CONNECTING THE BUILT AND NATURAL ENVIRONMENT

ASIC | 2015 | MINNEAPOLIS | MINNESOTA

Integrating Landscape Irrigation Control With Building Automation

Issues and Opportunities

Gaylen Atkinson, Chairman and Founder, Atkinson Electronics Inc. Salt Lake City, UT

April 27, 2015

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Agenda

- Benefits of marrying Building Automation Systems (BAS) with landscape irrigation
- Purposes of building automation/industry trends
- Reasons BAS building owners have an interest in landscape irrigation control
- Introduce design professionals that impact BAS/Irrigation integration
- Energy/water use efficiency initiatives
- Opportunities for BAS irrigation integration
- Suggestions for expanding the market for both BAS and landscape irrigation control

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Benefits of Marrying BAS with Landscape Irrigation

- BAS already exist in the majority of buildings
- Today's BAS are internet-connected and networked to all physical areas of the building
- Today's BAS utilize only a minor part of the built-in hardware/software capability and can be easily programmed to handle a wide variety of additional connections
- Current trends have raised water conservation to the same level as building energy
- Facility managers have responsibility for both building and grounds

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Purposes of Building Automation

- Remote monitoring and control for improved plant and staff operation
- Effective monitoring and targeting of energy consumption
- Increased occupant comfort and improved response to complaints
- Improved occupant life safety and property protection
- Flexibility for change of building usage

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Purposes of Building Automation Contd.

- BAS systems are implemented in large and small projects with extensive mechanical, HVAC, electrical, and plumbing systems
- Systems linked to the BAS typically represent 40% of a building's electrical usage (70% if lighting is connected)*
- Improperly configured building management systems are believed to account for 20% of building energy usage, or 8% of the total US energy usage*

* Source: Wikipedia

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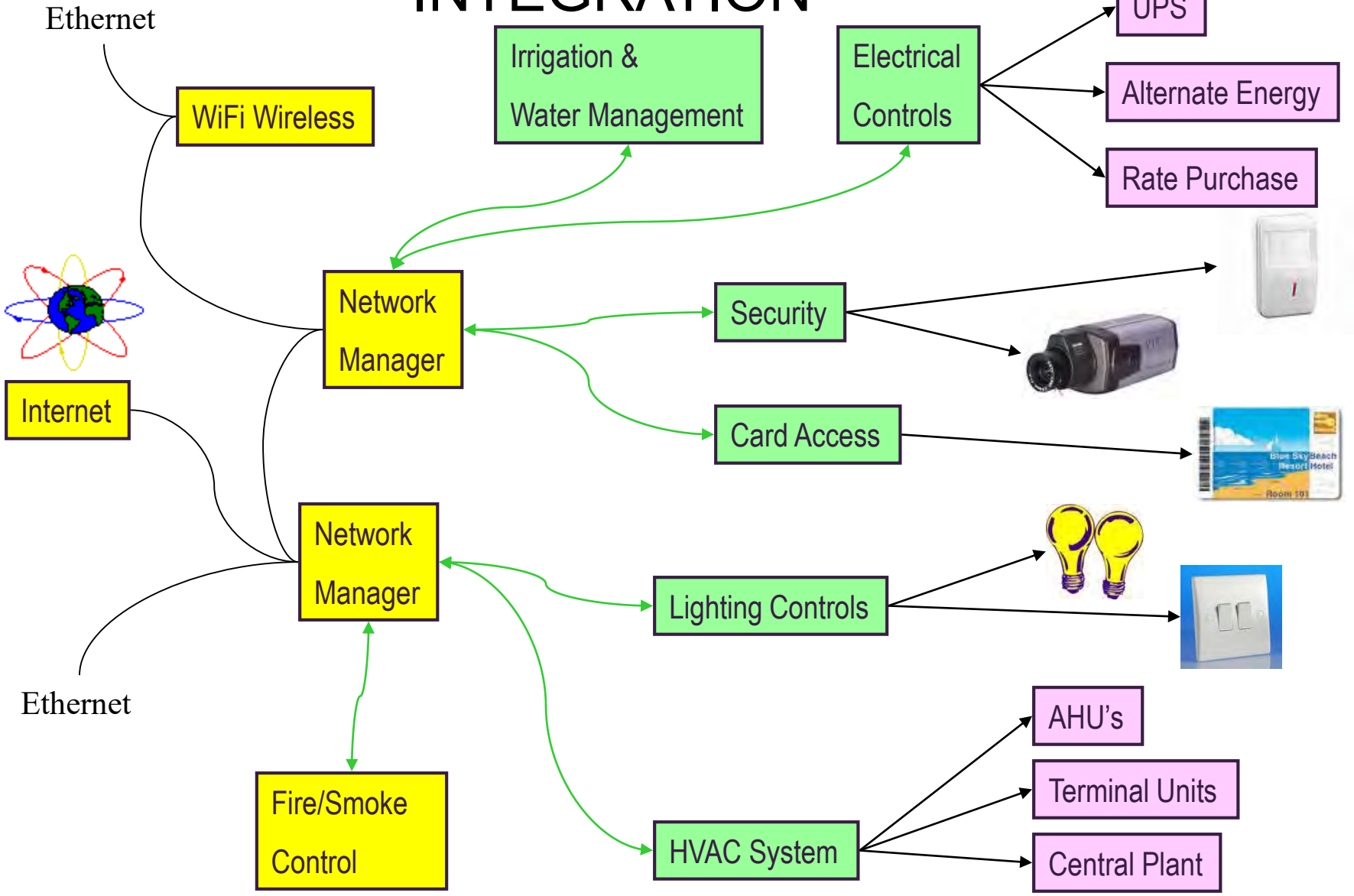
Industry Trends

