Parking Lot Stormwater Runoff

Research and
Best Management Practices

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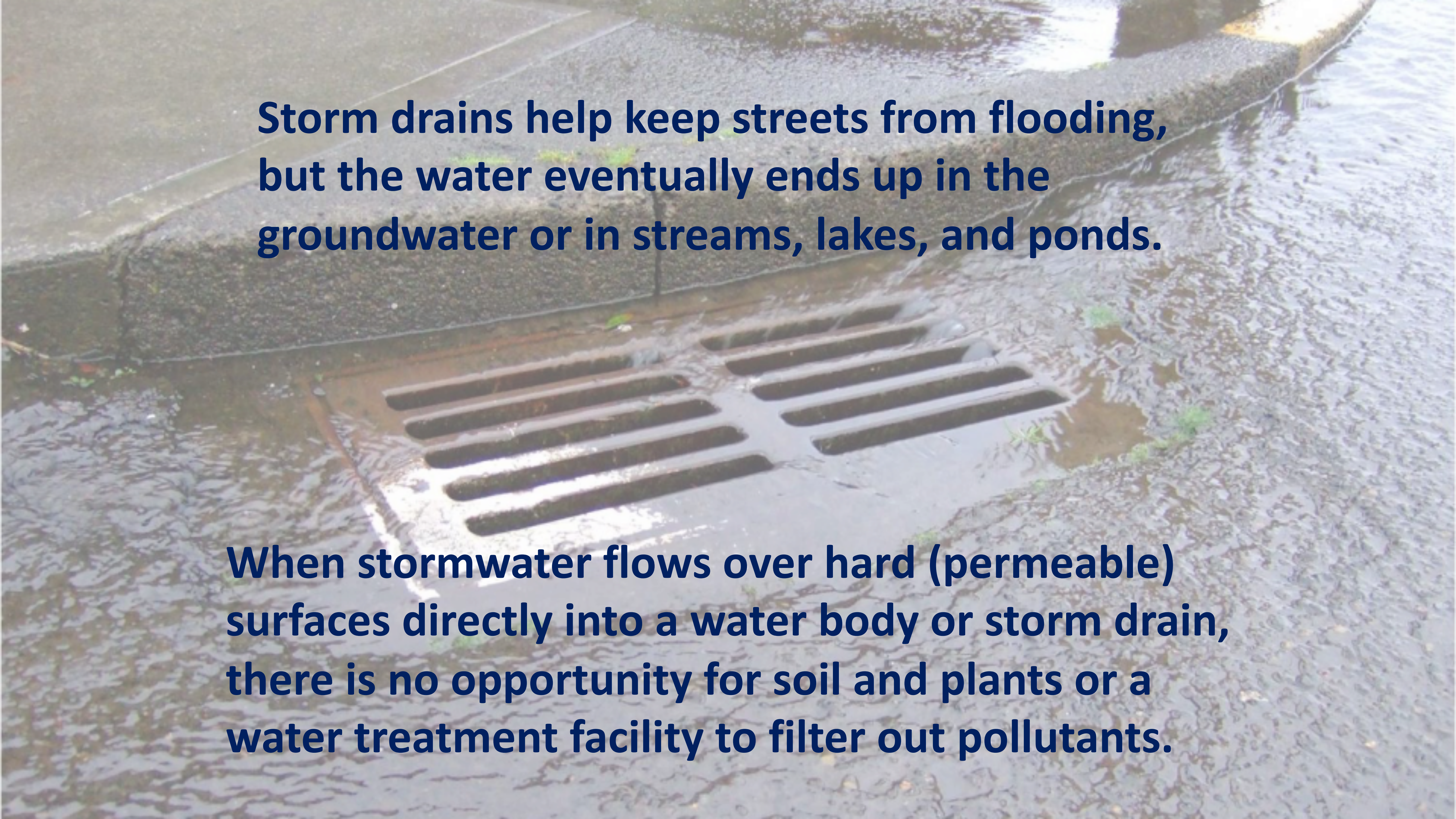


Storm drains help keep streets from flooding, but the water eventually ends up in the groundwater or in streams, lakes, and ponds.

When stormwater flows over hard (permeable) surfaces directly into a water body or storm drain, there is no opportunity for soil and plants or a water treatment facility to filter out pollutants.

