Low Impact Development (LID)

Green Infrastructure

Sustainable Infrastructure

Sustainable Urban Drainage Systems (SuDS)

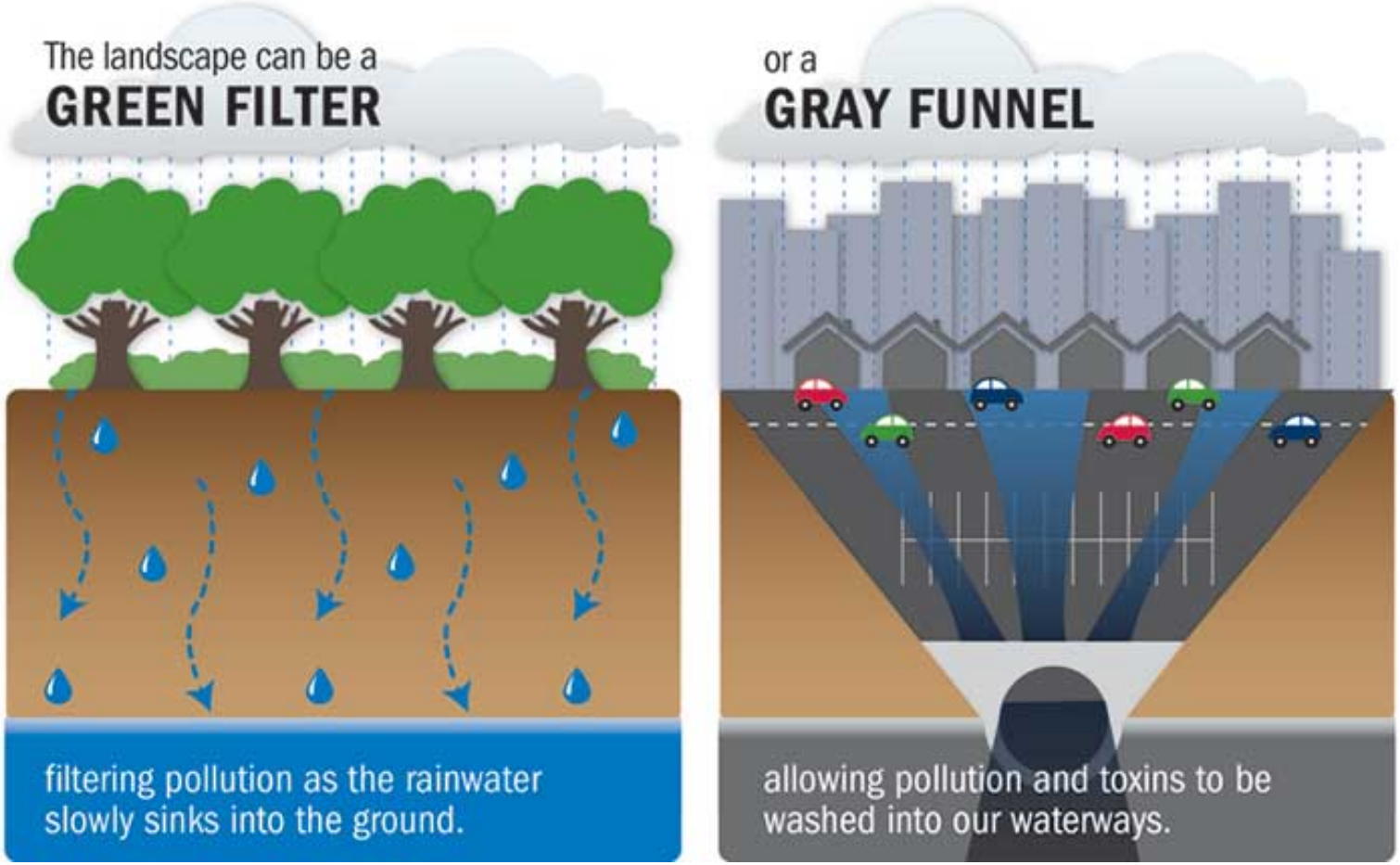
Low Impact Development (LID)

- Low Impact Development (LID),
- Green Infrastructure,
- Sustainable Infrastructure, and
- Sustainable Urban Drainage Systems (SuDS)

Are all terms for Stormwater Management techniques that try to replicate natural conditions, often by putting water into the ground

