Stormwater Low Impact Development Practices Seattle, Washington, U.S.A.

Les approches de développement à faible impact pour la gestion des eaux pluviales - Seattle, Washington, U.S.A

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RESUME

Dans le cadre de son engagement vis-à-vis du développement durable, la ville de Seattle a décidé de revoir ses pratiques de gestion des eaux de ruissellement et a choisi d'adopter des pratiques de développement à faible impact pour la gestion des eaux pluviales. La ville travaille à la réhabilitation d'un ensemble de HLM de 60 ha dans le quartier de High Point qui intègrera cette approche innovante. Ce projet mettra à disposition environ 1600 unités d'habitation pour des foyers à différents niveaux de revenus ainsi que des services divers tels qu'une bibliothèque publique, une clinique et des parcs reliés par des allées piétonnes afin d'encourager la les déplacements doux. Ce projet constitue un modèle d'intégration des pratiques de gestion des eaux pluviales à faible impact et confirme l'engagement de Seattle dans le développement durable.

ABSTRACT

As part of its commitment to sustainable development, the City of Seattle is revising its stormwater code and implementing Stormwater Low Impact Development (LID) practices. The City is presently redeveloping the 120-acre High Point low-income housing development, which incorporates innovative stormwater LID design approaches. The High Point project will provide approximately 1600 mixed-income housing units and public amenities such as a new public library, health clinic, and parks that are connected by pedestrian friendly right of ways to encourage walking. The High Point redevelopment provides a model of how to incorporate stormwater LID design approaches for infrastructure and site development, and confirms Seattle's dedication to sustainable development practices.

KEYWORDS

Drainage design, redevelopment, stormwater low impact development, stormwater management, sustainability.

1 INTRODUCTION - HIGH POINT REDEVELOPMENT PROJECT

The Seattle Housing Authority (SHA) is redeveloping the High Point housing project in Seattle by committing to sustainable LID development as a guiding principle for the neighborhood's revitalization. Construction on phase 1 of the two-phase High Point project began in June 2003, with phase 2 to be completed in 2009. Once a blighted neighborhood of 791 deteriorating housing units and inadequate infrastructure, the new development consists of approximately 1,600 residential mixed-income housing units on 120 acres and integrates an existing City Natural Drainage System (NDS) concept throughout a large and high-density residential area. The NDS system is the first of this scale to be incorporated into a new urban subdivision as part of the street grid while also creating a network of connected vegetated and grass-lined swales. This approach achieves a balance between neighborhood green space, pedestrian safety, and water quality improvements.

In Seattle, the term "natural drainage system" is used to describe a category of drainage capital improvement projects that strive to meet multiple goals within street right of way, which account for approximately 25% of Seattle's total land surface. The NDS program goals include infiltration, flow attenuation, filtering and bio-remediation of pollutants by soils and plants; reduced impervious surface; increased vegetation; and related pedestrian amenities. These NDS projects use natural features to mimic the functions of nature lost to urbanization and they include open spaces, vegetated swales, stormwater cascades, and small wetland ponds. At the heart of all NDS projects are the plants and trees, and the deep, healthy amended soils that support them. All three combine to form a living infrastructure that, unlike detention pipes and vaults, increases in functional value over time.

The High Point project area is approximately 10% of the Longfellow Creek Watershed, providing an opportunity to improve water quality and stream flows to Longfellow Creek and thus recovers depleted Coho Salmon runs. Seattle Public Utilities' (SPU) proposal to integrate an innovative drainage system into this predominately townhouse style housing development was uncharted territory. Discussions, analysis and planning took approximately two years. SHA collaborated with the City to achieve approval of the subdivision plan for the NDS that consists of a network of swales, ponds, and multi-functional open space throughout the 34 blocks of Right-of-Way (ROW).

