

LEAVENWORTH

REGIONAL STORMWATER QUALITY AND WETLAND MANAGEMENT PLAN





INTRODUCTION

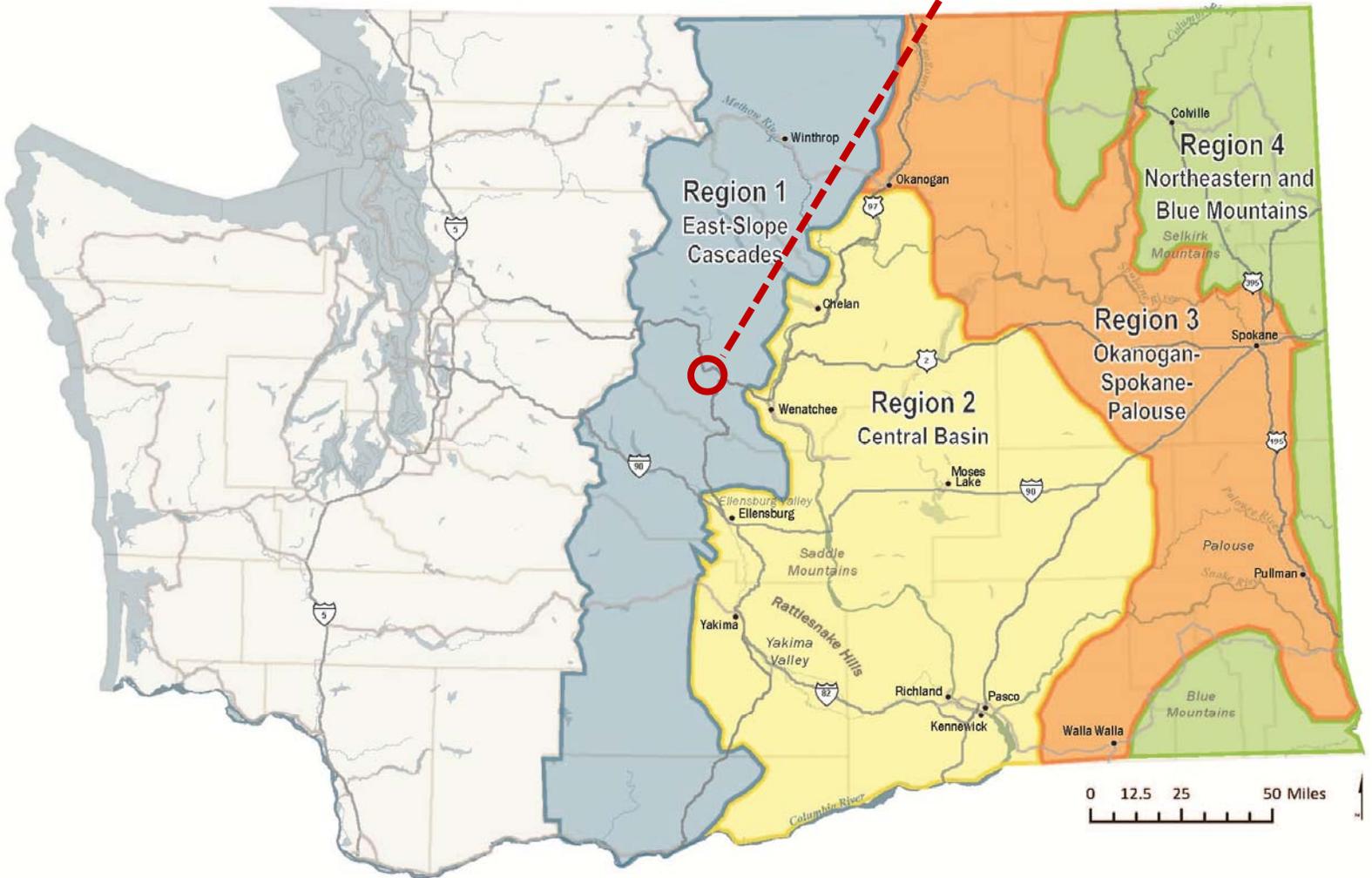


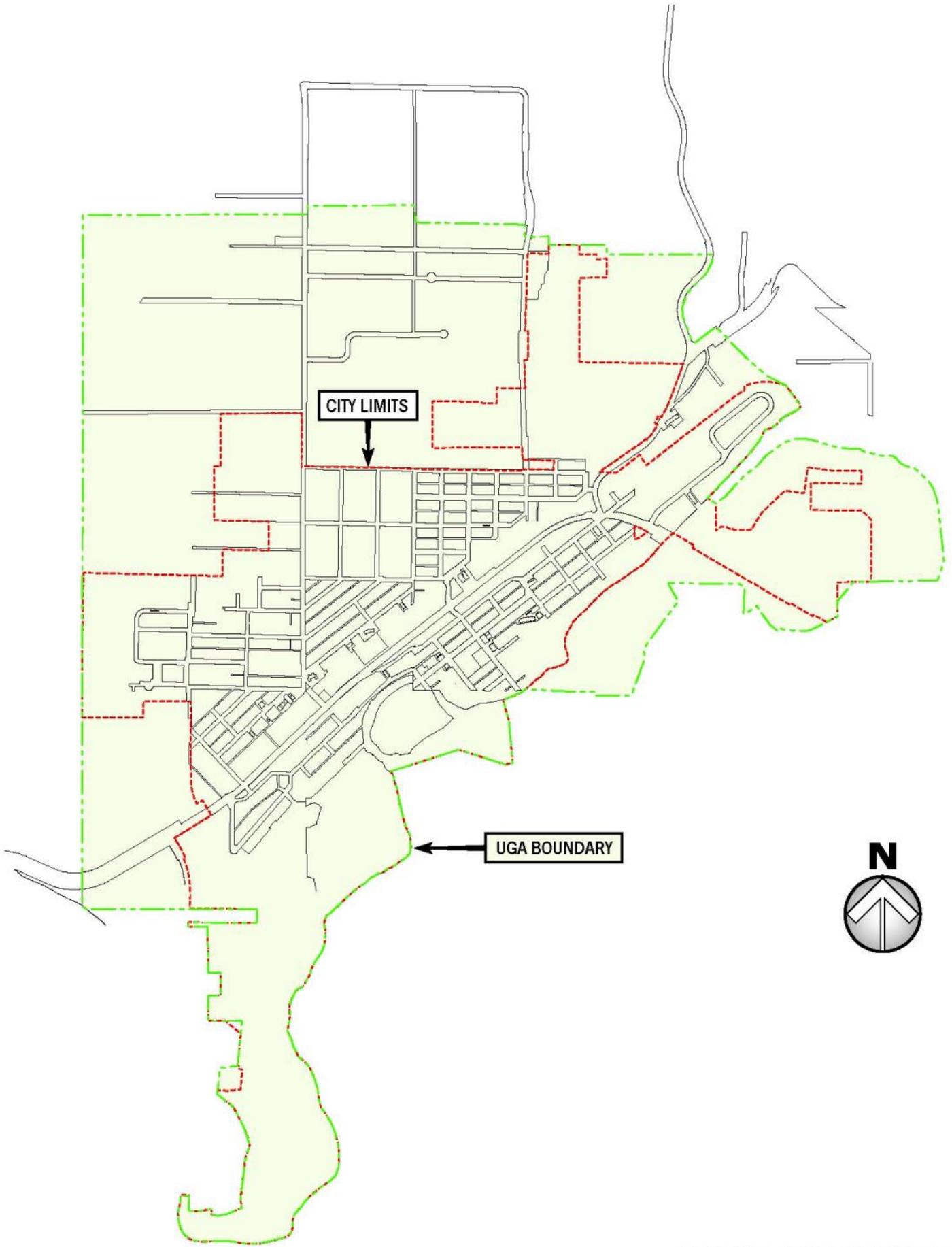
WHAT Regional Stormwater Quality and Wetland Management Plan

Who

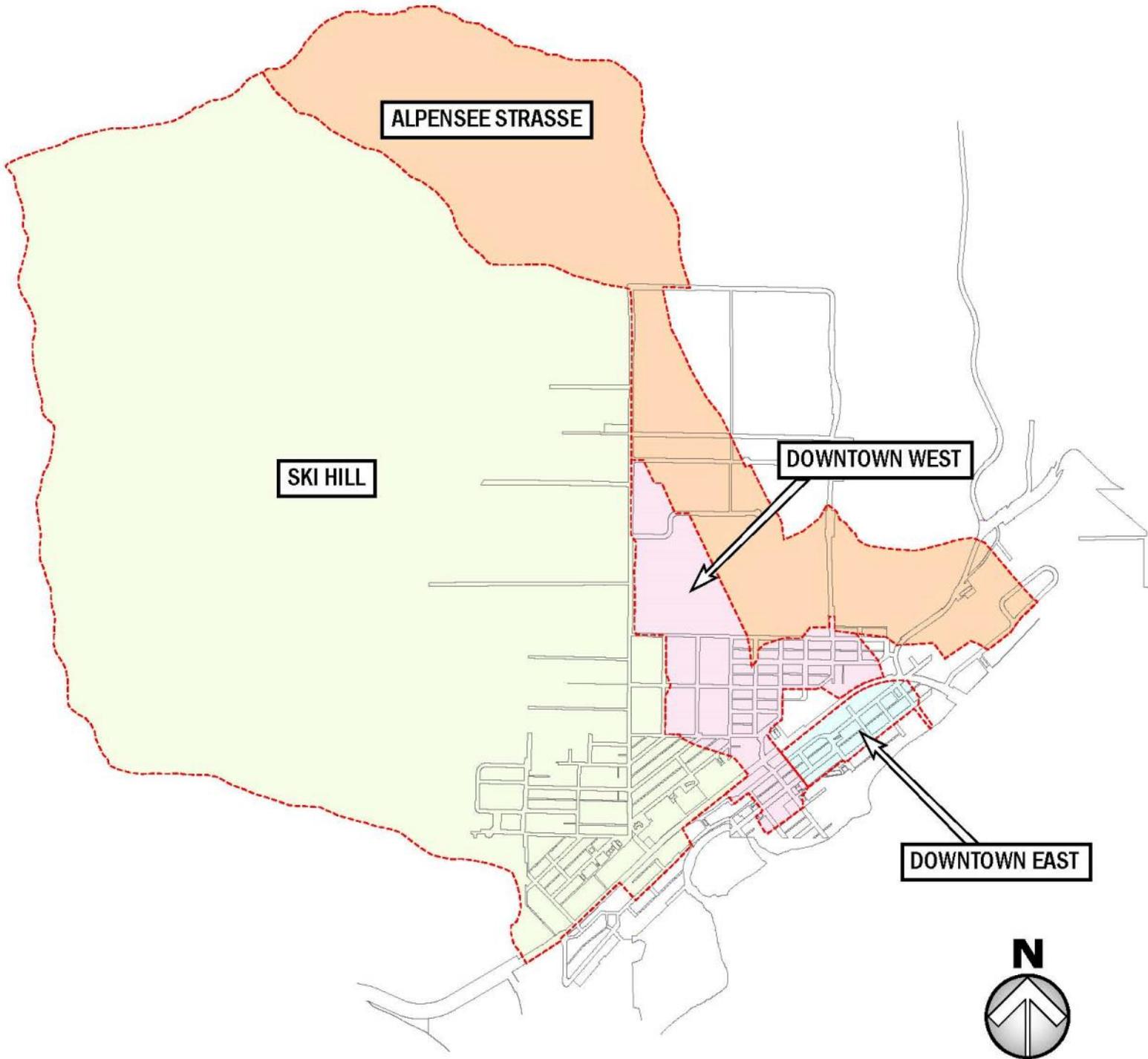


Where





**CITY OF LEAVENWORTH
VICINITY MAP**



LEGEND

PIPE DIAMETERS			
	12" OR LESS		SDMH / CB TYPE II
	15"		CB TYPE 1
	18"		PIPE: FIELD SURVEY CONFIRMED
	24"		PIPE NOT FIELD SURVEYED
	30"		DITCH
	36"		
	42"		
	48"		

