



SKYline
est. 1957 MINNESOTA

Water Mitigation Committee Open House

April 16, 2026



This information is being provided as an educational resource to Skyline Community members. Please note that the views and information provided in these slides was put together by individual water mitigation committee members. Each individual's perspective does not necessarily reflect the consensus of the committee and does not reflect any official stances by the City of Skyline. Community members are encouraged to reach out to committee members for more information.

Agenda

6-6:30 Visit Info & Feedback Tables, Plate up and settle in

6:30-8 Presentations

- Background & issues (Joanne)
- Tile system, ownership, and easements (Nancy)
- Tile condition, past maintenance, proposed future maintenance (Jim)
- Homeowner's survey results and high-level findings (Janet)
- Homeowner's guide - strategies for your property (Rob & Jen)
- Home basement waterproofing (Nick Barke, Complete Basements)
- Landscaping, vegetation, and soil health strategies (Joanne)
- Q&A

8-8:30 Visit Info & Feedback Tables, Fill out feedback forms



Background

Volunteer committee:

Nancy Kluck, Janet Nelson, Jim Attarian, Jen Heimer, Rob Pipal, Joanne Boettcher

Committee goal:

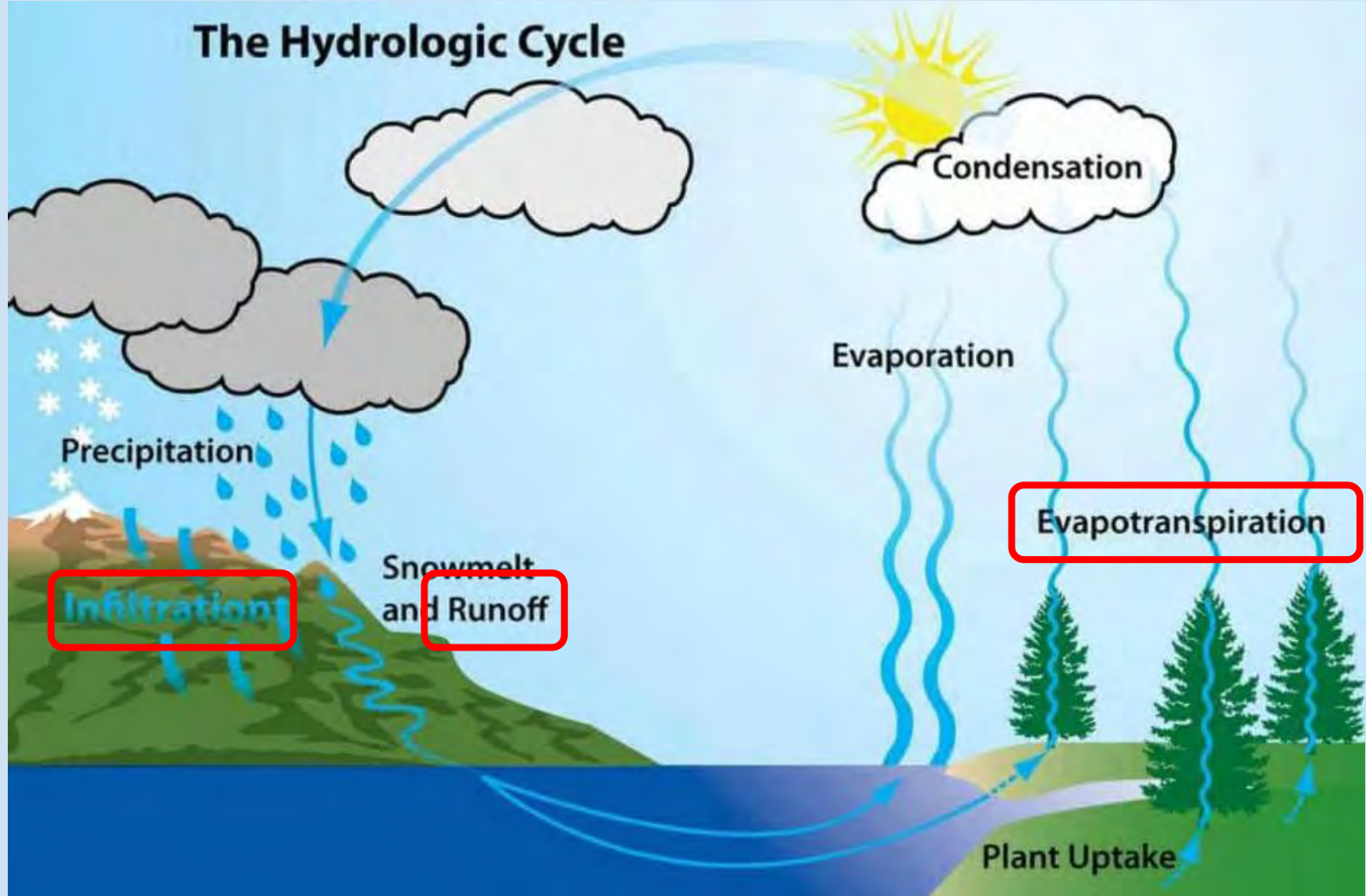
Develop and share strategies to help residents and ideas for City Council to consider



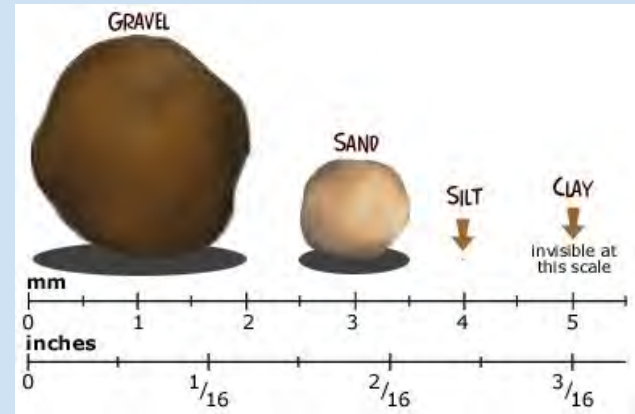
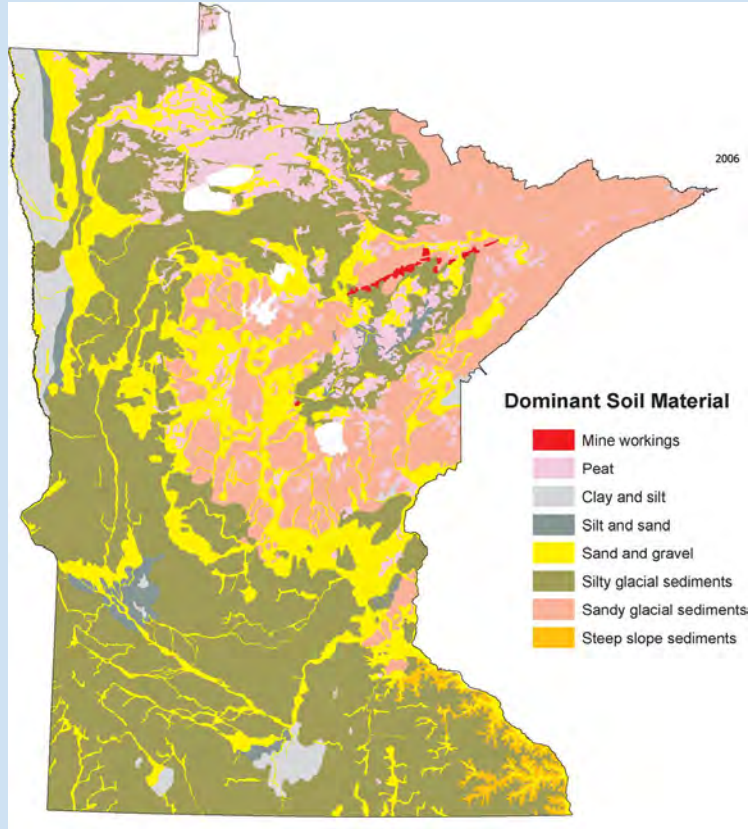
Many things contribute to Flooding Issues in Skyline

- “Heavy” (clay and loam) soils and high water table
- Increases in precipitation amounts and intensity
- Homes with (finished) basements
- Local or micro-site hydrology
- Degraded soil quality and vegetative communities
- Limited drainage infrastructure
- Functionality of drainage system
- Limited city budget and staffing