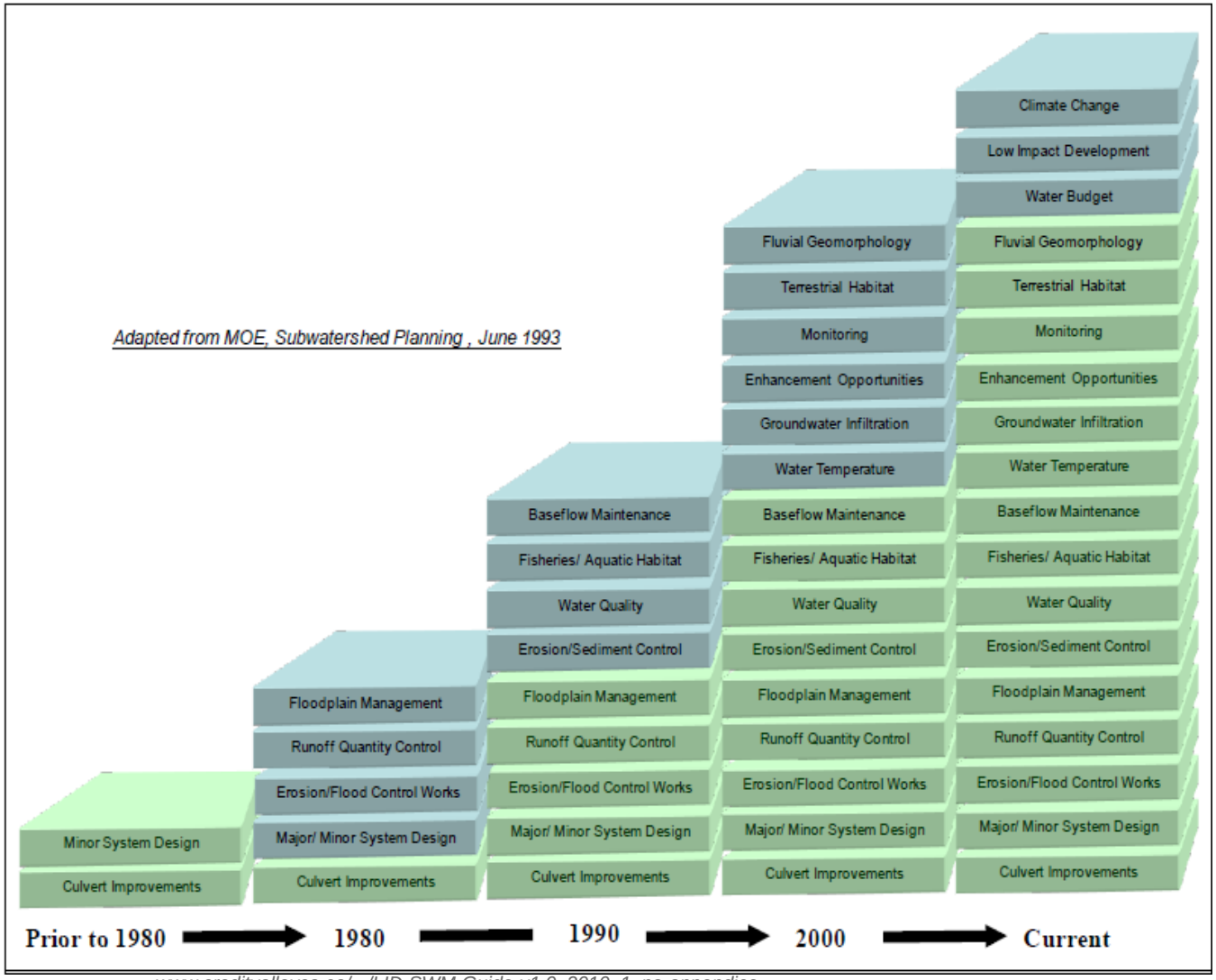
LID is a response to the problems / unintended consequences, associated with conventional Stormwater Management.

Green vs Grey



http://www.cbf.org/image/area---how-we-save-the-bay/issues/Green-Filter-Grey-Funnel_695.jpg

Stormwater Management - History



www.creditvalleyca.ca/.../LID-SWM-Guide-v1.0_2010_1_no-appendice...