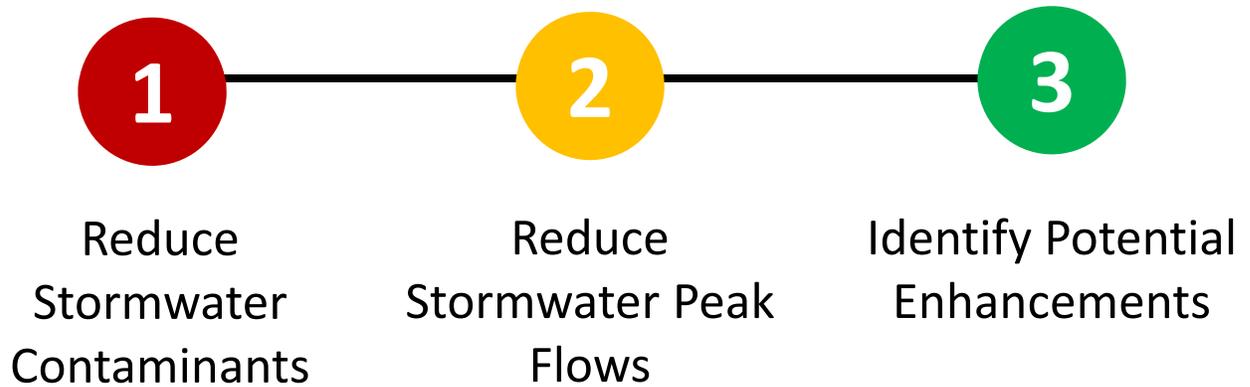
DRAINAGE BASIN KEY MAP

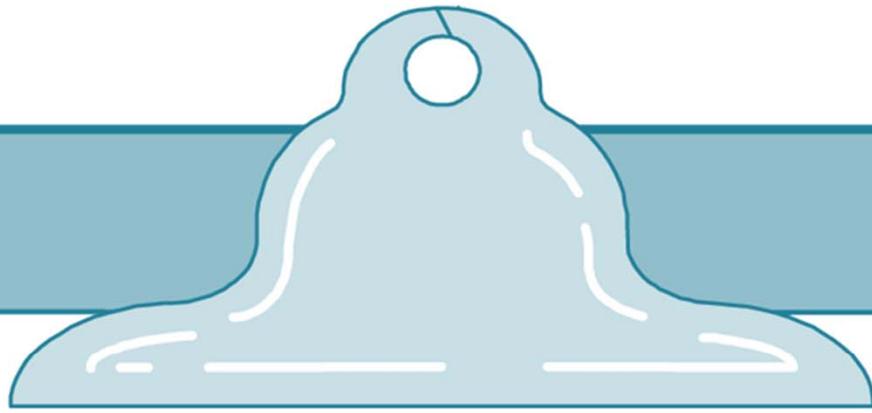
A scenic view of a town street with historic buildings, parked cars, and mountains in the background. The image is used as a background for the text.

PURPOSE

Provide stormwater management and wetland management guidance to the City of Leavenworth with respect to Green Infrastructure.

GOALS





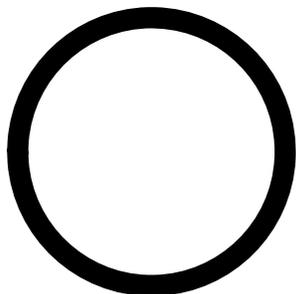
HOW?



Delineate/Rate Wetlands



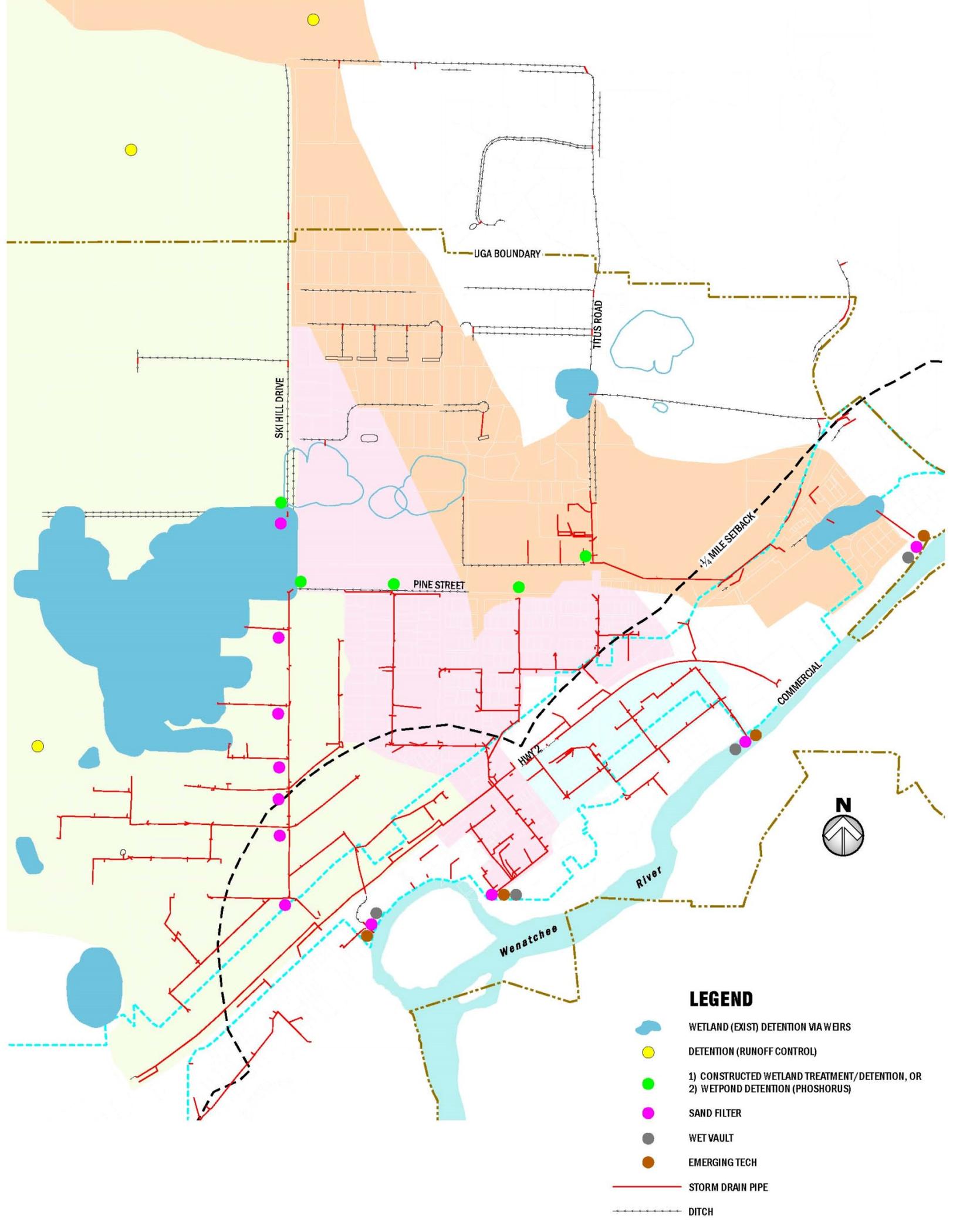
Characterize Stormwater
Hydrology/Hydraulics



Develop Green
Infrastructure Solutions



PROGRESS TO DATE



UGA BOUNDARY

SKI HILL DRIVE

TITUS ROAD

PINE STREET

1/4 MILE SETBACK

COMMERCIAL

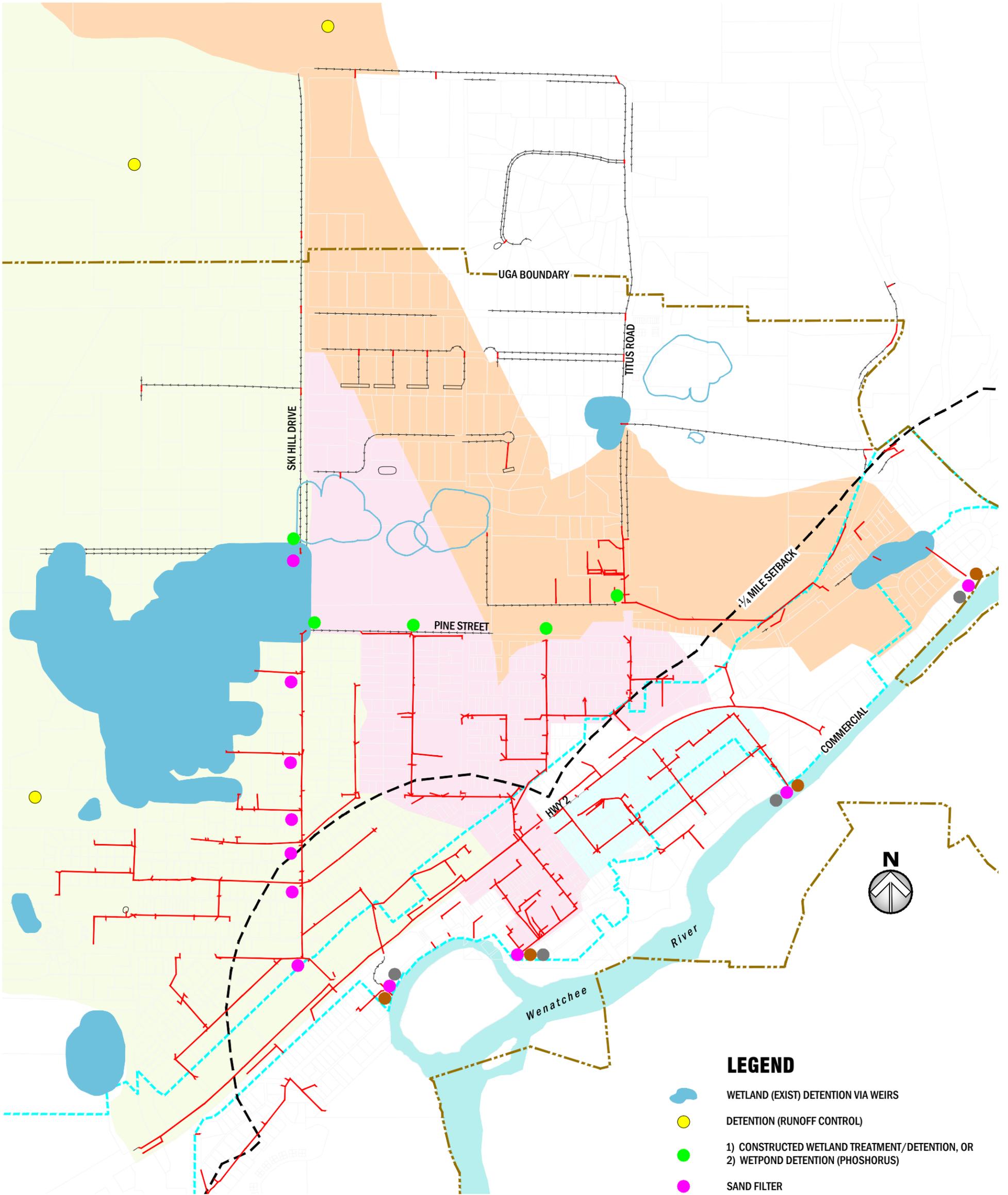
HWY 2

Wenatchee River



LEGEND

-  WETLAND (EXIST) DETENTION VIA WEIRS
-  DETENTION (RUNOFF CONTROL)
-  1) CONSTRUCTED WETLAND TREATMENT/DETENTION, OR
2) WETPOND DETENTION (PHOSPHORUS)
-  SAND FILTER
-  WET VAULT
-  EMERGING TECH
-  STORM DRAIN PIPE
-  DITCH



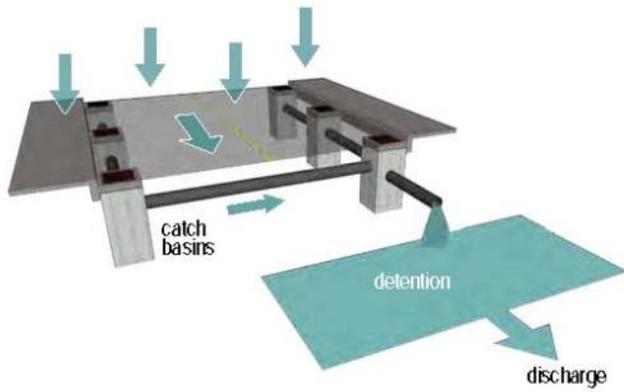
LEGEND

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-  DITCH

A photograph of a stormwater treatment wetland. In the foreground, there is a concrete channel filled with water, surrounded by lush green vegetation. In the background, there are several rows of railroad tracks, utility poles, and a city skyline under a clear blue sky.

