

Sustainable Yard Designs

Case Studies of Nature-Based Solutions for Stormwater Management



Building Worcester's Resilience to Climate Change

May 11, 2024

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Welcome & Introductions




Janet Moonan, PE
Team Leader





Catherine Druken
Project Landscape Designer


Facilitator: Luba Zhaurova, Dir of Projects, Dept of Sustainability & Resilience, City of Worcester


Agenda

- 2:45  Welcome & Introductions

- 2:50  Understanding Stormwater Flooding & Impacts

- 2:55  Stormwater Solutions for Private Properties

- 3:00  Case Studies

- 3:45  Conclude

Workshop Logistics



We want this to be an open dialogue.
Please raise your hand at any time to ask a question!



We also have dedicated time for
Q&A during various sections of the
presentation.

Understanding Stormwater Flooding & Impacts

Commonly used terms

- Stormwater
- Groundwater
- Impervious Surfaces
- Flooding

Stormwater is runoff from rain and **snowmelt** that flows over land or impervious surfaces and does not soak into the ground.

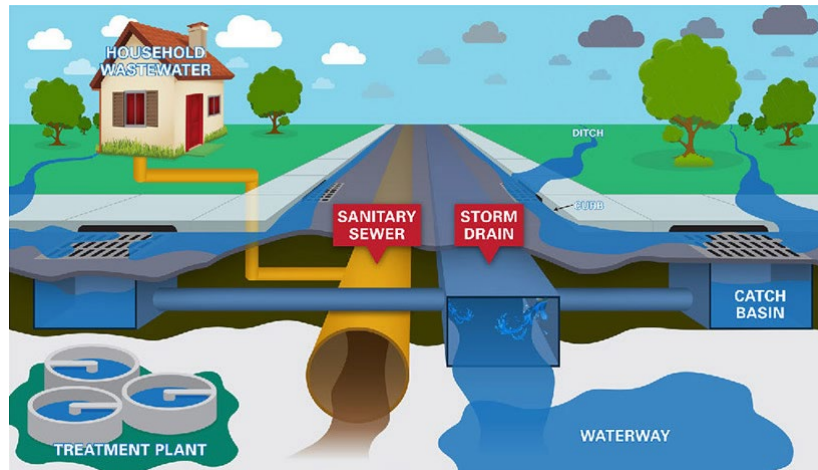


Image credit: U.S. EPA

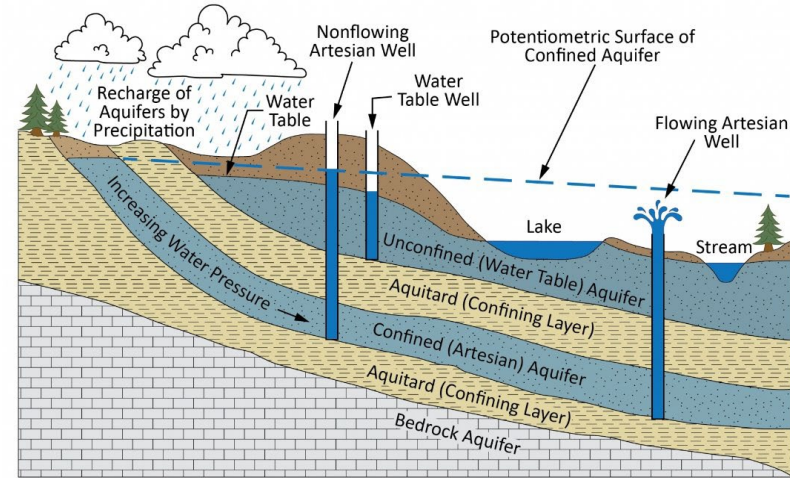
Understanding Stormwater Flooding & Impacts

Commonly used terms

- Stormwater
- Groundwater
- Impervious Surfaces
- Flooding

Groundwater is **water that exists underground in saturated zones beneath the land surface.**

When the water table rises, it rises everywhere across the affected region.



SOURCE: WWW.USGS.GOV/FAQS/WHAT-GROUNDWATER & GEOLOGY.UTAH.GOV/WATER/GROUNDWATER

Understanding Stormwater Flooding & Impacts

Commonly used terms

- Stormwater
- Groundwater
- Impervious Surfaces
- Flooding

Impervious areas include **hard surfaces** that make it difficult for stormwater to soak into the ground (e.g., **roofs driveways, patios, walkways, roads, parking lots, etc.**).

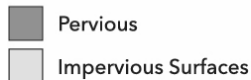
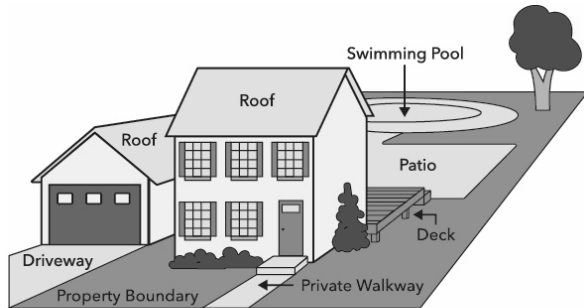


Image credit: City of Savage, MN

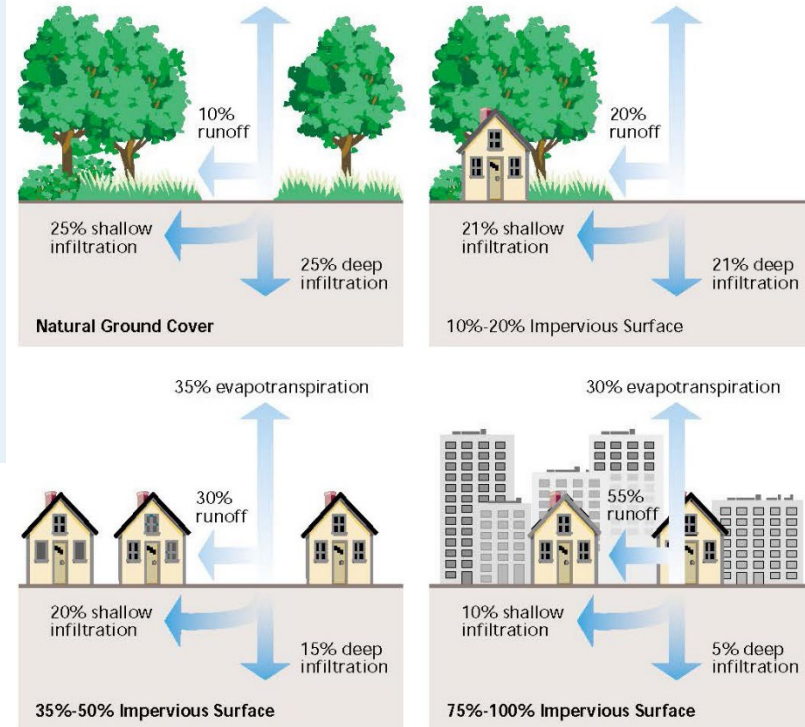


Image credit: U.S. EPA

Understanding Stormwater Flooding & Impacts

Commonly used terms

- Stormwater
- Groundwater
- Impervious Surfaces
- Flooding

Flooding is defined as “the covering or submerging of normally dry land with a large amount of water”. Often this is from excess water that collects in low lying areas during and after rainstorms or significant snowmelt.

Flooding may make roads impassable to vehicles.



Flooding may create a problem for those traveling by foot or bicycle.



Flooding may affect your yard or home.



Understanding Stormwater Flooding & Impacts

Worcester is anticipated to experience increased effects due to precipitation.

- On average, Worcester receives 45 inches of rain a year, now. By 2050, it is predicted Worcester will receive 54 inches of rain a year on average.
- More intense storms are expected.
- It is predicted there will be less snow and more rain and ice storms.

Not only is it anticipated that more rain will come during storms, but there will be longer periods of dryness (drought).

“There are 6,909 properties in Worcester at risk of flooding over the next 30 years. This represents 16.4% of all properties in Worcester”



SOURCE: (WORCESTER, MA FLOOD MAP AND CLIMATE RISK REPORT | RISK FACTOR) CDR.UMD.EDU (THE GROWING THREAT OF URBAN FLOODING: A NATIONAL CHALLENGE 2018, PHOTO BY BILL KOPLITZ/FEMA)



Any Questions?

Stormwater Solutions for Private Properties



REDUCE IMPERVIOUS SURFACES

Replacing impervious surfaces with permeable driveways, planted areas, and other options that infiltrate or absorb water can significantly reduce stormwater problems.

BUILD RAIN GARDENS

Rain gardens are specially designed and planted depressions in the ground that collect, filter, and treat stormwater.