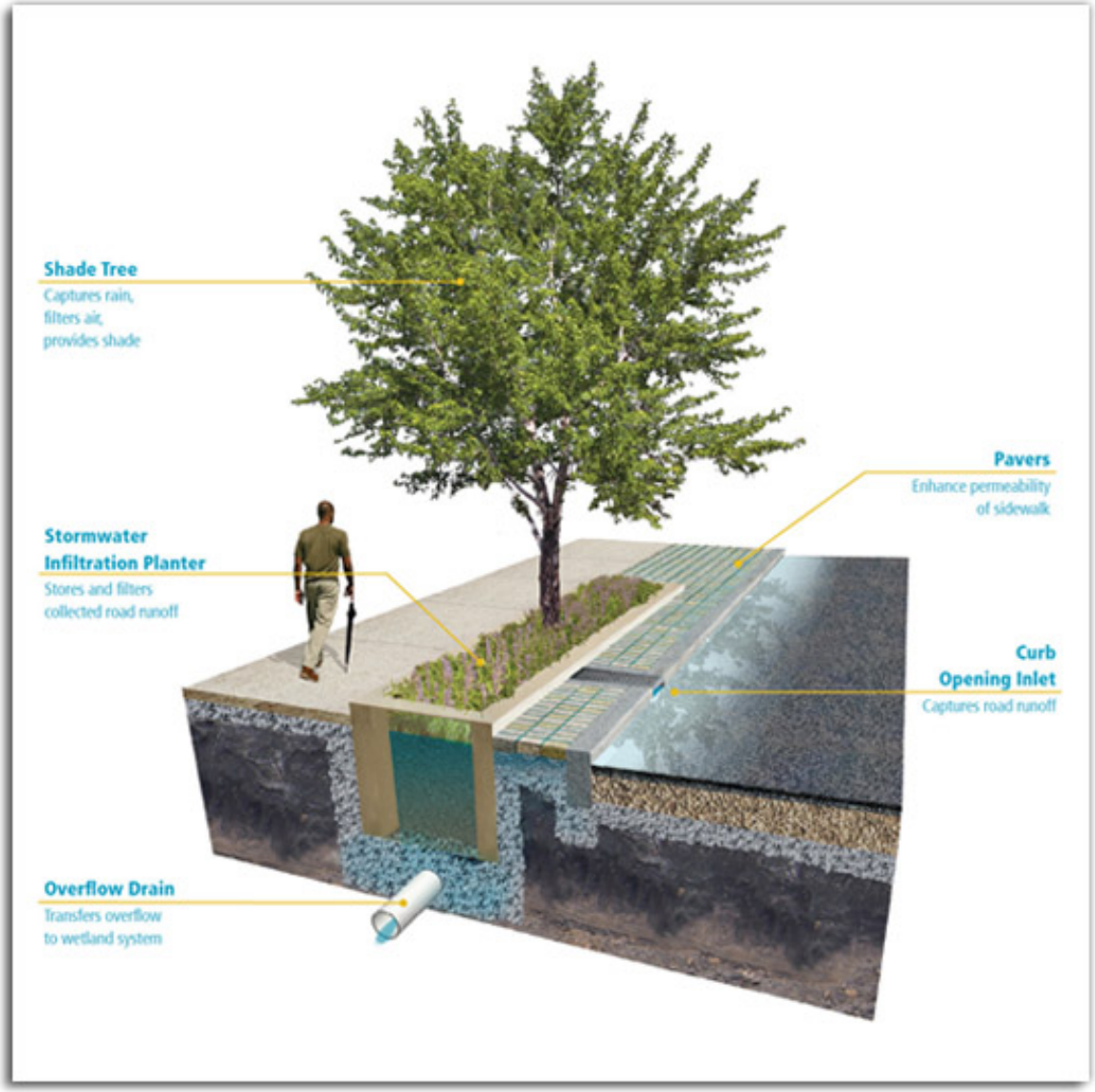
Stormwater Management – “Grey” History

- Pre 1980
  - Minor system / culvert improvements
- 1980’s
  - Flood Plain Management
  - Runoff Quantity Control
  - Erosion / Flood Control Works
  - Major / Minor System design
- 1990’s
  - Base-flow Maintenance
  - Fisheries / Aquatic Habitat
  - Water Quality (TSS)
  - Erosion / Sediment Control
- 2000’s
  - Fluvial Geomorphology (transport)
  - Terrestrial Habitat
  - Enhancement Opportunities
  - Groundwater Infiltration
  - Water Temperature
  - Monitoring
- Present
  - Climate Change
  - Low Impact Development (LID)
  - Water Budget