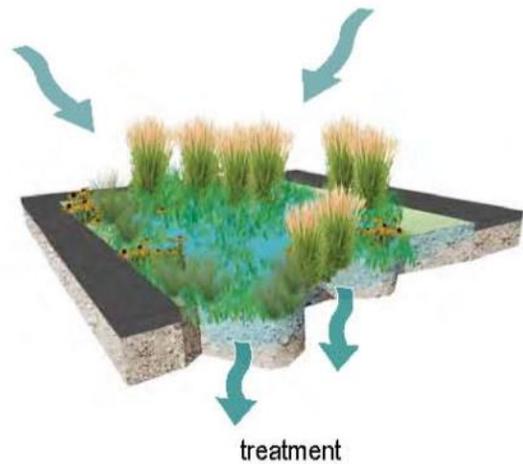
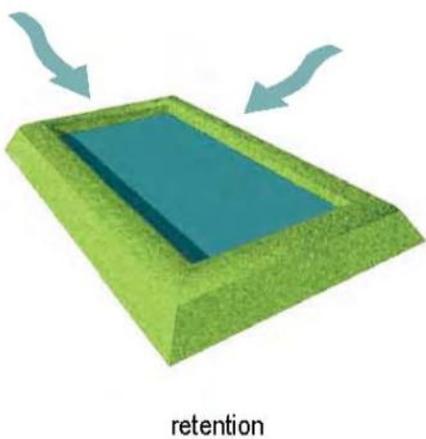
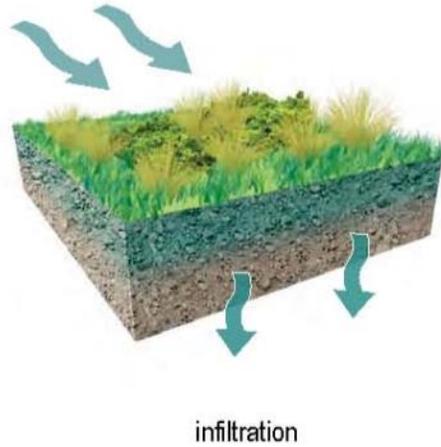
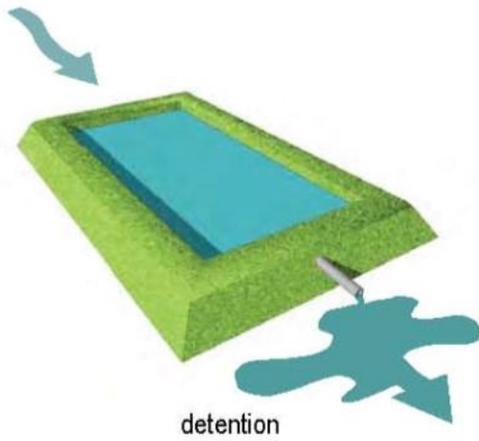
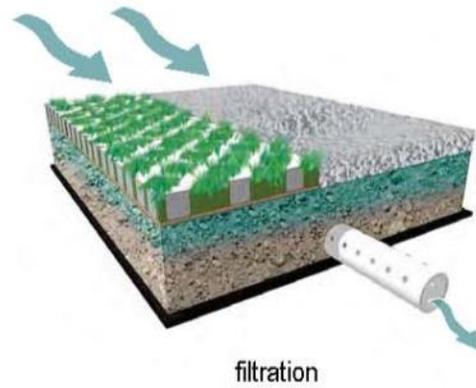
DEFINITION

The water quality treatment and runoff control of stormwater by utilizing and/or mimicking natural processes.



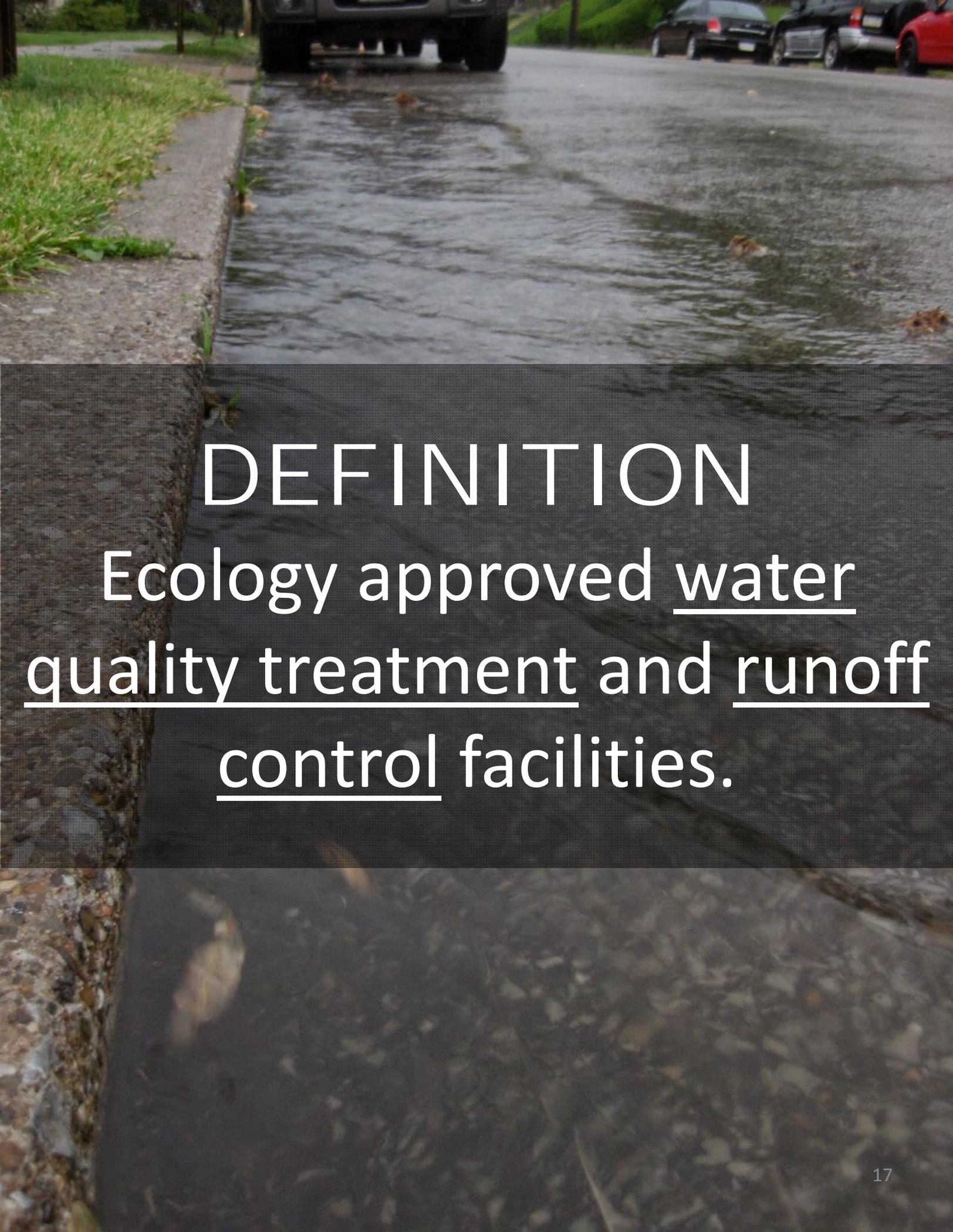
hard engineering
storm drainage management:
drain, direct, and dispatch

soft engineering
storm drainage management:
slow, spread, and soak





BEST MANAGEMENT PRACTICES (BMPs)

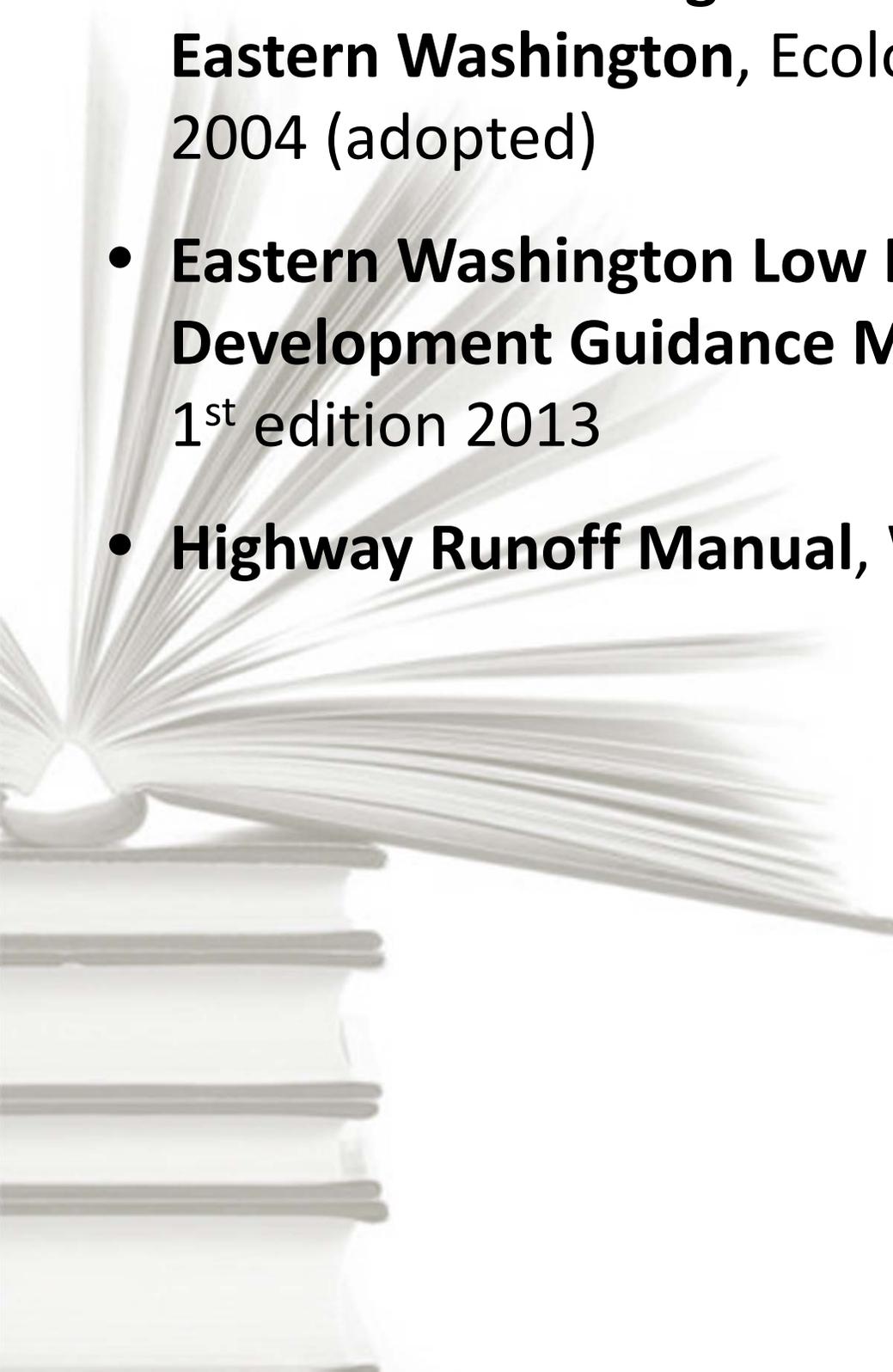


DEFINITION

Ecology approved water
quality treatment and runoff
control facilities.

Where BMPs are Defined:

- **Stormwater Management Manual for Eastern Washington, Ecology, 1st edition 2004 (adopted)**
- **Eastern Washington Low Impact Development Guidance Manual, Ecology, 1st edition 2013**
- **Highway Runoff Manual, WSDOT, 2014**



Performance Goals:

- **Water Quality Treatment**
 - Treat 90% of the annual runoff volume via the Water Quality Storm (6 month)
- **Runoff Control**
 - Adopt a network capacity design storm.