BASEMENT FLOOD REDUCTION PRACTICES

It is important to understand the source of flooding which can come from stormwater, groundwater, or both. Examples for stormwater mitigation include downspout extensions, foundation drains, and waterproofing.

PLANT TREES

Trees play a significant role in the water cycle through processes like interception, retention, infiltration, and transpiration. Large trees can capture and retain up to 332 gallons of water per storm event, which contributes to reduced surface runoff and enhanced groundwater recharge.

INSTALL VEGETATED BUFFERS

Trees, shrubs, high grasses, perennials, and other vegetation can be strategically planted to help slow, capture, and filter runoff and reduce stormwater impacts.

PIPED CONVEYANCE AND STORAGE

Adding gutters and downspouts to the home can help capture, redirect and channel water away from built structures. A variety of approaches using closed and perforated piping can be utilized. Cisterns and dry wells can be used to store water, too.

INSTALL CONVEYANCE SWALES

Vegetated swales are channels with moisture-loving plants and amended soils that intercept, treat, and slowly convey stormwater runoff to where it can be effectively infiltrated.

SOURCE: WWW.MASS.GOV (COASTAL ZONE MANAGEMENT) & EPA

Reduce Impervious Surfaces



SOURCE: WWW.EPA.GOV/CT

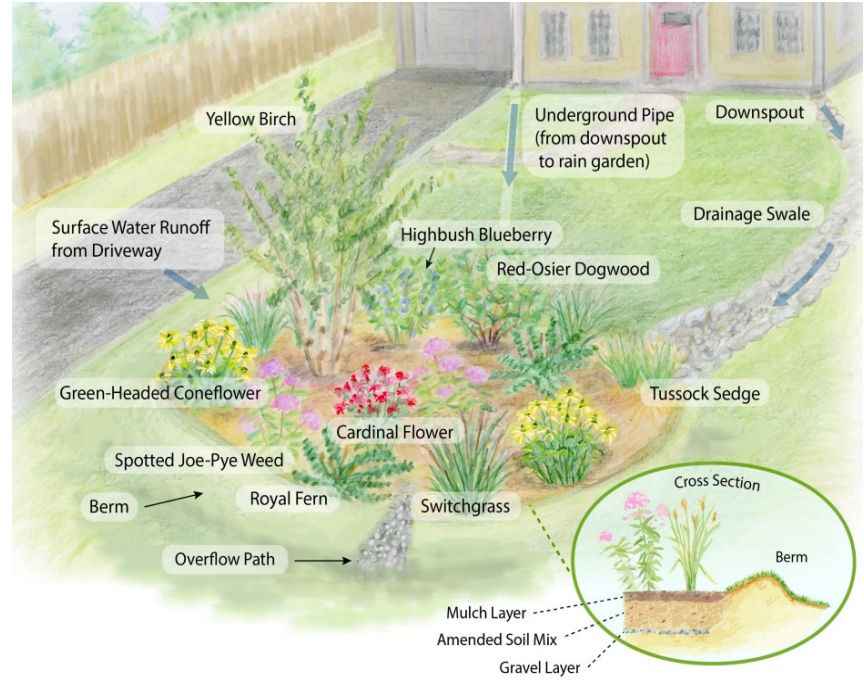


SOURCE: Wikipedia.com

Rain Gardens



SOURCE: WWW.MASS.GOV



SOURCE: WWW.AWWATERSHEDS.ORG

Install Conveyance Swales

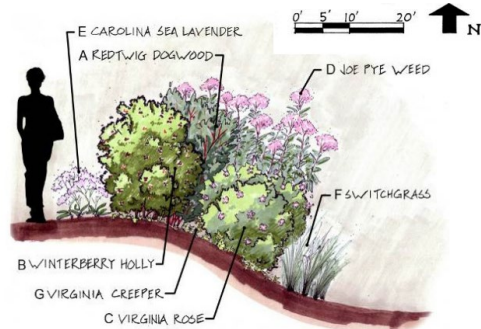


SOURCE: [AFTERWILDFIRENM.ORG/POST-FIRE-TREATMENTS/TREATMENT-DESCRIPTIONS/CHANNEL-TREATMENTS/CHECKDAM](https://afterwildfirenm.org/post-fire-treatments/treatment-descriptions/channel-treatments/checkdam)

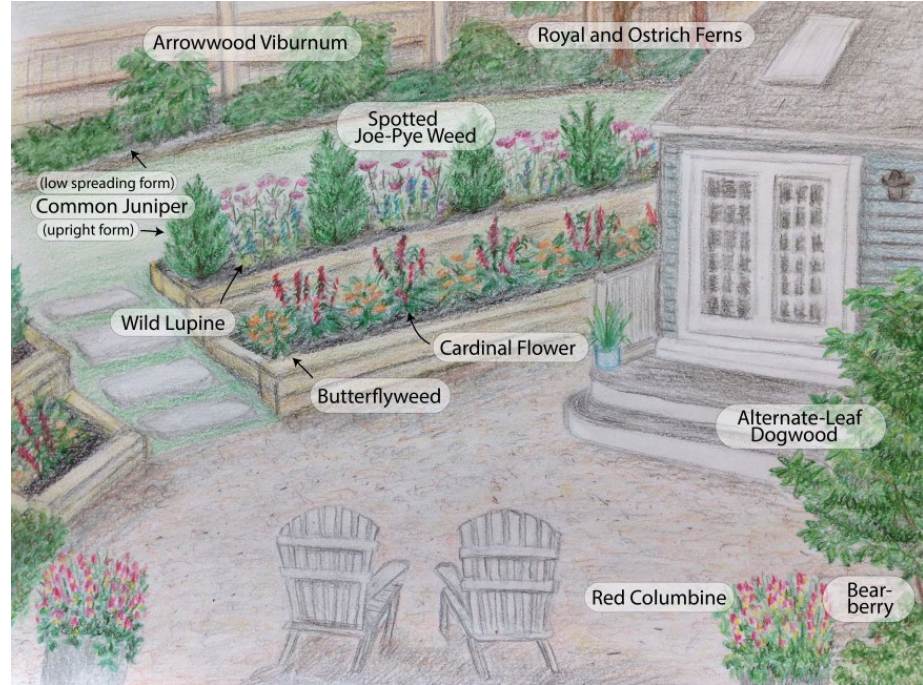


SOURCE: WWW.MASS.GOV (COASTAL ZONE MANAGEMENT)

Install Vegetated Buffers



SOURCE: WWW.GROWNATIVEMASS.ORG (UNIVERSITY OF RHODE ISLAND NATIVE PLANT SITE SOLUTIONS)

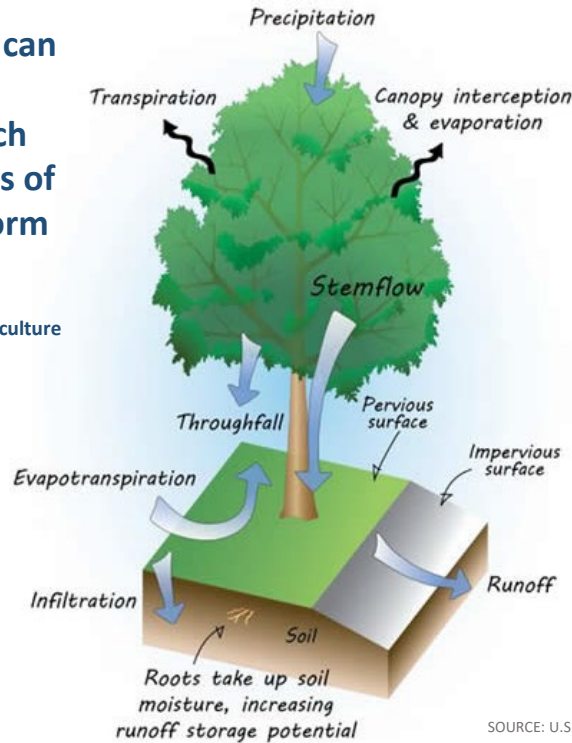


SOURCE: WWW.MASS.GOV (COASTAL ZONE MANAGEMENT)

Plant Trees

"A large tree can capture and retain as much as 332 gallons of water per storm event."