LID Designs target Multiple Goals

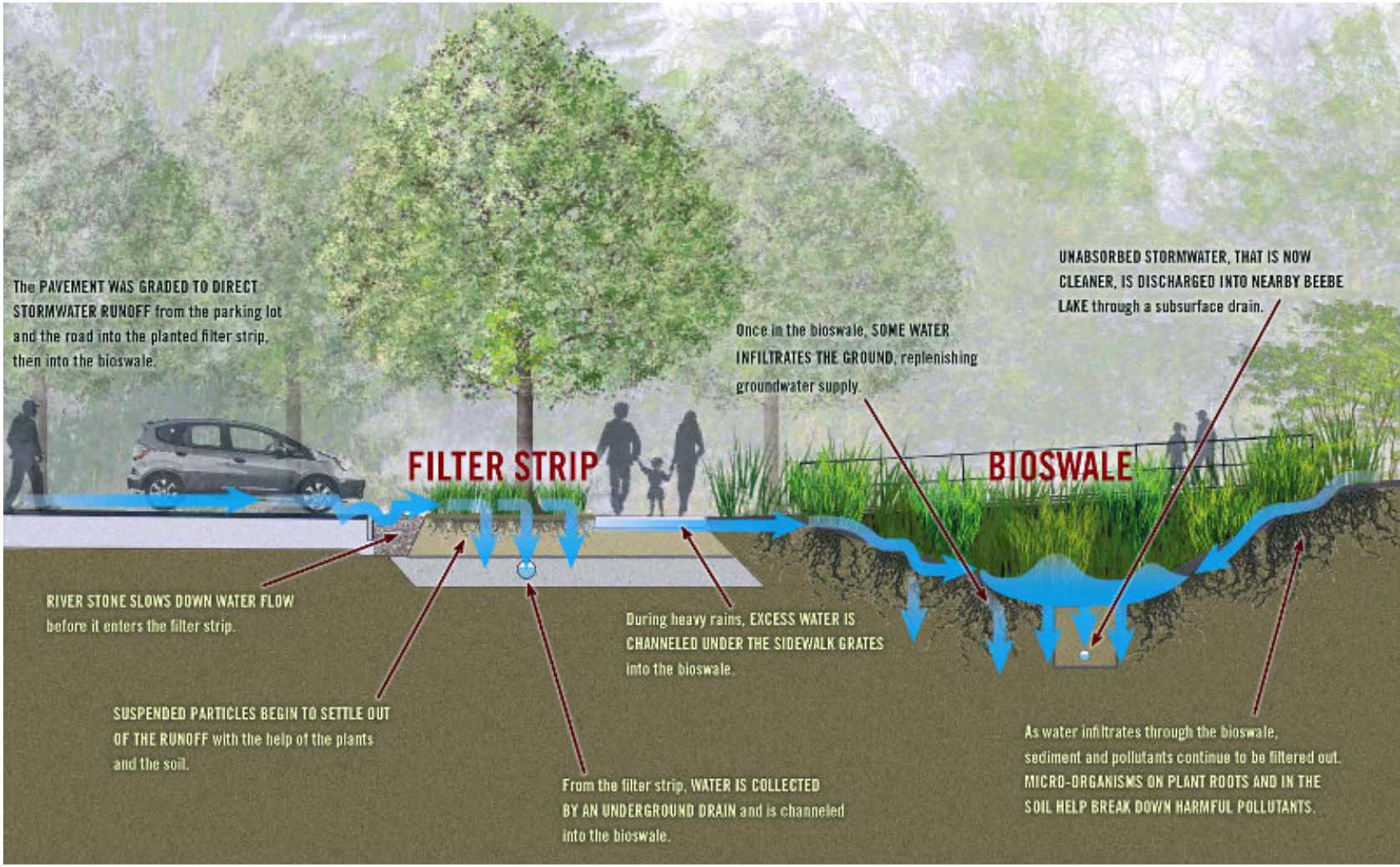
Image from **Gray to Green: Jumpstarting Private Investment in Green Infrastructure**

LID -Examples



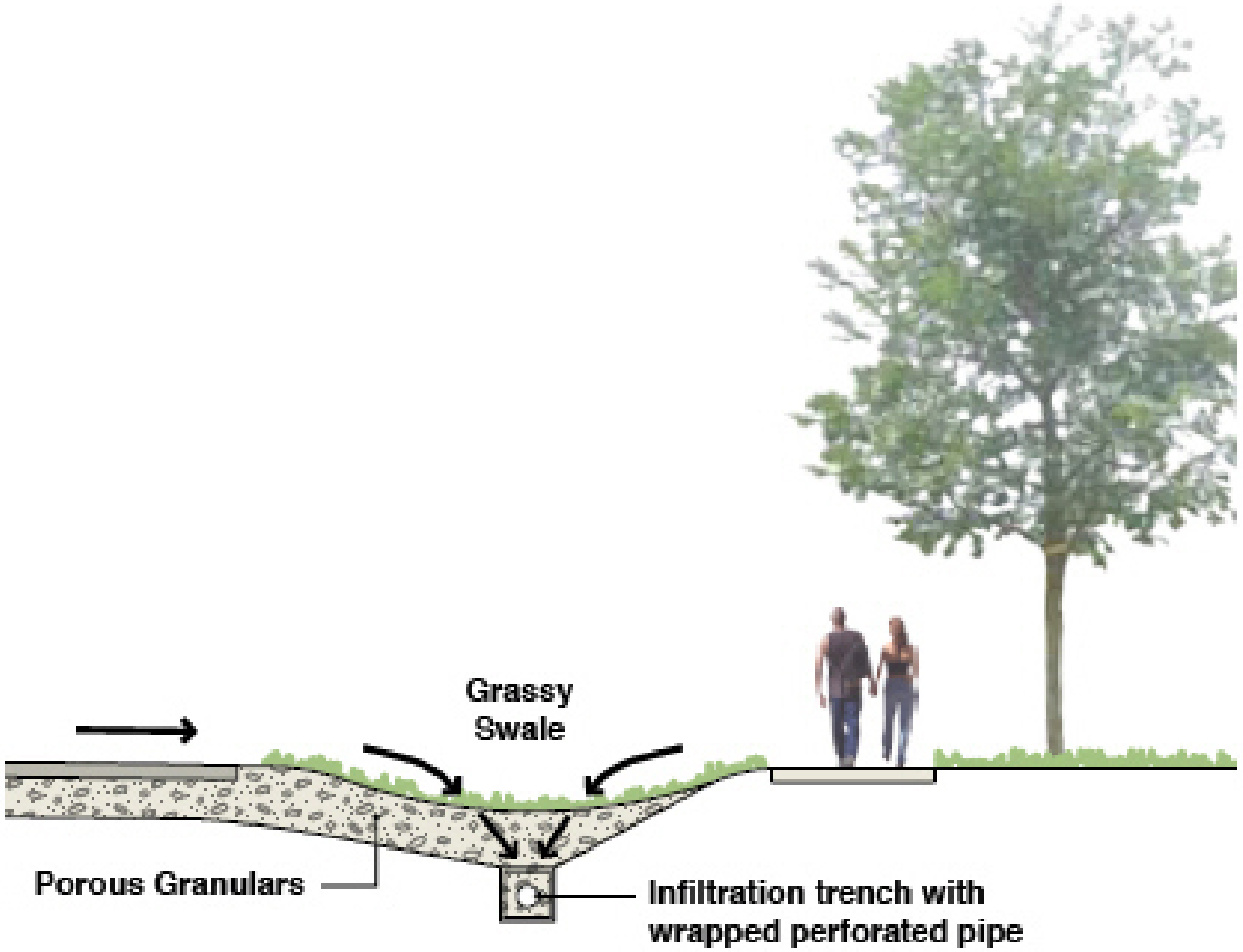
http://www.andeemazzocco.com/GreytoGreen.php

