Asset Management Committee PDP – Attachment
May 19, 2004
Pinehurst Natural Drainage System Project
Drainage Fund – Flood Control and Local Drainage

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NATURAL DRAINAGE SYSTEM PROGRAM BACKGROUND SUMMARY

SPU has commitments to our citizens to provide a stormwater management system while being good stewards of our urban water resources. The urbanization within Seattle has altered the hydrology and geomorphology of streams and caused predictable changes in stream habitat and water quality. In order for Seattle to maintain or enhance our diminishing species of salmon, we must shift our current approach to storm water conveyance. Emerging science (Booth et al, 2001) suggests approaches that both (1) delay timing of relatively small stormevents, and (2) infiltrate significant volumes of the runoff are needed to mimic the predeveloped hydrologic function of our watersheds.

The Natural Drainage System (NDS) demonstration projects meet citizens requests for street, pedestrian, and local drainage improvements while providing a net positive impact on our downstream receiving water bodies. AMC received a briefing on these programmatic goals 6-months ago and approved the program to continue. Since then, the NDS program has:

- completed construction of 75% of the Broadview Green Grid project,
- entered into the top 15 contenders for a Kennedy School of Government 'Innovations' award;
- secured a grant for High Point NDS project, and
- received a $3.7 million low interest loan for the Pinehurst Natural Drainage System Project.

The Mayor's 2004 Environmental Action Agenda supports the NDS program. The Draft 2004 Comprehensive Drainage Plan provides direction on the development of drainage infrastructure in neighborhoods where it does not currently exist and supports the use of NDS as a surface water management approach in areas draining to creeks.

The Pinehurst Project will be the third and final large-scale application of Seattle Public Utilities's (SPU) NDS Program. The demonstration grid projects allow us to evaluate the aspects of the NDS projects, including storm water function, vehicular and pedestrian function, community acceptance, and homeowner cooperation in maintaining landscape. All of these projects will be monitored to evaluate their performance. The scientific monitoring, in combination with detailed tracking of project costs, will provide SPU with a template for application of NDS improvements elsewhere in the City.

PROJECT BACKGROUND

The Pinehurst NDS (Pinehurst) project area is in Thornton Creek Watershed. The site is bound to the north by NE 120th St, on the south by NE 113th St (just north of Northgate Way), east by Lake City Way and west by 15th Ave NE as shown in Figure 1. There are about 240 houses in the project area.

Project area is conveyed to Thornton Creek by way of the Kramer ditch , which has a drainage area of approximately 135 acres. The Pinehurst subcatchment is 83 Acres, with 49 acres of that area directly contributing to the project area. In general, the basin flows to the southeast towards Kramer ditch.

There are many instances of spot flooding in the project area; however, there are no known historical claims. On a basin scale, there are many instances of flooding where Kramer ditchmeets the South Branch of the Thornton Creek. In addition, portions of the Kramer ditch are dredged annually by SPU Operations at an annual cost of $7,800.

The project area was selected based on monitoring needs and a preferred site selection criteria for potential NDS project streets. The preferred site selection criteria include the following:

1. Residential area
2. All potential project streets fall within on subbasin, and that subbasin area is at least 20-acres and has at least 12 potential project blocks. This criterion allows monitor the effects of our projects.
3. No existing local drainage infrastructure in the majority of the basin.
4. No existing formal street improvements, either sidewalks or asphalt or concrete streets on the potential project blocks.
5. All potential project streets must be a minimum of 300-feet from a critical slope area (so that infiltration technologies can be used)
6. Existing soils maps do not indicate clay in the area.
7. Longitudinal slope of project streets less than 8-percent (larger longitudinal slopes may limit infiltration capacity, or drive up project costs with the need for earth stabilization walls and fences)
8. Cross slope from one side of the street are not significant (larger cross slopes may limit ability to infiltrate, or drive up project costs with the need for earth stabilization walls and fences)
9. Potential project streets do not have a bus route on them.