US Department of Agriculture



SOURCE: U.S. EPA



SOURCE: WWW.WORCESTERCONSERVATION.ORG

Co-Benefits of Natural Stormwater Solutions

- ✓ Improve local water quality
- ✓ Reduce localized temperatures
- ✓ Improve/create wildlife habitat
- ✓ Foster biodiversity
- ✓ Add pollinators
- ✓ Increase local property values

- ✓ Improve local air quality
- ✓ Sequester carbon
- ✓ Visually pleasing
- ✓ Reduce noise from traffic/roads
- ✓ Improve physical and mental health
- ✓ Create outdoor spaces (a.k.a. "placemaking")

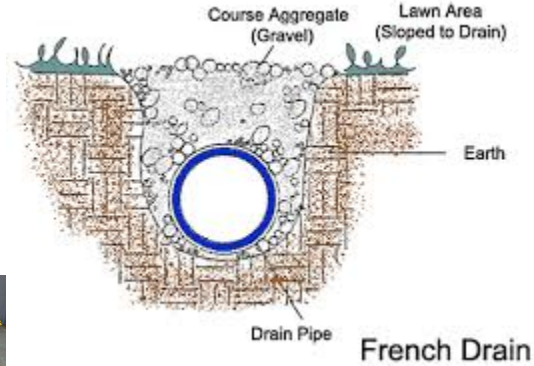
Piped Conveyance and Storage



SOURCE: US EPA



<https://www.pwdraincheck.org/en/stormwater-tools/metal-downspout-planters>



SOURCE: WWW.AWWATERSHEDS.ORG (ACTON WAKEFIELD WATERSHEDS ALLIANCE, NEW HAMPSHIRE)

Basement Flood Reduction Practices

Interior Perimeter Drains

Capture water at the basement's perimeter and directing it away.

Sump Pumps and Sumps

Collecting and ejecting water outside the home through use of sump pumps.

Dryproofing with Hydraulic Cement

Use of hydraulic cement to seal cracks and voids in concrete to prevent water entry.

Foundation Drains (Exterior)

Strategically placed drains prevent water from pressing against exterior walls.

Downspout Extension

Extend downspouts to carry roof runoff away from the foundation.

Drywells for Downspouts

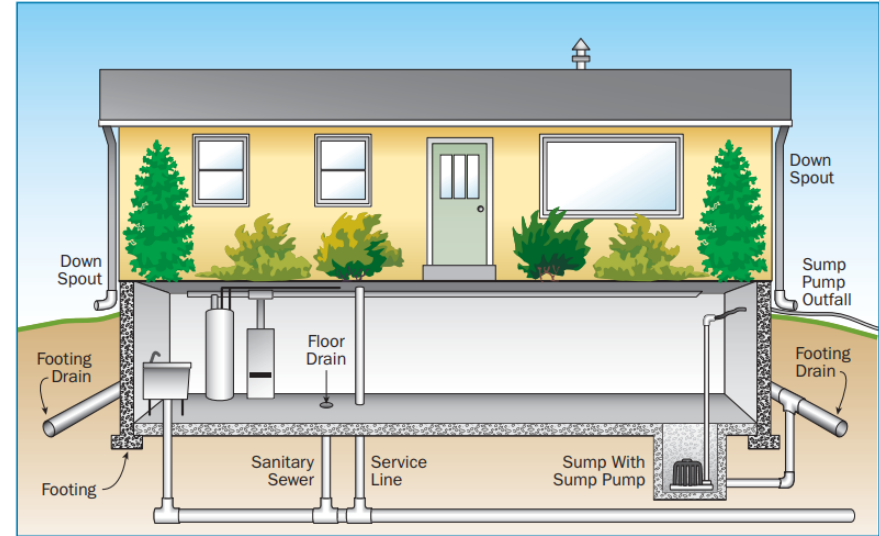
Use of drywells to manage water from downspouts by facilitating underground dispersal.

Rain Barrels/Cisterns

Capturing and storing rainwater to reduce runoff and provide a water source for landscaping.

Grading & Drainage

Ensure water flows away from foundation rather than accumulating in place.



Typical basement drain and sewer arrangement.

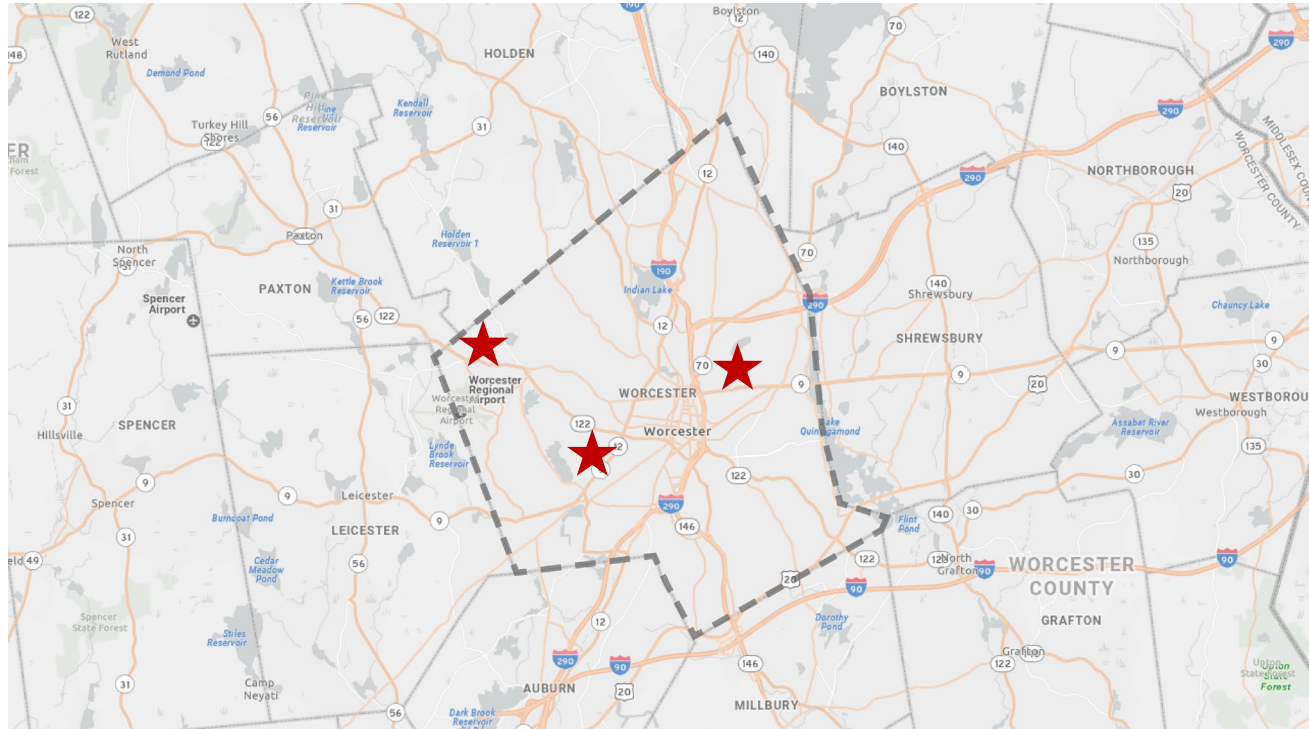
Note: The floor drain may or may not be connected to the sanitary sewer line.

SOURCE: WWW.FEMA.GOV/PDF/FIMA/FEMAS11-COMPLETE.PDF



Any Questions?