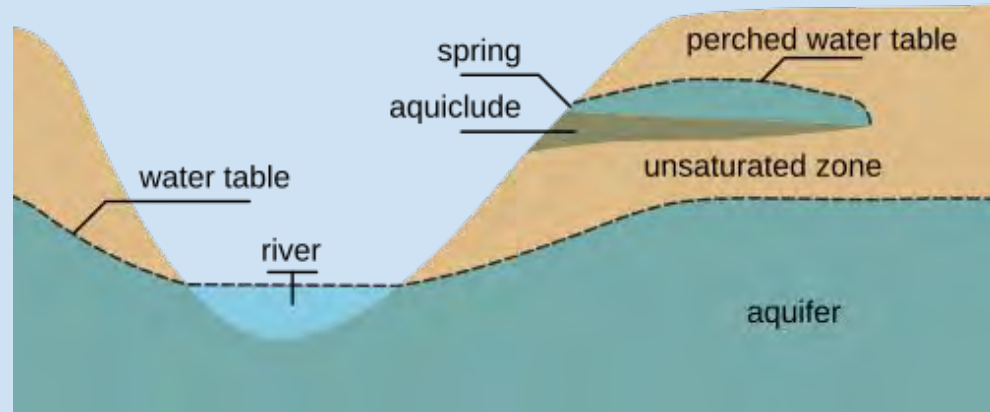
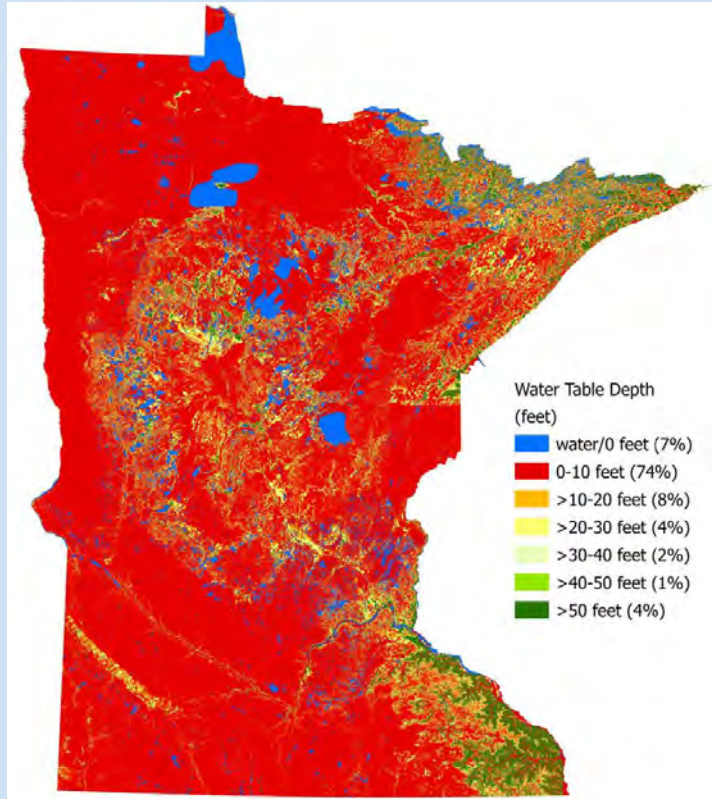
The Hydrologic Cycle



Issue: Soils

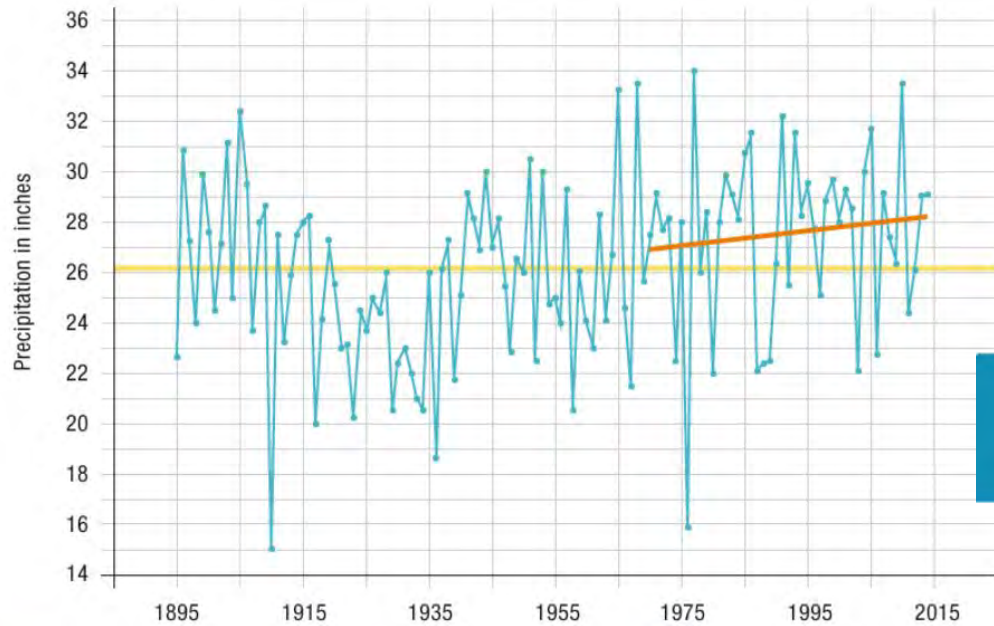


Issue: High water table



Issue: Increased precipitation amounts & intensity

Minnesota's average annual precipitation 1895-2014

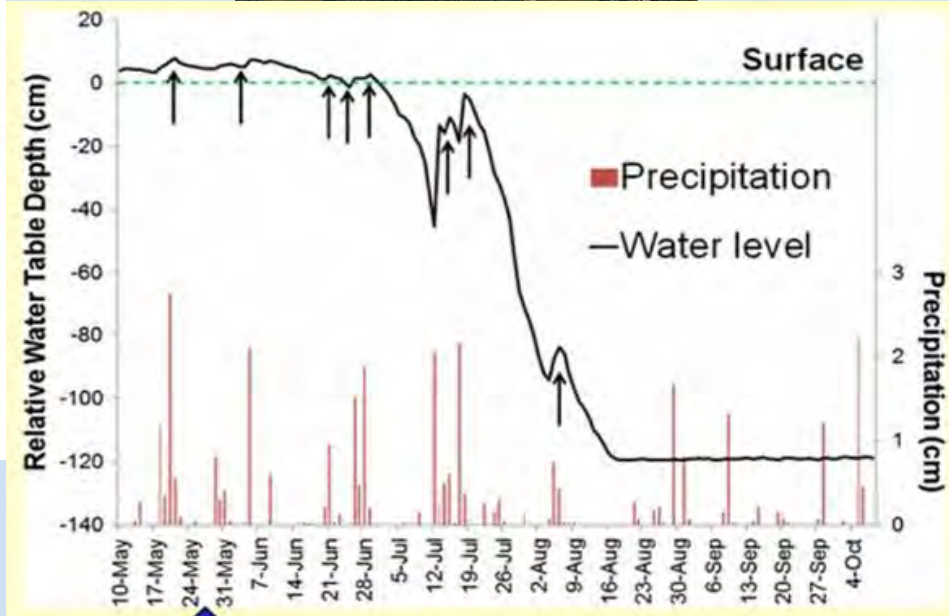
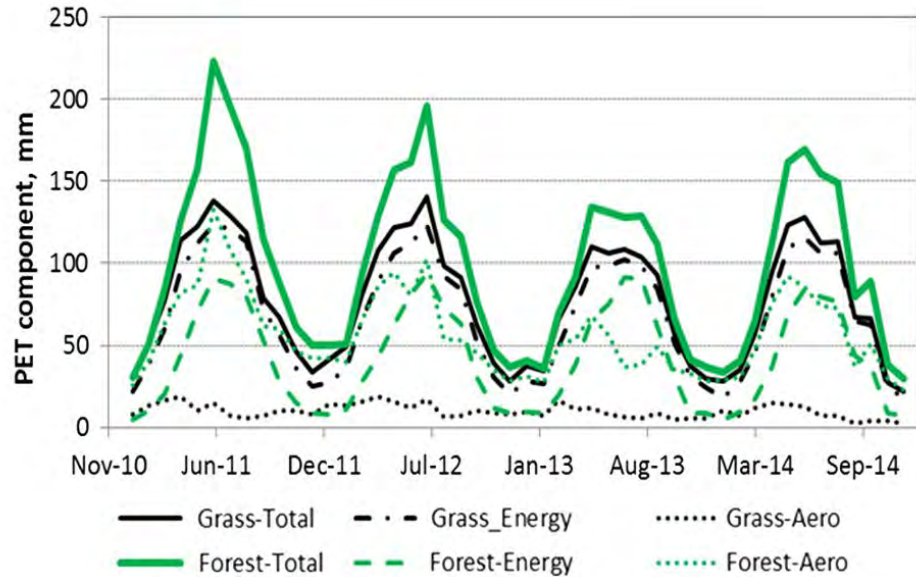


