Charles City Green Streets
Green Infrastructure Guide

Greetings!

Welcome to the future here in Charles City– Over the past two years, we have rebuilt some of our city's public assets with something called Green Streets – the infrastructure of tomorrow. Once we learned about green streets, we decided to be one of the first communities in the nation to benefit from this technology– our green streets will provide a better, longer-lasting, more durable, and more beautiful public realm that will reduce flooding, improve the quality of the river, reduce expenses, and add value to our neighborhoods. The details of how these green streets work are included in this brochure; come see for yourself why we're excited about our green streets in Charles City and why this is a project that Charles City will be proud of long into the future!

–Mayor James Erb
City of Charles City, Iowa

Charles City Green Street, September 2010

Introduction

The Charles City Green Streets project began in 2009 with a comprehensive plan to address the crumbling streets and stormwater system in Charles City. To take advantage of outside funding opportunities, the City immediately proceeded with preparation of construction drawings for the worst streets and in late 2010, the City completed construction on the new streets and rainwater management system. The system combines durable paving materials with ecologically sustainable stormwater **best management practices** (BMPs). The purpose of the BMP system is to emulate the water cycle of natural open space areas. The selected BMPs prevent stormwater runoff and associated flooding by allowing water to pass through the paving and infiltrate into the ground. The system also improves water quality by filtering and cleansing rainwater as it passes through the system. The system will last longer and require less maintenance than typical stormwater management systems, thereby reducing long-term costs.

Four different BMPs were employed in the project area to form the rainwater treatment system. The following practices are described in this brochure: porous unit paving, cobble infiltration areas, amended soil infiltration areas, and alley trench grates.

Through the innovative reconstruction of these streets and stormwater systems, Charles City's Green Streets serve as a model for sustainable design throughout the State of Iowa and across the nation. The design and construction of the project was funded in part by a $100,000 **Iowa Department of Natural Resources (DNR) I-Jobs** grant, a $631,000 **American Recovery and Reinvestment Act State Revolving Fund (ARRA-SRF)** low-interest loan and grant, and Charles City's Infrastructure Budgets.

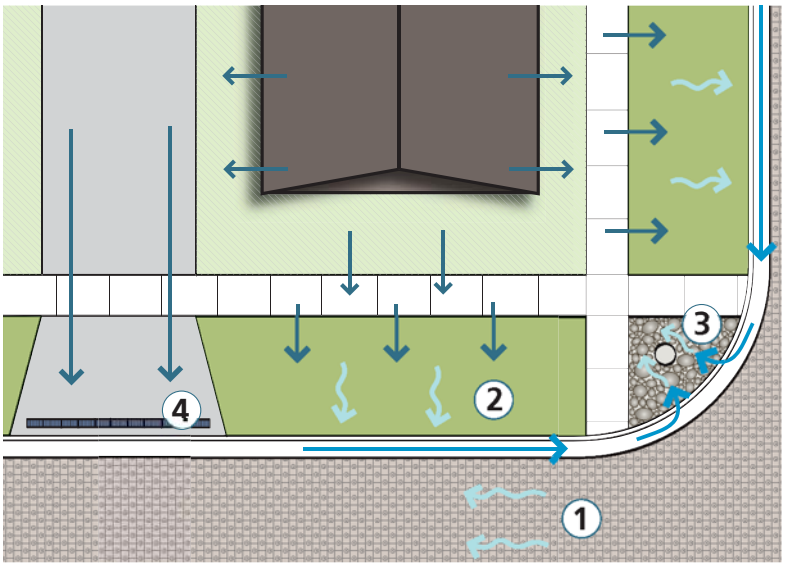
What is a BMP?
A Stormwater BMP (best management practice) is a management strategy that relies on natural processes (such as infiltration and evapotranspiration) to reduce flooding, improve groundwater recharge, and attain water quality goals.

BMPs can be designed into new developments or retrofitted into existing neighborhoods such as Charles City. The most technologically advanced BMPs include practices such as raingardens and bioretention swales, permeable pavement, rainwater harvesting and reuse systems, and green roofs.