- Today's BAS (for even the smallest buildings, including homes) are Internet-connected
- All thermostats, smoke detectors, cameras, door access points, HVAC controllers, etc. can be viewed via wireless on Internet ready devices
- Web services, such as weather bureau forecasts, cloud data storage and analytics, and emailed or texted building alarms are available anywhere
- Web browsers for laptops, tablets, or mobile phones are the standard automation system to human interface
- All systems are graphically represented with operational schematics, floor plans, watering zones, etc.

FULL BAS INTEGRATION



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Reasons BAS Building Owners Have An Interest In Landscape Irrigation Control

- Energy management, while maintaining a comfortable environment in spite of reducing electrical and heating bills, has been a big focus
- Water conservation is now at the forefront
  - Maintaining green landscape with the least amount of water
  - Recycled water from HVAC systems is available for irrigation
  - Xeriscape landscaping instead of vegetation raises outdoor temperatures and increases building energy costs
- BAS owners are asking why they have the latest technology to control building systems but the irrigation control is an unconnected clock

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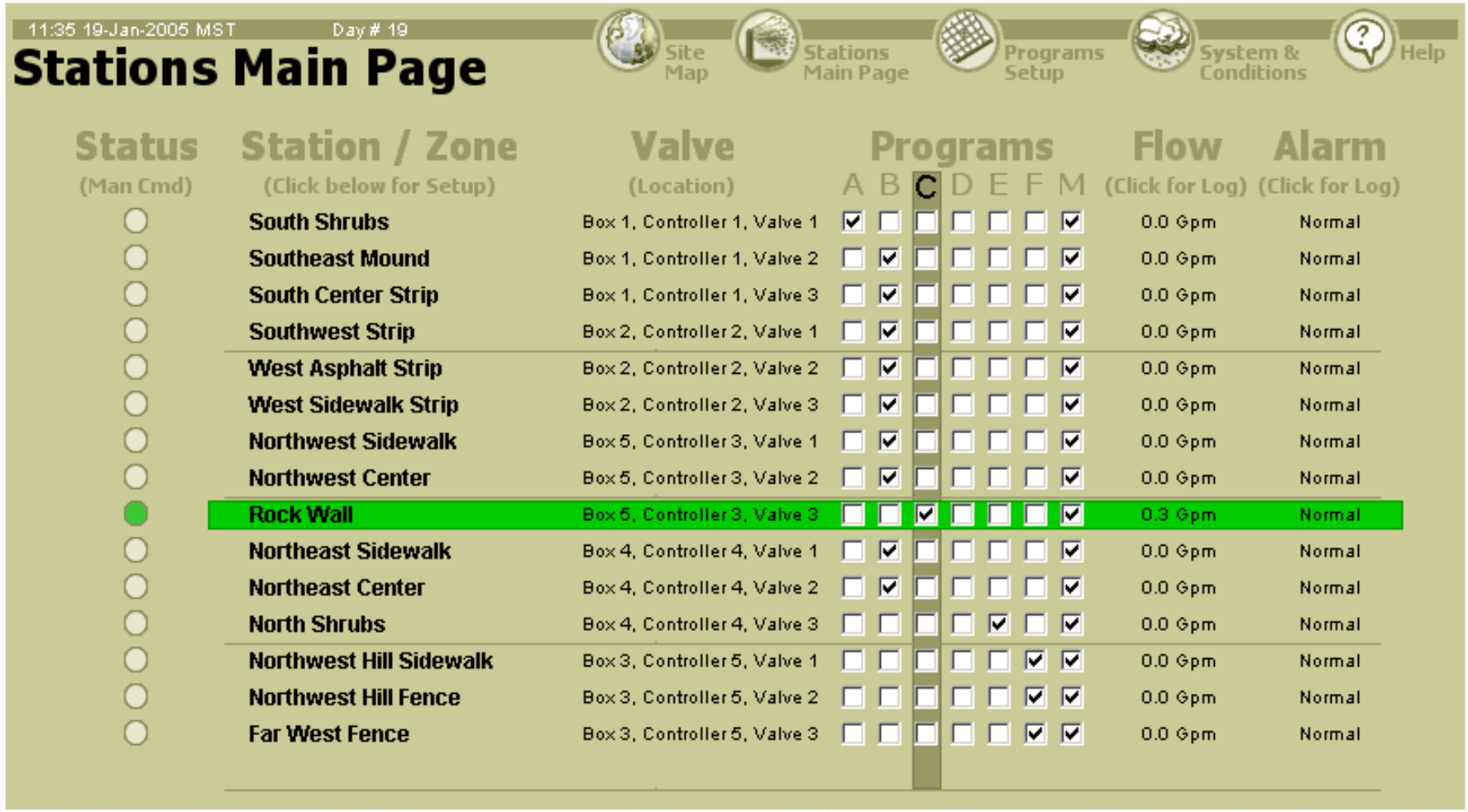
Reasons BAS Building Owners Have An Interest In Landscape Irrigation Control



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Example
Obtaining the Maximum Benefit From BAS

- Documentation required for exceptional BAS energy savings
  - The HVAC system design engineer prepares, while in the system integrated design phase, complete documentation of his or her:
  - System design objectives and energy efficiency targets.
  - Desired operating strategy of the HVAC system.
  - Desired control sequences to accomplish the energy efficiency targets.
  - “Initial thinking” of additional energy savings through system optimizations.

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Example
Obtaining the Maximum Benefit From BAS

- Having the BAS properly configured to match the building is the first step for any kind of energy management
- Exceptional energy savings starts with the above as a baseline and then adds a “knowledgeable and intelligent” building engineer who learns the building personality over time
- This building engineer implements control set point, sequence, and operational changes by benchmarking and optimizing energy efficiency. Optimizing each sub-system and their interactions is THE KEY TO EXCEPTIONAL ENERGY SAVINGS