2 BACKGROUND AND PHYSICAL OVERVIEW

The High Point neighborhood was built in 1942 as temporary housing for government workers during World War II. In 1952 the Seattle Housing Authority took ownership, creating much needed low-income housing. By the 1990's, the neighborhood was in dire need of significant upgrades and in 1999, the Seattle City Council authorized a revitalization of the area. In 2000, the United States Department of Housing and Urban Development (HUD) designated $35 million in federal grant money to SHA to begin the rehabilitation project. In 2001, after securing local and federal funding along with private investment, SHA developed a Master Plan to rehabilitate the area's dilapidated housing. The redevelopment project then became a partnership between the SHA, HUD, City of Seattle, and several community-based groups. In addition to the housing and infrastructure redevelopment of the site, project plans also include numerous public amenities such as new parks, a neighborhood center, a public library, a health center, and a commercial site to better serve the needs of low-income residents and seniors.

One of the major commitments of the project team was to develop the project in such a way as to have a net positive impact on the environment. The NDS

strategy is an innovative and very important component of this commitment. The area, which is located within the Longfellow Creek Watershed, collects stormwater runoff from an area of approximately 1,730 acres and then outfalls into the Puget Sound. The watershed started feeling the effects of land development as early as the 1900's. Physical barriers, piping of creek sections, unrestricted flow, and no water quality treatment reduced salmon return. Longfellow Creek is a high-priority, salmon-bearing watershed and has been identified by "the community and the City as a significant and valuable resource." The High Point development area plays a "particularly important role in the City's environmental stewardship responsibilities" (11/5/02 Memorandum of Agreement) for the Longfellow Creek Watershed.

During the planning of High Point, SHA was approached by SPU to develop a NDS strategy for the entire project as part of an Integrated Drainage Plan. The opportunity to develop a natural drainage approach in an existing large urban redevelopment project area was important to improving the protection of Longfellow Creek and as an example of what could be done to retrofit other City neighborhoods.

The subdivision design had already achieved a tight footprint with the new urbanist approach. This was not a typical large lot development, but one where the total unit lot size including the building footprint was as small as 1,200 square feet. The overall site plan was approximately 65% impervious. The City was asking SHA to go a step further and attempt to reduce the impervious area to 60% overall with the goal of increasing stormwater retention for small storms at the block scale. SHA was still required to meet conveyance and major stormwater discharge requirements necessitating the installations of traditional drainage systems. This included a conveyance pipe network and a stormwater pond.

2.1 Planning

A considerable amount of time from the planning through the design phase was spent on terminology. The semantics of High Point's drainage design led to discussions of the definitions of disperse, porous, infiltrate, pervious, discharge, convey, swale, filtration, etc. These words become important as they have different meanings to engineers, landscape architects, architects, regulatory staff, contractors, owners, developers, builders and real estate agents. Meanings or interpretations are not minor considerations when they affect bid prices and property values.

The NDS approach at High Point needed specific requirements and standards in order to convey the intent of the development. The desire to ensure the development will follow the intended approach and the need to explain the criteria and provide options for development resulted in five levels of commitment. The first was to take the unusual step of adding drainage thresholds in the Plat. The second was to develop a "Drainage Covenant" for the Plats of the High Point Community. The third was to develop technical standards for compliance with the Drainage Covenant. These standards have evolved from the originally envisioned design guidelines to an approach facilitating permitting and implementation. The fourth level was the development of a Covenant for Maintenance of Natural Drainage Landscape, Open Space, and ROW for the High Point Community. This association involves all properties within the Plats of High Point Community and includes authority for fee assessment, maintenance and enforcement of common areas including the natural drainage landscape. The fifth level is the Memorandum of Agreement (MOA) between the City of Seattle and the Seattle Housing Authority regarding funding and maintenance of the drainage system.

The High Point NDS began as a partnership between two public entities interested in redevelopment addressing community needs for affordable housing and a pedestrian friendly neighborhood incorporating progressive infrastructure. At times

partners had different priorities since SHA's primary commitment was to housing and community building. SPU's ultimate goal was fully implementing the NDS within the development and downstream water quality.