Case Studies



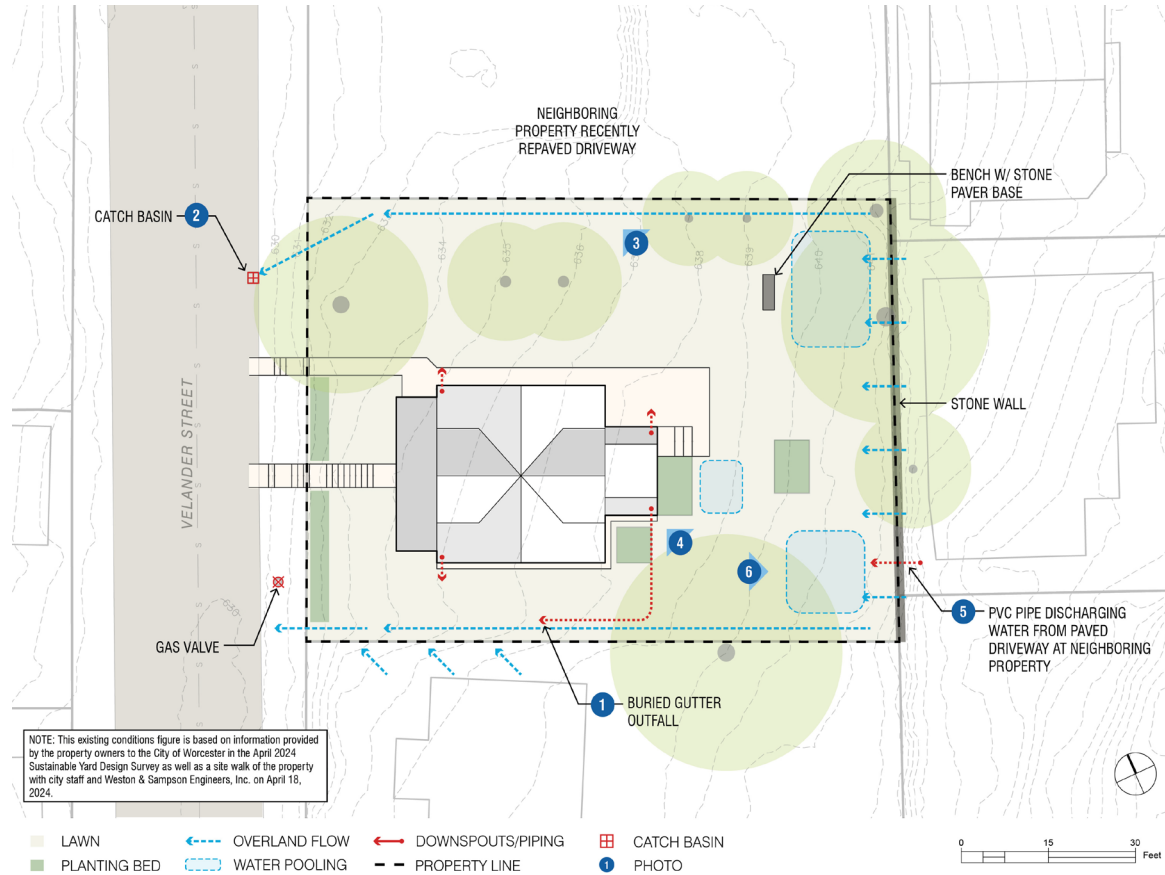
SOURCE:
WWW.MASSGIS.MA
PS.ARCGIS.COM

Case Study 1



SOURCE:
WWW.MASSGIS.MA
PS.ARCGIS.COM

Case Study 1: Existing Conditions



Case Study 1: Existing Conditions



1 GUTTER OUTLET ALONG SOUTH EDGE OF PROPERTY



2 CATCH BASIN ALONG VELANDER STREET CAPTURES WATER COMING OFF NORTH EDGE OF PROPERTY



3 WATER RUNS ALONG NORTH EDGE OF PROPERTY



4 BURIED GUTTER AT SE CORNER OF HOUSE

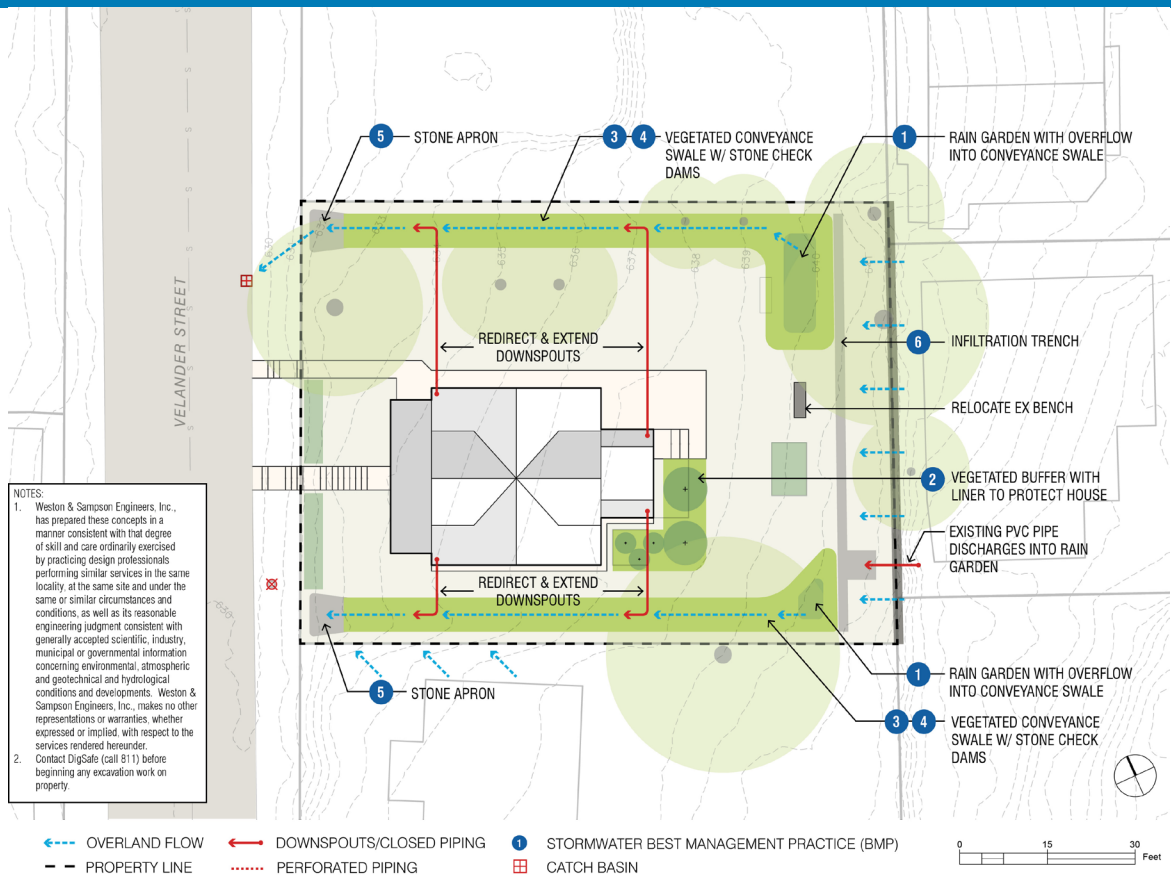


5 PVC PIPE DISCHARGING WATER FROM PAVED DRIVEWAY AT NEIGHBORING PROPERTY



6 POOLING IN BACK YARD

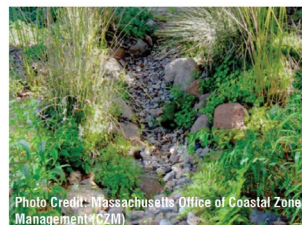
Case Study 1: Proposed Concept Sketch



