Northwest 117th Street and Northwest 120th Street. Improvements to the right of way were focused around four main components: drainage, the actual roadway, the landscape architecture, and the community benefits (SEA Streets website). By describing each of these four components, I will give a good general overview of the benefits of a low-impact, sustainable street renovation project.

The overarching drainage goal of the SEA Streets Project was to return the hydrology of the area to a pre-developed condition. This was accomplished using a dual approach, which combined hydraulic engineering with soil science and botany (SEA Streets website). The primary function of the hydraulic engineering was to control elevations, while the soil science and botany was utilized in the contoured roadside swales. Traditional drainage infrastructure, including culverts, catch basins, flow control structures, and slotted pipe, was used to supplement the stormwater management

capabilities of the swales. A more specific goal of the project was to reduce the two year, 24 hour peak runoff rate and volume using surface retention and detention. In order to provide maximum protection of salmonid species in the local stream, the project was designed to handle stormwater from the street right of way and property uphill from the street. This goal was accomplished by maximizing the stormwater time of concentration and the sites detention volume, which was achieved using a long flow path length and high surface roughness (SEA Streets website). An important drainage component of the SEA Streets Project, and one that isn't included in traditional street design, is that the entire right of way without hard surfaces was utilized for stormwater management. Improved drainage design was the primary goal of the SEA Streets Project.

Another important component of the project was street improvements. The two most important aspects of the street improvement were to create a curvilinear roadway and to significantly narrow the paved roadway (SEA Streets website). The curvilinear design has traffic-calming effects and creates a more aesthetically pleasing road. Included on both sides of the curvilinear roadway is a two-foot concrete border that serves a dual purpose: 1) it helps to control paving elevations, and 2) it visually defines the roadway edge (SEA Streets website). This second function is helpful for drivers trying to maneuver the narrow, curving street. The sidewalk also follows the curvilinear shape in order to maintain the aesthetic effect. This project only included a sidewalk on one side of the street, in order to minimize impervious surface.

The narrowed roadway was reduced from 25 feet to 14 feet wide in most segments, with an 18-foot width at the intersections (Horner 2). This width is sufficient for two standard sized vehicles to pass each other slowly. In order to accommodate

emergency or other large vehicles that need to pass the road has no curbs and a two-foot grass shoulder on each side that is designed to withstand vehicle loading (SEA Streets website). The rest of the 60 foot right of way was given over to the swales (Horner, 2). The street improvement aspects of the SEA Streets Project are very visible and highly functional, contributing significantly to the safety, aesthetic, and stormwater management components of the project.

The third component of the SEA Streets Project is the management of the landscape. This element of the project provides important aesthetic qualities, as well as stormwater management functions (SEA Streets website). Aesthetic improvements to the right of way include designing the sidewalk to not only be pedestrian accessible, but truly pedestrian friendly, actually drawing walkers to that feature of the project. Another element of the aesthetic improvements to the landscape was to artfully grade and plant the swales with native wetland and upland species, as well as to include granite boulders and washed river rock that are both attractive and serve to slow the runoff from the street (SEA Streets website). Stormwater management features include retaining large-scale trees and planting young trees to aid in evapotranspiration, which is an important step toward achieving pre-development drainage. Other vegetation along the roadway was also carefully selected to provide filtering and water-slowing functions (SEA Streets website). Soil amendment was also an important component. By mixing native soil with organic compost, future water and fertilizer needs were minimized. Clay was used a liner in the swales because it allows water to move up through soil in the dry season to help plants survive (SEA Streets website). It was important for the landscape architect to be involved in the project earlier and more intensively than in a traditional project. This is a

result of the realization that street projects will be ultimately more successful if they are viewed holistically, with engineers, landscape architects, property owners, and ecologists working side by side to ensure that the renovation achieves multiple objectives.

There were numerous community benefits identified by the project designers. The first is that it will improve the health of local creeks by reducing stormwater runoff at the source (SEA Streets website). In addition, the SEA Streets Project provides an example of the environmental benefits that come with using a system focused on the natural hydrology of the area; a system in which a particular piece of land is renovated based on its characteristics, instead of applying traditional, universal stormwater management techniques. A third benefit of the project is that it creates a soft-edged environment which is much more aesthetically pleasing and brings residents and visitors alike to walk along the site and enjoy the curvilinear road, artful swales, and native vegetation. Another benefit is that the increase in tree cover reduces summer heat, as well as absorbing air pollutants and rainfall (SEA Streets website). Finally, the SEA Streets project slows traffic and makes the right of way safer for vehicle passengers and pedestrians.