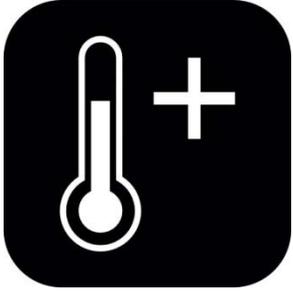


General Categorization

	CATEGORY		
SUB-CATEGORY	LID	Runoff Control	WQ Treatment
Bio-filtration	X		X
Bio-retention	X	X	X
Detention		X	
Dispersion	X	X	X
Infiltration	X	X	X
Oil/Water Separator			X
Sand Filter			X
Trees	X	X	
Wet Pond / Vault			X
Wetland: Constructed		X	X
Wetland: Existing		X	



DESIGN CONSIDERATIONS



CLIMATE



POLLUTION



CAPITAL COSTS



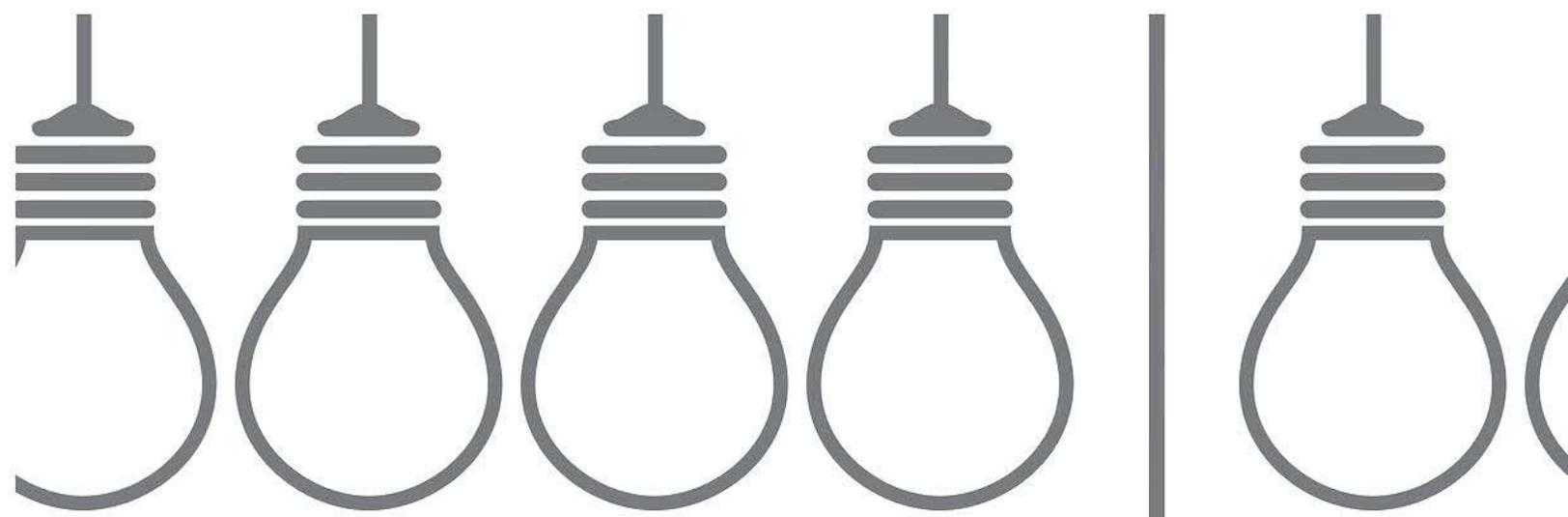
**OPERATIONS &
MAINTENANCE**



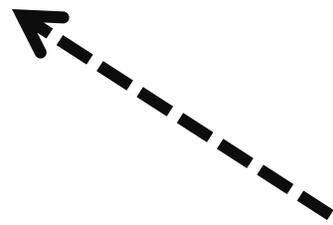
EFFECTIVE LIFE



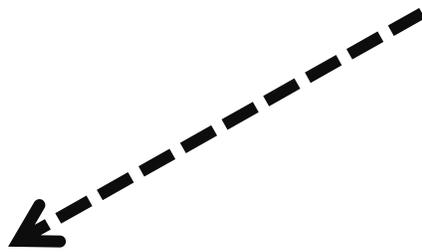
LEAVENWORTH DESIGN CONSIDERATIONS



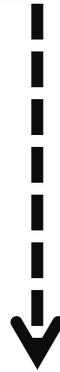
High
Groundwater



Wenatchee
River TMDL



Snow
Storage



A scenic view of a town street, likely in a mountain resort area. The foreground shows a paved sidewalk with colorful flower boxes. In the middle ground, there are people walking, parked cars, and a blue parking sign. The background features mountains under a cloudy sky. The word "APPLICATION" is overlaid in large white letters across the center of the image.

APPLICATION

Table 5.2.1 Typical Sources of Pollutants of Concern in Stormwater

Pollutant Sources	Pollutants of Concern
ROOFS:	
Uncoated metal	Zn
Vents & emissions ⁽¹⁾	O & G, TSS, Organics
PARKING LOT/DRIVEWAY:	
>High-use site	High O & G, TSS, Cu, Zn, PAH
<High-use	O & G, TSS
STREETS/HIGHWAYS:	
Arterials/highways	O & G, TSS, Cu, Zn, PAH
Residential collectors	Low O & G, TSS, Cu, Zn
High use site intersections	High O & G, TSS, Cu, Zn, PAH
OTHER SOURCES:	
Industrial/Commercial development	O & G, TSS, Cu, Zn
Residential development	TSS, Pest/ Herbicides Nutrients
Uncovered fueling stations:	High O & G
Industrial yards	High O & G, TSS, Metals, PAH

Notes:

Application of effective source control measures is the preferred approach for pollutant reduction. Where source control measures are not used, or where they are ineffective, stormwater treatment is necessary.

Legend:

Cu = Copper

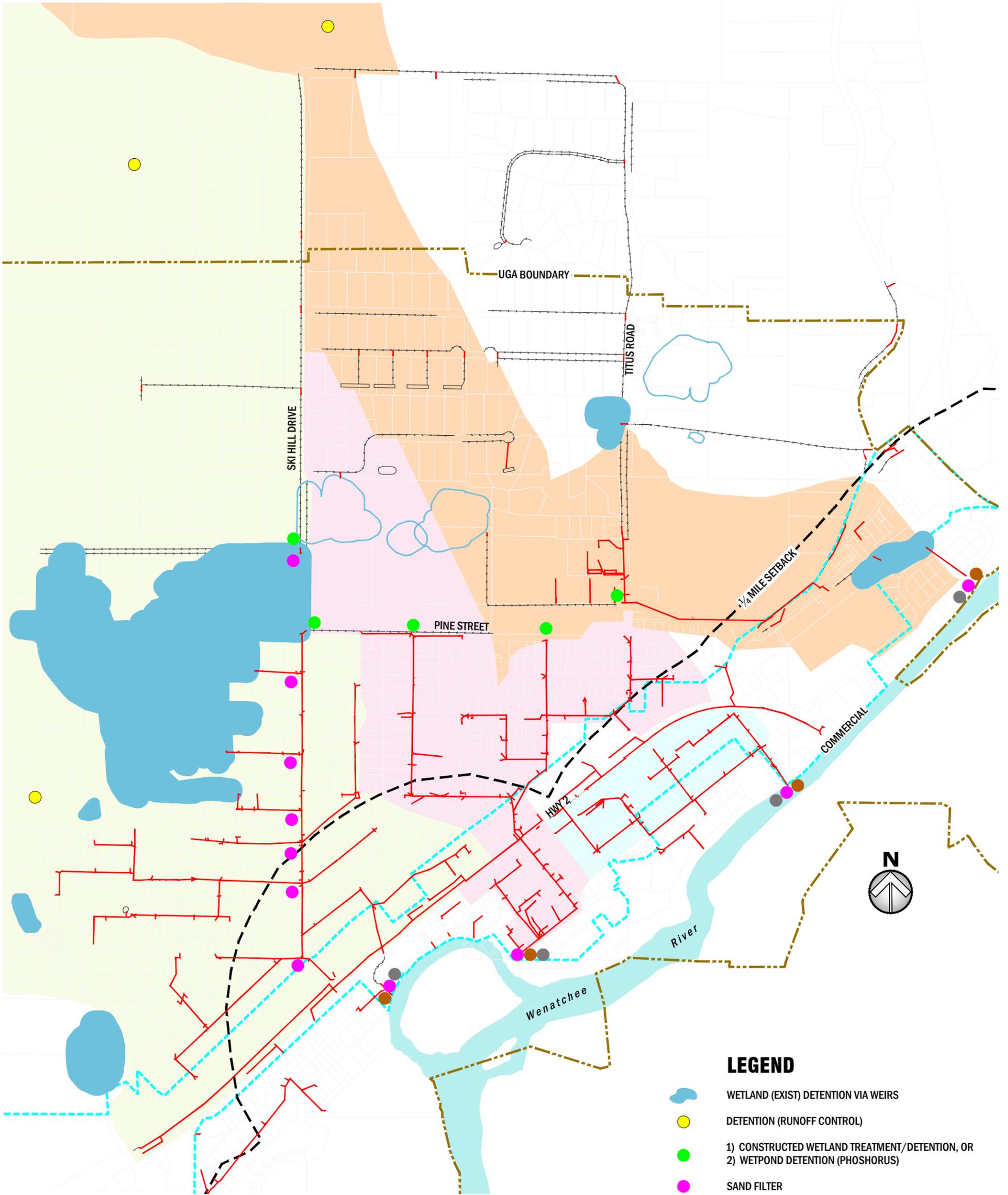
O & G = Oil and Grease

PAH = Polycyclic Aromatic Hydrocarbons

PGPS = Pollution-generating pervious surface

TSS = Total Suspended Solids

Zn = Zinc



LEGEND

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BMP	LID	Runoff Control	WQ Treatment	Treatment Agent	Oils	Phosphorus	Total Suspended Solids (TSS)	Metals	Pesticides / Fungicides	Capital Costs	O & M Costs	Effective Life (yr)	Region 1 Suitability	Cold Region Suitability	Pretreatment	Slope Limitations	High groundwater - Unsuitable	Footprint	Comments
Amended Soils LID4.2	√	√	√	Designer Soils												≤ 3:1		Varies	4 year soil maturation.
Bio-filtration: Media Filter Drain RT.07	√	No	√	Gravel, vegetation, alkaline granular mix	No	√	√	√		Low	Low to Moderate	5-20				≤ 4:1	√	Linear	Ideal for roads / parking - Seven alternatives. Snow storage.
Bio-filtration: Swale Continuous Inflow RT.06	*√	No	√	Vegetation	No	No	√	√		Low to Moderate	Low to Moderate	5-20				1.5-5%		Linear	*CA only. CA not allowed in areas with a phosphorus TMDL.
Bio-filtration: Swale Wet RT.05	No	No	√	Vegetation	No	No	√	No		Low to Moderate	Low to Moderate	5-20				≤ 1.5%		Linear	Specifically for areas with high groundwater and saturated soils.
Bio-filtration: Swale RT.04, T5.40	*√	No	√	Vegetation, Native Soils	No	No	√	*√		Low to Moderate	Low to Moderate	5-20	Limited Use	Fair		1.5-5%		Linear	*CA only. CA not allowed in areas with phosphorus TMDL.
Bio-filtration: Vegetated Filter Strip RT.02, T5.50	√	No	√	Vegetation	√	No	√	*√		Low	Low	20-50		Fair		≤ 3:1		Linear	Ideal for roads / parking - Three alternatives. Snow storage. *CA only. CA not allowed in areas with phosphorus TMDL.
Bio-filtration: Vegetated Roof LID4.7	X	X	X	Vegetation														Varies	Highest benefit from large buildings. Small benefit from residences. High roof loads (lb/sf). Energy savings
Bio-infiltration Pond / Swale IN.01, T5.30	√	√	√	Vegetation, Native Soils	√	No	√	√	√	Low to Moderate	Low	5-20	Preferred	Fair	√	≤ 1%	√	Small to Large	Snow storage.
Bio-retention RT.08, LID4.4	√	√	√	Vegetation, Designer soils	No	No	√	√		Moderate	Moderate	5-20						Small	Snow storage. Flexible footprint. High groundwater limitations. Phosphorus TMDL: Underdrain not allowed; Potential 1/4 mile setbacks.
Detention: Pond FC.03, F6.10	No	√	No	NA	No	No	No	No		Moderate	Low	20-50						Small to Large	Snow storage. Required to be above seasonal water table. Fencing.
Detention: Rain Water Harvesting LID4.9	√	No	No	NA	No	No	No	No	No									Small	Supplements other water sources. Roof material limitations.
Detention: Tank / Vault F6.11, F6.12	No	√	No	NA	No	No	No	No		Moderate to High	High	50-100						Small	
Detention: Wet Pond CO.01	No	√	√	Low energy environment	No	√	√	No	No	Moderate	Low to Moderate	20-50	Limited Use	Fair to Good				Large	Storage component must be above water table. Requires adequate water source.
Dispersion: Natural / Engineered FC.01, FC.02, F6.40, F6.41, F6.42, LID4.3	√	√	√	Vegetation, Native Soils	√	√	√	√		Low	Low	50-100				≤ 3:1		Linear	Ideal for roads / parking. Utilizes only native existing vegetation. Groundwater vertical separation (≥3').
Infiltration: Drywell IN.05, F6.20	√	√	No	Native Soils						Low to Moderate	Low to Moderate	5-20	Acceptable w/Limitations	Fair to Good	√		√	Small	