1 RAIN GARDEN



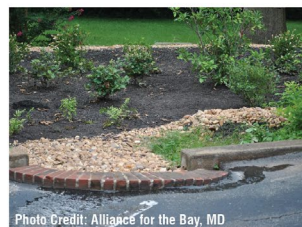
2 VEGETATED BUFFER



3 VEGETATED CONVEYANCE SWALE



4 STONE CHECK DAM

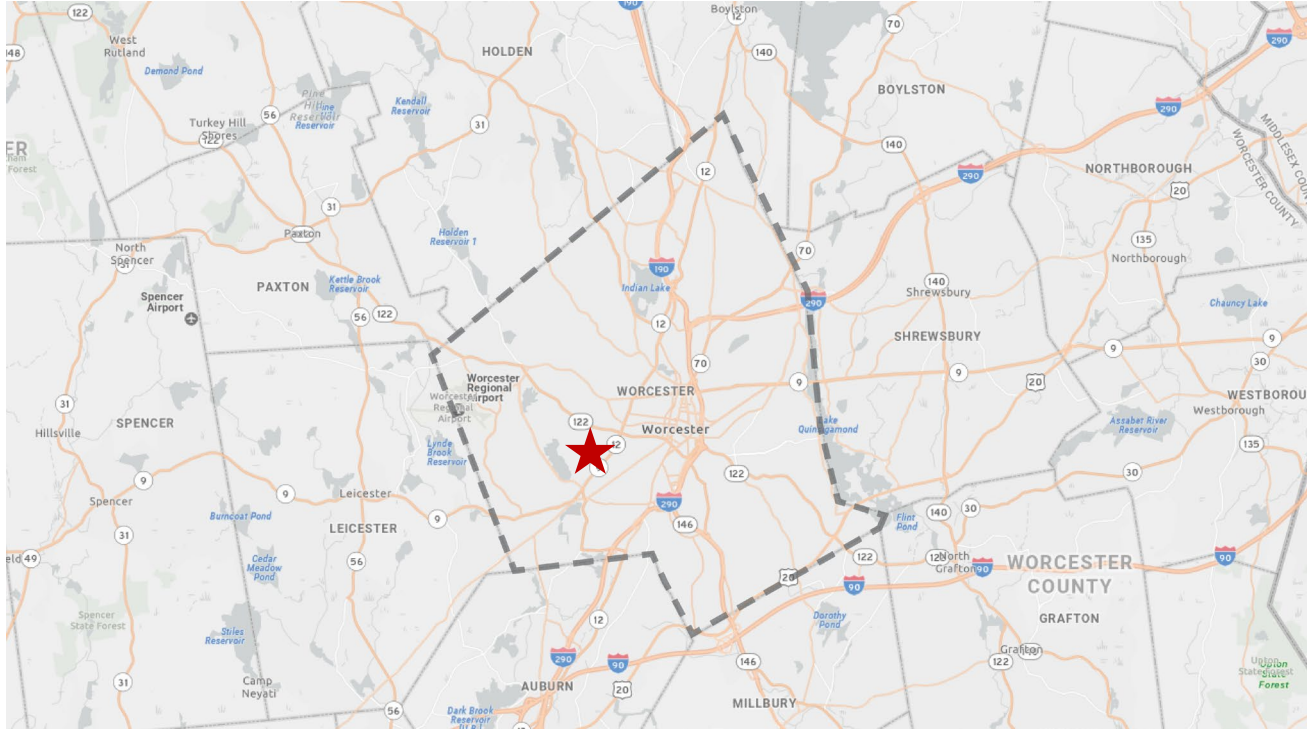


5 STONE APRON



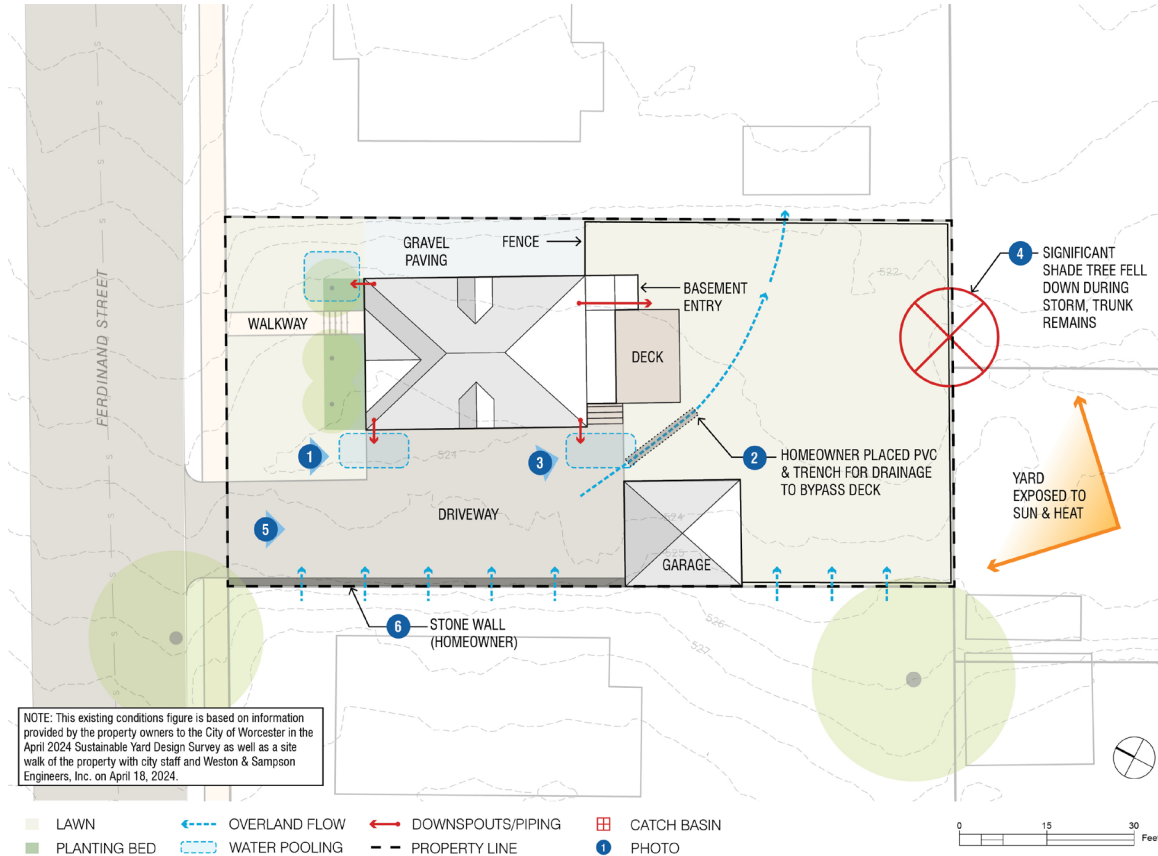
6 INFILTRATION TRENCH

Case Study 2



SOURCE:
WWW.MASSGIS.MA
PS.ARCGIS.COM

Case Study 2: Existing Conditions Plan



Case Study 2: Existing Conditions Plan



1 WATER POOLING AT DRIVEWAY



2 HOMEOWNER PLACED PVC & TRENCH FOR DRAINAGE TO BYPASS DECK



3 EROSION AND WATER DAMAGE AT BASE OF DECK



4 SIGNIFICANT SHADE TREE FELL DOWN DURING STORM, TRUNK REMAINS

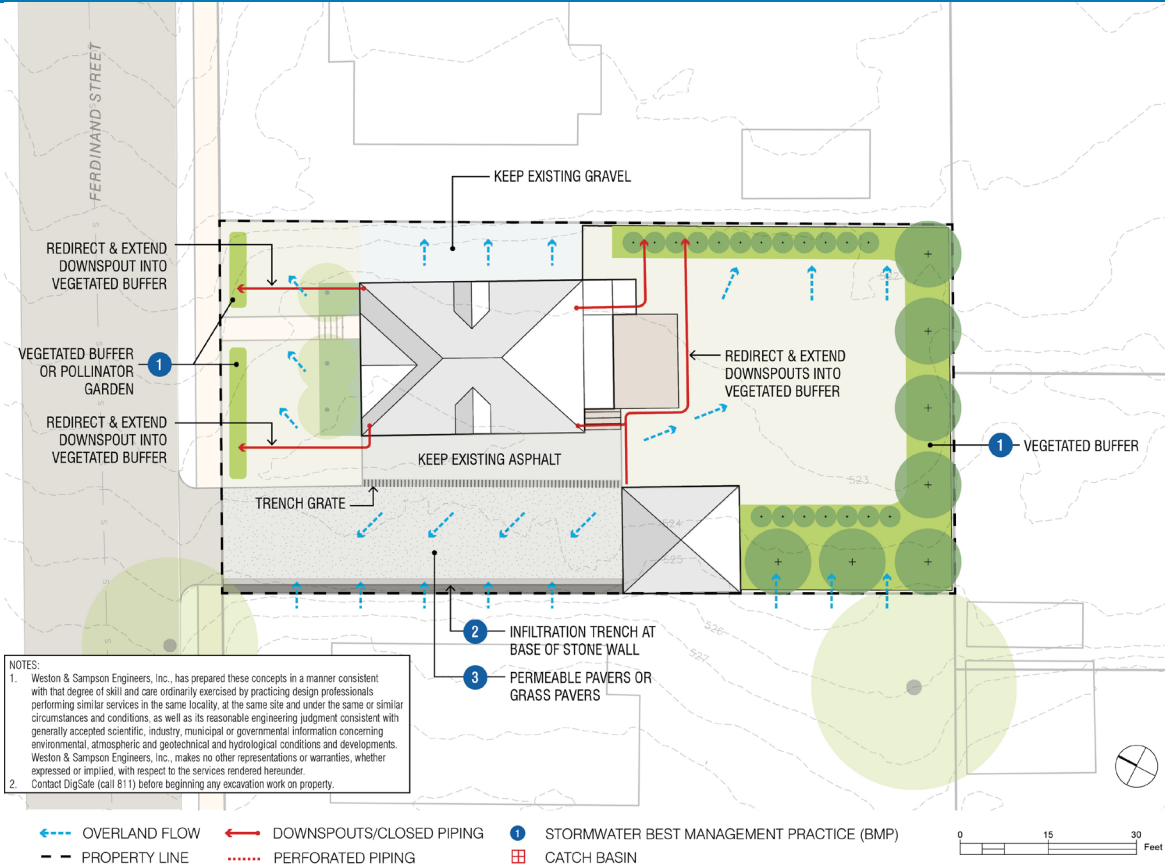


5 SIGNS OF WATER POOLING IN ASPHALT DRIVEWAY