The deterioration of a lake

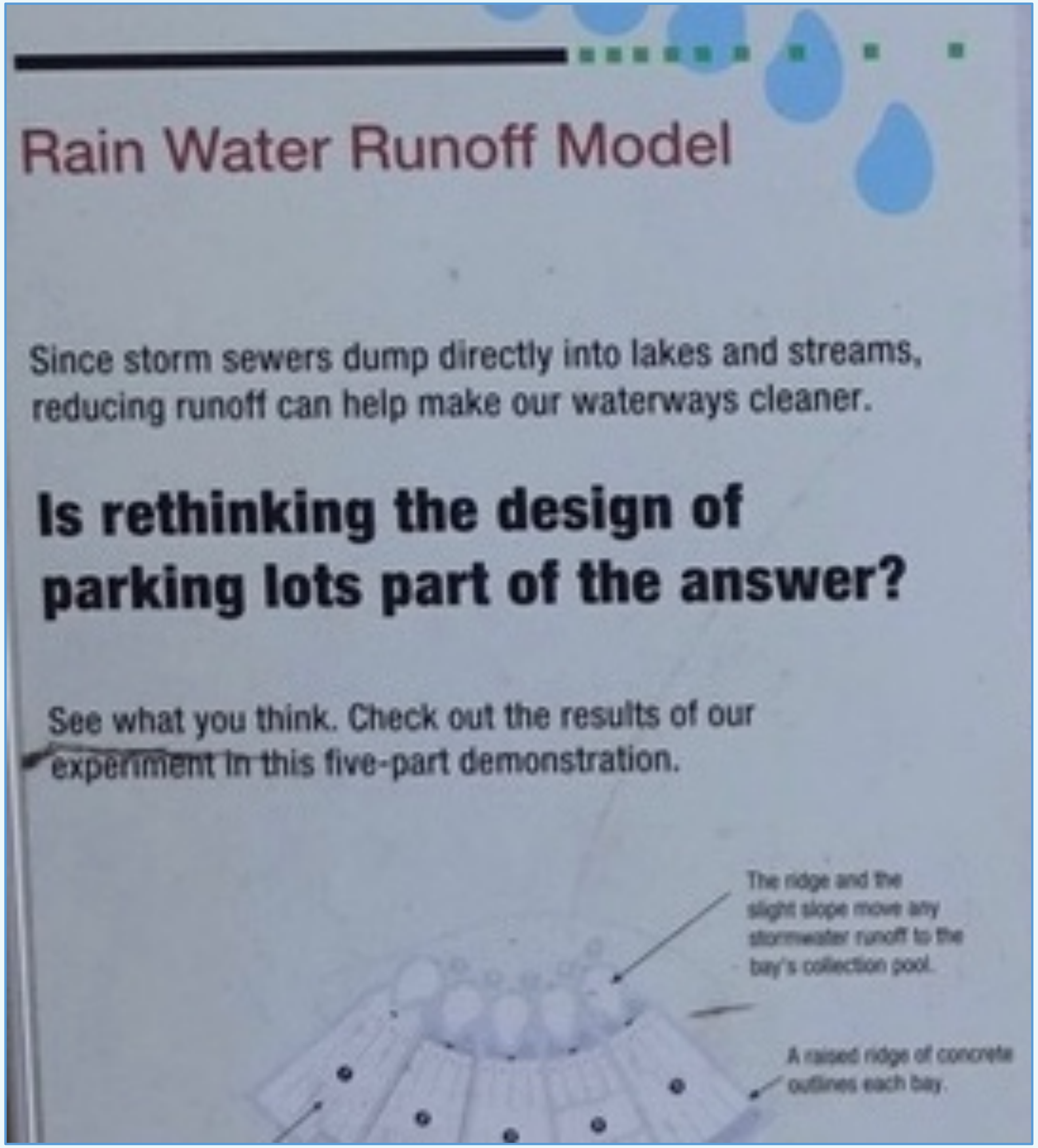
impairs the lake’s recreational value and decreases property values of homes.

Nutrients, oills, metals, and other pollution from stormwater runoff promotes invasive weeds and harmful algal blooms, negatively impacting water quality and causing major environmental damage. Algae can cause serious health problems in people and animals.

The University of Minnesotta Landscape Arboretum conducted an experiment to measure how different parking lot designs affect the amount of stormwater runoff.

They created five small lots with different kinds of pavement and runoff protection. Retaining pools gathered the runoff from one inch of rain.

Each retaining pool can hold 2730 gallons of water.