Monitoring of SEA Street Project

I will now turn to the SEA Streets monitoring study completed in November 2002 by the Department of Civil and Environmental Engineering at the University of Washington. The study is titled "Hydrologic Monitoring of the Seattle Ultra-Urban Stormwater Management Projects", and actually provides monitoring data for two projects by the Seattle Public Utilities. I will focus on the analysis of the specific SEA

Street Project completed on 2nd Avenue Northwest and which I have described in detail above.

The SEA Streets Project was monitored for flow in relation to precipitation to determine whether the street renovation actually achieved any stormwater reductions. The flow was measured using "shaft encoder floats and pressure transducers that recorded water depths behind V-notch weirs", while "precipitation was recorded using tipping bucket gauges" (Horner Abstract). Other objectives of the study were to: 1) Evaluate receiving water ecosystem benefits that could be achieved with widespread application of these (ultra-urban) project types; and 2) Develop a long-term, systematic approach to ultra-urban stormwater management in Seattle (Horner 1). Baseline data was collected on the pre-existing street from March 11 to July 11, 2000. Construction began in July 2000 and was completed in January 2001. The data reported in this study was recorded from October 1, 2000 through April 2002.

The baseline monitoring data recorded from March 11 to July 11, 2000 helps to put the runoff rates for different street types into perspective. The cumulative measured runoff volume from the existing 2nd Avenue Northwest was 8601 ft^3. A conventionally designed road with a curb/gutter/sidewalk system would have produced an estimated 14806 ft^3 of runoff under the same precipitation. The estimate of runoff from the SEA Streets Project was 4989 ft^3. This runoff total is 42 percent less than the runoff from the pre-existing street and 66 percent less than from a conventionally designed road (Horner 5). This represents a huge reduction in stormwater runoff and huge benefits for the local creek system.

The monitoring data from October 1, 2001 through April 2002 demonstrated that the 2nd Avenue SEA Streets Project attenuated 98 percent of the wet season runoff and all of the runoff during the dry season (Horner 30). Researchers discovered that the project design can manage 2300 ft^3 of runoff from a single storm event, which is equal to about 0.75 inches of rain on its catchment. To put that number in context, the mean storm quantity at Seattle-Tacoma International Airport is 0.48 inch (30). In the wet months, the SEA Streets Project reduces runoff discharged to the local creek system by a factor of 4.7 in comparison to the conventional street (30). The SEA Streets Project at 2nd Avenue Northwest has proven to be highly successful at reducing runoff and managing stormwater.

My 124th Street Renovation Proposal

I propose that PLU work with Pierce County to renovate 124th Street on lower campus between the Women's Center and Tinglestad Hall using the design strategies and techniques of the SEA Street Project. The natural stormwater management, aesthetic improvements, and safety improvements of the SEA Street Project are undeniable, and the same principles could be applied on the campus of PLU. This project would be expensive, but would serve as a visual demonstration of PLU's commitment to sustainability. As I have demonstrated in this paper, this commitment is rooted in PLU's Lutheran heritage in the form of Christian environmental ethics. It is also located within the burgeoning field of sustainability within higher education. It is entirely in line with David Orr's arguments about design as pedagogy and the importance of incorporating water into curriculum. I have shown that many aspects of campus geology are conducive

to a natural drainage project of this type. Finally, I have extensively outlined the philosophy, design, and effectiveness of a similar project.

More study will most certainly be required before a project of this scope could be completed on campus. This would include hydrological analyses, engineering design, and analyzing potential special interest conflicts, to name just a few. And, of course, a sustainable street renovation of 124th Street could not be modeled exactly after the SEA Street Project. But the momentum and energy for sustainability on campus are strong, and a sustainable street renovation project would be a bold demonstration of PLU's commitment to sustainability.

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Figure 1: Picture of 2nd Avenue NW in Seattle before SEA Streets renovation (Seattle Public Utilities).

Figure 2: Picture of 2nd Avenue NW in Seattle after SEA Streets Renovation (Seattle Public Utilities).

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Figure 3: Aerial view of the completed SEA Street Project at 2nd Avenue NW in Seattle (Seattle Public Utilities).

Figure 4: Aerial view showing the before (bottom half) and after (top half) of what a potential 124th Street sustainable street renovation could look like (Susan McPartland).