6 WATER RUNOFF FROM NEIGHBORING PROPERTY ALONG STEEP SLOPE

Case Study 2: Proposed Concept Sketch



1 VEGETATED BUFFER



2 INFILTRATION TRENCH

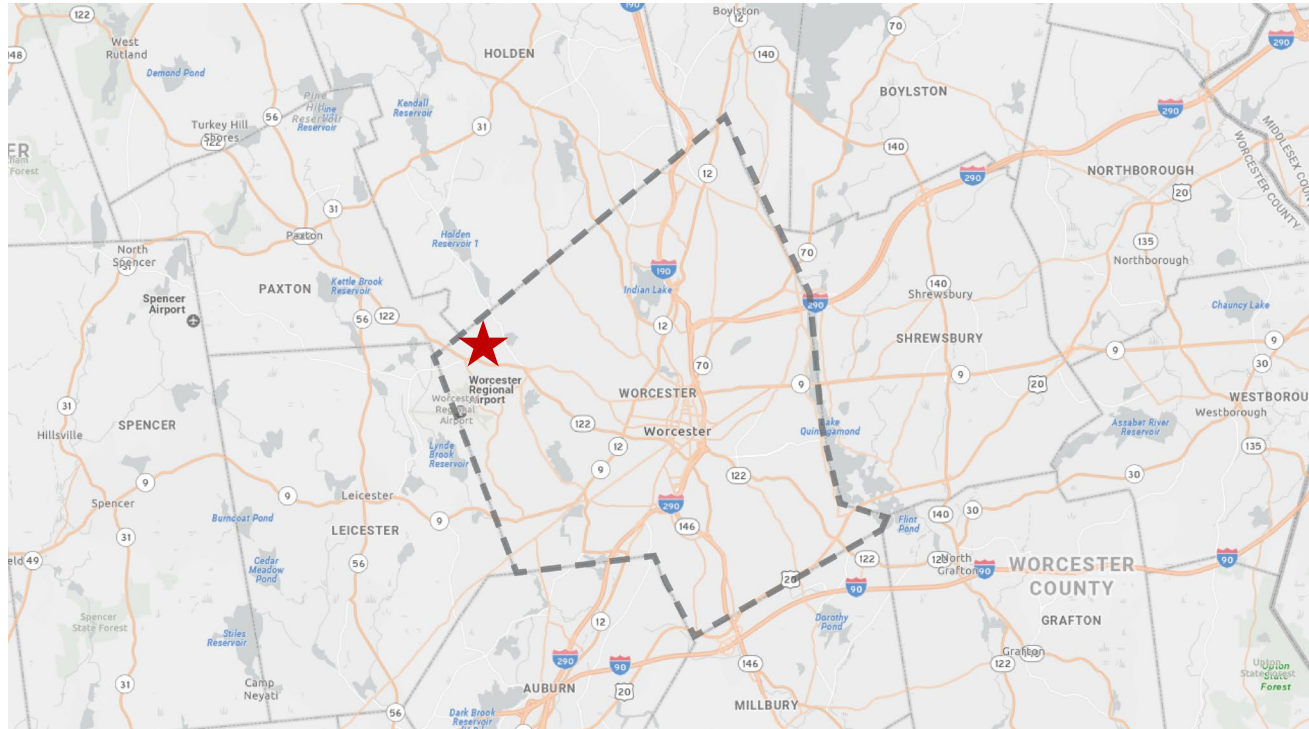


3 PERMEABLE PAVERS



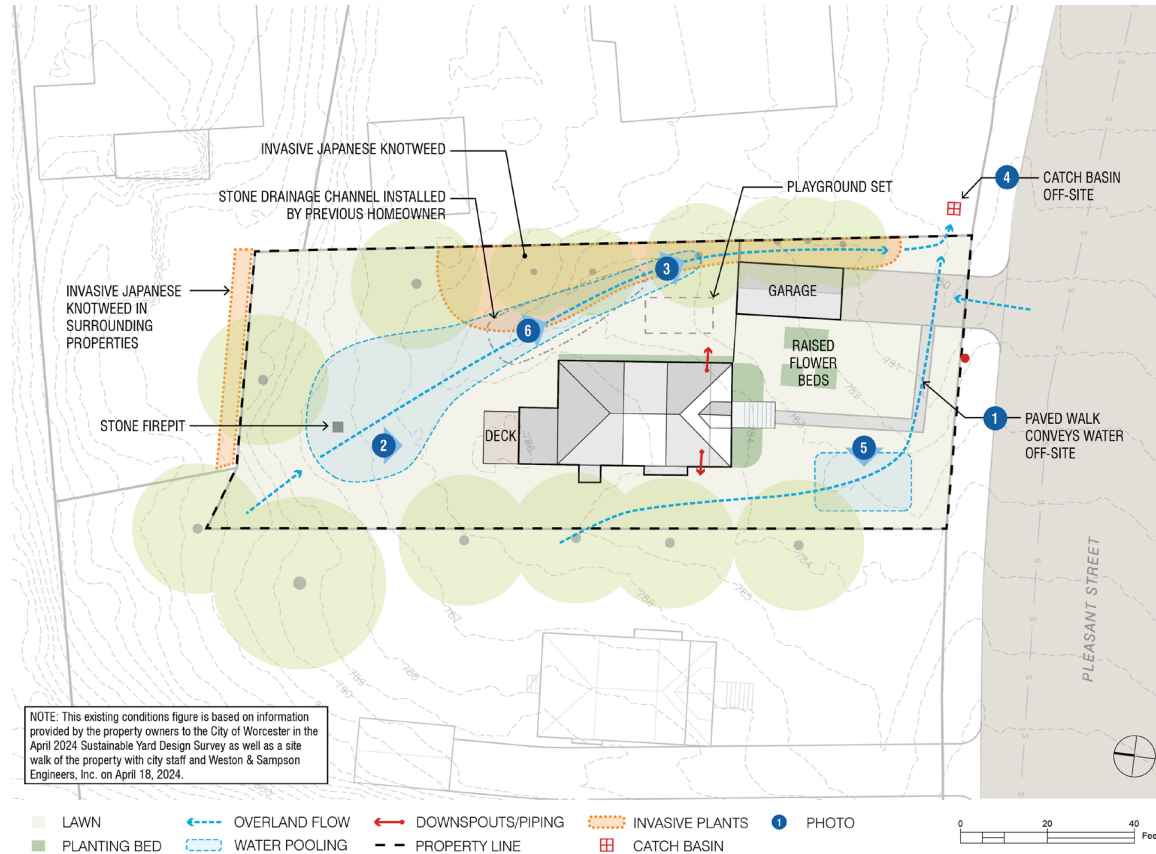
4 TRENCH GRATE

Case Study 3



SOURCE:
WWW.MASSGIS.MA
PS.ARCGIS.COM

Case Study 3: Existing Conditions Plan



Case Study 3: Existing Conditions Plan



1 PAVED WALK CONVEYS WATER OFF-SITE



2 SIGNIFICANT WATER IN BACK YARD



3 WATER RUNS ALONG NORTH EDGE OF PROPERTY
TOWARDS CATCH BASIN BEYOND



4 CATCH BASIN OUTSIDE OF PROPERTY

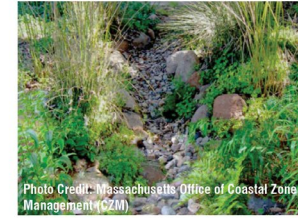
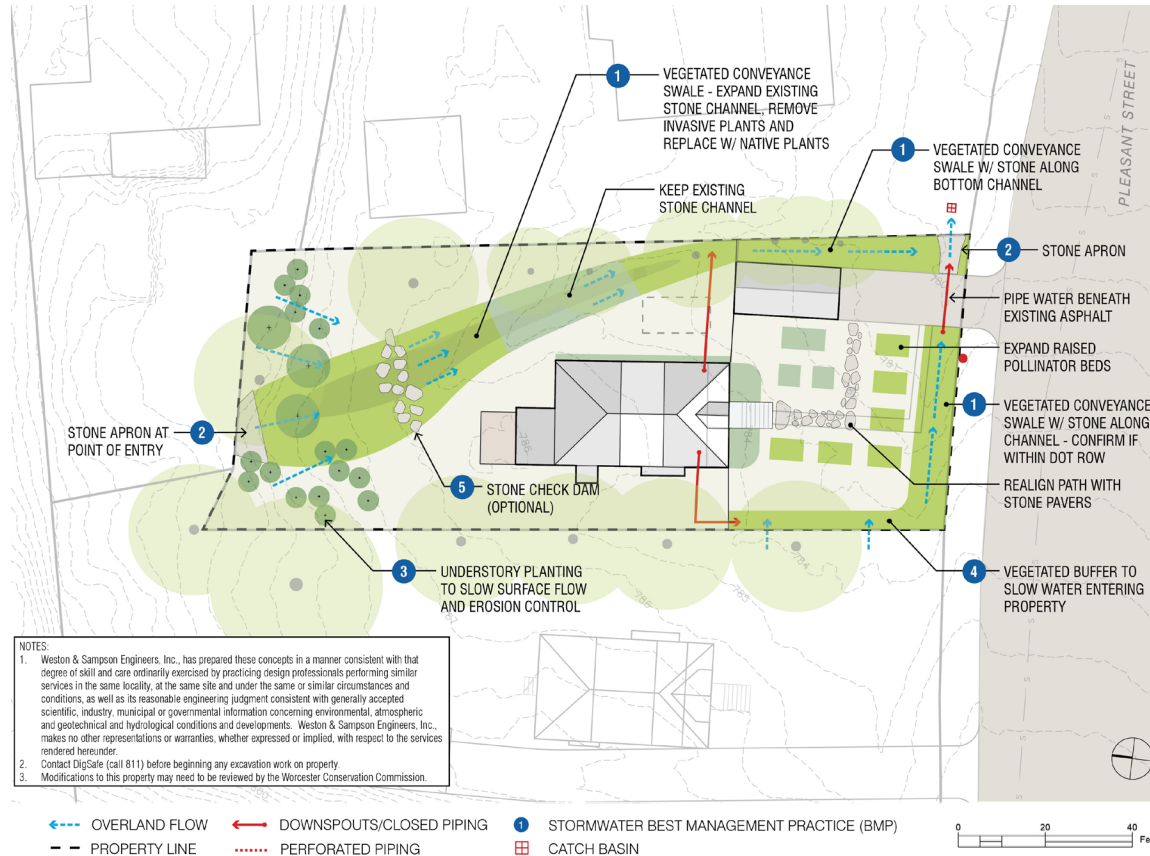