University Runoff Model Experiment

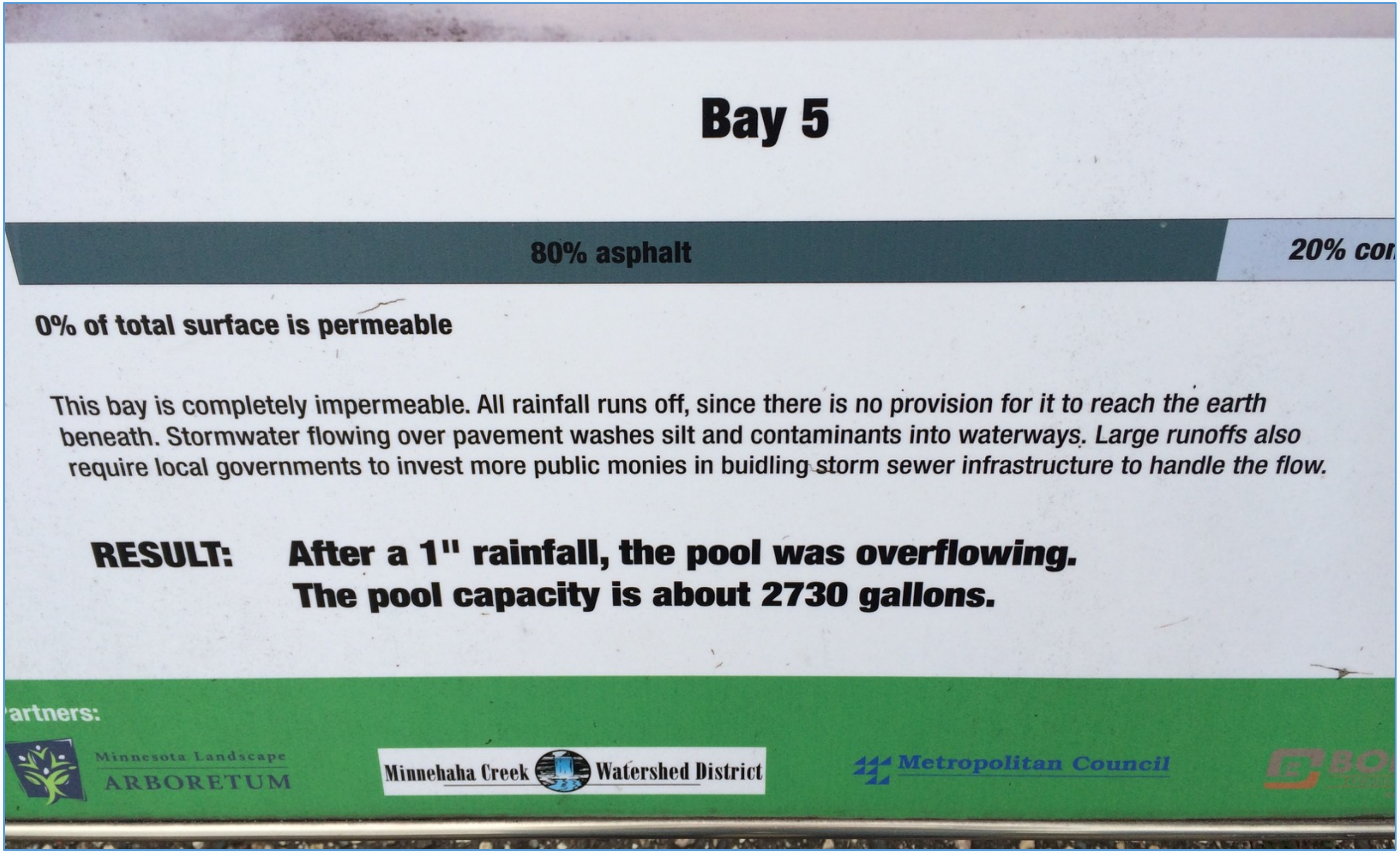
The researchers constructed five retaining pools, Bay 1 through Bay 5. They then constructed five strips of parking lots, each with a different mechanism for affecting storm water runoff. They measured the amount of water that filled each retaining pool with one inch of rain. The results were stunning.


Stormwater Retaining Pool
2730 gallon capacity

Parking lot, sign explaining the parking lot bay, and retaining pool.

Parking Lot #5 (Bay 5)

Conventional Impermeable Pavement


Bay 5
80% asphalt
20% con
0% of total surface is permeable
This bay is completely impermeable. All rainfall runs off, since there is no provision for it to reach the earth beneath. Stormwater flowing over pavement washes silt and contaminants into waterways. Large runoffs also require local governments to invest more public monies in buidling storm sewer infrastructure to handle the flow.
RESULT: After a 1" rainfall, the pool was overflowing.
The pool capacity is about 2730 gallons.
artners:
Minnesota Landscape ARBORETUM
Minnehaha Creek Watershed District
Metropolitan Council


Parking Lot #4 (Bay 4)
Two Grass Strips Next to Impermeable Pavement.

Bay 4

65% asphalt | 20% concrete | 1

15% of total surface is permeable

The addition of two grass strips to this bay helps absorb runoff. There is no barrier curb, so any stormwater flows easily from the pavement into the lower grass area. Bollards keep cars off the grass. The simple addition of grass strips reduces the amount of runoff in the Bay 4 pool to half the level in Bay 5's pool.

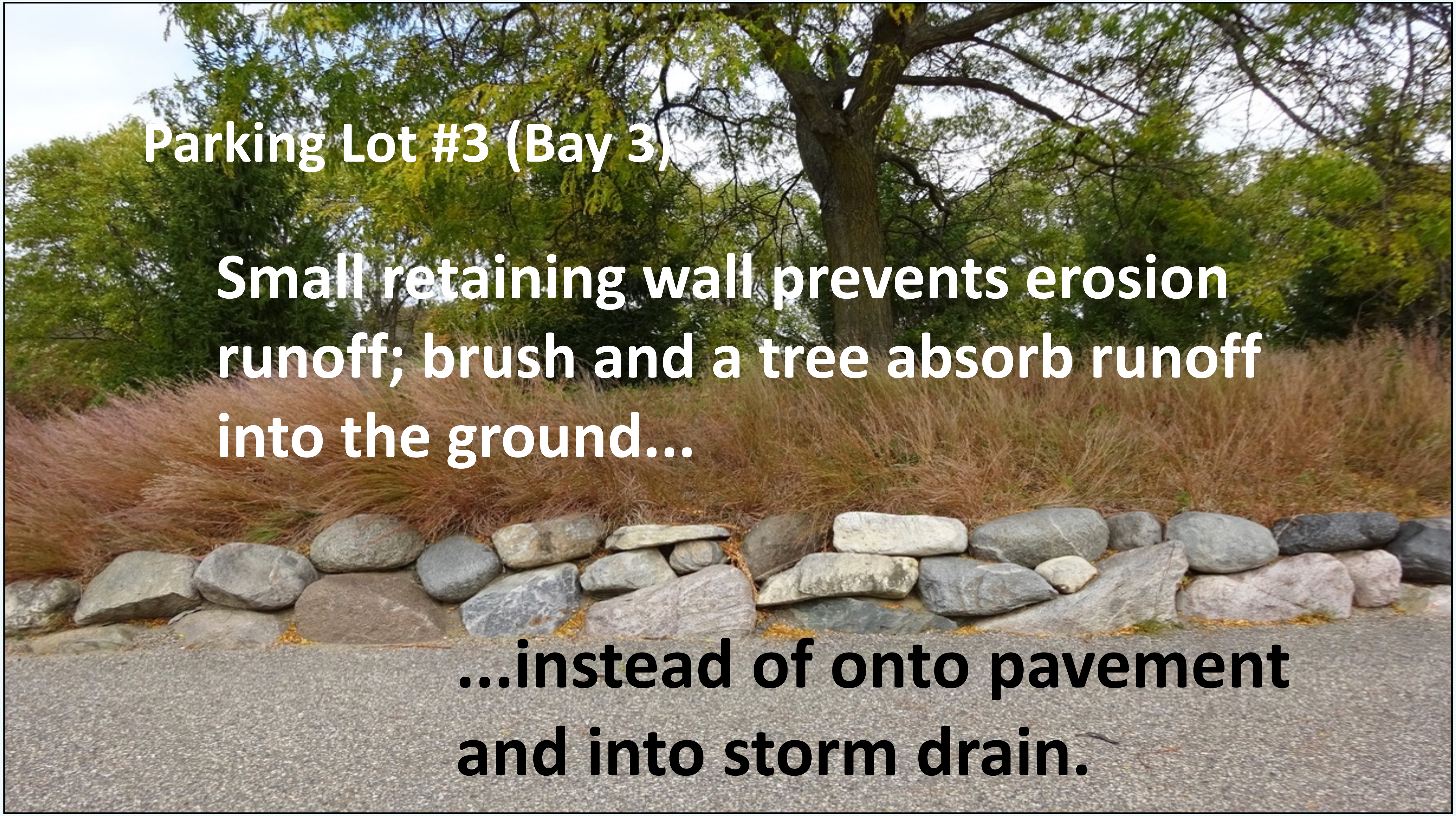
RESULT: **After a 1" rainfall, the pool level rose 6½". Runoff was about 1478 gallons.**