The Pinehurst project site meets all these criteria. Several other potential project basins in the Thornton Creek watershed were identified. The Pinehurst Project area was selected due to the known flooding problems downstream of the basin where the Kramer ditch joins the South Branch of Thornton Creek.

PROJECT GOALS

There are several goals of the Pinehurst NDS project, which will be discussed in this section.

Local Conveyance: For all project streets, project improvements will eliminate spot flooding problems and provide drainage conveyance up to the service levels defined in the 2004 Comprehensive Drainage Plan.

Water Quantity: Infiltration and Detention: On a basin scale, the project will manage stormwater runoff volume for the full project area drainage basin to at least the 6-month storm event (1.08 inches in 24-hours) and up to the 2-year storm event (1.68 inches in 24-hours).

Water Quality: The project will provide water quality treatment per City of Seattle and Washington Department of Ecology (DOE) standards for the total drainage area. Many codes only require treatment of new impervious area.

Neighborhood Goals: Improving the Pinehurst neighborhood by bringing local improvements including new street paving and landscaping is a goal of the project. One sidewalk per block will also be incorporated in support of the Mayor's and SPU Director's initiatives.

Program Efficiency and Learning: Since the Pinehurst project is an NDS Demonstration project, it will work to improve 1) SDOT and SPU design standards, 2) evaluation procedures including modeling methodology, and 3) design and construction techniques, which will lead to more cost-

effective design with potentially higher-drainage benefits. A comprehensive preliminary engineering (PE) report is being prepared as part of this project.

PROJECT DESCRIPTION

A draft PE study was recently completed by SPU staff and was prepared in accordance with street design guidelines developed with SDOT staff for the project. Although SDOT staff have stated that some guidelines may be re-evaluated during the implementation of the project, we assume that any changes in the guidelines would have a minor impact. The PE study evaluated different street configurations and alignments at the block scale. Based on this evaluation, three block scale street templates were prepared including two new templates that have not previously been used on other NDS projects. Details on the templates are presented in the next section. The PE study also evaluated 33 potential project blocks (330 feet long each) in the study area, as shown on Figure 2, and prioritized the blocks by their potential for the highest infiltration and water quality benefit. Based on the block scale templates and the prioritized blocks, four options for application in the overall project area developed. The four applications are termed Project Basin Options. Two of the options include NDS elements using different block scale templates. One option includes the Do Nothing option and another contrasts one of the NDS options to a traditional system. All but the Do Nothing option includes work on 11.5 blocks.

BLOCK SCALE TEMPLATES

This section discusses block scale templates that were developed for the Pinehurst project. Although a preferred template is recommended, the project team would like approval to utilize all the templates if necessary.

Block Scale Template Descriptions

The following section describes each of the three block-scale templates. For each template, parking and a 5 feet wide sidewalk will be provided on one side of the street.

Template I: Curvilinear Street

This is the same block scale template used at the Broadview Green Grid project currently under construction. The roadway is 20-feet wide and has a curvilinear alignment as shown in Figure 3. The existing street would be removed and replaced with a new asphalt concrete pavement (ACP) section. The sidewalk is adjacent to the roadway and designed to withstand vehicular loading. The sidewalk will be called a pedestrian pathway, since it is only separated by a 2-inch curb, and its use is intended to provide space for vehicles to pass each other as well as a pedestrian walking area. Swales are added on both sides of roadway alignment. This template yields the second largest bottom swale area as shown in Table 1. The drainage volume and benefit is a direct function of the bottom swale area; so the latter is used for block scale comparisons.

Template II: Offset Street

This is a new template that has not been used before in NDS projects. The roadway is 20-feet wide and has a linear alignment as shown in Figure 4. It is also offset between 6 and 9 feet from the existing street alignment. Offsetting the roadway allows the drainage swales to obtain larger bottom areas and therefore to increase infiltration potential. This option would also replace the existing street with an ACP section. The swales would generally be on one side of the roadway with sidewalks on the opposite side near the edge of the ROW. The sidewalk is separate from the roadway. The Offset template yields the largest bottom swale area and is comparable in cost to the Curvilinar template as shown in Table 1.