Why BMPs?
Expanses of paved surfaces - such as in residential and commercial districts - create stormwater runoff, which carries urban pollutants into local streams and rivers and contributes to flooding problems downstream. These pollutants come from our cars, streets, and lawns. Stormwater BMPs can help mitigate these negative impacts of stormwater runoff to improve the health of lakes, streams, and wetlands, including the Cedar River.

Charles City Green Streets *Rainwater Treatment System Overview*

a. Rainwater Diagram



Rainwater falling within the project area is collected and treated by the four rainwater system BMPs. See below for a description of each system component.

1. Porous Unit Paving
2. Amended Soil Infiltration Areas
3. Cobble Infiltration Areas
4. Alley Trench Grate

What are the Benefits of the Charles City Green Streets Project?

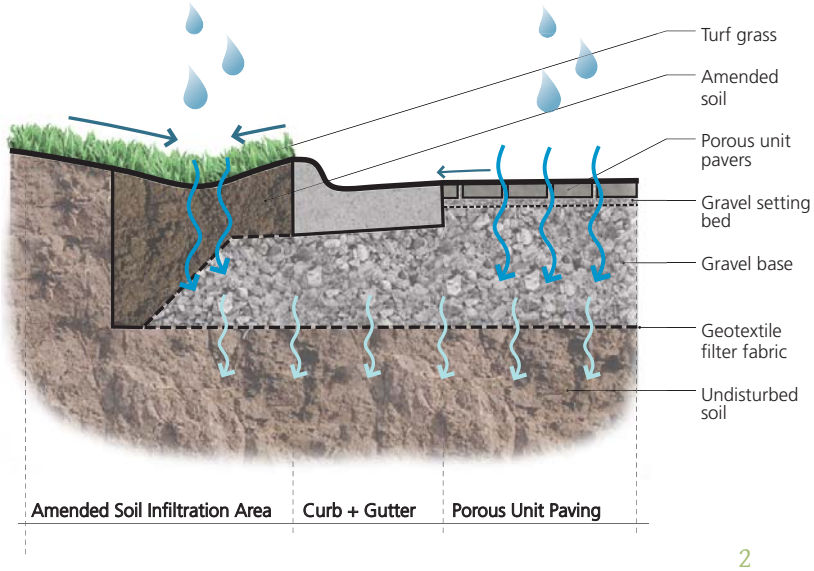
There are numerous benefits to the Green Streets improvements in the project area. In particular, the system:

- Reduces the volume of stormwater by 100% during small rain storms and over 50%during large storms. This and projects like this throughout the watershed can reduce flooding on the Cedar River.
- Reduces the speed of stormwater during large rain storms by over 90%. This eliminated the need to replace downstream storm sewers in the neighborhood south of the new streets, reducing project costs and neighborhood disruption.
- Filters sediments, oil and grease, metals, fertilizers and pesticides, and other urban pollutants from runoff. This and projects like this throughout the watershed can improve the health of the Cedar River.
- Reduces icing due to ponding on the streets, making for safer roads and reducing the need for salt, thereby improving water quality.

Porous Unit Paving

The new streets in the project area are constructed of porous interlocking pre-cast concrete unit pavers. Rainwater falling on the streets flows through the gaps between the pavers and infiltrates into the gravel layers below where adsorption and naturally occurring microbes cleanse the runoff. The existing sandy soils under the streets in this neighborhood are highly permeable, making this neighborhood especially suitable for a porous paving system.

b. Porous Unit Paving + Amended Soil



What is Porous Pavement?

Permeable paving materials include interlocking concrete (or clay) unit pavers, porous concrete, or porous asphalt. These systems allow rainwater to flow through the paving surface into underlying layers of gravel and soil. The water moves very slowly through the underground layers where it is cleansed, slowly evaporated, and released to deeper soil layers or storm sewers. These systems reduce stormwater runoff, reducing ponding in the neighborhood and flooding downstream and improving water quality. In comparison to a traditional system, the quantity of water that drains to the storm sewers from permeable pavement is significantly reduced and the quality is improved.