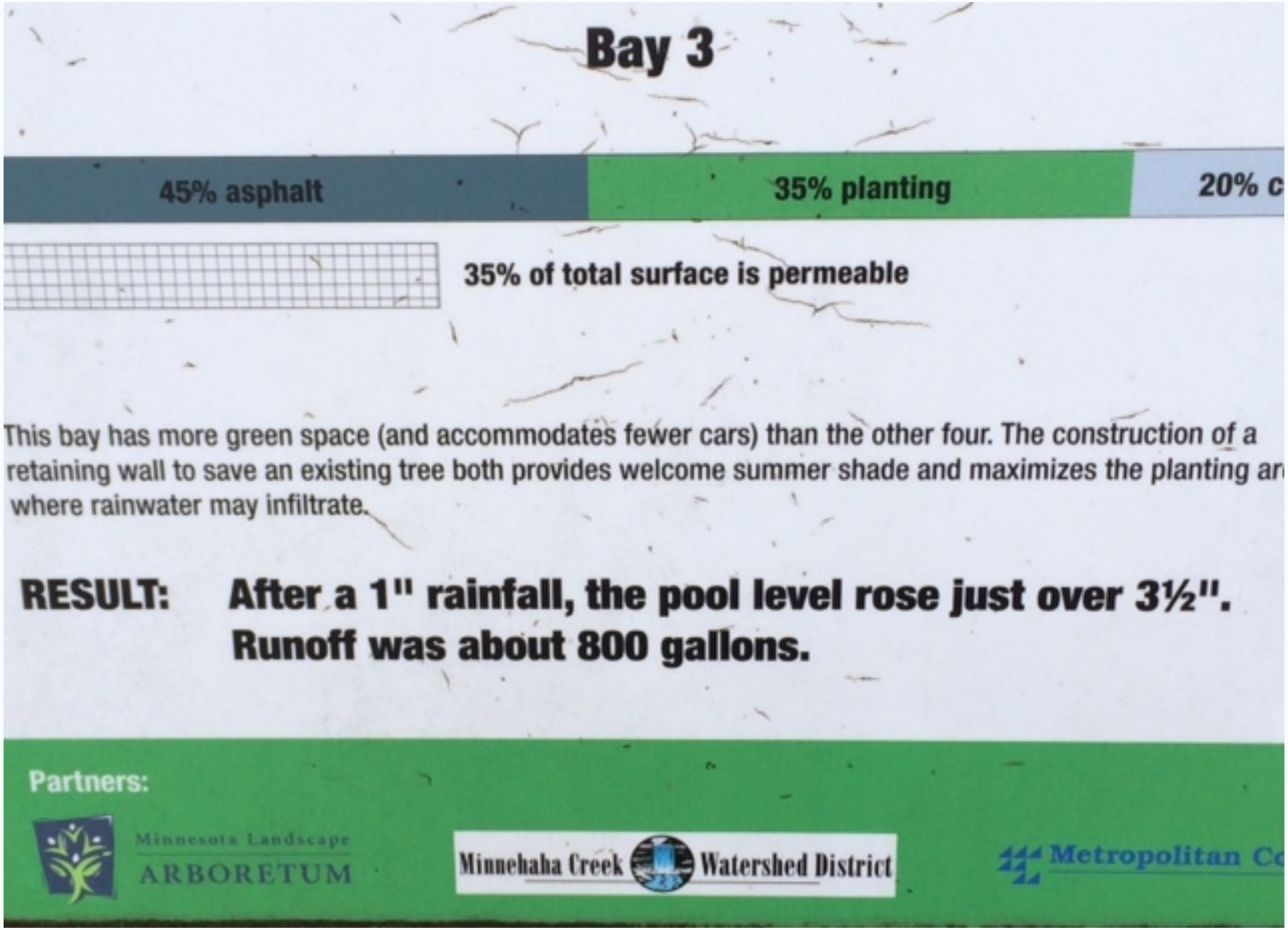
Partners:

Minnesota Landscape ARBORETUM

Minnehaha Creek Watershed District

Metropolitan Council


Parking Lot #3 (Bay 3)
Small retaining wall prevents erosion runoff; brush and a tree absorb runoff into the ground...
...instead of onto pavement and into storm drain.