Yearly precipitation 1895-2014, average 26.24" 1970-2014 trend, +0.33"/decade

Timeline of Minnesota's historic mega-rain events 1866-2014



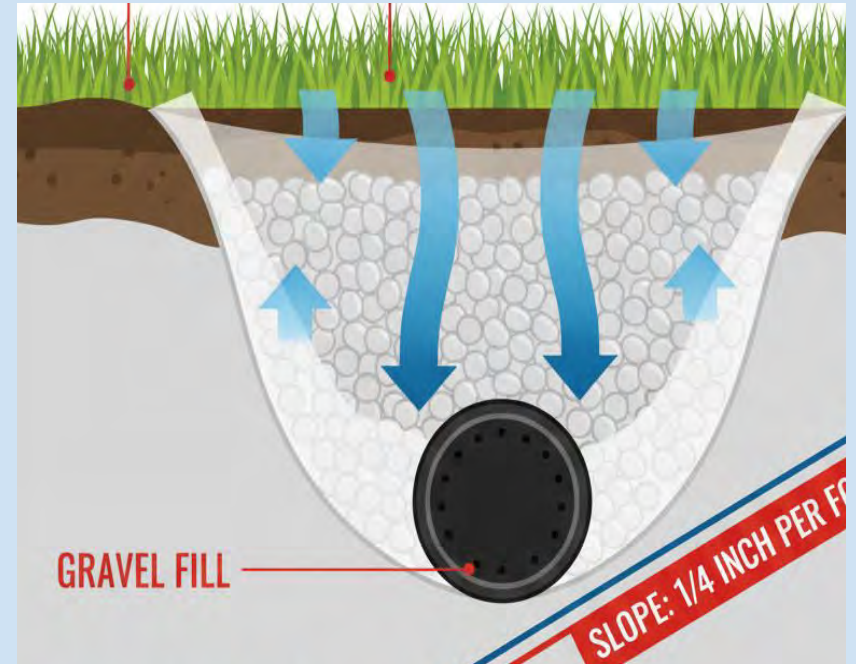
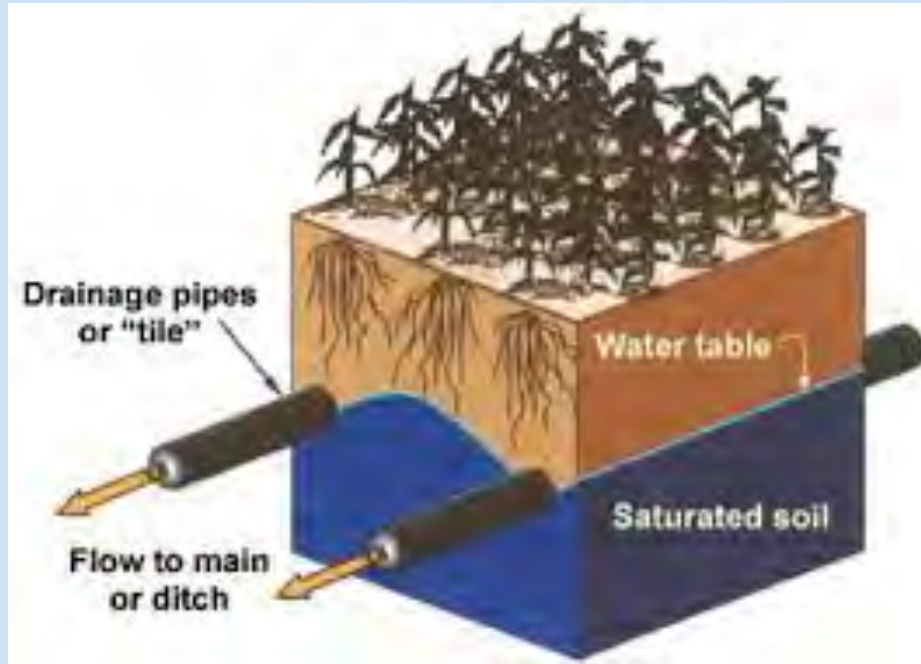
Issue: Changes to vegetation



Issue: Local/micro-site hydrology and basements



Issue: Limited drainage infrastructure & function



Limited budget and staff





**Drain Tile Lines
Easements**
April 2026

Talking points

- **City of Skyline Drainage Tile lines**
- **Location of Line #1,# 2, #3 and #4**
- **Easements**
- **Where are they?**
- **History of the easements?**
- **How to find documentation about your property and easements?**
- **General guideline when there are easements on your property?**



- **Two of the City of Skyline Drainage Tile Lines have easements**
 - **These are generally located on the back 10 ft of the property.**
 - **There are a few homes on the drain line with no record on file for easements**
 - **A few properties have easements along side yards**
-
- **Two of the Drainage Tile Lines are Privately owned by households on the line and do NOT have an easement on file.**

What is an Easement?

To understand the concept of easement property, consider the following key points:

- An easement is a legal right to use someone else's land for a specific purpose.
- It does not grant ownership of the land, only limited use rights.
- Easements can be created through agreements, necessity, or by law.
- Common types include utility easements, access easements, and conservation easements.
- Easements can be permanent or temporary, depending on the agreement.
- They are typically recorded in property deeds to ensure legal recognition.

The City of Skyline Drainage Tile Lines and easements

The City of Skyline Drainage Tile Line easements contain the two city's drainage tile lines which were placed for subterranean water drainage created by extreme weather.

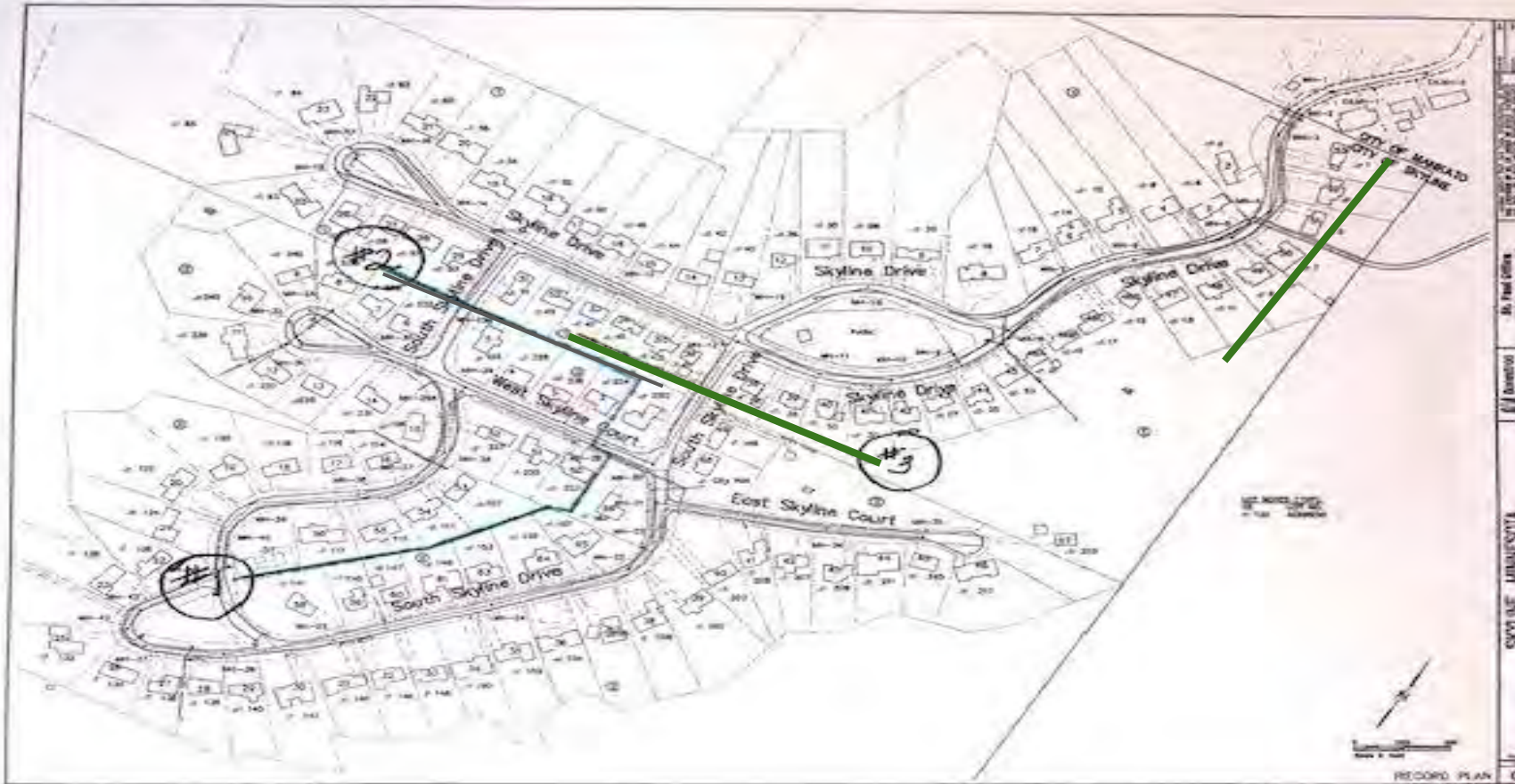
These easements are also very important for the city officials to have immediate access for repairs and improvements.