Many city departments became involved in the High Point natural drainage approach since, in one way or another, the design criteria and space needs impacted all of them. Although there was an undercurrent of "we are being compromised for drainage," the discussions were valuable in getting interdepartmental understanding of each other's requirements. SHA remained committed to trying this new approach and continually thought of ways to use the drainage design to spearhead community building. This type of commitment was crucial in keeping all parties focused on the long-term goal while intermediate hurdles popped up.

To help ensure the success of the project's sustainability initiative, SHA realized it would depend on active participation of community members. Early on in the planning process, SHA enlisted the assistance of local neighborhood groups to help engage area residents. The local involvement was successful for ongoing community involvement through meetings, forums, newsletters, and strengthening relationships with City personnel.

3 REVISED PLAT'S DRAINAGE REQUIREMENTS

Since existing City stormwater code did not require stormwater low impact development practices be incorporated within the redevelopment project, the project team encountered a dilemma for requiring and regulating the progressive drainage design approach. Restricting each Plat to include the new drainage requirements was originally not a step that SHA, the surveyors, or land-use attorney wanted to undertake. However, after reviewing the project's proposed drainage requirements it was determined that this was the best alternative for achieving the regulations associated with the project. Therefore the original Plats were revised to include the new drainage LID requirements.

To achieve the project's drainage goals, each Plat was identified as having an "Allowable Percent Impervious Surface Coverage." During the review of each individual project, a "Permit Submittal Chart for Drainage Requirements" is filled out and checked to ensure an applicant does not exceed a predetermined allowable percentage of impervious surface. Once the project is permitted, the actual "total percent of impervious coverage" for a given block is entered into the City GIS system. This will be used to prevent future redevelopment from exceeding previously permitted impervious surface thresholds. The revised Plat requirements provide greater flexibility, and create the ability to control site development of future remodeling projects that come in for permit.

4 DESIGN GOALS

In developing the NDS for the High Point project, SHA and SPU looked to mitigation measures that could manage and treat the stormwater closer to its source while at the same time meeting SHA's goal of building an affordable housing community with a traditional in-city neighborhood feel. For example, standard curb and gutters were a requirement in order to blend in with the adjacent older neighborhoods. Some of the stormwater mitigation measures include: allowing building roof drainage to sheet-flow across a lawn and planting areas, amending the soil of lawns and landscape areas to improve the absorption capability of the soil, developing filtration drainage swales to treat stormwater runoff from adjacent properties and streets, mitigating the allowable impervious and pervious areas for a site, and using porous paving materials.

The proposed drainage system approach for the main High Point drainage sub-basin includes an integrated network of both NDS facilities such as vegetated swales and conveyance swales, along with the traditional catch basin/inlet structures with a drainage conveyance-piping network for the large storm events. In addition, a stormwater detention pond was included and sized to provide flow control for the 2-year, 25-year, and 100-year, 24-hour design storms. The traditional drainage systems of pipes and detention were required when it was determined that on-site soils, even with amendments, would not fully accommodate larger flows.

Subdivision design establishes the relationship between buildings and infrastructure. Yet infrastructure design is typically an afterthought to the site layout dictated by pre-existing standards. This project incorporates both planted and grassy swales throughout the development as a priority of the site layout. The swales have specially-engineered soil beneath the grass and plants that store and treat the runoff from the roadway and housing development. This system provides a much greater opportunity to cleanse, cool and infiltrate stormwater runoff than the traditional piped and centralized stormwater management approach.

4.1 Design Approach and Modeling Results

The natural drainage approach combines creative street edge alternatives and stormwater management techniques which provide infiltration, filtering and flow control to reduce pollutant discharge, decrease erosion, and stabilize the creek water temperature. For this project the NDS goal of infiltrating stormwater into the native soil was not pursued due to the steep slope adjacent to the project site. Based on modeling results, the stormwater runoff from the system will function similar to pre-developed pasture conditions despite the neighborhood's high density. In developing the natural drainage plan, the landscape architects applied the various options tailored to the needs of each neighborhood block. These included a network of grass and tree-lined streetscape treatments along with vegetated swales throughout the new street ROW to retain and slow stormwater runoff while bringing aesthetic value to the neighborhood. The street edge treatments combine the traditional feel of an established Seattle neighborhood with garden walks, which encourage a more walkable neighborhood.