Template III: Existing Street

In this template, the existing chip-sealed street , width of 19 to 22 feet, remains as shown in Figure 5. A new sidewalk is added to each block and is separate from the roadway. The swales would be on both sides of the street. This template yields the smallest bottom swale area and is the lowest cost template as shown in Table 1.

Template Comparisons

Below is a comparison of the per block average estimated construction costs, bottom swale area, and normalized comparison to Template III – Existing Street. A graphical comparison is also shown in Figure 6.

Table 1: Block-Scale Template Comparisons Table, per 330 LF block

	Average Construction Cost per 330 LF	Average available bottom swale area	Performance relative to Template III
Template I: Curvilinear Street	$141,000	863 SF	2.0
Template II: Offset Street,	$139,000	1465 SF	3.3
Template III: Existing Street	$109,000	440 SF	1.0

Because the project will not have available funding to improve drainage retention on every street in the study area, water from upstream non-project streets will be directed onto the project streets. Therefore, the preferred template would have the maximum drainage benefit to handle the larger drainage area.

Because the Offset block-scale template yields the largest bottom swale area (and hence drainage volume benefit) and is comparable in cost to the Curvilinear and Existing Street block-scale templates, we recommend use of the Offset template if possible. However, we are requesting approval of all the templates since existing site conditions or community concerns may require use of the other templates.

PROJECT BASIN OPTIONS

The following section present the four Project Basin options considered in this PDP. The following information for each site will be presented in Table 2.

- Number of project streets
- Pros and Cons
- Annualized drainage volume reduction
- Achievement of conveyance goal
- Percentage of drainage volume reduction goal
- Percentage of drainage peak reduction goal
- Achievement of water quality goal
- Achievement of neighborhood goal
- Annualized maintenance costs
- Total estimated project post

Some options utilize various block scale templates discussed above. Table 2 compares the different drainage benefits and costs of each option. A sidewalk and parking would be added on

one side of the project streets in all options except the Do Nothing option. Figure 7 shows the location of the prioritized project streets that were identified in the PE. These streets have potential for the highest infiltration and water quality benefits.

Option 1 - Do Nothing

This option represents the existing condition in which there are many instances of spot flooding in the project area and in downstream sub-basins and basins. This option does not bring new infrastructure to the Pinehurst neighborhood.

Option 2 - Offset NDS

In this option, the Offset block scale template is applied to 11.5 blocks in the areas shown on Figure 8. A new ditch and culvert system is also added on portions of NE 117th St. to mitigate against flooding problems and to convey water to the NDS project streets. Modifications to an existing ditch and culvert system on NE 113th St. are also included to prevent a long-term erosion problem.

Option 3 – Offset and Curvilinear NDS

In this option, the Offset block scale template is applied to 5.5 blocks and the Curvilinear template is applied to 6 blocks in the areas shown on Figure 9. Similar modifications to NE NE 117th St. and NE 113th St. are included in this option.

Contrast to Traditional

This option includes use of a traditional drainage system to achieve the same drainage volume reduction benefit as Option 2. The system incorporates curb gutter and pipe storm drain elements. It also includes an infiltration/detention pond that is necessary to reduce the drainage volume as shown on Figure 10. Six residential properties would need to be acquired for construction of the pond.

Basin Scale Option Evaluation

Option 2 and the traditional drainage system meet the same number and level of project goals. However, the traditional system is substantially more expensive than Option 2. Option 2 and 3 have approximately the same cost, but the drainage benefit of Option 2 is substantially higher. The Do Nothing option does not meet any of the project goals.

ECONOMIC ANALYSIS & BENEFITS

Pinehurst Economic Analysis

The recommendation is for Option 2 or Option 3 for the project. The project helps SPU meet service levels in water quality and creek protection. In addition, the Comprehensive drainage plan (Mayor's draft Feb. 5, 2004, p 3.2) sets as SPU's policy to ". . . evaluate, prioritize and fund new drainage infrastructure projects in areas of the city lacking basin drainage infrastructure . . .". The project has a net cost of $1.9 million, but these are offset by the many benefits which were not quantified.

