

Green Streets – An Innovative Street Design Approach

“Great streets do not just happen. Overwhelmingly, the best streets derive from a conscious act of conception and creation of the street as a whole. The hands of decision makers are visible.”
- Allan B. Jacobs

Circulation and streetscape design is perhaps the most critical factor for building a healthy and safe community. Research shows that public streets and roads cover nearly one-third of our urban landscapes. Streets may be considered as the backbone of our urbanized civilization acting as efficient conveyors of traffic daily. However, often we tend to overlook that the massive impervious surfaces are also a high environmental polluter by depositing pollutants directly into streams and water bodies threatening natural habitat and species. In the past, sewage and industrial waste were considered as chief polluting sources, however since 1980s “nonpoint” pollution caused by runoff from impervious surfaces (such as roads, roofs, lawns, driveways, parking lots etc.) has gained much attention. In fact, nonpoint pollutants have been recognized as the No.1 environmental pollutant in U.S.

As we all struggle towards a more sustainable world future, it seems appropriate to rethink about our urban landscape. It seems necessary not only to improve our existing infrastructure and design but think of newer concepts to promote sustainable design values. The Green Streets design approach was popularized in the Portland Metro 2040 Growth Concept and Regional Transportation Plan.



Source: <http://www.portlandonline.com/bes/index.cfm?c=degab>

What are Green Streets?

“Green Streets” mimic natural conditions by managing runoff on the surface and at its source. According to the *Green Streets – Innovative Solutions for Stormwater and Stream Crossings* the a “green street” may be defined as –

- One component of a larger watershed approach to improving the region’s water quality
- Designed to incorporate a system of stormwater treatment within its right of way
- Minimizes the quantity of water that is piped directly to streams and rivers
- Makes visible a system of “green” infrastructure
- Incorporates the stormwater system into the aesthetics of the community
- Maximizes the use of street tree coverage for stormwater interception as well as temperature mitigation and air quality improvement
- At points where it crosses a stream or other sensitive area, a “green” street is located and designed to ensure the least impact on its surroundings

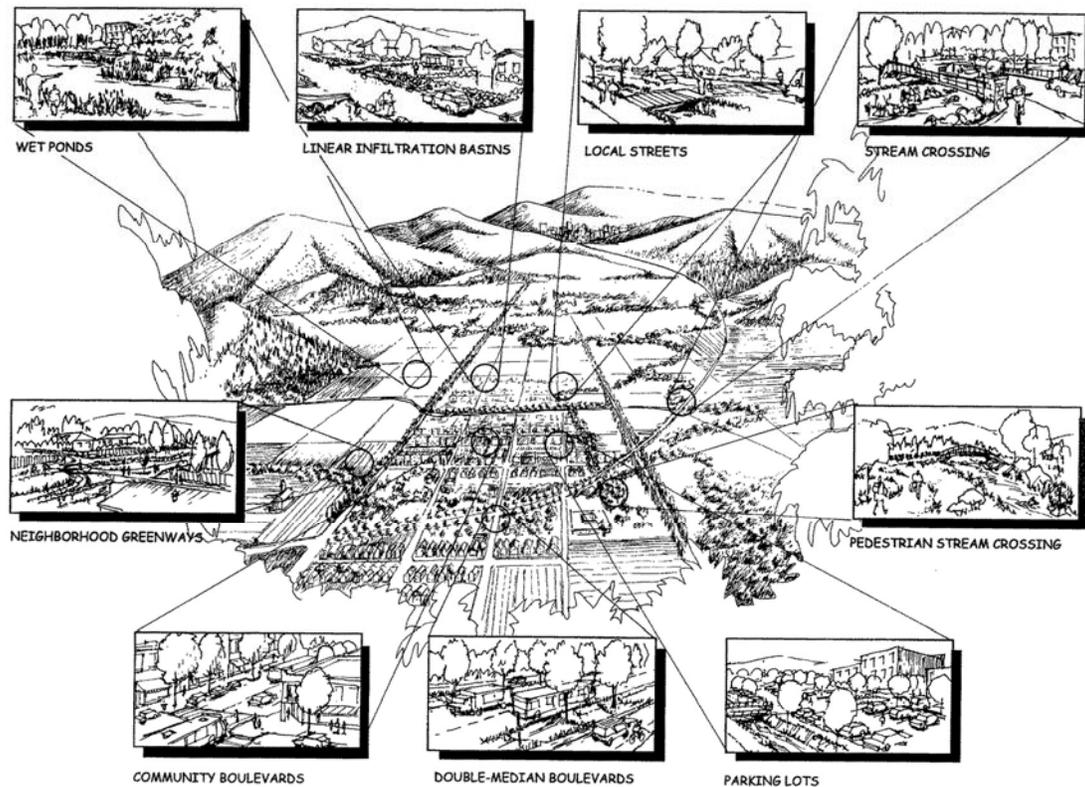
- Requires a more broad-based alliance for its planning, funding, maintenance and monitoring.

Green Street design approach is a unique way of assessing sustainable street design alternatives by integrating various solutions. This design approach tries to blend the natural hydrological cycle within the designed urban landscape. The key features of green streets are:

Reduction of impervious surface – Urbanization has created vast impervious landscapes which challenge the environmental sustainability of our cities. By reducing the amount of impervious surface requirement in Green Street and integrating planting and landscaped areas, this alternative street design concept helps in stormwater management and reduction of heat island effect.