Bay 3
45% asphalt
35% planting
20% c
35% of total surface is permeable
This bay has more green space (and accommodates fewer cars) than the other four. The construction of a retaining wall to save an existing tree both provides welcome summer shade and maximizes the planting ar
where rainwater may infiltrate.
RESULT: After a 1" rainfall, the pool level rose just over 3½". Runoff was about 800 gallons.
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Minnehaha Creek Watershed District
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Parking Lot #2

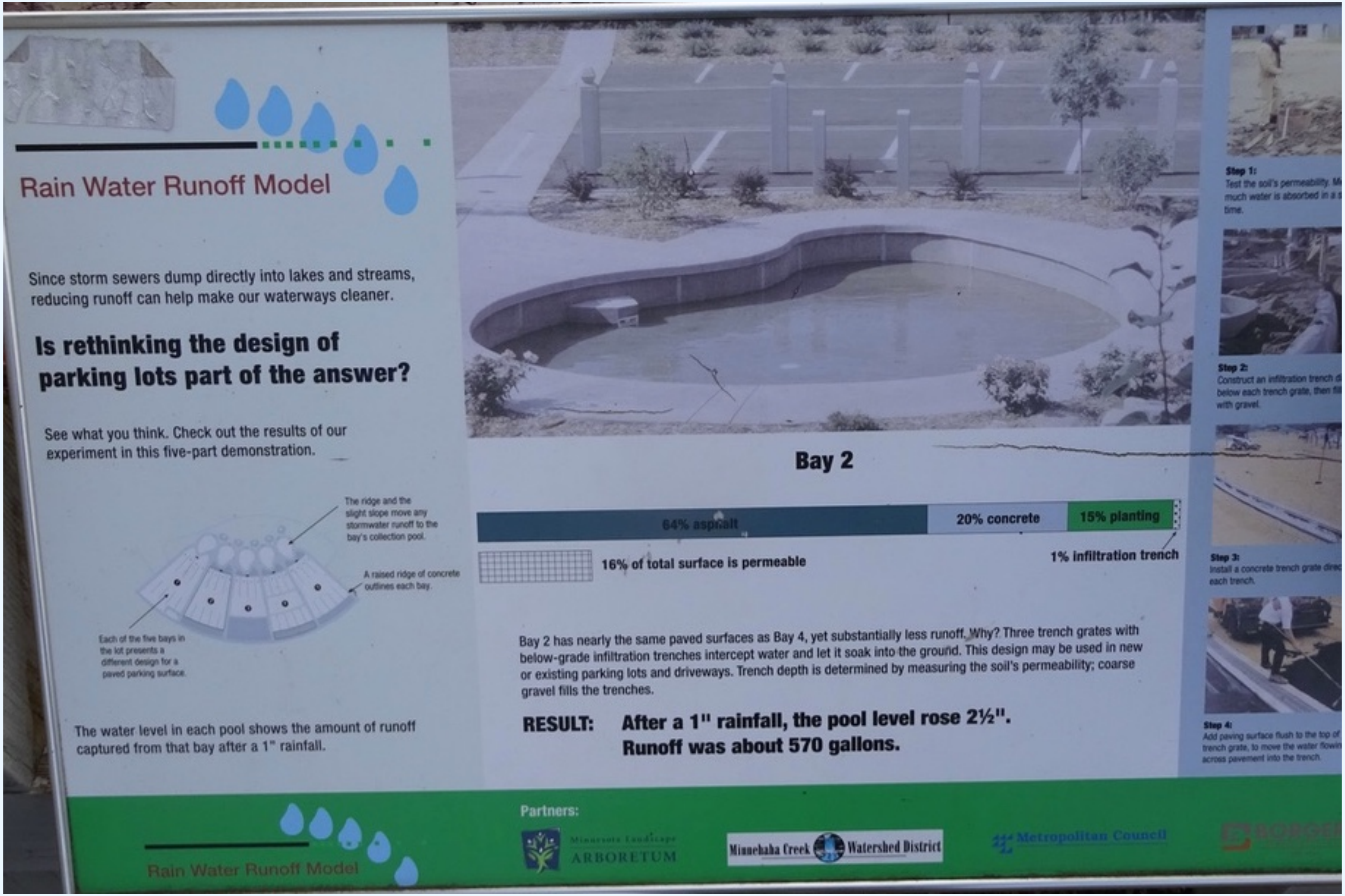
Narrow drainage trenches intercept water and let it soak into ground. Trenches are dug at intervals across the parking lot.

Can be dug into existing parking lots and new ones.

Plants (upper left) along side of lot prevent excessive runoff onto lot.