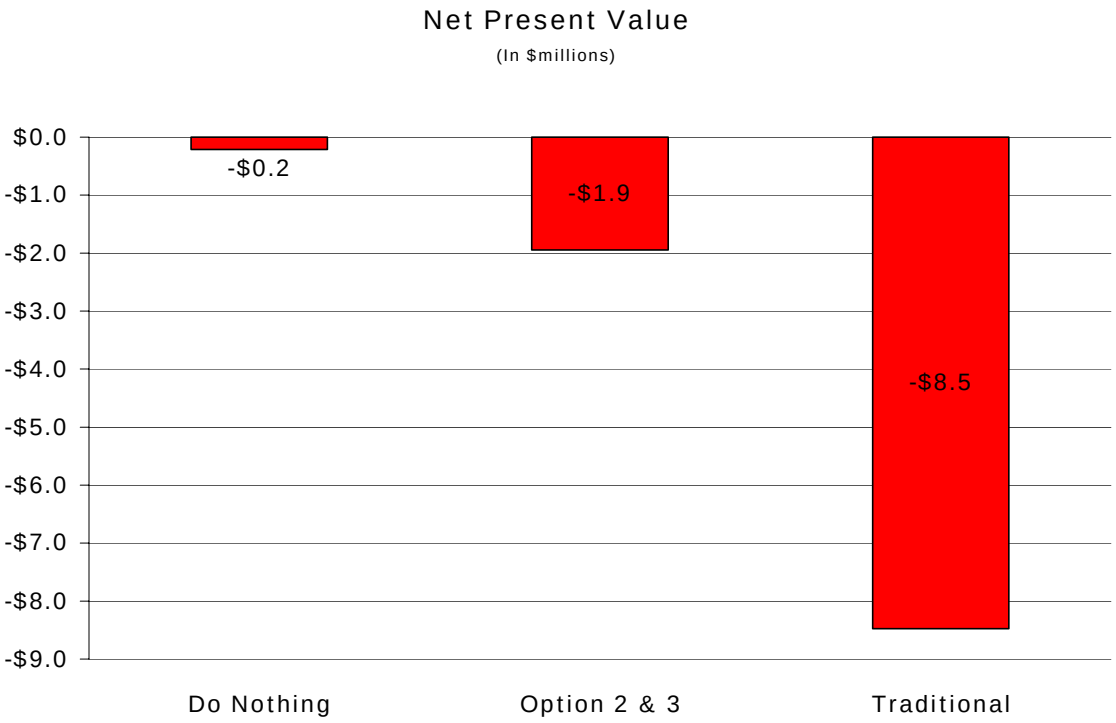
Comparison with Broadview

As an illustration of how new designs considered in the development of demonstration projects, the NDS offset design of Pinehurst project treats runoff from 49 acres for $4.6 million, while Broadview treated runoff from only 32 acres for the same cost.

Cost Benefit Analysis

When considering only the quantifiable benefits of the project, the net present value of Option 2 and 3 are negative- the costs exceed the benefits on a present value basis by $1.9 million. Yet, the project delivers many benefits which were non-quantified including:

- Reduced water quantity – 9.7 and 4.8 million gallons per year are infiltrated for Options 2 and 3, respectively
- Improved water quality – meeting DOE standards
- May decrease property flooding downstream at Kramer ditch
- Improved transportation: sidewalks, and new road pavement
- Aesthetic benefits
- Increased City's tree canopy



Benefits

Non-quantified Benefits

Drainage Benefit:

Benefits to SPU drainage include reducing volume, peak flow and mitigating spot flooding. Mitigating runoff from the project area will help stem the rising pressure from development in other parts of Thornton creek. While other areas of the basin are being paved over and increasing discharge into Thornton creek, Pinehurst basin will be reducing its contribution. The benefit of the natural drainage system is that it does not move the problem of excess stormwater downstream and reduces total volume, which traditional conveyance systems can not do.