History of the City of Skyline Easements

- The original easement history dates to **May of 1957**
- City of Skyline created a Drainage Agreement and Easement with homeowners on the interior **lots** of Skyline.
- **The purpose of this agreement was to erect a drainage system consisting of intercepting tile lines laid over and upon the lots.**
- **The intent was to provide a drainage system for subterranean waters from all the people who owned land abutting upon or contiguous to the lots .**
- In **December of 1969**, another agreement with the homeowners along the easement where homeowners assigned all their rights, title and interest under the original Drainage Agreement to the Village of Skyline.
- **Ownership of the property remains with the homeowner.**

Which properties have Easements?

- ❑ Review the city map
 - ❑ Find your property
 - ❑ See the location of the Drainage Tile line
-
- ❑ Most properties and lots located in the interior sections of the City of Skyline both in Skyline 1 and Skyline 2 will have easements for the cities Drainage Tile Line. *The Drainage Tile Lines are identified as Line #1 and Line #2*
 - ❑ *Line #3 Drainage Tile Line* is privately owned by 8 households. *Line #4* is a privately owned by 6 households. These line are both located behind the homes. *There are NO EASEMENTS on file with the City of Skyline for either of these drainage lines.*



SKYLINE, MINNESOTA

AS PER OFFICE

10/17/2008

RECORD PLAN

Where can you find documentation about the easement agreement for my property?

- **All homes with easements on their property have that language listed on their Deed.** When you purchase a home, the previous owner needs to provide a lot survey at closing showing where the property corners and easements are. If you can't find the survey, every homeowner can find information and descriptions of their easement and property lines listed on their Certificate of Survey, Abstract or Deed located at the Blue Earth County Government Center.
- Generally, this easement will be located at the back of your property lot line. Each easement is approximately 10 ft. That will mean 10 ft of each resident's property. **City maps are available for the exact location of these tile lines.**

General guidelines to help property owners better understand what may be allowable within the easement located on their property?

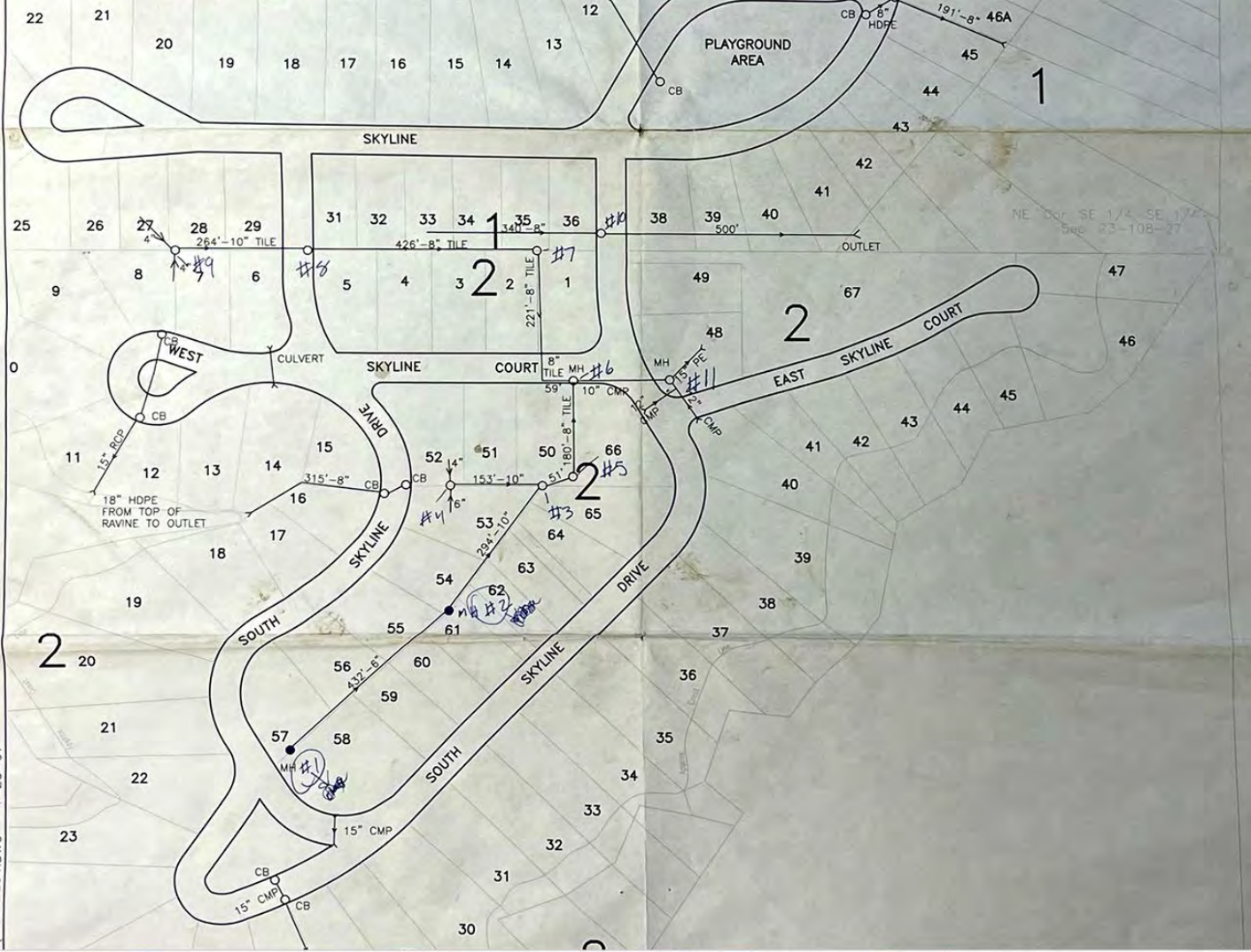
Surface landscaping is typically allowed

- **Planting trees and shrubs** is discouraged in easements that involve drainage ways.
- ***Some structures may be allowed provided they are easily moved or removed from foundations to provide access to the easement.***
 - **Sheds** with portable floors
 - **Fences** installed on the property line that do not interfere in any way with existing easement access.
 - **Irrigation systems** that do not interfere in any way with existing underground tile lines.
 - **Decks** that are not permanently attached to the house and located in the easement must be free standing
 - **Any structure placed on the easement should be approved by City Council.**
 - No construction or landscaping that will change or alter drainage patterns is allowed.
- **Good idea to check with the city before adding structures to the easement area.**



Tile Condition, Past and Future Maintenance
Jim Attarian

STM-2234.DWG 4-28-97



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2/19/2026

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Maintenance Plan 2026

Root Control

RootX

- Initial application (done)
- Apply after Jetting (April May)
- Fall application

Trees in problem areas should come down and stumps killed.

Mud/Gravel Clearing

- Jetter with volume boost from firehoses to fully flush lines
- Dig out manholes (again)
- Fit outtake lines with elbows to allow dirt to settle in manholes, to prevent dirt intrusion into the lines.

Complete line camera inspection. Some areas may need professional scoping.