The natural drainage plan also creates multi-functional open spaces including a new pond park, pocket parks, and areas for children to play. These spaces also serve as underground water storage. The plan also calls for minimizing some street widths from 32 to 25 feet to reduce impervious areas and add to the traditional urban character of the neighborhood. To help reduce stormwater run-off, porous concrete pavement was used on two City street sections, half of the public sidewalks, and for parking and access on many of the private properties. In an effort to not only limit waste, but also to mimic a forest's natural duff layer, the project has used on-site wood chips from trees and vegetation to protect the critical root zone of the trees that will be preserved. Amended soils are required throughout the project site to increase the rate of infiltration and water-holding capacity.

The following additional performance goals were used for the site:

1) Bioretention swales are estimated to infiltrate approximately 75% to 80% of the water quality storms. This is slightly less than the goal of infiltrating 100% of the water quality storm event. Additional water quality treatment was provided via biofiltration in the grass-covered and vegetated swales, gravel pocket parks, and via dead storage in the detention pond. The effectiveness of these additional water quality treatment components has not been quantified. SPU used the block-scale results to make quantitative estimates of water quality effectiveness as part of the Plat Drainage Report (2003).

2) Creek Protection Goal - The site must match the baseline flow duration and peak intensity of flows associated with the 2-year storm for the pre-developed condition identified as being pasture. Based on the modeling, the creek protection goal is being met in terms of both peak flow and flow duration standards.

3) Stormwater Conveyance – The pipe storm drain system will convey the 25-year, 24-hour storm event. The pond's outlet structures will convey the 2-year, 25-year, and 100-year design storm events. Based on modeling results at the point of compliance, the storm drain and pond overflow systems meet design goals.

4.2 Delineation of the NDS Swales within the public ROW

Assumptions for the location, length and cross-section of the NDS swales within the public ROW were based upon discussions with SHA and SPU. The locations for the NDS facilities were based on a two-step process:

1) Delineate which side of the street the swale would be located: Based on the housing concept plan, the swales were located on the side of the street with the least amount of driveway crossings and existing street trees to be saved.

2) Delineate the location for each swale type: shallow grass-lined and deeper vegetated. Since the NDS swales would be located within the planter strip of the street ROW, the ability for pedestrians to easily cross the planter strip to reach their parked vehicles was a primary criterion that determined the location of shallow grass-lined and deeper vegetated swales. Vegetated swales have also been located to delineate the intersections and within areas that have parking restrictions.

4.3 Site design

Site design strategies were also required in order to meet the 60% impervious goal for the townhouse style of housing. At the planning level this appeared very feasible, but as the design worked through programming the impervious areas (such as the overhangs, patios, walks, driveways, storage sheds, and mailbox zones), it became apparent that more aggressive strategies would be required. The City was concerned about the ability through current City regulations to restrict development beyond the zoning. This resulted in applying restrictions to properties at a "parent-lot" level that were recorded in the Plat. These restrictions cover impervious area, drainage connection points and requirements to disperse roof drainage on-site.

Design modifications were required to keep individual parcels within the Plat's requirements. These changes primarily impacted the percent of impervious surface and required revisions to accommodate porous pavements and therefore reviews for permits became a concern. City planners and engineers did not believe their current review process could accommodate the review of the NDS design strategies. Initially, it was thought that guidelines would be sufficient however, as discussions progressed, it was apparent that a much tighter set of guidelines would be required. The new requirements for implementing the LID practices are identified in the *High Point Community: Site Drainage Technical Standards* manual. This 86-page document allows designers to work from a set of approved standards as well as give builders some certainty in the process. This manual includes stormwater LID parameters and practices to be followed for each High Point City Block's project.