5 WATER POOLING IN FRONT OF HOUSE



6 STONE DRAINAGE CHANNEL INSTALLED BY PREVIOUS
HOMEOWNER AND INVASIVE JAPANESE KNOTWEED
THROUGHOUT BACK YARD

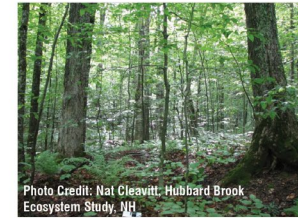
Case Study 3: Proposed Concept Sketch



1 VEGETATED CONVEYANCE SWALE



2 STONE APRON



3 UNDERSTORY PLANTING FOR EROSION CONTROL



4 VEGETATED BUFFER



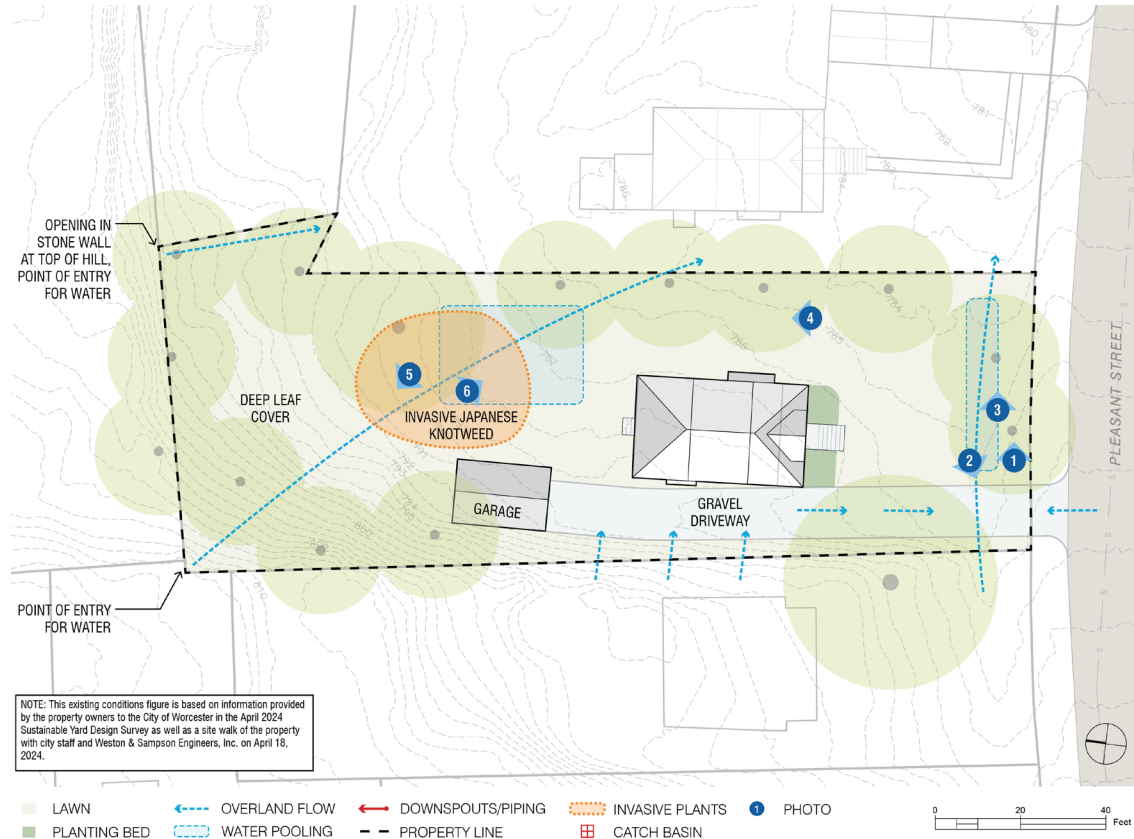
5 STONE CHECK DAM

Case Study 4



SOURCE:
WWW.MASSGIS.MA
PS.ARCGIS.COM

Case Study 4: Existing Conditions Plan



Case Study 4: Existing Conditions Plan



1 WATER CHANNEL ALONG FRONT OF PROPERTY TOWARDS CATCH BASIN BEYOND



2 WATER SHEETING FROM ROAD AND DRIVEWAY TOWARDS CHANNEL



3 SIGNIFICANT WATER POOLING IN FRONT OF PROPERTY



4 PATH OF WATER ALONG SHADY EDGE OF PROPERTY

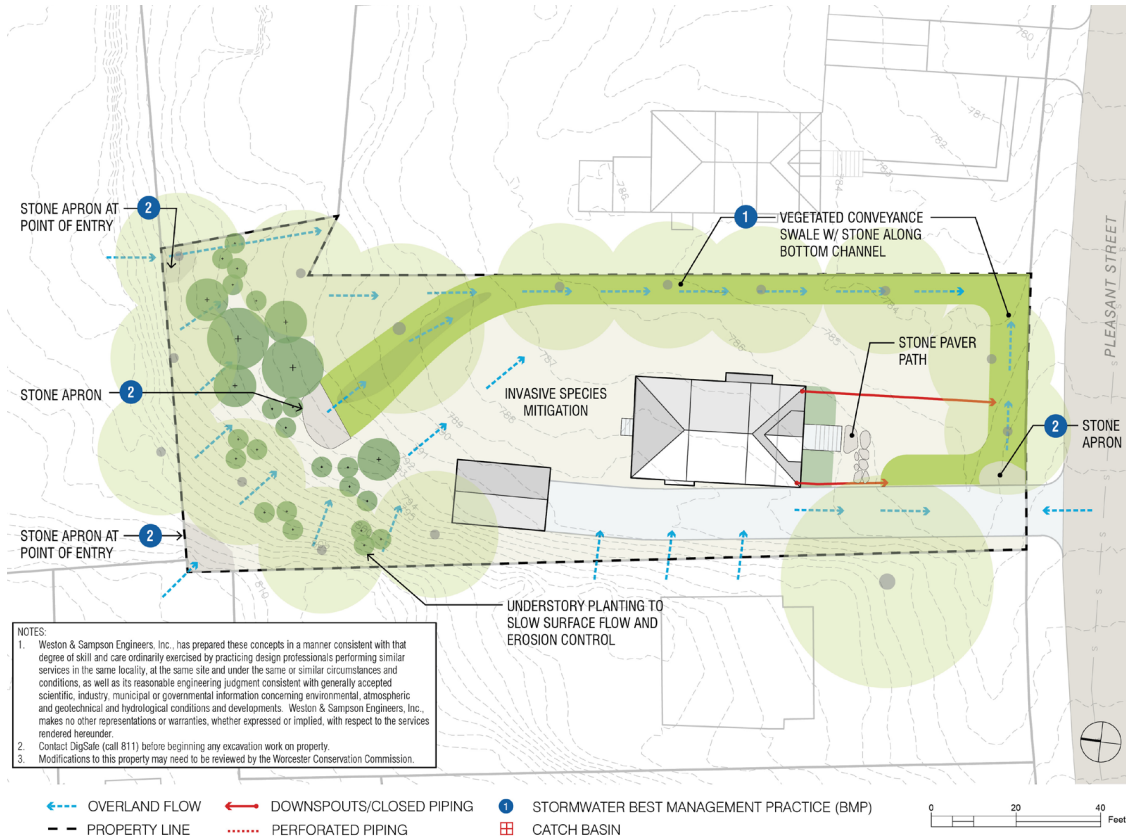


5 DEEP LEAF LITTER ALONG STEEP SLOPE AT BACK OF PROPERTY



6 INVASIVE JAPANESE KNOTWEED AND WATER POOLING IN BACK YARD

Case Study 4: Proposed Concept Sketch



1 VEGETATED CONVEYANCE SWALE

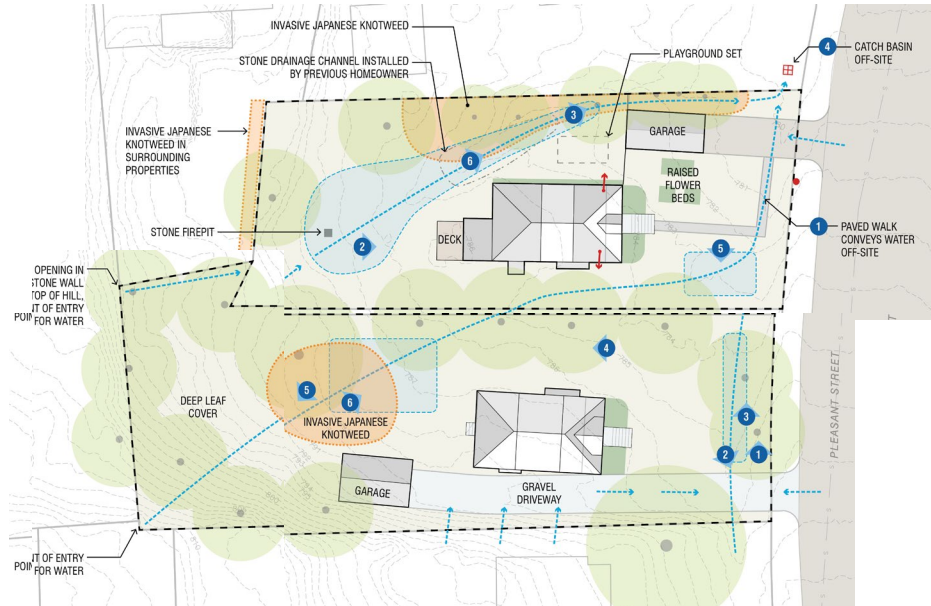


2 STONE APRON



3 UNDERSTORY PLANTING FOR EROSION CONTROL

Water Doesn't Respect Boundaries



KEY TAKEAWAYS

- Water will always choose the path of least resistance, no matter the boundary on a map.
- Working with neighbors is an opportunity for a greater chance of success.

Working Together



KEY TAKEAWAYS

- Collaborations like this can serve as a model within your own neighborhood.

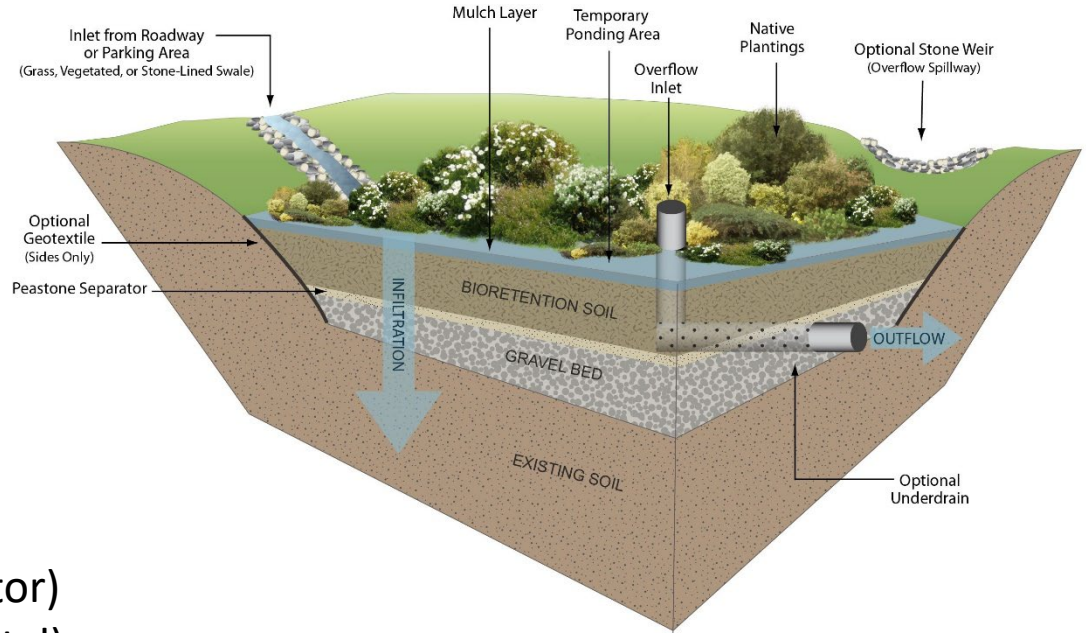
Cost Considerations

Materials:

- Soil mediums and mulch
- Stone mediums and paving
- Downspouts and extensions
- Trees and shrubs
- Perennials and groundcovers
- Seed mixes

Don't forget to consider:

- Your time
- Labor costs (e.g. landscape contractor)
- Equipment costs (e.g. excavator rental)
- Maintenance costs (e.g. Initial watering period for plant establishment)



Source: MA Clean Water Toolkit, Geosyntec

Considerations for Planting

Right plant, right place.

UMASS Extension Landscape, Nursery and Urban Forestry Program guidelines for selecting landscape plants.