BMP	LID	Runoff Control	WQ Treatment	Treatment Agent	Oils	Phosphorus	Total Suspended Solids (TSS)	Metals	Pesticides / Fungicides	Capital Costs	O & M Costs	Effective Life (yr)	Region 1 Suitability	Cold Region Suitability	Pretreatment	Slope Limitations	High groundwater - Unsuitable	Footprint	Comments
Infiltration: Permeable Pavement IN.06, LID4.6	✓	✓	✓	Native Soils	✓	✓	✓	✓		Medium	High	Similar to HMA					✓	Varies	Numerous limitations. Restricted to light-medium vehicular loads. Susceptible to clogging (winter sanding, sedimentation).
Infiltration: Pond IN.02, T5.10, F6.21	✓	✓	✓	Native Soils	No	✓	✓	✓		Moderate	Moderate	5 - 10	Acceptable w/Limitations	Fair	✓	≤ 3%	✓	Medium to Large	Snow storage.
Infiltration: Swale T5.21	No	No	✓	Native Soils													✓	Medium	Little data to support its use.
Infiltration: Trench IN.03, T5.20, F6.22	✓	✓	✓	Native Soils	No	✓	✓	✓		Low	Low	20-50	Acceptable w/Limitations	Fair	✓		✓	Linear	
Infiltration: Vault IN.04	✓	✓	✓	Native Soils	No	✓	✓	✓		Moderate	Moderate to High	5-10	Acceptable w/Limitations	Fair	✓	≤ 4%	✓	Varies	
Oil Water Separator: Baffle / Coalescing T5.100, T5.110	No	No	✓	???	✓	No	No	No	No					Poor to Fair	✓			Small	Intense maintenance. Last choice for oil control.
Sand Filter: Basic, Large T5.80, T5.81		No	✓	Sand	✓-	✓-	✓	✓-	✓-				Preferred	Poor	✓			Medium to Large	Not effective in winter.
Sand Filter: Vault, Linear T5.82, T5.83		No	✓	Sand	✓-	✓-	✓	✓-	✓-				Preferred	Fair to Poor	✓			Small to Medium	Effective in winter.
Trees LID4.5	✓	✓								Low	Low	Long	✓	✓				Small	Large trees provide highest benefit. Utility conflicts. Encourages infiltration.
Wet Pool / Pond RT.12, T5.70, T5.71	No	No	✓	Low energy environment	No	✓	✓	No		Moderate to High	Low to Moderate	20-50	Limited Use	Fair to Good				Large	Less suitable / effective in semi-arid locations. Snow storage??
Wet Vault T5.72	No	No	✓	Low energy environment	No	No	✓	No	No	Moderate to High	High	50 - 100		Good				Small	
Wetland: Constructed Treatment / Detention CO.02	No	✓	✓	Aquatic Plants	No	No	✓	✓	✓	Low to Moderate	Moderate	20-50	Limited Use	Good				Large	Year round adequate water supply. Evaporation can be a concern. Aquatic plant establishment required.
Wetland: Constructed Treatment RT.13, T5.73	No	No	✓	Aquatic Plants	No	No	✓	✓	✓	Moderate to High	Moderate	20-50	Limited Use	Good				Large	Year round adequate water supply. Aquatic plant establishment required. Not intended as an aquatic habitat.
Wetlands: Natural		✓	Never	Aquatic Plants	No	No	No	No	No	None	None				✓				Hydroperiod analysis required.

BMP	LID	Runoff Control	WQ Treatment	Treatment Agent	Oils	Phosphorus	Total Suspended Solids (TSS)	Metals	Pesticides / Fungicides	Capital Costs	O & M Costs	Effective Life (yr)	Region 1 Suitability	Cold Region Suitability	Pretreatment	Slope Limitations	High groundwater - Unsuitable	Footprint	Comments
Bio-filtration: Media Filter Drain RT.07	√	No	√	Gravel, vegetation, alkaline granular mix	No	√	√	√		Low	Low to Moderate	5-20				≤ 4:1	√	Linear	Ideal for roads / parking - Seven alternatives. Snow storage.
Detention: Wet Pond CO.01	No	√	√	Low energy environment	No	√	√	No	No	Moderate	Low to Moderate	20-50	Limited Use	Fair to Good				Large	Storage component must be above water table. Requires adequate water source.
Dispersion: Natural / Engineered FC.01, FC.02, F6.40, F6.41, F6.42, LID4.3	√	√	√	Vegetation, Native Soils	√	√	√	√		Low	Low	50-100				≤ 3:1		Linear	Ideal for roads / parking. Utilizes only native existing vegetation. Groundwater vertical separation (≥3').
Sand Filter: Basic, Large T5.80, T5.81		No	√	Sand	√-	√-	√	√-	√-				Preferred	Poor	√			Medium to Large	Not effective in winter.
Sand Filter: Vault, Linear T5.82, T5.83		No	√	Sand	√-	√-	√	√-	√-				Preferred	Fair to Poor	√			Small to Medium	Effective in winter.
Wet Pool / Pond RT.12, T5.70, T5.71	No	No	√	Low energy environment	No	√	√	No		Moderate to High	Low to Moderate	20-50	Limited Use	Fair to Good				Large	Less suitable / effective in semi-arid locations. Snow storage??

Emerging Technology

Manufacturer	Product	Pretreatment	Oil	Metals	Basic	Phosphorus
AquaShield	Aqua-Filter System		Pilot	Pilot	Pilot	Pilot
AquaShield	Aqua-Swirl System	General			General	
BaySaver Technologies	BayFilter			Conditional	General	Conditional
BaySaver Technologies	BaySeparator	Conditional				
Bio Clean	Modular Wetland 0.46 cfs or 20,145 cf			General	General	General
Contech	CDS Stormwater Treatment	General	Pilot		Conditional	
Contech	Filterra System 100 in/hr		General	General	General	General
Contech	Filterra Boxless 100 in/hr		General	General	General	General
Contech	Jellyfish Filter		Pilot		Conditional	Pilot
Contech	Media Filtration Perlite				Conditional	Conditional
Contech	StormFilter MetalRx Media			Conditional	Conditional	
Contech	StormFilter Perlite				Conditional	Pilot
Contech	StormFilter PhosphoSorb				Conditional	Conditional
Contech	StormFilter ZPG Media				General	
Contech	UrbanGreen BioFilter		Pilot	Pilot	Conditional	
Contech	Vortechs System	General				
Environment 21	StormPro	Pilot				
Hydro International	Downstream Defender	General				
Hydro International	Up-Flo Filter				Conditional	
Imbrium Systems	Stormceptor	General				
Kristar / Oldcastle	FloGard Perk Filter 2.1 cfs				General	General
Lean Environment	Enpurion Metals Treatment			Conditional	Conditional	
Royal Environmental	ecoStorm plus				General	
StormwaterRx	Aquip			Conditional	Conditional	Conditional
Torrent Resources	Maxwell Plus		Pilot		Pilot	
WSDOT	Media Filter Drain			General	General	General
WSDOT	CA Biofiltration Swale		Conditional	General	General	

General
Conditional
Pilot

Ok
Under Testing
Notification to Ecology Required

A photograph of a stone-lined culvert pipe discharging into a body of water. The pipe is surrounded by a wall of large, light-colored rocks. In the background, there are tall, dry grasses and green shrubs. The water in the foreground is calm and reflects the surrounding environment. A semi-transparent grey banner is overlaid across the middle of the image, containing the text "Global BMPs" in a bold, black, sans-serif font.

Global BMPs

Amended Soils



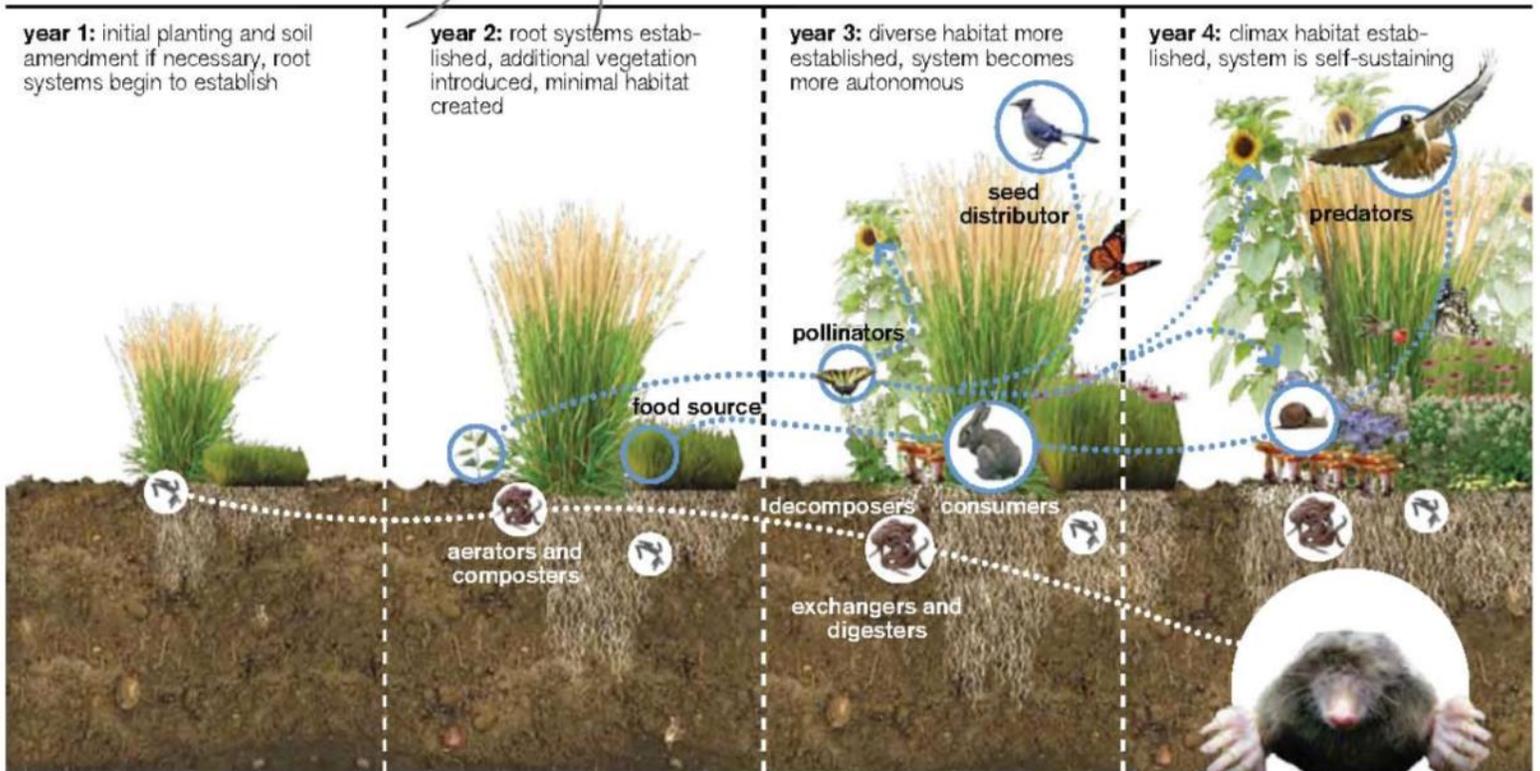
Integrated Pest Management: Purple Martins and bats can eat anywhere from 200 to 300 mosquitoes an hour. Other predators such as dragonflies and fish eliminate larvae in water.