5 PERMITTING AND CONSTRUCTION

The City of Seattle's Department of Planning and Development (DPD) coordinated with SPU & SHA to resolve permitting challenges. While it was initially thought that partnering on drainage might simplify the overall permitting process, it

actually became more complicated because of the non-standard stormwater LID practices. Because the innovative design proposals were not in the city code, SPU and SHA had to agree on a mechanism that would provide uniform standards for current and future development. SPU, SHA, and DPD agreed to use the Plats as the mechanism to provide uniform standards in lieu of city code. These design goals were achieved through the project permitting process and tracked via GIS by DPD. The City of Seattle is currently revising its stormwater code to include more LID practices for future development.

An early goal was to develop an affordable approach to natural drainage that could be implemented in other City neighborhoods. As the design progressed, it was a challenge to avoid engineering design criteria that would inflate construction costs. The second area of concern was not attracting potential bidders due to the unusual drainage approach and high level of attention to the project. The team attempted to describe the work with routine construction materials and terminology in order to minimize the cost impact of implementing the non-standard drainage design.

Since this is the first large scale approach for a NDS in the City of Seattle, there's a higher level of City oversight than a typical project. The contractors are required to protect the natural drainage zones and the porous pavement from both traffic and adjacent drainage until project sites are adequately stabilized. To SHA and SPU's satisfaction, successful and very competitive bids were received.

6 PUBLIC/PRIVATE PARTNERSHIP

The City of Seattle wanted to move beyond simply replacing each housing unit and revitalize the neighborhood with mixed-income housing. This project required a commitment from private developers who would share in the City's commitment to LID practices. Private developers have invested 311 million dollars in the redevelopment project. The public contribution from SHA is approximately 204 million dollars. This includes 2.7 million dollars from the Seattle Public Utilities, over 63 million from selling portions of previously owned High Point property, and significant grants from local, federal, and non-profit investment sources. The new development will provide 755 total units affordable to people earning 80 percent or less of median income including 350 units for very-low-income households (earning 30 percent of median income), 250 tax credit units for working families at up to 60 percent of median income, and 75 independent and assisted-living housing units for seniors living 30 percent below income. The project is planning 804 units of market rate housing including 160 units of market-rate independent and assisted senior housing, 255 single-family homes, and 389 town homes and condominiums. The project has been successful in finding higher-income buyers who are attracted by the prospect of living in a sustainable neighborhood.

7 BENEFITS AND AMENITIES

The natural drainage approach provides much needed green space in dense urban areas. Multi-functional open space includes detention ponds and storage under neighborhood parks. In addition to reducing runoff and preserving the health of the creek, vegetated swales that include grasses, perennials and shrubs support the natural system and create "garden walks." The result is a more walkable neighborhood reducing the desire to drive vehicles as frequently. The open space also encourages a feeling of community. Neighbors can connect through a community garden, gathering spaces in Central Commons Park, and a connection to a walking trail. Reduced street width from 32 to 25 feet not only reduces impervious areas, but also gives an historical look and feel to the neighborhood streets.

8 CONCLUSION

The High Point redevelopment project provides guidelines for future construction of publicly and privately funded homes that encourages sustainable design approaches. Using a performance-based approach, the design meets the needs of the client, infrastructure stakeholders, and serves an ecological function. Most importantly, the High Point model challenges beliefs that dense urban design and ecological performance are mutually exclusive. The City stormwater code and the High Point redevelopment project confirm Seattle's environmental commitment to sustainable development to maintain a high quality of life.

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Consultants: Herrera Environmental Consultants, Inc.; Mithun Architects; RW Beck Inc.; Shannon and Wilson, Inc.; SvR Design Company.

WEB LINKS

City of Seattle - Stormwater Code and Director's Rules (SMC 22.800 – 22.808): http://www.seattle.gov/dclu/codes/sgdccode.htm
City of Seattle – Department of Planning and Development, High Point Project: http://seattle.gov/dpd/Planning/Planning_Exhibit/HighPoint/index.htm
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