Water Quality Benefit:

Water quality benefits are two fold. First, the reduction in volume of stormwater leaving the site reduces the amount of pollutants. The biofiltration effects on water quality are a secondary benefit.

Transportation Benefit

Although the transporation benefits are mostly dictated by SDOT, the non-drainage portion of the project includes sidewalks, new street pavement, and additional street trees.

Aesthetic Benefit

Residents in the area have expressed their appreciation for the aesthetic qualities of NDS Streets. The NDS streets are favored places for neighborhood residents to take walks and are viewed as “open space”.

Quantified Benefits

Increase in Home Values

It was assumed that the aesthetic design will increase home values on the project streets. With NDS and traditional street improvments, a one time 5% increase in home values was assumed. Home values were estimated at the median price of homes in Seattle $268,000 with 10 homes per block over 11.5 blocks.

This estimate of increases in home values is based on a report from Dave Mongrin of Lake Realty in November 2003. He reported to Ron P. the sale of a home at 11750 2nd Avenue (on SEA Street) which increase 24% from 7/2000 to 10/2003. Median home prices in Seattle rose 9% from 2001 to 2003, so 15% could be attributed to SEA Street. (Assuming that no major home improvements were made)

Savings from Federal Loan

The federal loan for $3.7 million at an interest rate of .5% over 20 years has already been accepted by City Council. Compared to SPU's usual 5.5% rate for 30 years loan, the federal loan will save SPU $1.4 million. The loan requires that the project reduce existing runoff from the site by 50%. Both project basin options #2 and #3 achieve this objective.

Cost

Option 1 Do nothing

Cost of Project: $0 million
PV of Maintenance Cost: $213,000
Cost of Maintenance Dredging at 107th and 30th for $7300/year
And cleaning of catch basins $ 600 per year for 11.5 blocks
NPV is cost of $213,000

Option 2 or 3 NDS at Pinehurst

Cost of Project: $4.6 million
PV of Maintenance Cost: $371,000
Includes:

- Maintenance of trash racks
- Soil Replacement every 15 years
- Vactoring every 2 years
- One half the cost of landscaping $500/year.
- Reduced level of Kramer ditch dredging (see below)

Contrast to Traditional

Cost of Project: $9.8 million
Includes:

- Project cost of catchbasins, maintenance, and detention/infiltration pond
- Purchase of six properties averaging $272,000 each.

PV of Maintenance cost: $218,000
Includes:

- Catchbasin cleaning every year
- Pond dredging every 5 year
- Reduced level of Kramer ditch dredging (see below)