LID – Examples



https://www.sce.cornell.edu/ps/smgi/index.php

LID - Examples

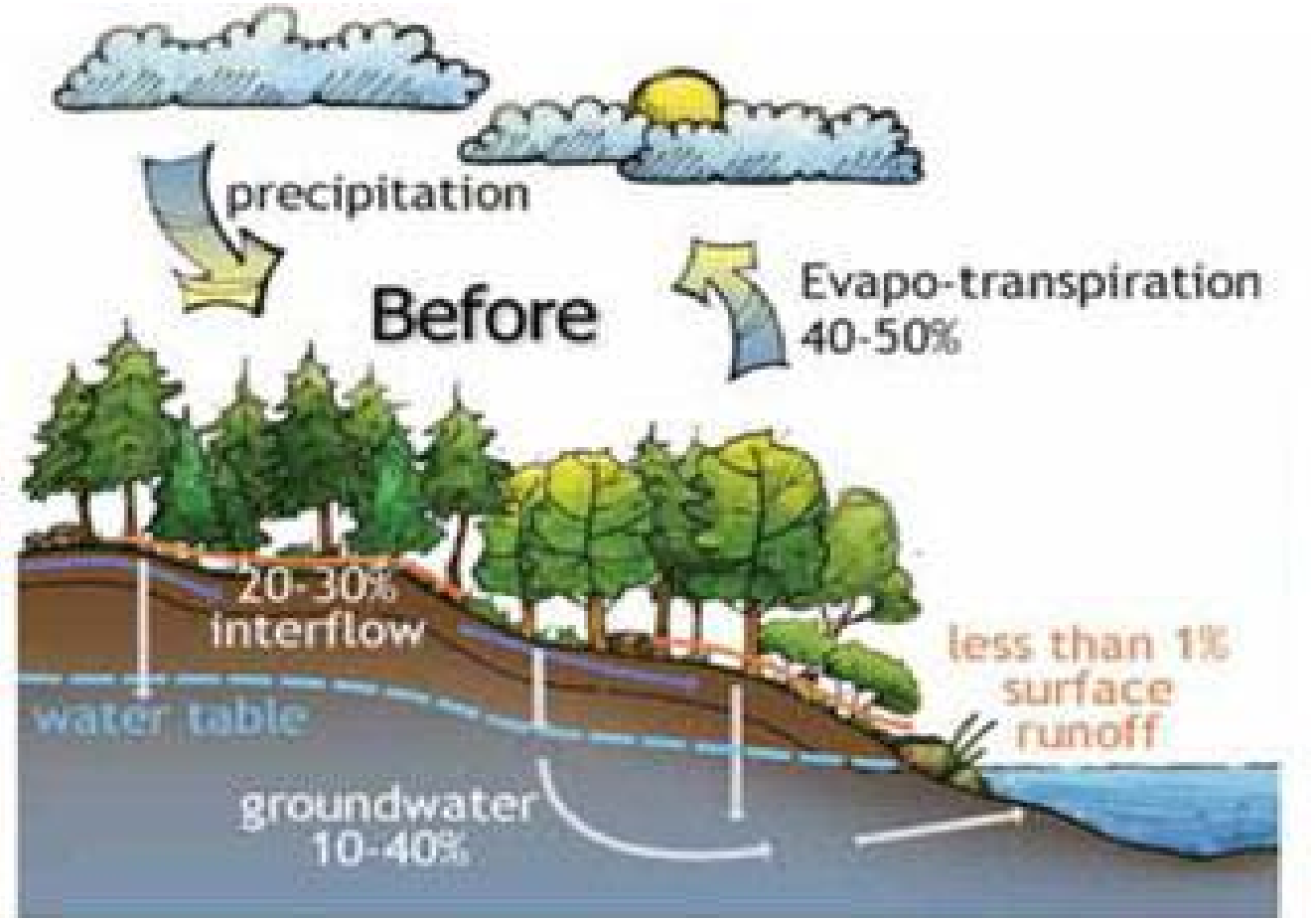


http://ottawa.ca/en/city-hall/planning-and-development/community-plans-and-design-guidelines/design-and-planning-0-1--36