Improve water quality – Urban stormwater runoff pollutes the natural water system by contributing to the combined sewer overflows (CSO). The type of planting and biofiltration process used in green street design help to treat runoff. This helps in improving the quality of runoff and prevents soil erosion. The design helps in controlling the volume and flow-rate of water reducing chances of water quality impacts of fine sediment erosion.

Use the public right-of-way for multiple purposes – The green street design approach recognizes and respects the finite limits of our natural land resources. By integrating stormwater infiltration and other public utilities and opportunities for recreation, the design promotes shared uses within the public right-of-way.



Source: *Green Streets – Innovative Solutions for Stormwater and Stream Crossings*

Application of Green Streets Design Solutions

Green street design solutions may be applicable to both new streets and existing streets. Typically designing green streets in new development are less complicating than retrofitting in existing development. The table below from *Green Streets – Innovative Solutions for Stormwater and Stream Crossings* list some of these issues:

Issue	Retrofit	New construction
Planning implications	Installation of appropriate designs are restricted to existing ROW; easements onto private property need to be negotiated. Existing street system may not correspond to site conditions, thereby restricting the range of designs available.	Creation of new road system that incorporates designs can lay framework for new development. A "system" of treatment facilities can be designed from the outset to adhere to particular site conditions and existing natural drainage systems (streams).
Right of way requirements	ROW restricted by adjacent development. Must ensure that installation of designs does not come at expense of pedestrian and bicycle facilities.	Dedication of new ROW can incorporate designs. Pedestrian and bicycle accommodations can be incorporated from the outset of street design.
Edge of roadway condition	Substantial modification to edge of roadway may be met with public resistance. See costs.	Edge treatments can be designed in accordance with chosen stormwater design.
Street trees	Proposed system must adapt itself to existing street trees due to expected public resistance to tree removal. Provides opportunity for increased street planting but location and species choices should reflect available planting area.	Tree placement and species can be fully incorporated into the system.
Utilities	Installation of designs would generally have to "work around" existing utilities due to prohibitive expense in moving utilities.	Utilities can be consolidated and localized to eliminate conflict with designs.
Overflow contingencies	Existing storm drain system can serve as overflow carrier	Overflow regime must be considered.
Costs	Structural BMP retrofit of existing development is expensive requiring retrofit to existing storm drain facilities, to existing municipal open space (i.e., detention ponds) or to other developed sites (i.e., underground storage in downtown areas). Retrofits are typically funded by a municipality.	With exception of major streets, structural designs for new development are typically funded by a private land developer.
Stream crossings	Replace culverts with clear-span bridges (or at a minimum, bottomless culverts). The abutments should be set back from the river bank and outside the active floodplain* so that the edge remains undisturbed and flood risks are not increased. The extra costs of the structure can be offset by working 'in the dry' (not in the river), and therefore unrestricted by the season.	Opportunity for clear-span bridges set back from the river bank and outside the active floodplain*, preferably with an arch to increase span/depth ratio and resulting high aesthetic appeal. The extra costs of the structure can be offset by working 'in the dry' (not in the river), and therefore unrestricted by the season.

*This criterion to be expanded to apply to varying types of crossings and valley topography.

In streets where landscaped curb extensions aren't feasible, there are several sustainable stormwater management alternatives, including:

- Swales that infiltrate and store stormwater runoff
- Lowered planter strips
- Permeable surfaces, such as porous paver blocks and pervious asphalt or concrete
- Street trees

(Source: <http://www.portlandonline.com/bes/index.cfm?c=degab>)

Cost Implications of Green Streets

One of the main constraints for Green Streets has been their high cost implications. Besides the political issues of designing new streets or retrofitting existing streets, the high maintenance cost

has been a deterrent in the design popularity. The table below compares the costs between traditional streets and green streets (based on information from *Green Streets – Innovative Solutions for Stormwater and Stream Crossings*):

Type of Street	Traditional Street	Green Street
New construction regional blvd.	\$1,108,968.00	\$1,422,093.00
Retrofit of 4-lane urban arterial	\$148,247.00	\$1,263,677.00
Culvert Construction	\$21,000.00	\$83,000.00

Note: A reasonable estimate of maintenance of green streets is \$700/year.

Green Streets vs. Traditional Streets

Green streets provide a more complete integration of necessary functions like water quality treatment along with high flow conveyance. Green streets approach can have considerable savings when it comes to “end of pipe” treatment by reducing extra cost for stormwater pipes and treatment. On the other hand, traditional streets are designed only on the basis of conveyance. Therefore even though apparently it may seem they are less expensive, we should not ignore the long term negative environmental impacts caused by these streets.

Based on the practical limits of high construction and maintenance costs, skilled labor requirement and political acceptance of green street design by the community, the question about the design feasibility and viability arises. Tree-lined streets with landscaped strips along sidewalks may be another cheaper alternative for upgrading traditional streets. It may not be able to filter all pollutants from the runoff, but the simple addition of trees and landscaped strips will help in the following ways:

- Reduce impervious surface
- Promote walkability and pedestrian friendliness
- Use the public right-of way for multiple purposes
- Reduce heat island effect
- Prevent soil erosion
- Low maintenance cost.

However, we need to be careful about the types of planting we choose for such streets and refrain from using water-intensive plants.



References:

Green Streets – Innovative Solutions for Stormwater and Stream Crossings. 2002. Metro.

Creating Livable Streets – Street Design Guidelines. 2002. Metro

<http://www.portlandonline.com/bes/index.cfm?c=degab>

<http://www.metro-region.org/article.cfm?articleid=262>