year 1: initial planting and soil amendment if necessary, root systems begin to establish

year 2: root systems established, additional vegetation introduced, minimal habitat created

year 3: diverse habitat more established, system becomes more autonomous

year 4: climax habitat established, system is self-sustaining

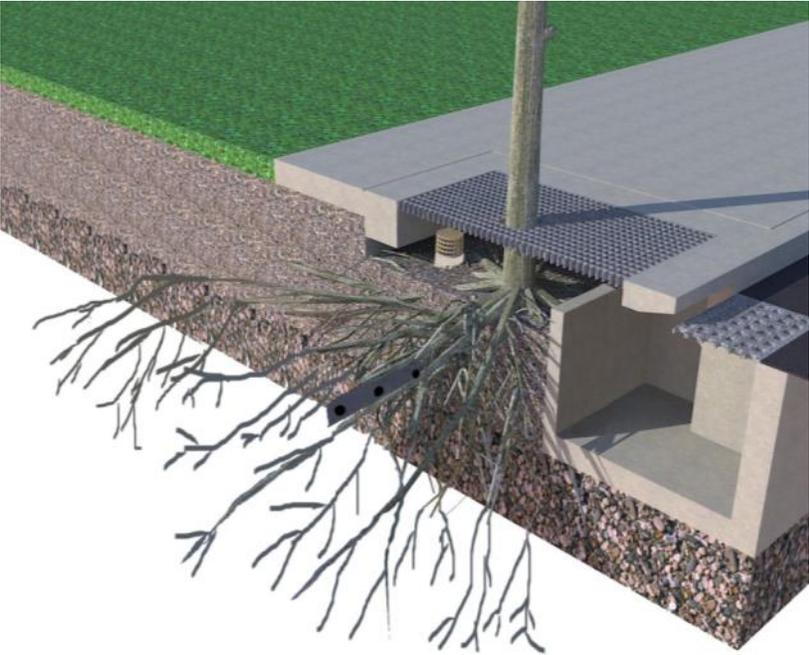


establishment stage → increasing resiliency → maturation stage

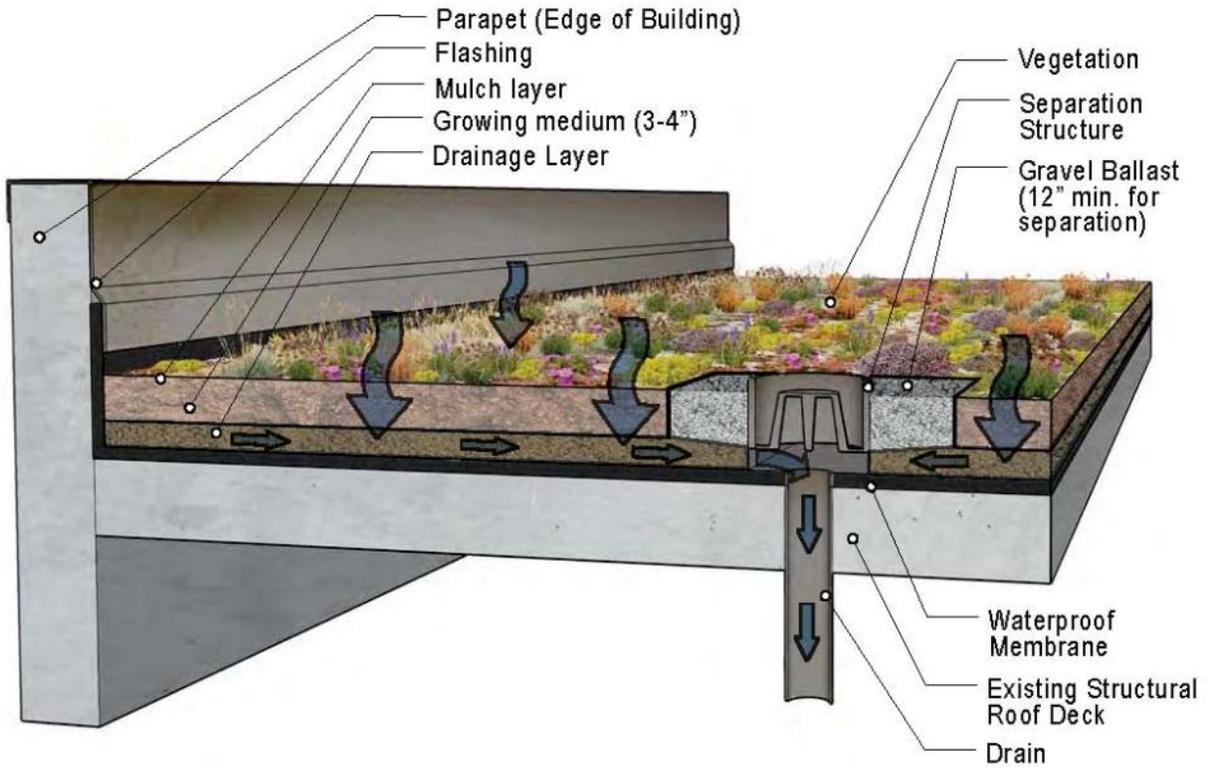
Rainwater Harvesting



Trees



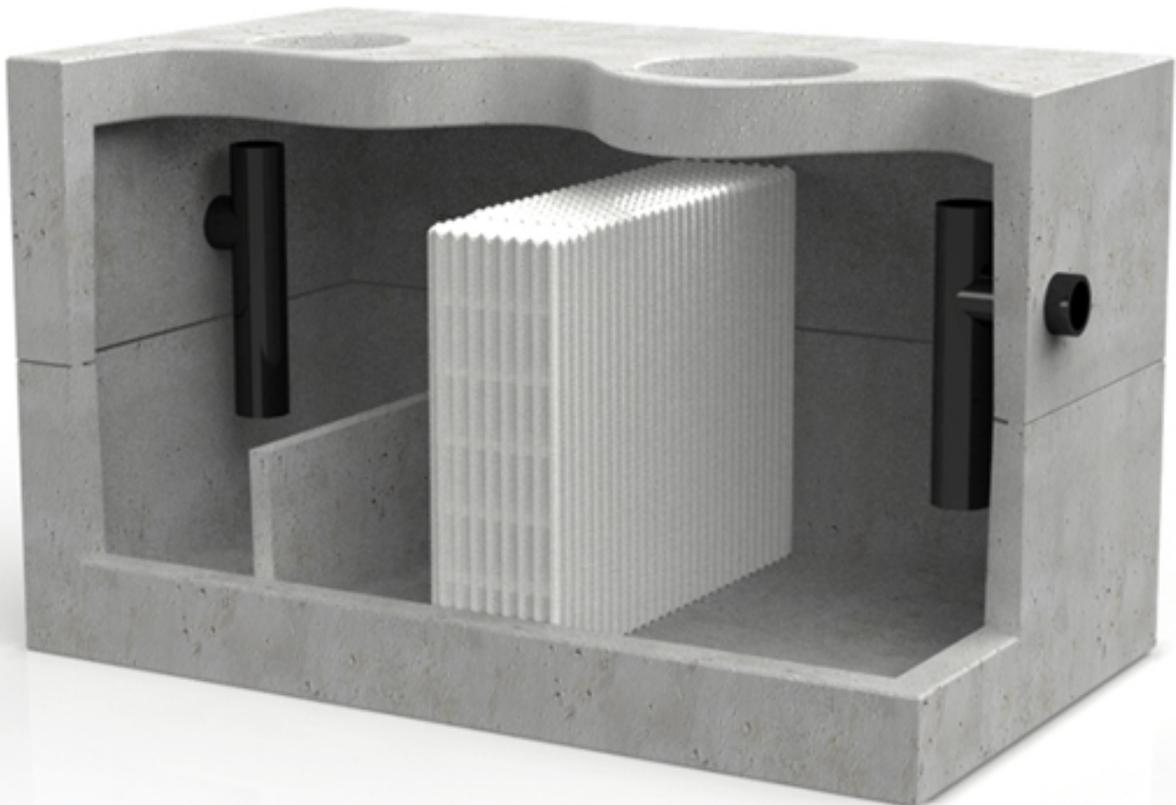
Vegetated Roofs



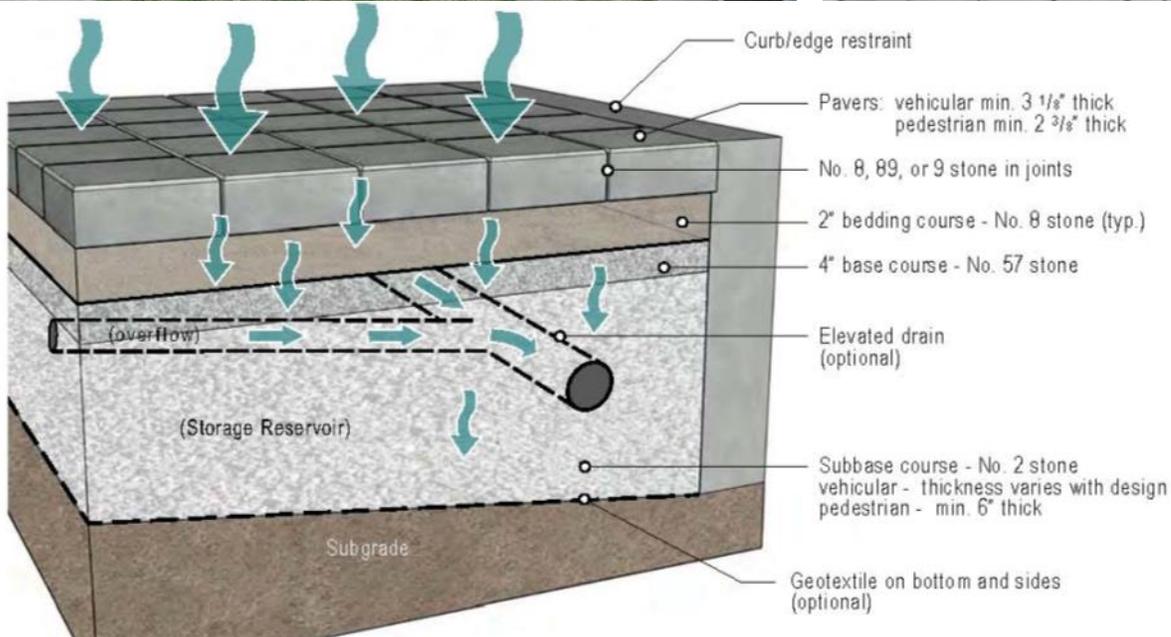


ROAD/PARKING BMPs

Oil/Water Separator



Pervious Pavement



Vegetated Filter Strip



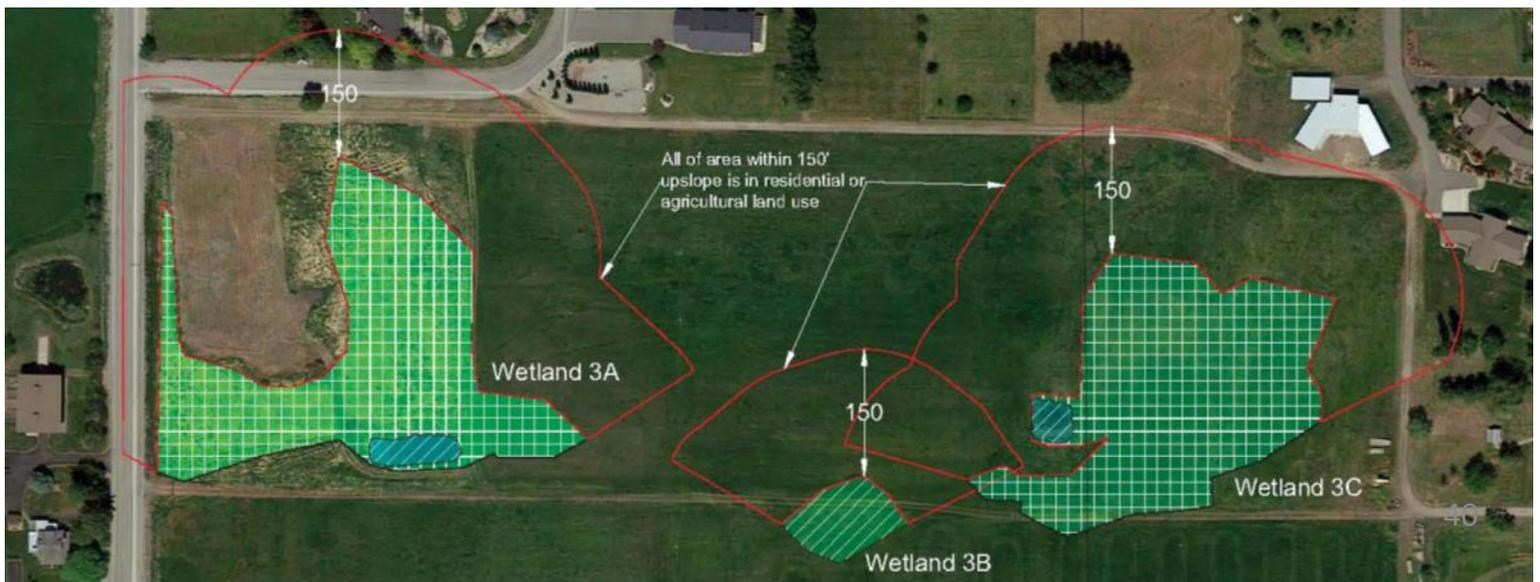
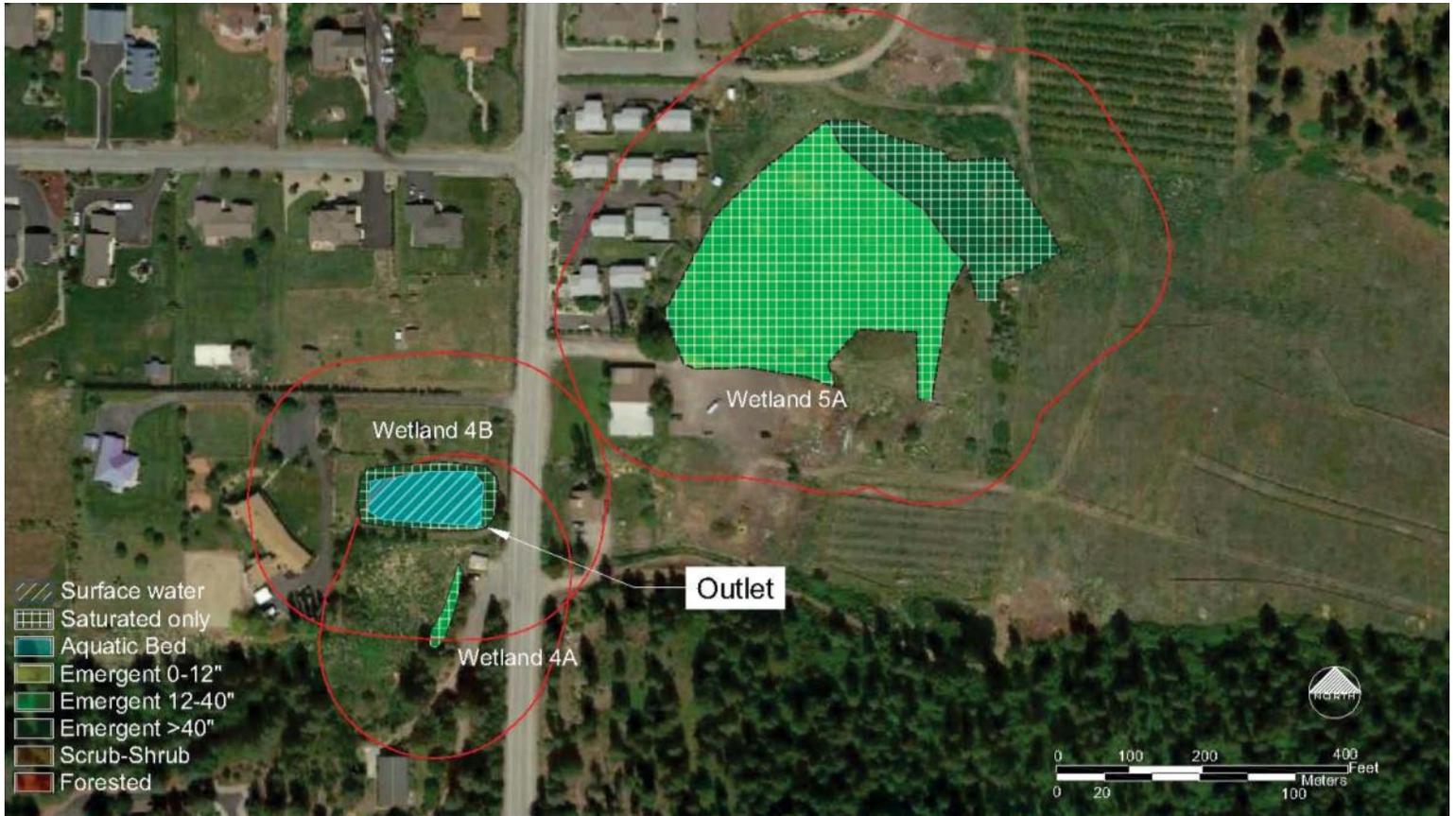