LID - Examples

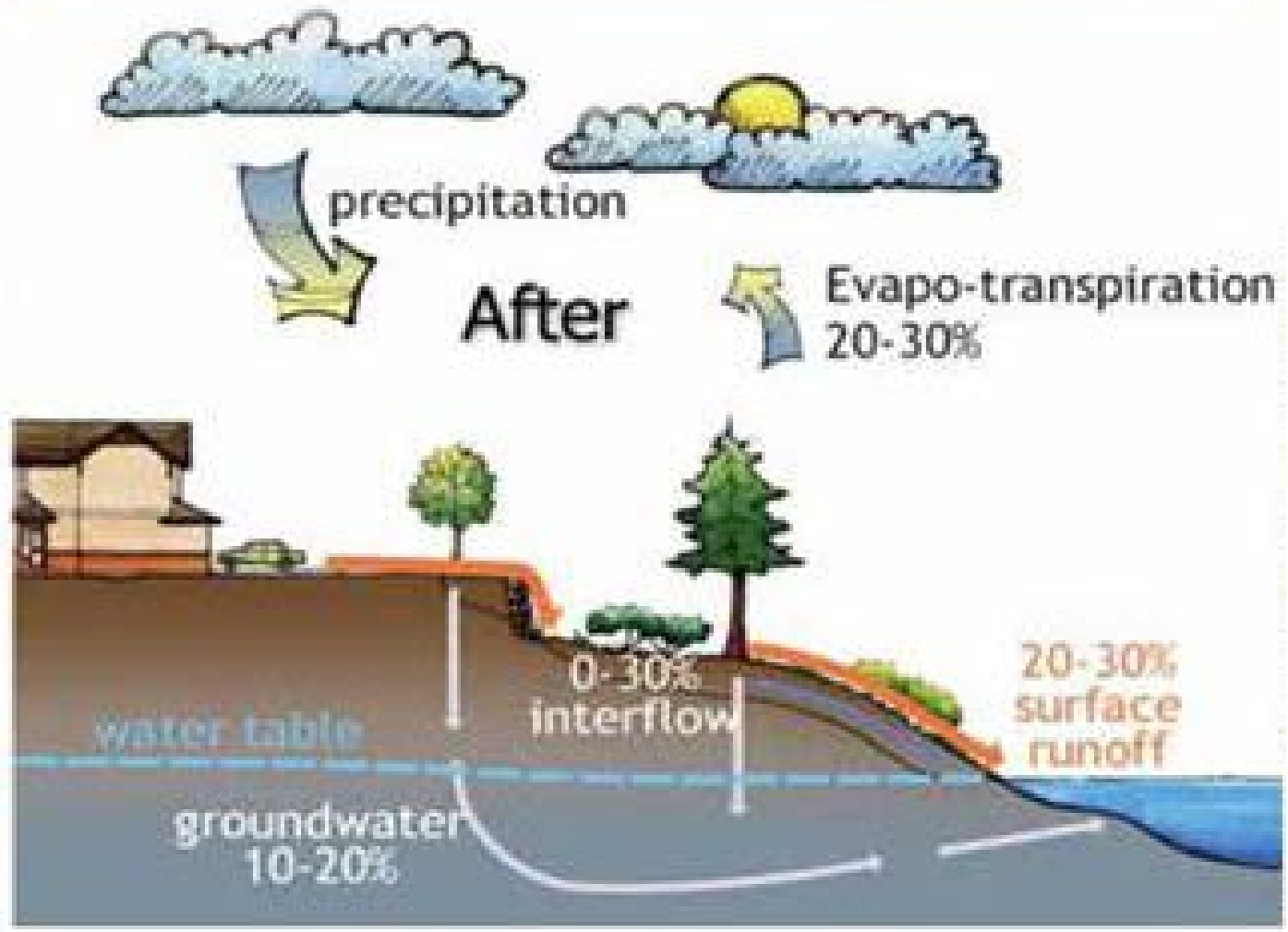
http://209.205.95.211/joomla/green/index.php/business-trends/153-storm-water-management-by-naturesdesign