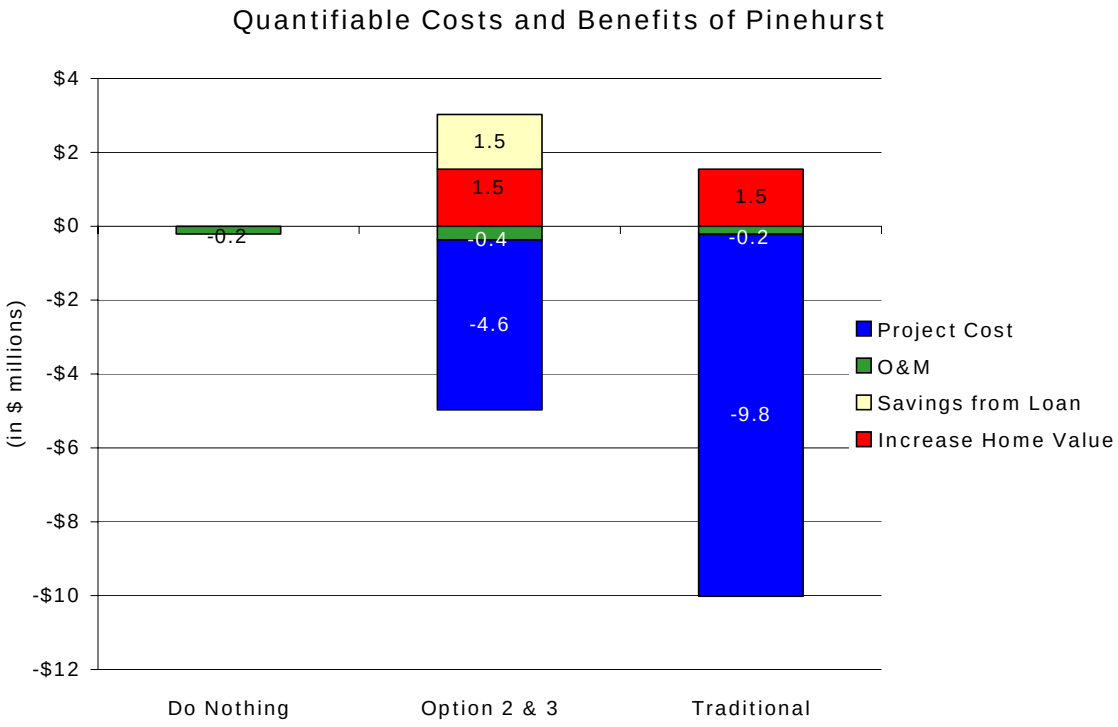
Reduction in Kramer ditch dredging

At the junction of 170th and 30th, a section of culverts get dredged every other year at a cost of $7270. This will be reduced by 36% since the project area makes up that percentage of the drainage area.

Maintenance Costs:

					Who Pays?		
		Cost	Frequency	Blocks	Neighbors	O&M	CIP
Traditional	CatchBasin cleaning for	$600	Annual	11.5		Yes	
	Pond Dredge	$12,000	Every 5			Yes	
NDS	Mulch	$1,000	2nd and 3rd year	11.5	After 3rd year, assume half or $500/year done by SPU		2nd and 3rd year
	Water						
	Weed						
	Plant						
	Trash	$330	Annual	11.5		Yes	
	Soil Replacement	$8,655	Every 15	11.5		Yes	
	Vactor	$645	Every 2	11.5		Yes	

Cost Benefit Analysis



Option	Description	Costs (in $1,000)			Benefits (in $1,000)			Benefit - Cost	Benefit to Cost Ratio
		Project Cost	NPV of O&M (50 yrs)	Present Value of Costs	Savings from Loan	Increase in Home Value	Present Value of Benefits		
1	Do Nothing	0	-213	-213	0	0	0	-213	0.00
2 and 3	11.5 blocks offset or mixed	-4,600	-371	-4,971	1,485	1,541	3,026	-1,945	0.61
	Traditional	-9,800	-218	-10,018	0	1,541	1,541	-8,477	0.15

RECOMMENDATIONS

Block Scale Templates: We recommend approval of the three block-scale templates described above so that all can be used if necessary.

Preferred Option Recommendation: Project Basin Option 2 – All Offset is the recommended project basin option since it achieves the maximum drainage benefit and the highest number of project goals at the lowest cost. Since community concerns and unknown site conditions may limit the use of the Offset template, we would also like approval for changes to Option 2 as long as these changes achieve at least the drainage volume benefits of Option 3. Both of these options will meet the conditions of the Washington Public Trust loan.

Budget: The project budget is currently $4,355,000 and was estimated before the start of preliminary engineering. Based on the results of the PE study, typical cost on other NDS projects, and the new policy change that the first three years of post-construction maintenance be paid for by the CIP project, we are requesting that he total project budget be increased to $4,625,000.

Schedule: The project team has just completed preliminary engineering and is requesting approval to proceed with design and construction. The following is the estimated project schedule:

Design Phase: May 2004 to 2Q05
Construction Phase: 2Q05 to 3Q06
2nd and 3rd Year Maintenance: 3Q07 to 3Q09
Close-out: 4Q09