WETLANDS

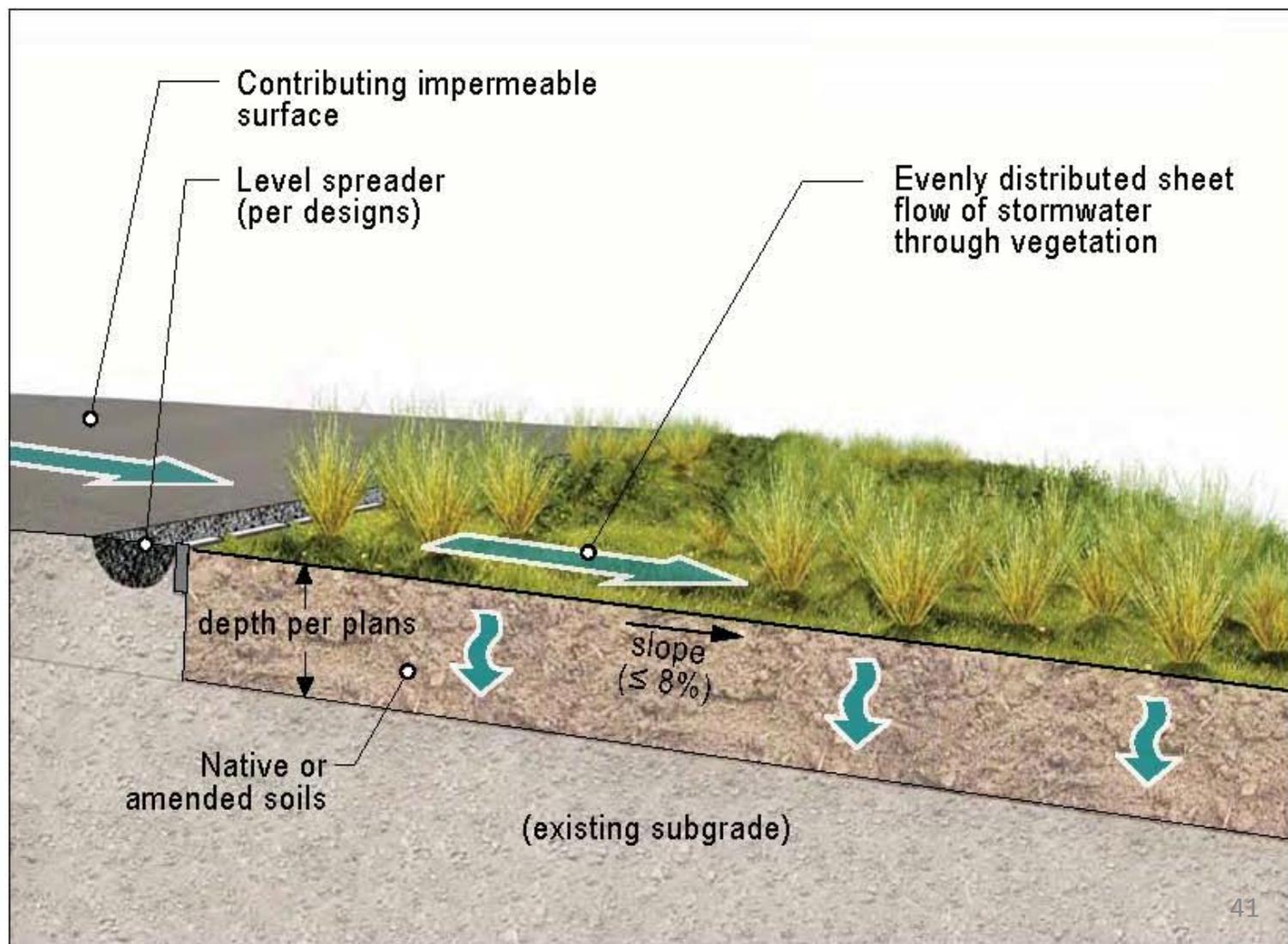
Constructed



Existing



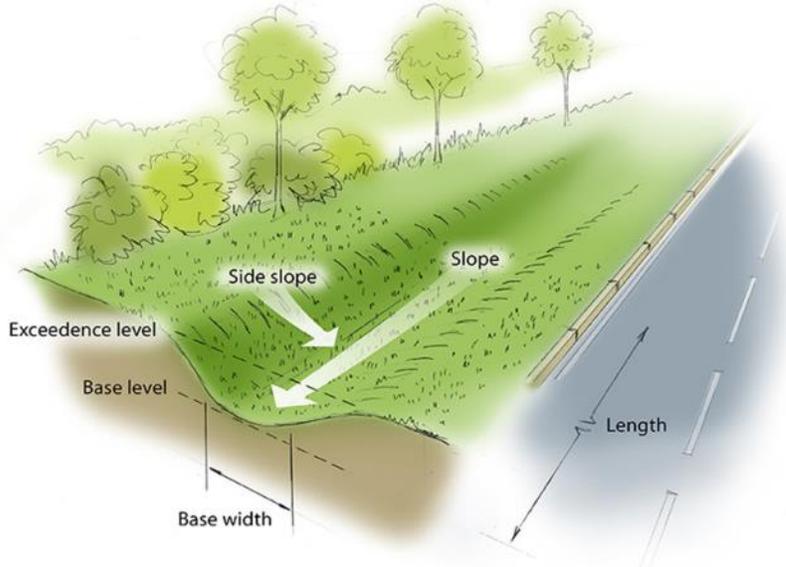
Dispersion



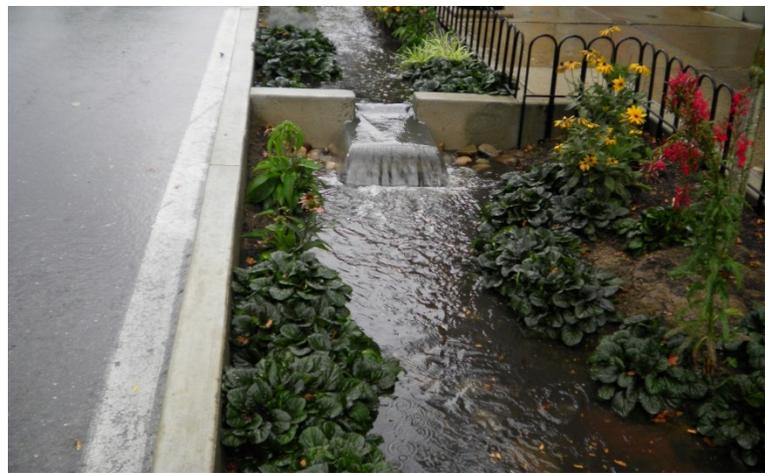


BIO

Bio-Filtration



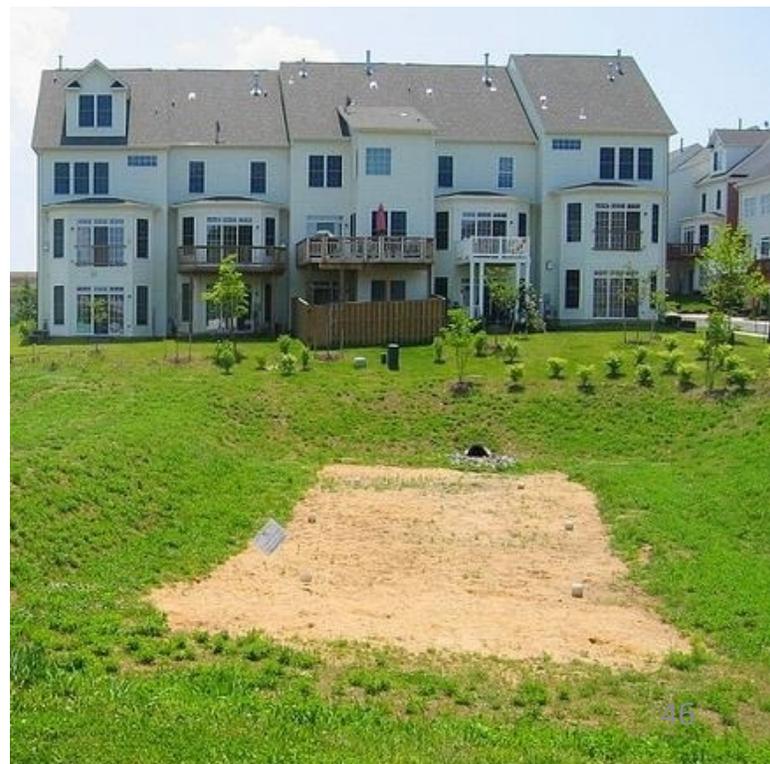
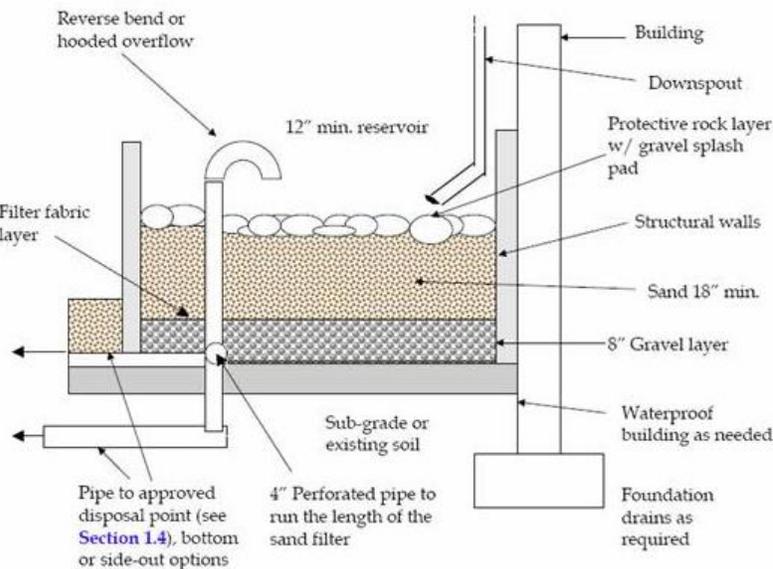
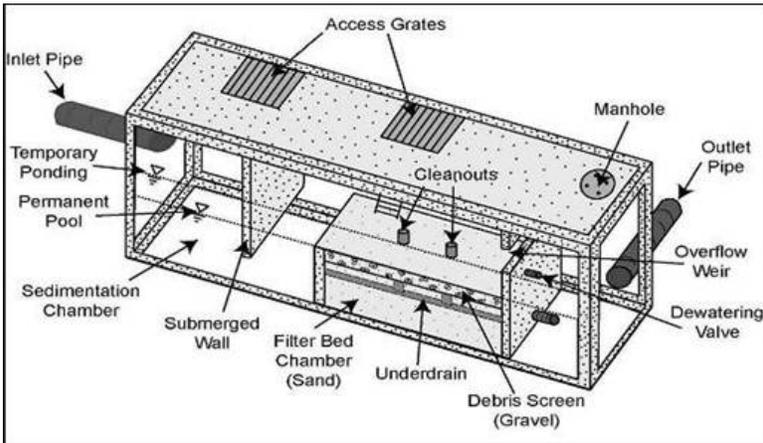
Bio-Retention



Bio-Infiltration



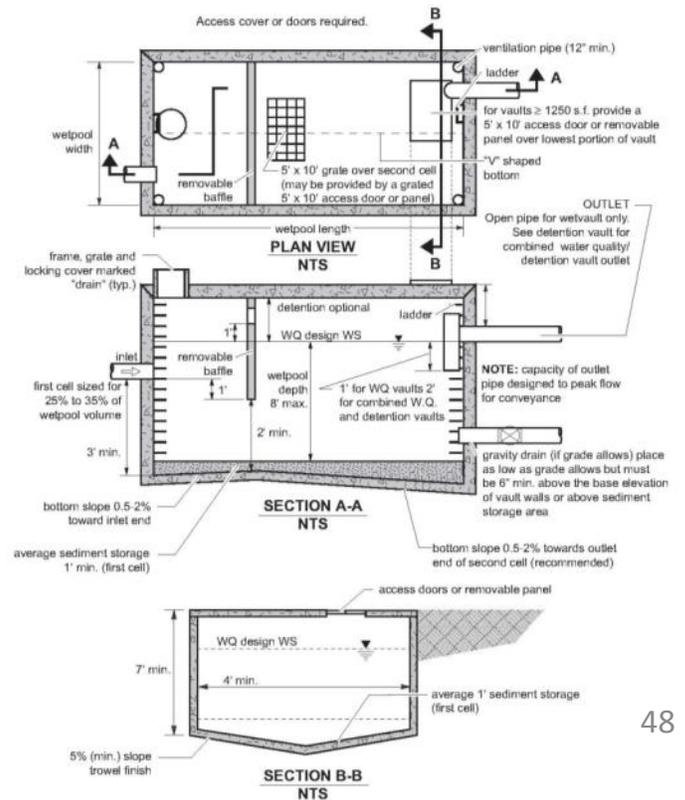
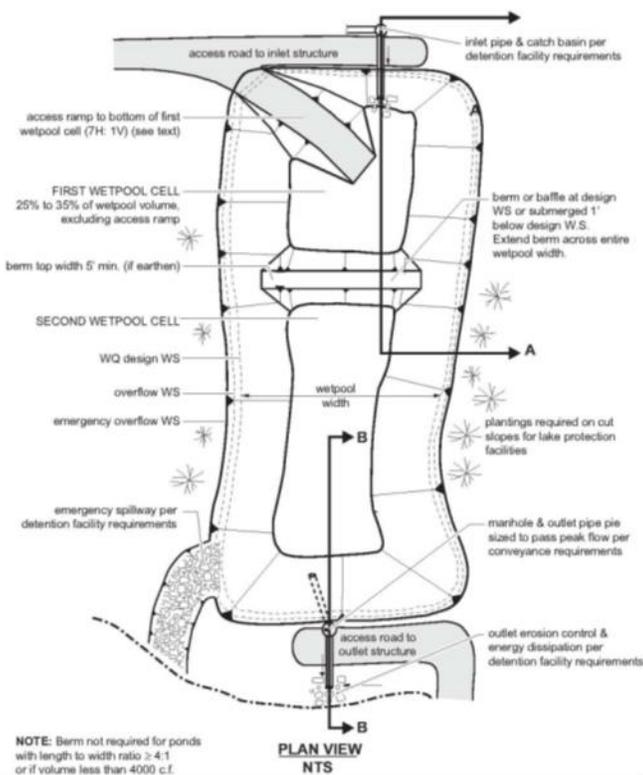
Sand Filtration



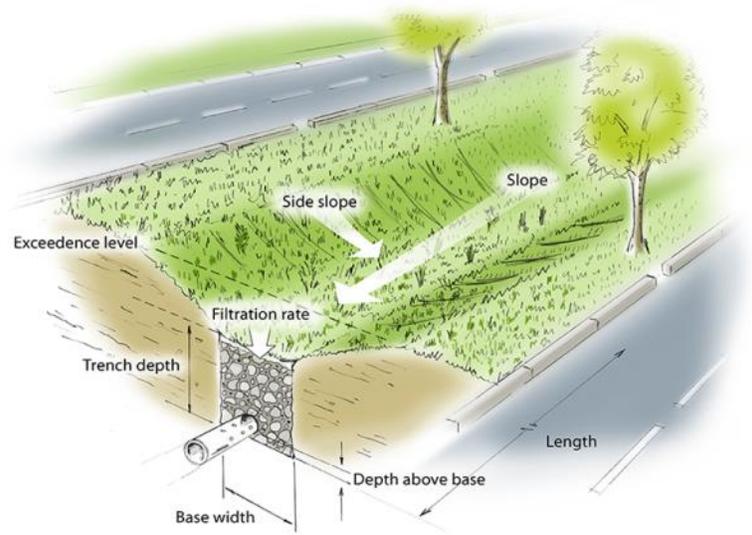
Detention



Wet Pond/Vault



Infiltration



Emerging Technology



LID swales, flow-through planters or infiltration planters

Pedestrian crossing over swale



Flow-through or infiltration planters at corners

Catch basin receives overflows