LID aims to copy Pre-Development conditions



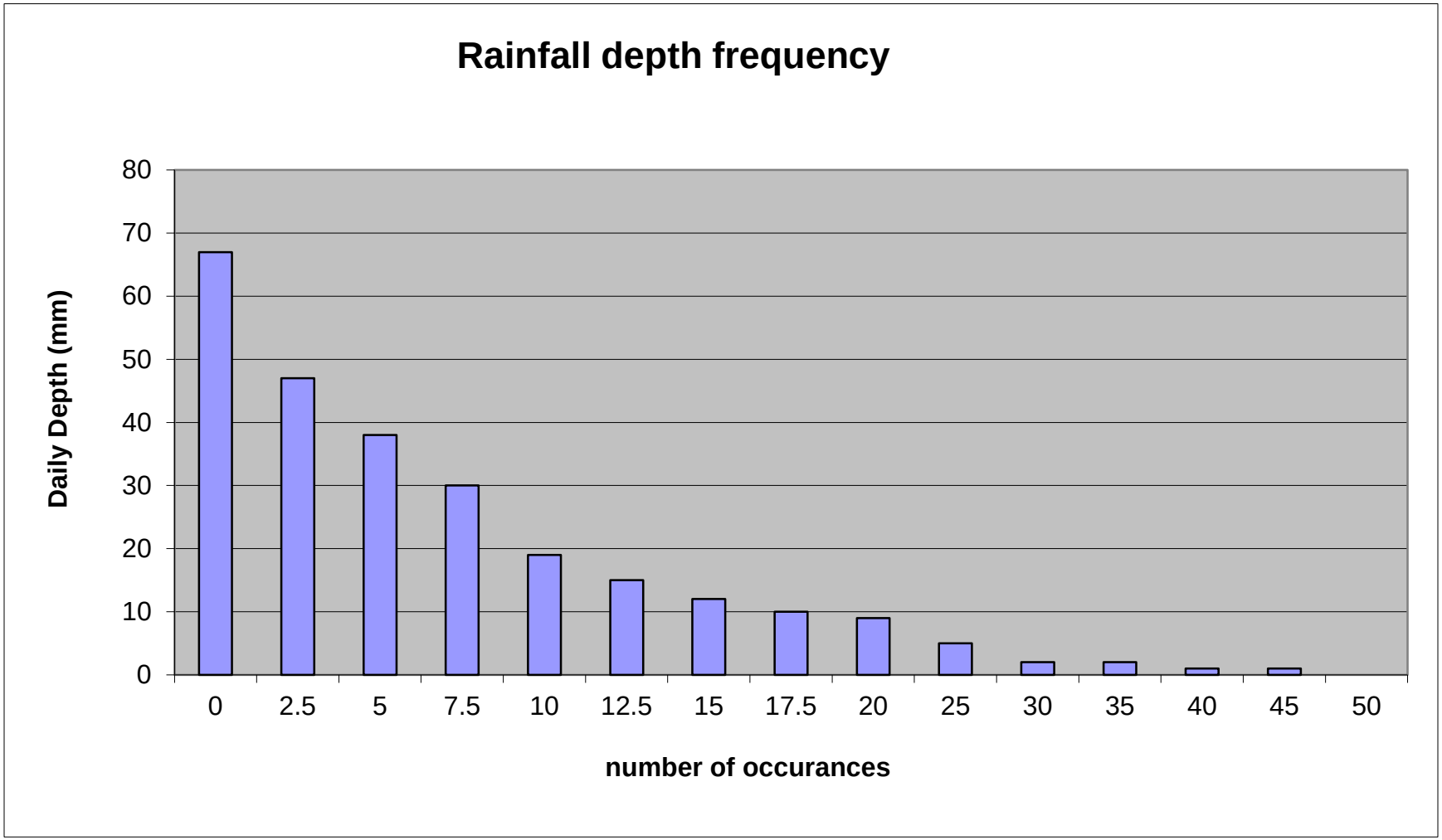
https://www.teachengineering.org/view_activity.php?url=collection/usf_/activities/usf_stormwater/usf_stormwater_lesson01_activity1.xml