Lot #2


Closeup of grates over trenches



Rain Water Runoff Model
Since storm sewers dump directly into lakes and streams, reducing runoff can help make our waterways cleaner.
Is rethinking the design of parking lots part of the answer?
See what you think. Check out the results of our experiment in this five-part demonstration.
The ridge and the slight slope move any stormwater runoff to the bay's collection pool.
A raised ridge of concrete outlines each bay.
Each of the five bays in the lot presents a different design for a paved parking surface.
The water level in each pool shows the amount of runoff captured from that bay after a 1" rainfall.
Bay 2
64% asphalt
20% concrete
15% planting
16% of total surface is permeable
1% infiltration trench
Bay 2 has nearly the same paved surfaces as Bay 4, yet substantially less runoff. Why? Three trench grates with below-grade infiltration trenches intercept water and let it soak into the ground. This design may be used in new or existing parking lots and driveways. Trench depth is determined by measuring the soil's permeability; coarse gravel fills the trenches.
RESULT: After a 1" rainfall, the pool level rose 2½". Runoff was about 570 gallons.
Step 1:
Test the soil's permeability.
much water is absorbed in a
time.
Step 2:
Construct an infiltration trench
below each trench grate, then
with gravel.
Step 3:
Install a concrete trench grate
each trench.
Step 4:
Add paving surface flush to the top of
trench grate, to move the water
across pavement into the trench.
Partners:
Minnesota Landscape Arboretum
Minnehaha Creek Watershed District
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Rain Water Runoff Model

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Four Steps for Constructing Trenches

Step 3:
Install a concrete trench grate directly above each trench.

Step 4:
Add paving surface flush to the top of the trench grate, to move the water flowing across pavement into the trench.


Parking Lot #1
Permeable pavers make parking
surface 65% permeable.


Permeable Paving Stones

65% permeable pavers **20% con**

80% of total s

bay has the largest amount of "flow-through" or permeable surface. Rainwater is absor
ting zones and throughout the entire permeable paver parking surface. *Infiltration is aide*
mestone rock beneath the bricks and infiltration trenches below that.

ESULT: After a 1" rainfall, the pool level rose 1½".
Runoff was about 340 gallons.

artners:

Minnesota Landscape ARBORETUM

Minnehaha Creek Watershed District

Metr


Five demonstration parking lots
University of Minnesotta Landscape Arboretum
Bay 5
Bay 4
Bay 3
Bay 2
Bay 1