Suggested Regular Maintenance

Annual RootX treatment (if trees not felled)

Surveillance scoping and flow testing

Jetter as needed

- Limitations of Jettering
- Potential pipe damage

Flooding

Observations:

- Time from onset of rainfall to basement flooding is short, so at least some surface water must penetrate to footing level quickly.
- People described almost immediate relief of standing surface water and basement inflow when Line 2 was opened, suggesting rapid movement of ground/surface water into the tile line.
- Swales between houses from backyards to road seem lacking, so water may largely be trapped in the backyards or around houses (My observation: I hope I'm wrong)

Conclusions:

- A fair percentage of the rainfall around the houses and backyards may be trapped without runoff to the streets and surface storm drains.
- A good portion of surface water seems to move quickly to the footing level.
- The tile lines, designed to drain water from house foundation drains, may in fact be dewatering the entire area, as some homeowners have described.

How does ground water enter the tile line directly?

- Seams opening up due to pipe sections shifting.
- Mortar at seams failing. (Ours is 75 years old)
- Partial pipe collapse or cracking.



Can the tile line handle the water load?

It depends on what percentage of rainfall stays in the backyards and penetrates to the deep subsoil, and the rate at which it occurs. Let's look at the limiting case example, 100% water is trapped in the backyard area.

Rate of rainfall into collective backyards

900 foot length of pipe, 50 foot on either side = 90,000 sq feet
=2.1 acres

2 inches rain/hour x 2.1 acres = 113,000 gallons/hour or **1900 gpm**

Takeaway Capacity

900 foot concrete drain pipe, 1%/2% slope, 0 head (gpm)

900 foot concrete drain pipe, 1% slope, 8 foot head (gpm)

6" 250/350

450

8" 550/750

900

10" 1000/1400

1400

In our scenario, with 8 inch lines flowing at capacity, the backyard area is gaining net 1000-1400 gpm. **Roughly the equivalent of 1 large backyard inground swimming pool dumped into the collective backyards every 20 minutes.**

Bottom Line: The tile line system was designed to collect water weeping into the footing drain system, it was not meant to be the major route of dewatering of the entire backyard area. Aging of the line however has likely led it to become exactly that. Note that water penetrating through open seams, cracks, etc competes with footing drain water for line capacity.

The ability of the tile line to keep up with hydraulic load depends upon a number of factors: the rate of rainfall, the fraction of water trapped around the houses and in the backyards, and the rate at which it penetrates into the deep subsoil and into the pipe. It's complicated.

But wait, there's more...

Maximal flow rates listed earlier are for pipes that are completely full. For a full 900 foot section of pipe at 1% grade, the end of the pipe is 9 feet below the head, meaning that the hydraulic pressure at the end is 9 feet minus frictional loss along the pipe. For an obstructed pipe frictional loss is zero, and the the pressure would be 9 feet of water...or about the pressure at the deep end of a swimming pool. In that scenario, a tile system draining into the line would experience back pressure which could force water back to the house. For a flowing pipe the pressure is somewhat less, but not zero.

How do we prevent flooding?

1. Optimize water management at the household level. (Subject of the next presentations)
2. System improvements

Tile system fixes to consider

Ultimate: Replace tile line with 10-12” solid double wall HDPE pipe, and twin with perforated drain pipe surrounded by gravel/sand to drain deep water. Build separate surface system to drain surface water. Expensive, and would be a huge disruption of the backyards.

Practical Optimize the current tile line system and concentrate on surface water management.

Surface water in perspective

In a 6" rain, 1 acre collects 162,000 gallons of water
Equivalent to 6 backyard swimming pools (20'x 40' diving pool)



Homeowner Survey Results and Findings
Janet Nelson



Homeowner's Guide: Strategies for Your Property

Robert Pipal & Jen Heimer

Why Drainage Matters

- **Foundation Protection:** Water is the "primary agent of destruction" for residential structures.
- **Hydrostatic Pressure:** Prevents water from pushing against basement walls.
- **Health & Safety:** Reduces the risk of mold, mildew, and wood rot in crawl spaces.
- **Soil Stability:** Manages the expansion and contraction of soil that causes structural cracks.

Recognizing Common Problems (Outdoors)

- **Standing Water:** Pooling near the foundation hours after rain.
- **Soggy Lawns:** Persistent "spongy" areas in the yard.
- **Landscaping Erosion:** Mulch or soil being washed away near the house perimeter.
- **Neighborly Impact:** Note how shared fences or driveways redirect water toward your lot.



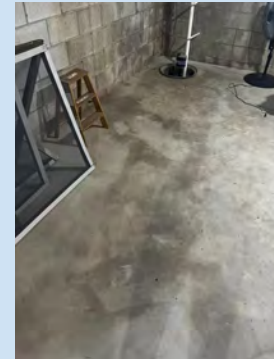
Recognizing Common Problems (Indoors)

Visible Stains: Watermarks on the lowest levels of the structure.

Efflorescence: White, powdery mineral deposits on concrete walls.

Musty Odors: Persistent "basement smell" indicating hidden moisture.

Structural Red Flags: New or widening cracks in foundation or basement walls.



The First Line of Defense: Gutters & Downspouts

Gutter Health: Must be clear of debris, securely fastened, and slightly angled toward outlets.

The 6-10 Foot Rule: Downspout extensions should direct water at least 6 to 10 feet away from the foundation.

Termination Points: Use splash blocks, plastic extensions, or buried pipes to disperse concentrated flow.

Pro Tip: *If water "overshoots" in roof valleys, install splash guards.*

Proper Grading: The Golden Rule

The Goal: Ensure the ground slopes **away** from the house.

The Metric: A fall of **6 inches over the first 10 feet** of distance.

Maintenance: Use a long level or string line to confirm the slope.

- Add and compact soil in "lifts" rather than one large dump.
- Finish with topsoil and mulch to prevent erosion.

Subsurface Drainage Systems

French Drains:

- A trench filled with gravel and a perforated pipe wrapped in filter fabric.
- Best for intercepting groundwater on slopes or perpetually soggy yard areas.

Foundation Drains (Weeping Tile):

- Installed deep at the foundation footing.
- Collects groundwater and routes it to a **sump pit** where a pump expels it.

8-Step Guide to Roof Drainage

1. **Evaluate:** Look for pooling, overflows, or watermarks.
2. **Clear Debris:** Regularly clean leaves and twigs from gutters.
3. **Ensure Slope:** Confirm gutters angle toward downspouts.
4. **Install Guards:** Use gutter guards to keep pathways clear and reduce maintenance.
5. **Inspect Flashing:** Check chimneys, vents, and joints; repair leaks immediately.
6. **Redirect Downspouts:** Use extensions to guide water to safe drainage areas.
7. **Advanced Solutions:** Consider catch basins or underground pipes for complex issues.
8. **Schedule Maintenance:** Set a routine inspection calendar to catch problems early.



Common DIY Mistakes to Avoid

Neglecting Inspections: Waiting until the basement floods is too late.

Incorrect Gutter Sloping: Stagnant water leads to rust and corrosion.

Ignoring Capacity: Ensure gutter size matches your roof area and local rainfall levels.

Poorly Positioned Downspouts: Never let a downspout dump water right at the foundation corner.

Eco-Friendly Strategy: Rain Gardens

What it is: A shallow basin that holds runoff while it soaks into the soil.

Placement: Downslope from the house, at least several feet from the foundation.

Planting: Use deep-rooted native plants that handle both "wet feet" and dry spells.

Benefit: Reduces polluted runoff while creating a small wildlife habitat.



Choosing Permeable Surfaces

The Problem: Solid slabs (patios/driveways) create fast channels of water.

The Solution:

- **Open-Joint Pavers:** Let rain seep into the base.
- **Gravel Shoulders:** Catch "splash" along driveways to reduce puddles.
- **Flagstone in Gravel:** A permeable alternative to solid concrete patios.

Small Landscape Features

Swales: Shallow, smooth ditches that guide "sheet flow" across a lawn.

River Rock Ribbons: Slows water down and prevents ruts in tight side yards.

Channel Drains: Use these where water must cross a walking path or driveway.

Post-Storm Checklist

Check Outlets: Clear leaves from gutter elbows and downspout ends.

Rake Mulch: Push mulch back into beds and top up low spots near the foundation.

Skim Sediments: Clear debris from rain garden inlets and catch basin grates.