Porous Unit Paving, *Charles City, 2010*

Amended Soil Infiltration Areas

Behind the curb at the edges of the porous unit paving are amended soil infiltration areas. Runoff from the adjacent roofs, front yards, and sidewalks filters through the amended soil and into the gravel below the street's porous unit paving. The amended soil infiltration areas have been planted with turf grass, however, other grasses or perennials may be planted in these areas. Shrubs with shredded hardwood mulch may also be used.

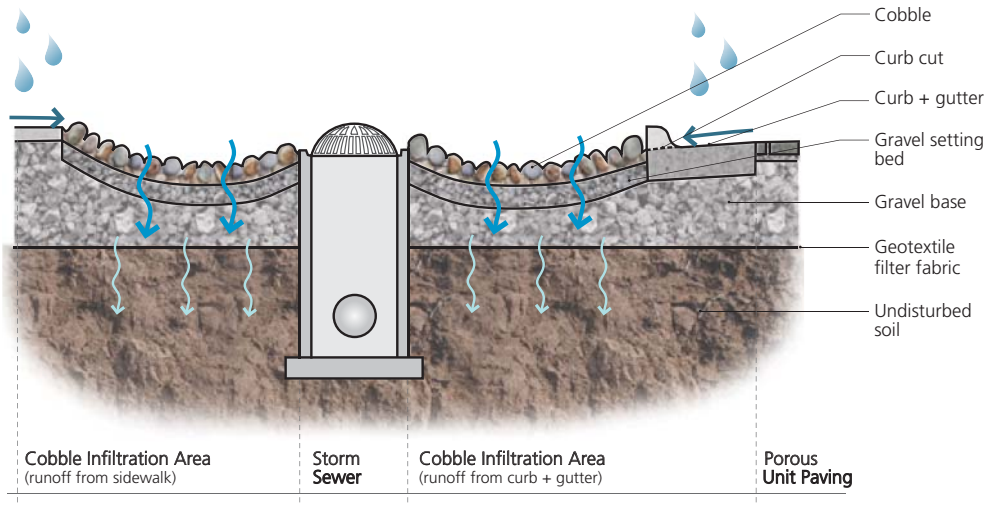
What are Amended Soil Infiltration Areas?

The amended soil infiltration areas are long, linear rain gardens composed of an engineered soil over a gravel drainage layer. The engineered soil is created by amending topsoil with sand and compost. A geotextile fabric prevents the amended soil from washing into the gravel. Amended soil infiltration areas are highly permeable relative to conventional lawns, capturing runoff from adjacent sidewalks and driveways and diverting the runoff away from the storm sewer system and into the gravel below the streets.

Cobble Infiltration Areas

To capture rainwater runoff that flows down the new curb and gutter, cobble infiltration areas are located in the triangular area between the sidewalks at the intersections. A cut-out in the curb (called a curb cut) allows water to flow from the gutter into the cobble infiltration area. The cobble infiltration areas are composed of a surface layer of stone over two gravel layers.