Site Considerations

- light availability, intensity and duration (full sun to deep shade)
- water availability, both quantity and quality
- exposure to wind and temperature extremes soil type, drainage, compaction
- hardiness zone
- competition from existing vegetation
- below ground conditions in urban sites
- above ground wires or obstructions.

Aesthetic Considerations

- Growth habit, i.e. pyramidal, columnar, spreading, etc.
- season and color of bloom
- foliage color, texture, and shape
- winter interest of bark, fruit, or structure
- benefits to wildlife
- fall color
- longevity



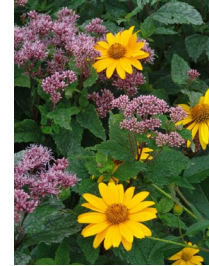
SOURCE: AG.UMASS.EDU/LANDSCAPE/FACT-SHEETS

IMAGE SOURCES: WWW.NATIVEPLANTTRUST.ORG & WWW.MISSOURIBOTANICALGARDEN.ORG

Resources for Planting

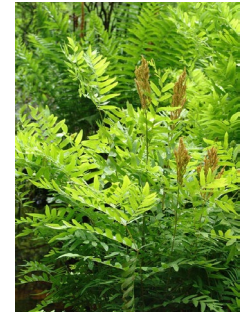
Plant Selections by Function

- **Pollinator Garden** (massnrc.org/ppd/)
- **Rain Garden** (mass.gov/info-details/stormwater-solutions-for-homeowners)
- **Understory Planting for Erosion Control** (mass.gov/info-details/stormwater-solutions-for-homeowners)
- **Vegetated Buffer** (mass.gov/info-details/stormwater-solutions-for-homeowners)
- **Vegetated Swale** (mass.gov/info-details/stormwater-solutions-for-homeowners)



Where to Purchase Native Plants

- **Grow Native Massachusetts** (gownativemass.org/Great-Resources/nurseries-seed)
- **Native Plant Trust** (nativeplanttrust.org)
- **Native Plant Initiative** (apcc.org/our-work/education/native-plant-initiative/)
- **Blue Stem Natives** (bluestemnatives.com)
- **New England Wetland Plants** (newp.com)
- **Tree Talk Natives** (treetalknatives.com)
- **American Beauties Native Plants** (abnativeplants.com)
- **Lady Bird Johnson Wildflower Center** (wildflower.org)
- **National Nursery and Seed Directory** (npn.rngr.net/resources/directory)
- **Arbor Day Foundation** (arborday.org)



SOURCE: WWW.GROWNATIVEMASS.ORG



Any Questions?

thank you



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