Conclusion

Grade First: Most problems disappear once you get the slope right.

Capture & Clean: Once the foundation is safe, use rain gardens to manage the rest.

Read Your Lot: Watch how rain moves during a storm—treat the *path*, not just the symptom.



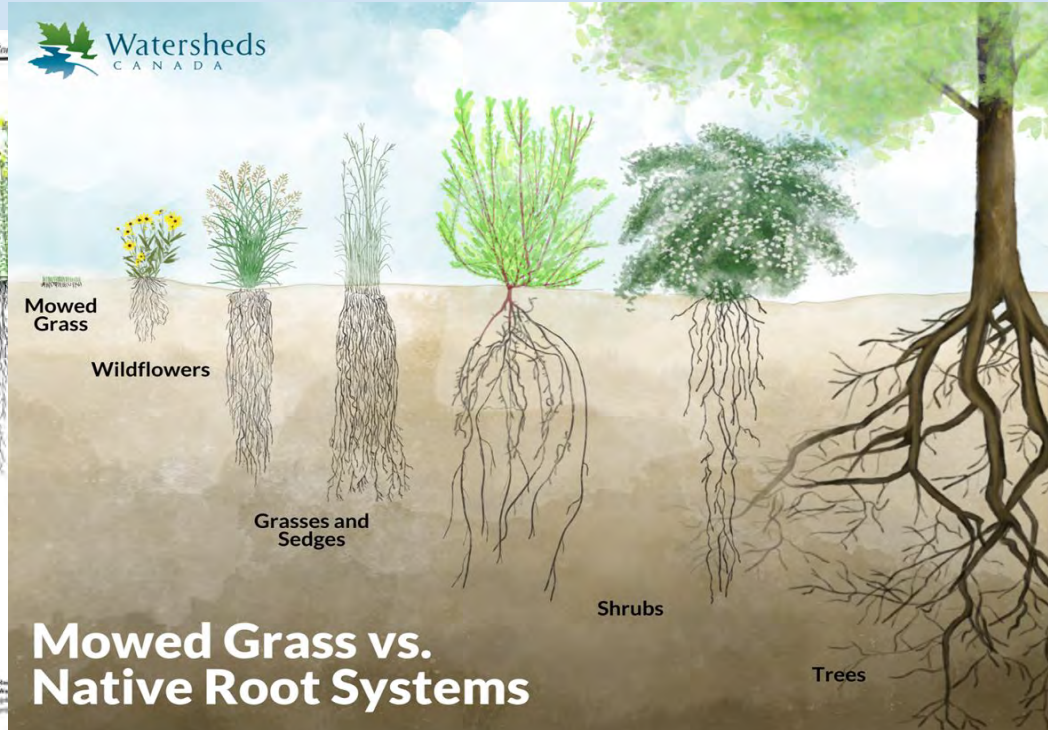
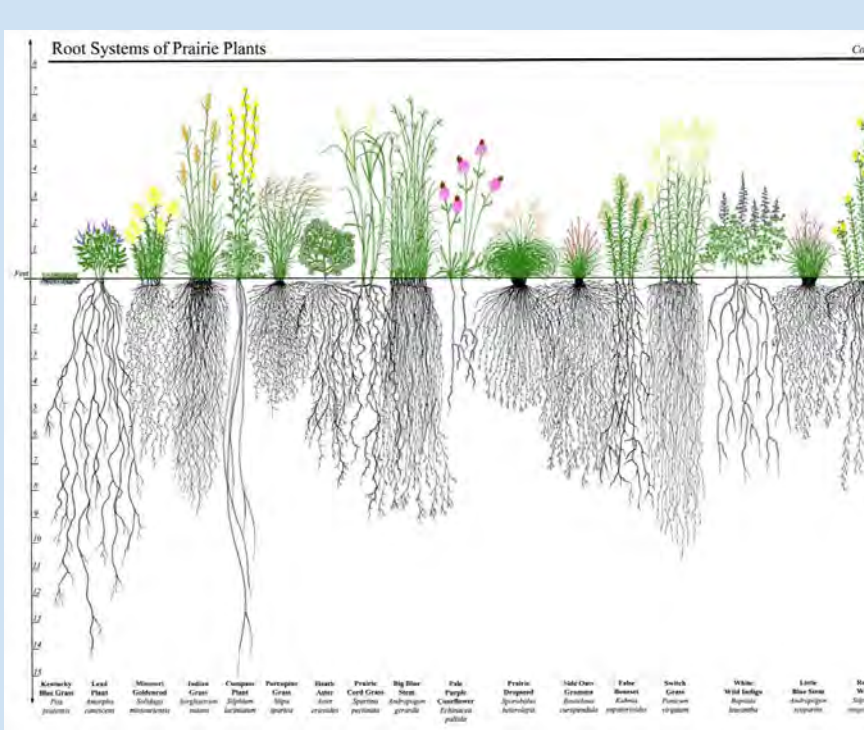
Home Basement Waterproofing
Nick Barke, Complete Basements



**Landscaping, Vegetation, &
Soil Health Strategies**

Joanne Boettcher

Dense native plantings and healthy soils to improve infiltration, evapotranspiration, and ecology





Green infrastructure for Minnesota communities



Pale purple coneflower, prairie coreopsis, butterfly milkweed, penstemon, and spiderwort create a rainbow of bloom at the RWMWD office in Little Canada. Photo courtesy of Ramsey-Washington Metro Watershed District.

NATIVE VEGETATION

This lakeshore restoration site in Cumberland, WI was planted with a diverse native plant community. The site's mid-summer bloom showcases blazing star, coneflower, black-eyed Susan, cut-leaf coneflower, gray-headed coneflower, and wild bergamot. Sedges and grasses provide structure that supports these beautiful blooms. Photo courtesy of Britta Hansen, Emmons & Olivier Resources.



Native plants are plants that evolved in a specific region and ecosystem over millennia. They are specially suited to the soils, climate, plant community, insects, and wildlife of their location. In contrast, non-native plants were introduced to a location and did not co-evolve with the local plant and animal community. Non-native plants are considered invasive species when they aggressively out-compete native plant species.

Why native plants instead of non-native plants?

Advantages of native plants include their hardiness, role as exclusive food sources for some insects, and ability to provide special habitat for local insects and animals. With their deep-rooted structure, native plants offer superior erosion protection, water filtration and cleansing, and soil improvement.

Since native plants and insects co-evolved, they have formed interdependencies. For instance, milkweed plants have substances that are toxic to most insects. However, Monarchs have evolved tolerance to the toxic substances, and the caterpillars can only eat milkweed. Similarly, many native insects have a special relationship with a particular

plant during a part of their life: some bees require the pollen of certain native flowers, many caterpillars can only eat the leaves of certain native trees – these insects are called specialists. These closely evolved relationships between plants and insects are partly why non-native plants can outcompete native plants: there are no local insects that have evolved to consume them.

Why do we care about native, specialist insects?

Native, specialist insects are a critical foundation for food webs. In his 2007 book "Bringing Nature Home: How Native Plants Sustain Wildlife in Our Gardens," Dr. Doug Tallamy reports that chickadees feed their nestlings over 6,000 caterpillars in just the first few weeks of their life. Tallamy also found that most caterpillars are specialists and depend almost entirely on native plant species for their food. To preserve our bird and wildlife populations, we must preserve the insects they feed on, and to do that, we must provide the native plant communities they depend on.

Anyone can add native plants to their landscape. Start with a small area and expand through time. Here's how to get started:

- **Get to know your site.** Understand your light conditions (full sun, part sun, or shade), soils (sandy, silty, or clayey), and drainage (well drained, moist). Learn about the native plant communities in your area on the Minnesota Department of Natural Resources website.
- **Determine your project goals and type.** Project types include trees, shrubs, prairie plantings, manicured prairie or woodland gardens, shoreline restorations, and more. Find inspiration by visiting natural areas and local native plantings.
- **Prepare your site.** Site preparation is crucial to any native planting. The prior land use, on-site vegetation, and project size will determine appropriate site prep. Prep methods could include lawn smothering, herbicide treatment, sod removal, cultivation, cover cropping, soil amendments, ground shaping, and more. Often, a full growing season of preparation and weed elimination is needed for sites with invasive species. Good site prep can substantially reduce maintenance early in the project.

These black-eyed Susans, at Minneapolis' Heritage Park filtration basin, are a pioneer species, meaning they fill in and mature quickly. They are commonly included in seed mixes to provide color and density early in a prairie planting. Photo courtesy of Britta Hansen, Emmons & Olivier Resources.