Permeable pavement in parking lanes

Street trees for shading and stormwater interception

Infiltration planter or flow-through planter (minimum 10' setback from building)

Vegetated roof

Sculptural roof drain (stormwater art)



Flow-through planters (next to building) for run-off from non-vegetated roof areas

Permeable pavers

Disconnected downspout and splash basin

Infiltration or flow-through planter for street, parking, or sidewalk runoff

Permeable pavement

Connect planters for greater capacity and/or convey overflows to receiving drainage system

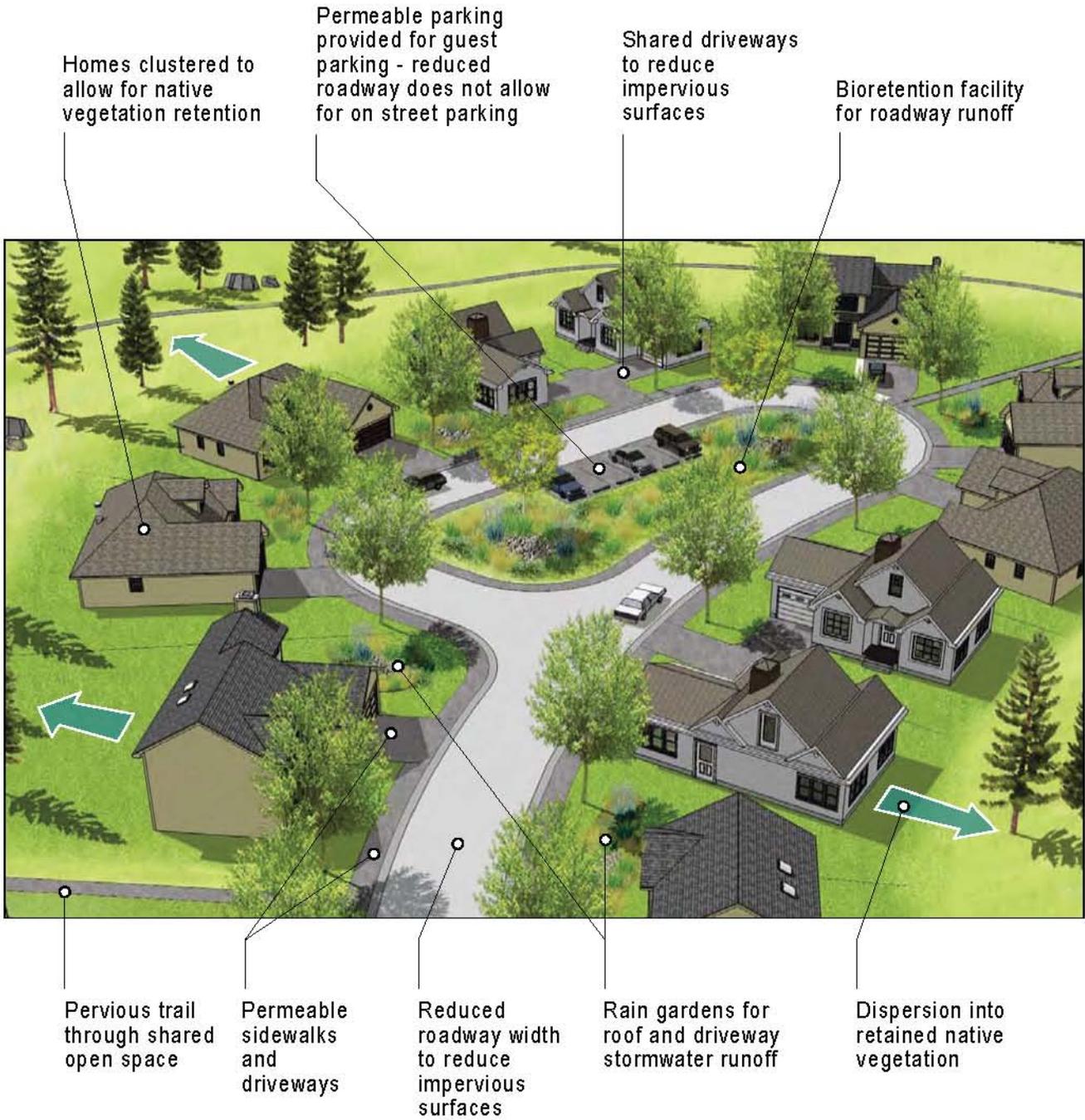


Locate planters at end of parking aisles

Overflow inlet

Permeable paving drains to planters or LID swales

Curb cuts





QUESTIONS?