Examples of "Green" Stormwater Runoff Practices

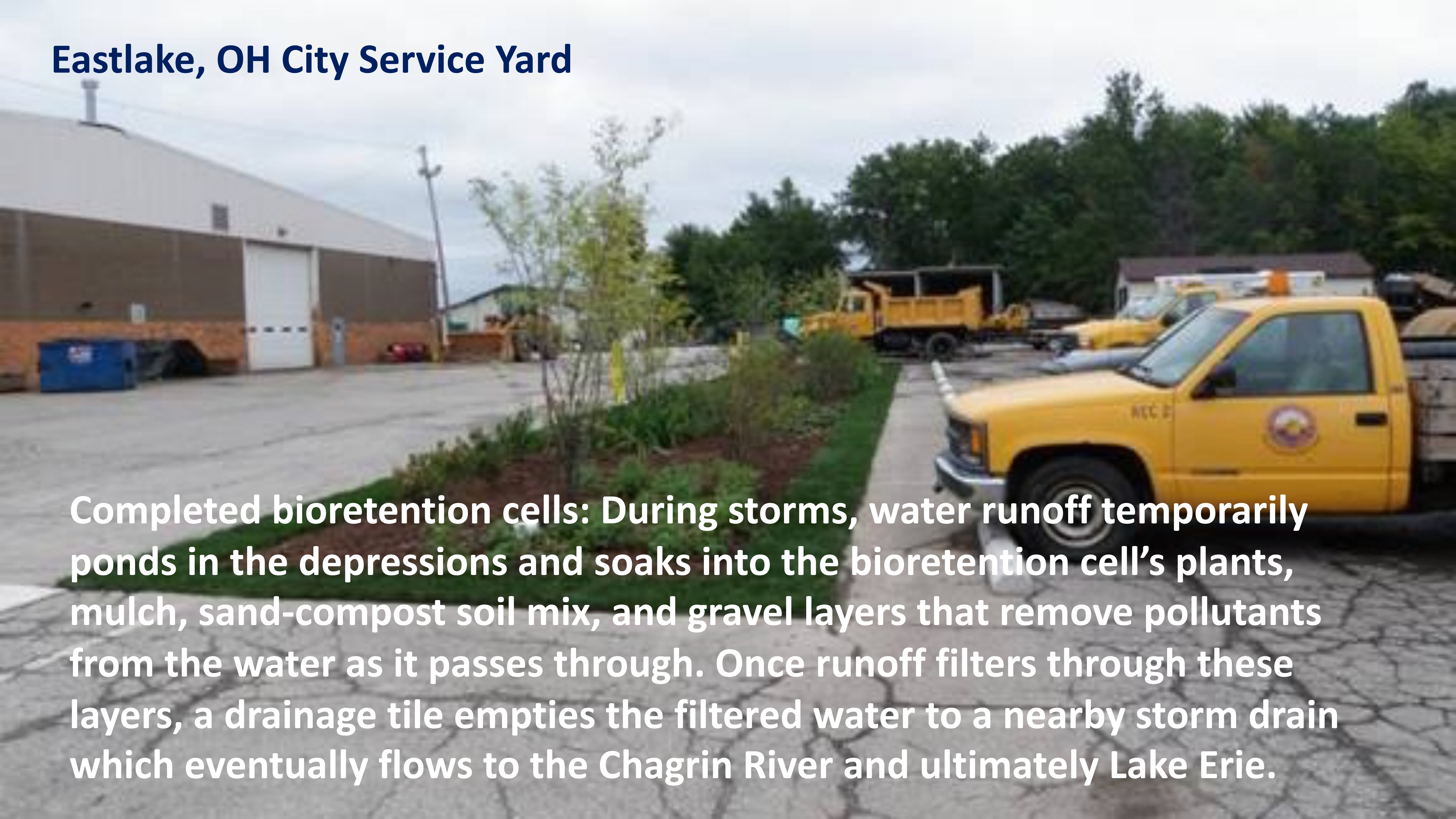
Tarrytown, NY

The green infrastructure captures and releases stormwater at a slower pace to prevent erosion along the Andre Brook and Hudson River. Natural vegetative features filter out oil, grease, and other pollutants before release into the Andre Brook.

Eastlake, OH

First step in construction of two bioretention cells in the City's Service Yard utilizing grant funds obtained through the Ohio Environmental Protection Agency's Surface Water Improvement Fund (SWIF) program.

Eastlake, OH City Service Yard



Completed bioretention cells: During storms, water runoff temporarily ponds in the depressions and soaks into the bioretention cell’s plants, mulch, sand-compost soil mix, and gravel layers that remove pollutants from the water as it passes through. Once runoff filters through these layers, a drainage tile empties the filtered water to a nearby storm drain which eventually flows to the Chagrin River and ultimately Lake Erie.

Lakewood, OH

BEFORE:

Street along Madison Park: The impervious surface encompassed about 18,000 square feet of asphalt and generated about 434,360 gallons of stormwater run-off annually.

AFTER:

Decorative concrete pavement and bioretention basins, with related storm drainage and plantings.

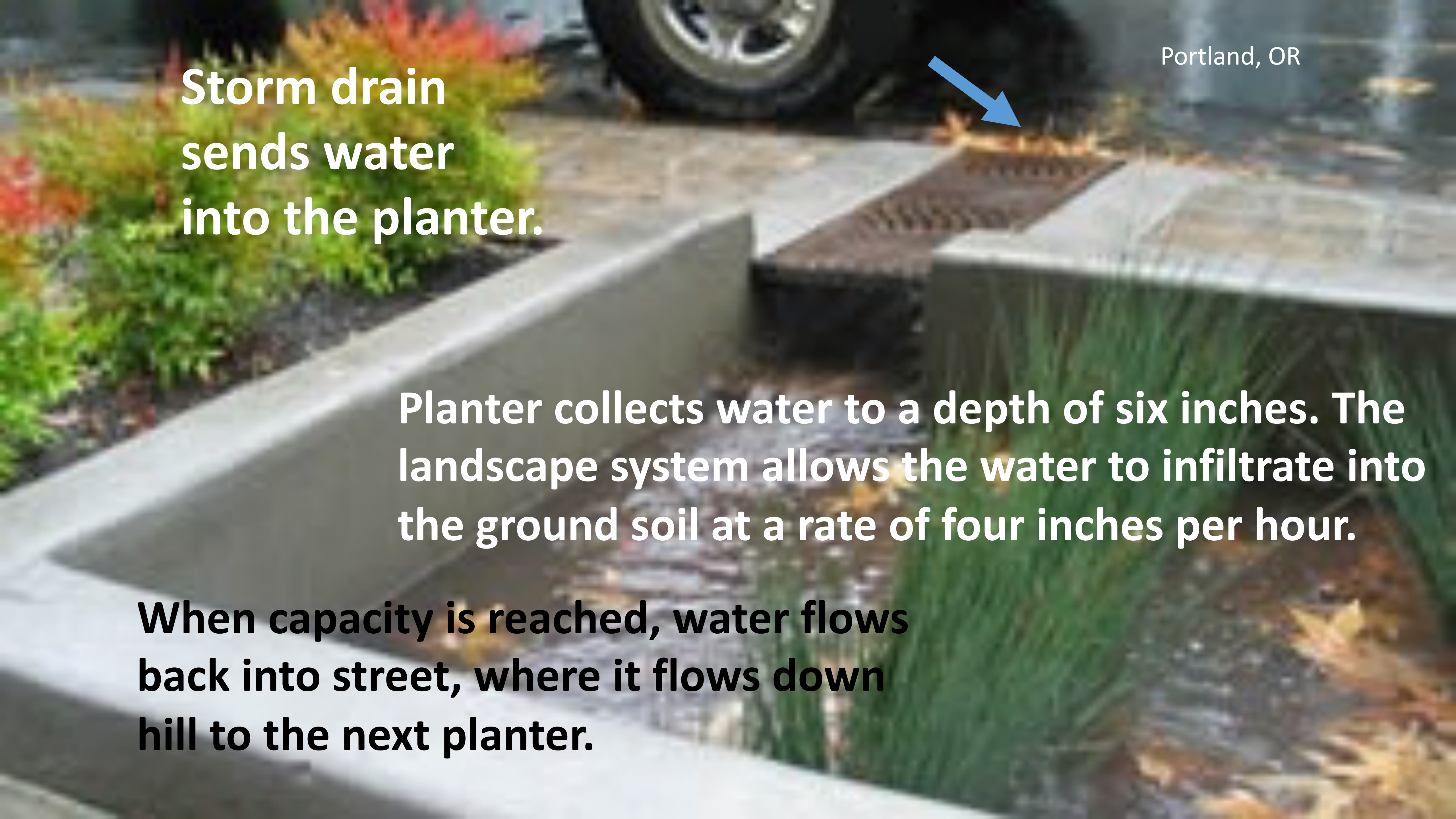
Project is estimated to reduce stormwater run-off by 402,823 gallons annually.