Native shrubs can be planted in rows to create privacy, wind blocks, strategic shade, or in the case of this common elderberry shrub row in Mankato, edible landscaping. Trees along the west side can help shade and cool buildings in the hot summer months. Photo courtesy of Joanne Boettcher, MPCA.

- **Develop your planting list.** Once you know what your site characteristics and project goals are, you are ready to develop a planting list. The Blue Thumb Plant Finder can help you develop a list of native plants suited for your site and project type. The Minnesota Board of Water and Soil Resources website, seed mixes page, and the Minnesota Wildflowers website are also great resources.
- **Buy and install your plants.** Plants should be purchased from reputable Minnesota native nurseries. The Blue Thumb Plant Finder lists retailers. Use caution purchasing plants from nurseries that are not specialized in native plants to ensure you are getting the right species, locally originated, and legally grown and not wildly collected. Small bareroot trees and shrubs are an affordable option, but trees can also be purchased as larger, more expensive established plants. Prairie plantings can be done with seeds, small plant plugs, or potted plants.
- **Maintain your project.** Native plants can take longer to reach maturity. You may need to water in the first year. You will need to remove weeds, especially in the first few years, until your plants fill in. Trees and shrubs can take longer to reach maturity.

SOIL HEALTH



Healthy soils tends to be dark in color, have an earthy aroma, and a cottage cheese-type texture. The dark color comes from high organic matter. The earthy aroma indicates a healthy microbial population. The texture is a product of the microorganisms, which "glue" soil particles together in clumps, increasing infiltration and resisting erosion.

Soil health is the simple term reflecting the complex physical, chemical, and biological properties of soil and its organisms, also described as soil's ability to function as a vital, living ecosystem. Soil health is an often overlooked but critical component to the water cycle and ecology.

Soil is a dynamic, living ecosystem, made up of minerals, organic matter, air, water, and living organisms. A teaspoon of healthy soil can contain a billion microorganisms and thousands of species. Similar to the interdependent relationship native plants and animals have, the microorganisms in soil have relationships with the plants growing in them. Healthy and diverse vegetation relies on healthy and diverse soil microbiology, and vice versa.

Healthy soil acts as a natural sponge, infiltrating, storing, treating, and using water to support plant growth. Healthy soil also resists erosion, captures and stores carbon, and helps recharge aquifers. Healthy soil produces more nutritious vegetables and higher crop yields than depleted soil, requiring less artificial fertilizer and herbicide.

Organic matter content of soil is a critical component of soil health, with 5% being a general minimum recommended value. Topsoil contains the most organic matter. Managing for soil organic matter and soil health includes a few key principles: high cover, low disturbance, living and deep-rooted plants, and high biological diversity.

Management practices to improve soil health

Lawns

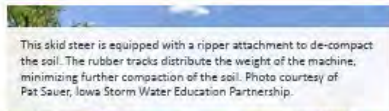
- Mow high, at least 3 inches. Avoid mowing too frequently and when the soil is wet.
- Decrease or eliminate the use of chemical fertilizers, herbicides, and insecticides.
- Use high-quality compost or other organic sources of fertilizer when needed, which can be determined by soil fertility testing.
- Interseed or reseed lawns with diverse seed mixes (e.g., bee lawn or native ground covers), low/no-mow fescue grasses, or clover.
- Convert lawns to diverse native plantings and/or add native trees and shrubs for low-maintenance options.

Gardens and landscapes

- Minimize or eliminate tilling and chemical use.
- Never leave the soil bare. Use living ground covers if possible. Organic mulch like leaves, wood chips, or compost can also be used. Avoid rock mulch and landscape fabric.
- Use cover crops before, during, or after food crops.
- Add native plants to flower gardens and landscapes.
- Create "soft landings" under tree driplines by replacing turf with native plants.



Lawns with higher plant diversity, lower mowing frequency, and less chemical use create healthier soils. Clover fixes nitrogen from the atmosphere, providing natural fertilizer to grass. The clover, self heal, and yarrow in this lawn mix also provide food for pollinators. Photo courtesy of James Wolffin, Twin Cities Seed Co.



This skid steer is equipped with a ripper attachment to de-compact the soil. The rubber tracks distribute the weight of the machine, minimizing further compaction of the soil. Photo courtesy of Pat Sauer, Iowa Storm Water Education Partnership.



Management practices to protect and improve soil health during (re)development:

Prior to construction

- Develop a soil management plan, including areas that should not be disturbed.

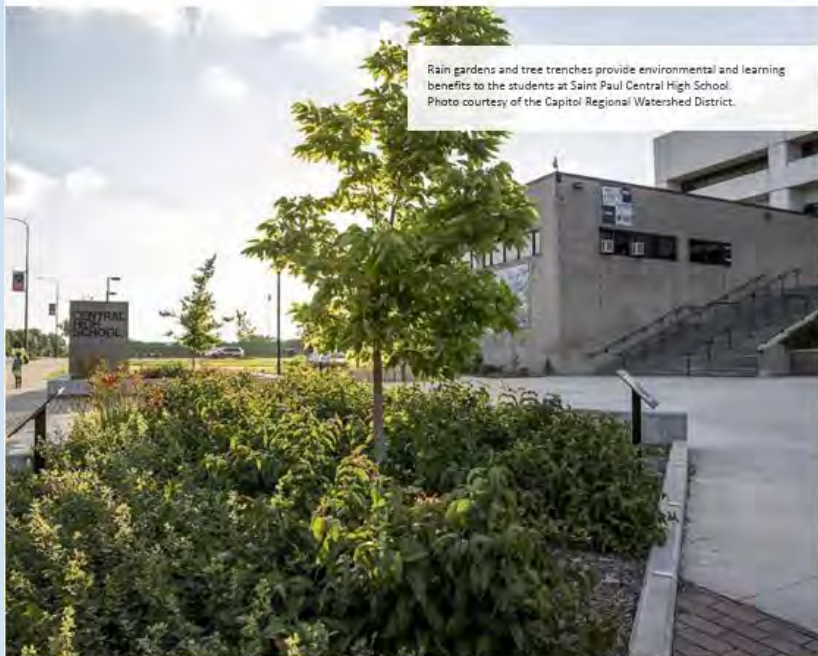
During construction

- Demarcate areas that are not to be disturbed.
- Select minimally compacting equipment for work.
- Avoid degrading soil structure by overworking soil or smearing soil during construction. Avoid disturbing soil when it is too moist.
- When stockpiling topsoil, build smaller piles so that oxygen is available to the soil in the center of the pile. Cover stockpiles to prevent erosion.
- Cover exposed ground with cover crops or mulch.

After construction

- Use soil ripping or subsoiling to de-compact any compacted subsoil.
- Respread topsoil and add compost if needed. Till compost into the top few inches of soil.
- Plant vegetation that is as diverse and deep-rooted as possible. Use Minnesota native plants whenever possible.

TREES



Rain gardens and tree trenches provide environmental and learning benefits to the students at Saint Paul Central High School. Photo courtesy of the Capitol Regional Watershed District.

Trees are an excellent way to integrate green infrastructure into the landscape and achieve a number of benefits. Trees intercept rainfall where it can be absorbed by the leaves and rootzone, reducing the amount of runoff. In addition to benefits to water quality and quantity, trees clean air, reduce heat island effects, sequester carbon, reduce noise pollution, and cool houses, businesses, and cars when in the shade.

Trees are a key strategy for communities to address and adapt to climate change moving forward. In fact, the State of Minnesota Climate Action Framework has established a goal for communities to have 40% of their area covered by tree

canopies by 2050. To meet this goal and the desired benefits, we need to plant more trees today.

Trees can be used in both low tech and high tech green infrastructure applications. Home and business owners can easily add trees to the landscape. High tech tree applications like tree trenches and tree boxes are often used in dense urban environments with lots of impervious surface area. These practices require substantial planning and design.

Next we discuss recommendations and tree selection options that can help you select and plant trees.