Conventional Stormwater Management tends to increase Post Development runoff

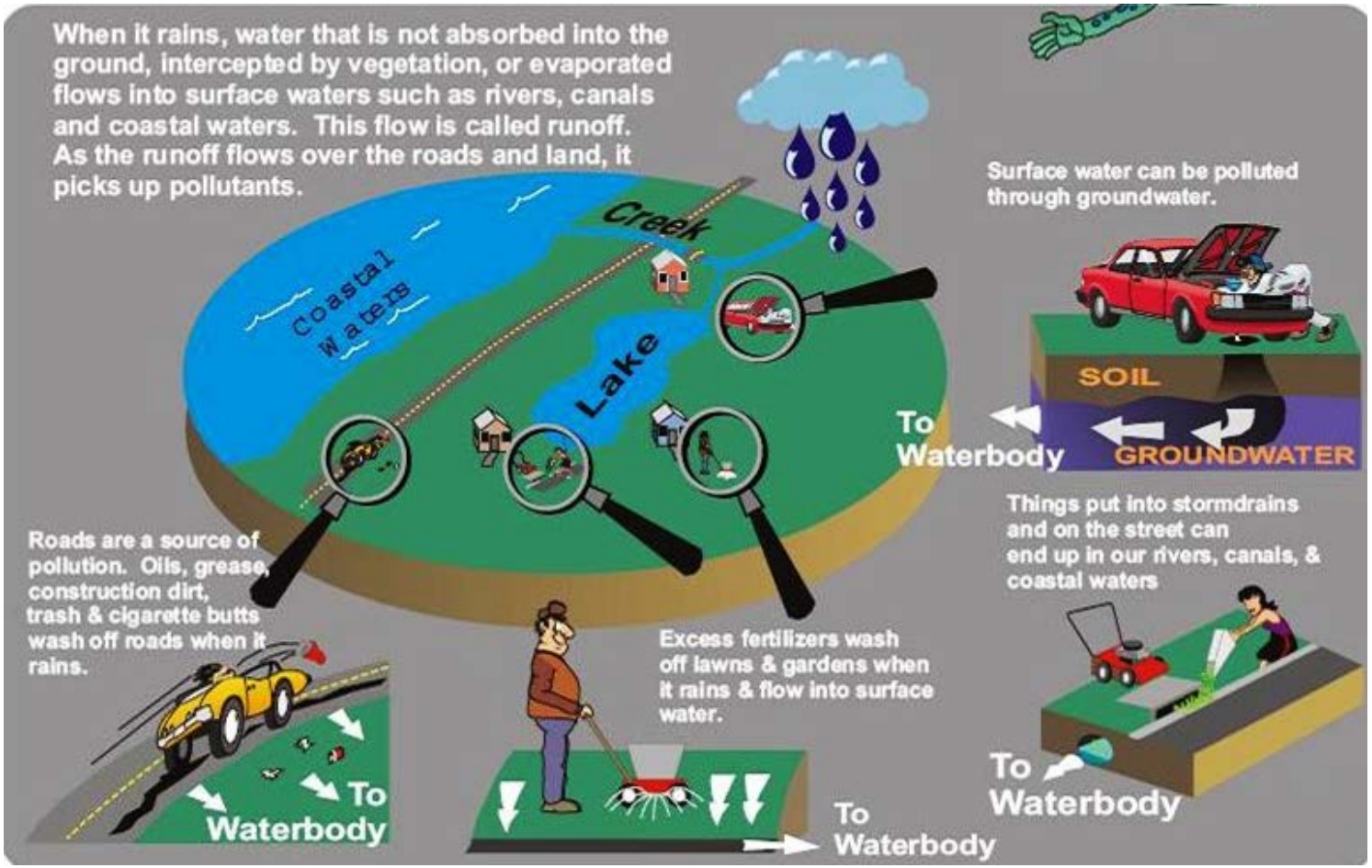


https://www.teachengineering.org/view_activity.php?url=collection/usf_/activities/usf_stormwater/usf_stormwater_lesson01_activity1.xml

Most Rainfall occurs in small events that LID's can manage



Runoff contains Pollutants



http://www.google.ca/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=&url=http%3A%2F%2Fwww.palmettobay-fl.gov%2Fcontent%2Fstormwater-runoff&bvm=bv.117218890,d.cWw&psig=AFQjCNHEob_xw3geD32IMQeHGd-XXuu7oA&ust=1458321221849940

Typical Urban Runoff Pollutants

Pollutant	Units	Residential	Open / Non-Urban
TSS	mg/l	101	70
TP	µg/l	383	121
TKN	µg/l	1900	965
Total Copper	µg/l	33	NA
Total Zinc	µg/l	135	195

Source: National Urban Runoff Program (US EPA 1983)

TSS - Pollutant Particle Sizes

Particle Size (µm) National Urban Runoff Program (NURP 1983)	% of Particle Mass	Average Settling Velocities (m/s)
≤ 20	0 – 20	0.00000254
20 – 40	20 – 30	0.00001300
40 – 60	30 – 40	0.00002540
60 – 130	40 – 60	0.00012700
130 - 400	60 – 80	0.00059267
400 - 4000	80 - 100	0.00550333

Typical SWM Facility Pollutant Removal (%)

Pollutant	**LID**	Stormwater Wetlands	Stormwater Wet Ponds	Stormwater Dry Ponds	Open Channel
TSS	**89**	72	80	49	81
TP	**65**	48	52	20	24
TKN	**46**	24	31	24	56
Total Copper	**86**	47	57	29	65
Total Zinc	**87**	42	64	29	71

Source: National Pollutant Removal Database, Version 3, September 2007, Center for Watershed Protection

LID includes Infiltration, Bio-retention, and Filtering processes

Stormwater Management – Summary

The meaning of the term, Stormwater Management, has evolved over time

It has gone from getting water from frequent rains away from a site, to trying to control:

- Quantity, (matching peak flow rate post to pre)
- Quality, (removal of pollutants on suspended solids)
- Volume, (mitigating increase in runoff volume)
- Frequency, (infiltrate runoff from “everyday” events)
- Climate Change, (many unknowns, resilience key)

LID / Green / Sustainable Infrastructure, is a potential solution to multiple problems,

(but not a “silver bullet”).

LID – Goal recap

- Infiltrate rainfall to:
  - reduce runoff frequency & volume;
  - increase stream base-flow;
  - Improve water quality by capturing pollutants;
  - reduce stream erosion & enhance fish habitat;
  - reduce flooding (& flood damages) by mitigating development related increases in runoff;
- Replicate Natural Landscape
- Reduce Construction and O&M costs;

with Overland Flow Routes, from Master Drainage Planning.

LID
Green Infrastructure
SUDS