c. Cobble Infiltration

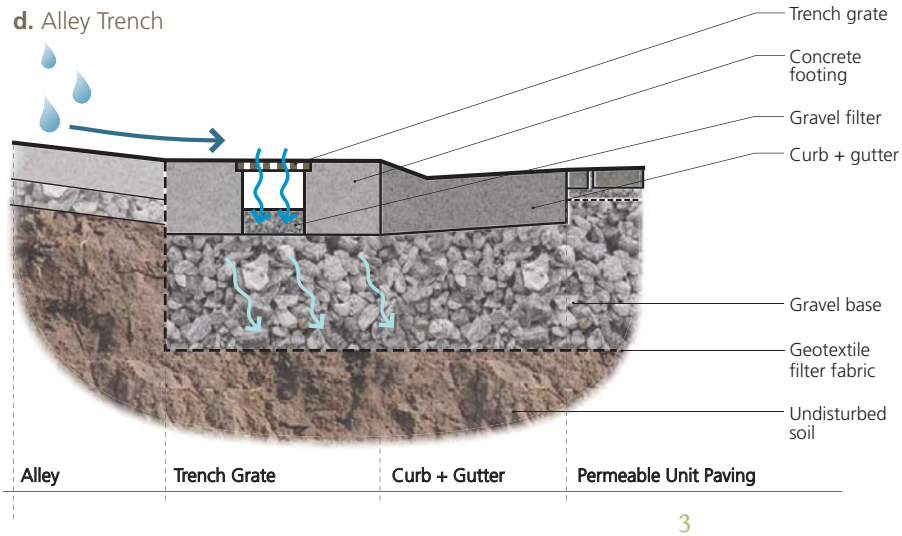


Cobble Infiltration Area, *Charles City, 2010*

Alley Trench Grate

To capture rainwater that flows from backyards and unpaved alleys, trench grates are located at the alleys directly behind the new curb and gutter to capture sediment that could clog the permeable pavers. The trench grate intercepts rainwater runoff before it can reach the porous unit street paving. Once in the grate, the water is filtered through a layer of gravel, and then released into the gravel beneath the porous unit paving.

d. Alley Trench

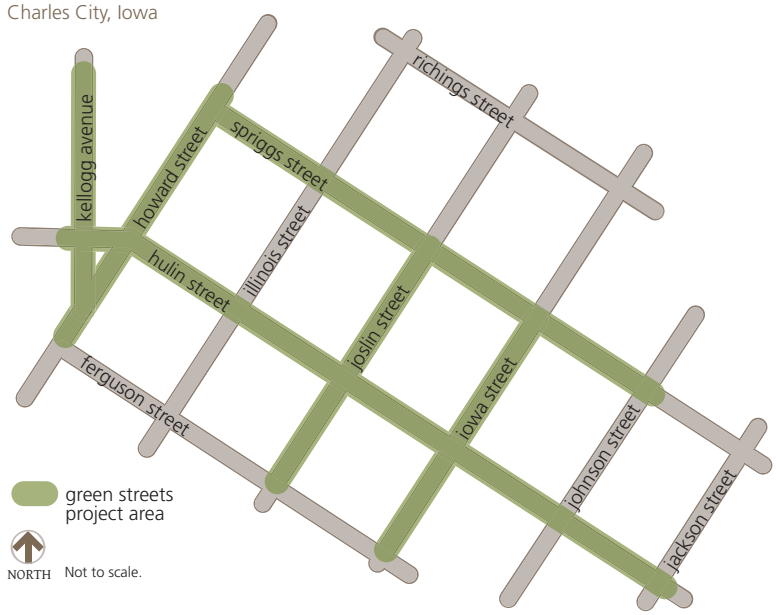


Alley Trench Grate, *Charles City, 2010*

Project Extents

The Charles City Green Streets project site was selected based on to the combined concerns of deteriorated streets and neighborhood flooding. A pavement condition report prepared by the Center for Transportation Research and Education rated the condition of the selected streets as "poor" or "very poor". A stormwater report prepared by Conservation Design Forum showed that the existing storm sewers were undersized.

e. Project Boundary map
Charles City, Iowa



The Green Streets rainwater management system addressed the poor condition of the streets and stormwater problems with one solution. The brick pavers provide a durable, long lasting road surface that will reduce long term maintenance and replacement costs. Utilizing permeable pavers, combined with the other three BMPs (amended soil infiltration areas, cobble infiltration areas, and alley trench grates), reduces the rainwater runoff that previously contributed to neighborhood flooding problems without needing to replace the existing storm sewers. As an added bonus, the project helps to reduce flooding and improve the health of the Cedar River.

The City is evaluating other streets for future Green Streets projects and has applied for state and federal funding to reconstruct three additional streets.

The **Charles City Green Streets Green Infrastructure Guide** is brought to you by the City of Charles City, IJOBS, the State Revolving Fund, and the Iowa DNR.

If you have any questions or comments regarding the rainwater management system, please contact the City of Charles City.

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