Recommendations for tree plantings:

- **Select the right tree species.** Select a tree for the soil, sun, and moisture conditions. Native trees provide a range of ecological benefits, but non-native trees may work better in some circumstances.
- **Purchase smaller trees.** Smaller trees handle transplantation better than large trees. They are less expensive, require a smaller hole, and are less prone to girdling.
- **Dig the right hole.** Dig a hole as deep as and at least twice as wide as the existing roots. Most new roots will grow out horizontally from the tree's root ball. Square holes may reduce root girdling.
- **Spread the roots.** Trees that come in containers often have roots growing in a circle. These trees are at risk of becoming girdled. Splay the roots away from the center. Cut the roots to free them if they are severely bound.
- **Mulch, water, and protect.** Either plant ground cover species under the new tree or mulch with organic matter. Water new trees deeply weekly or more. Cage or wrap small trees to protect from herbivores in winter and weed whippers in summer.

These tree trenches and parking lot in Eagan were designed to funnel stormwater to an underground collection area, where the trees can access and use it. Photo courtesy of Brendan Dougherty, Barr Engineering Co.



A Dutch-elm disease resistant elm tree variety was planted along the Metro Light Rail Transit Green Line in Minneapolis-St. Paul. Photo courtesy of the Capitol Regional Watershed District.

While Minnesota has over 50 native tree species and over a hundred shrub species, not all work for every application. Do some research before selecting a tree or shrub. For instance, maples are generally not recommended for new plantings because Minnesota's urban landscapes already have an abundance. Another example, cottonwoods are prohibited in some communities due to their abundant spring seeds.

Some native tree and shrub species that you might consider include:

- American Basswood
- Kentucky Coffeetree
- Hackberry
- Swamp White Oak
- Burr Oak
- Ironwood
- River Birch
- Serviceberry
- American Pussy Willow
- American Hazelnut
- Red Osier Dogwood
- Prairie Ninebark
- American Plum
- Arrowwood
- Common Elderberry

The Minnesota Stormwater Manual provides more details on trees, including tree lists for tree trenches and boxes as well as larger lists of native and non-native trees for urban applications.

Native vegetation project highlight: Gallea property lawn conversion

The Gallea home on the Sauk River Chain of Lakes in Cold Spring came with a 308-foot shoreline, over an acre of mowed grass, and a failing retaining wall. When the Galleas applied to replace their failing retaining wall, the Stearns Conservation District riparian specialist asked if they had considered restoring their property to a more natural state.

After extensive research into the benefits of native plants and "lake scaping," the Galleas decided to partner with Stearns Conservation District, transforming their property with lush native plants that help slow and absorb water

running off the roof and driveway, keeping phosphorus and other pollutants out of the lake.

The Galleas have since become advocates for shoreline restoration and native plants, hosting annual tours of their property for homeowners considering similar projects. The Galleas have saved hundreds of hours a year on lawn care and spend approximately \$600 a year on annual maintenance, which includes periodic controlled burns. A key piece of advice from the Galleas is to not over-irrigate the new plantings—too much water fuels weed growth.



The Galleas replaced much of their lawn with native plants, including trees, shrubs, flowers, and prairie grasses. The only lawn mowing they do anymore is limited to the walking path. Photo courtesy of Kirsti Marohn and Ben Hovland, MPR News.



This previously compacted, unhealthy lawn was aerated and then top-dressed with a thin layer of high-quality compost (top image). The resulting lawn not only looks better but is better able to infiltrate rain. Photos courtesy of Polk County Soil and Water Conservation District.

Soil health project highlight: Residential soil quality restoration

Construction activities during development commonly leave soils compacted and organic matter degraded. This results in pooling water, excessive runoff, and poor-looking lawns. To compensate, residents pour money and time into fertilizer, irrigation, and chemical treatments, not knowing that the root of the problem is their soil.

Iowa Stormwater Education Partnership has developed a soil quality restoration (SQR) program to help residents

improve the quality of the soil under their lawns. Soil quality restoration is the practice of aerating the soil and adding compost. This process reduces compaction, increases soil pore space, and increases organic matter, restoring the soil's ability to function like a sponge and absorb rain. They have reported that lawns that have undergone SQR require less overall maintenance, less watering during dry periods, fewer fertilizer applications, and minimal pesticide treatments.

Rain gardens/bioretention



The bioretention basin at the University of Minnesota's Huntington Bank Stadium parking lot uses multiple plant species to create a dense root zone to filter and use stormwater. The different colors and textures in this basin make this a visual show piece. Photo courtesy of Erin Hunker, SRF Consulting.



Top plant picks for bioretention practices: moist/lower zone

Plant	Season in bloom
Black Chokeberry Shrub	Spring
Red-osier Dogwood Shrub	Spring
Winterberry Shrub	Spring
Fox Sedge	Spring
Palm Sedge	Spring
Bottlebrush Sedge	Spring
Porcupine Sedge	Spring
Soft Rush	Spring
Sensitive Fern	Spring
Switch Grass	Summer
Prairie Cord Grass	Summer
Marsh Milkweed	Summer
Northern Plains Blazing Star	Summer
Giant Hyssop	Summer
Blue Lobelia	Summer
Sneezeweed Helenium	Fall
Joe-Pye Weed	Fall
Red-stemmed Aster	Fall

Top plant picks for bioretention practices: dry/upper zone

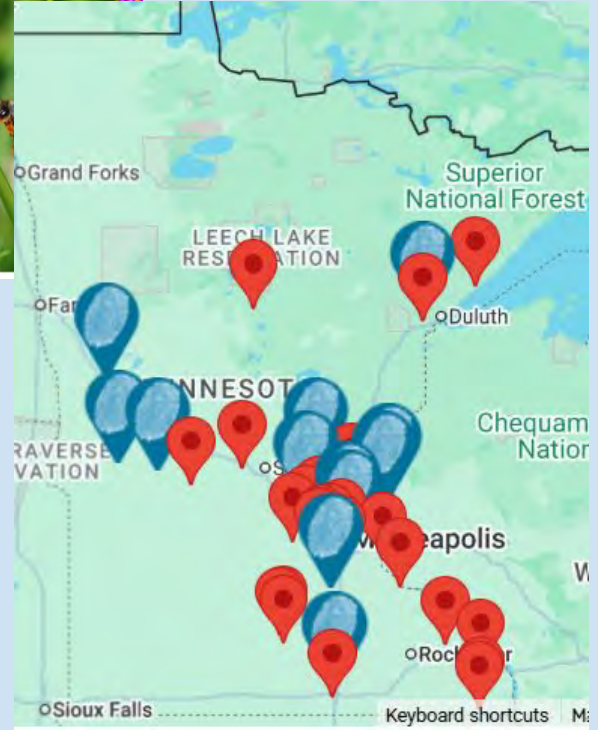
Plant	Season in bloom
Wild Geranium	Spring
Golden Alexanders	Spring
Prairie Alumroot	Spring
Wild Strawberry	Spring
False Solomon's Seal	Spring
Prairie Dropseed	Summer
Little Bluestem	Summer
Indian Grass	Summer
Butterfly Milkweed	Summer
Mountain Mint	Summer
Long-bracted Spiderwort	Summer
Spotted Bee Balm	Summer
Prairie Wild Onion	Summer
Prairie Sage	Summer
Prairie Coreopsis	Summer
Showy Goldenrod	Fall
Smooth Aster	Fall
Western Sunflower	Fall

Bioretention projects should be planted with moist-tolerant plants in the lower zones and dry-tolerant plants in the upper zones of the area. Plants that bloom through all seasons should be used.

Lawns to Legumes program and resources



Blue Thumb Plant Finder tool
Lists of native plant retailers



Nannyberry (*Viburnum lentago*)

- Medium to large shrub
- 12–20 feet tall and 6–12 feet wide
- Full-part sun
- Adapts to most soils
- Edible berries



American Plum (*Prunus americana*)

- Medium to large shrub
- Can sucker/be aggressive
- 10–20 feet tall and 5-10 feet wide
- Full-part sun
- Adapts to most soils
- Edible fruit for humans and wildlife
- Keystone species (ecologically)



Gray Dogwood (*Cornus racemosa*)

- Medium shrub
- 6-15 feet tall and 6–12 feet wide
- Full sun - mostly shaded
- Adapts to most soils
- Berries for birds



Bur Oak (*Quercus macrocarpa*)

- Large tree (many in Skyline)
- Up to 80' tall
- Full-part sun
- Medium soils
- Acorns for wildlife
- Keystone species (ecologically)



Hackberry (*Celtis occidentalis*)

- Medium-large tree (new small trees in parks)
- Up to 50' tall
- Full-part sun
- Medium-medium wet soils
- Berries for wildlife





Thank you!
Q&A