Cost: $107,500 grant from EPA to Great Lakes Restoration Initiative.


Lakewood, OH
Street-side bioretention areas include planter walls, curb and gutter, and decorative trench grates.

Portland, OR

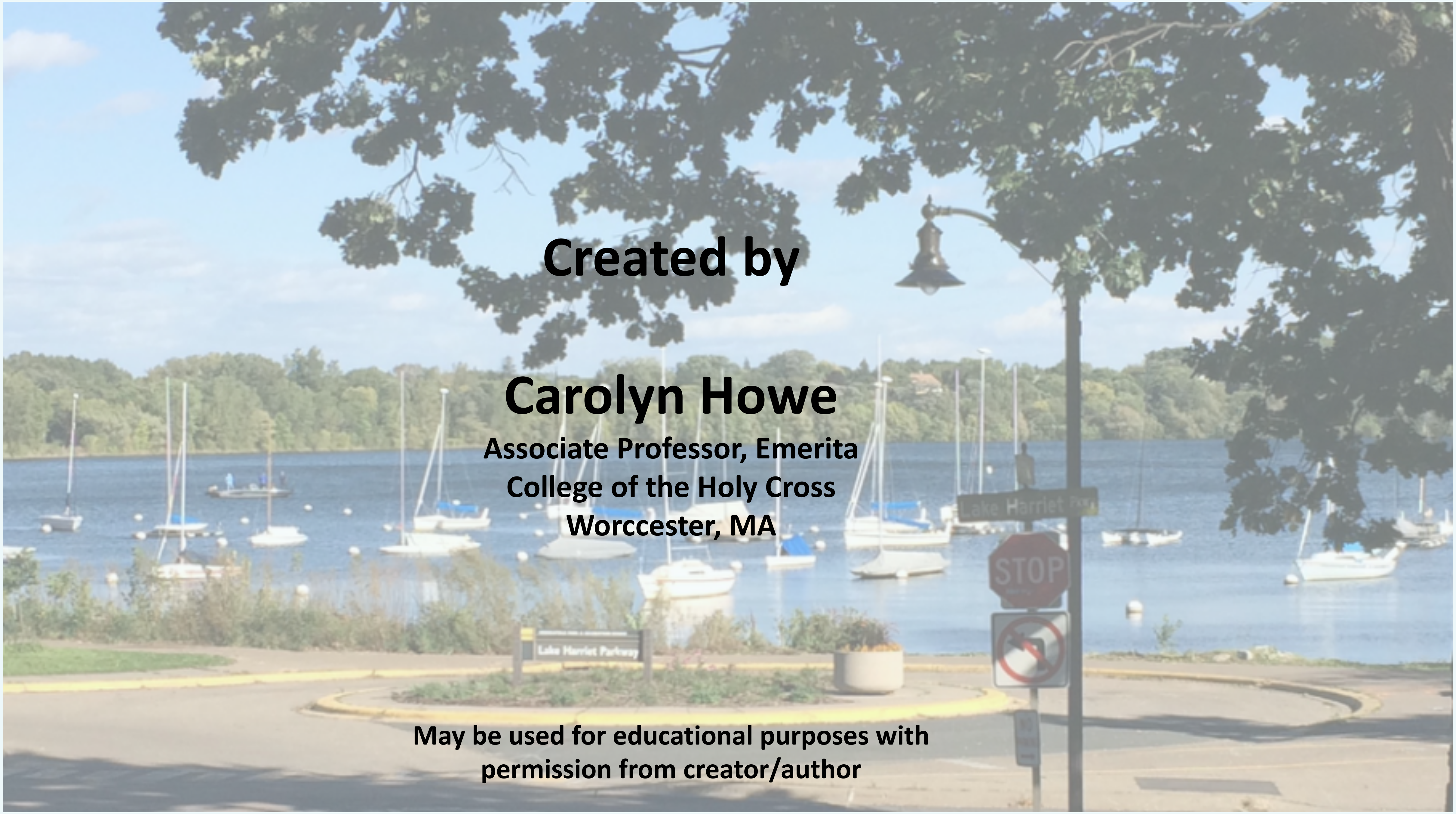
Stormwater runoff from SW 12th St. flows downhill along the existing curb until it reaches the first of four stormwater planters.


Portland, OR
Storm drain sends water into the planter.
Planter collects water to a depth of six inches. The landscape system allows the water to infiltrate into the ground soil at a rate of four inches per hour.
When capacity is reached, water flows back into street, where it flows down hill to the next planter.

The state of Maryland initiated a stormwater runoff project in 2015 that involved creating green medians along a 17-mile stretch of Interstate 97.


Road and parking lot runoff
is part of the problem, but…


…working together we CAN have
cleaner lakes and streams!



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