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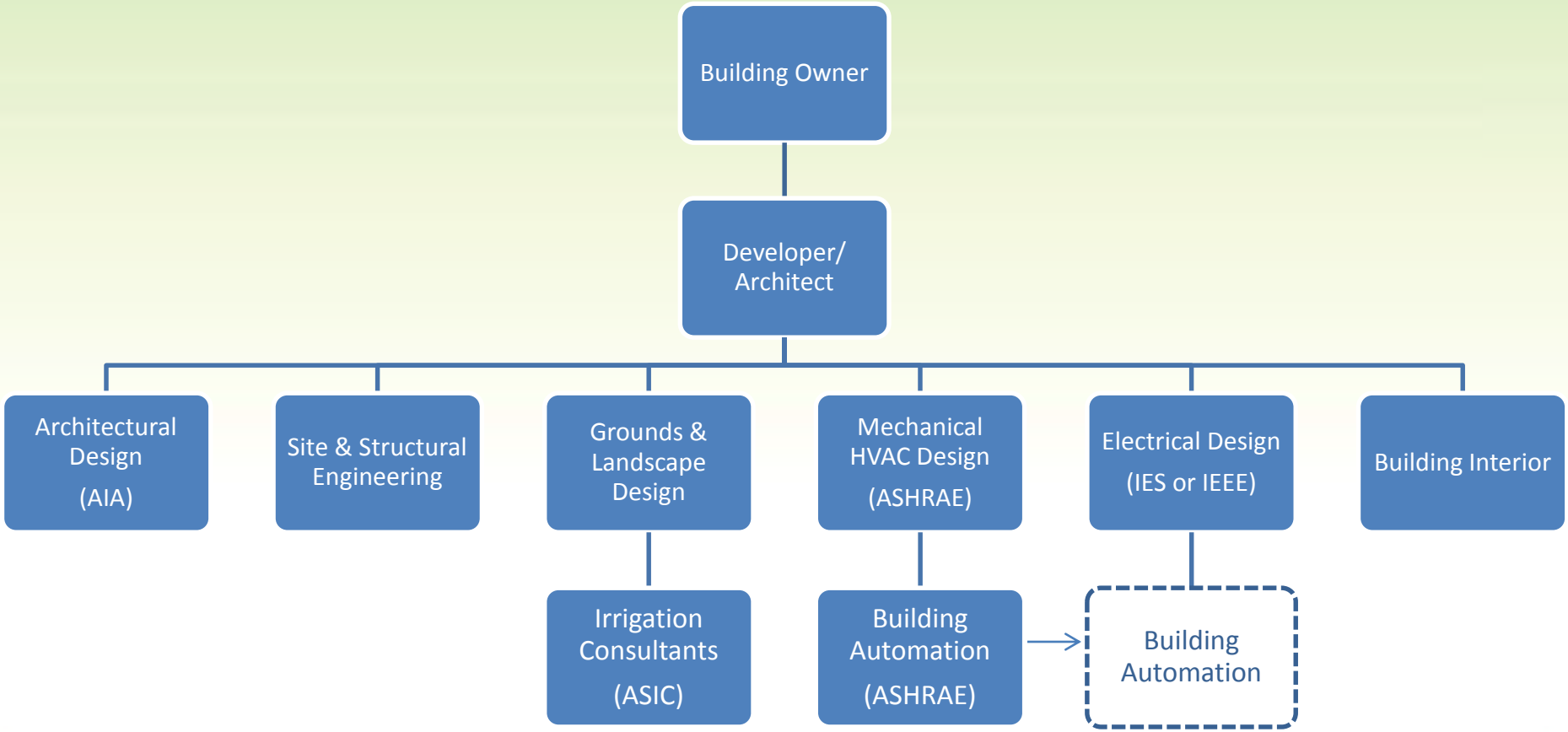
Industry Players For Building Construction



ASHRAE

American Society of Heating, Refrigerating, and Air Conditioning Engineers

ASHRAE advances the arts and sciences of heating, ventilation, air conditioning, and refrigeration to serve humanity and promote a sustainable world. With more than 53,000 members from over 132 nations, ASHRAE is a diverse organization representing building system design and industrial processes professionals around the world.

ASHRAE

- ASHRAE members include
  - Professional engineers, engineering professors, manufacturers, sales and construction organization professionals
  - Technical professionals associated with the industry of building environments, HVAC, and energy utilization
- ASHRAE is best known as the energy code writing organization responsible for ASHRAE 90.1, the building energy code adopted by the federal government, most states, and many countries worldwide.

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Energy/Water Use Efficiency Initiatives

- ASHRAE 91 building energy code
  - Commissioned by the federal government during the Arab Oil Embargo of 1973
  - Continuously updated and adopted by states to enforce building energy use in residential and commercial energy buildings
  - ASHRAE is a partner with DOE and USGBC in a 2030 zero-energy standard for all new construction and retro-construction
- ASHRAE 189 overall energy and water resource code and standards
  - Adds to ASHRAE 91, water utilization and efficiency standards
  - Minimum environmental site impact requirements
  - Carbon footprint considerations for sustainability initiatives

Energy/Water Use Efficiency Initiatives

- Zero energy and sustainable building design
- Reusing water for landscape irrigation purposes
  - Cooling tower/evap cooler blow-down
  - Condensate from HVAC coils
  - Rain water storage
  - Grey water from sewer system

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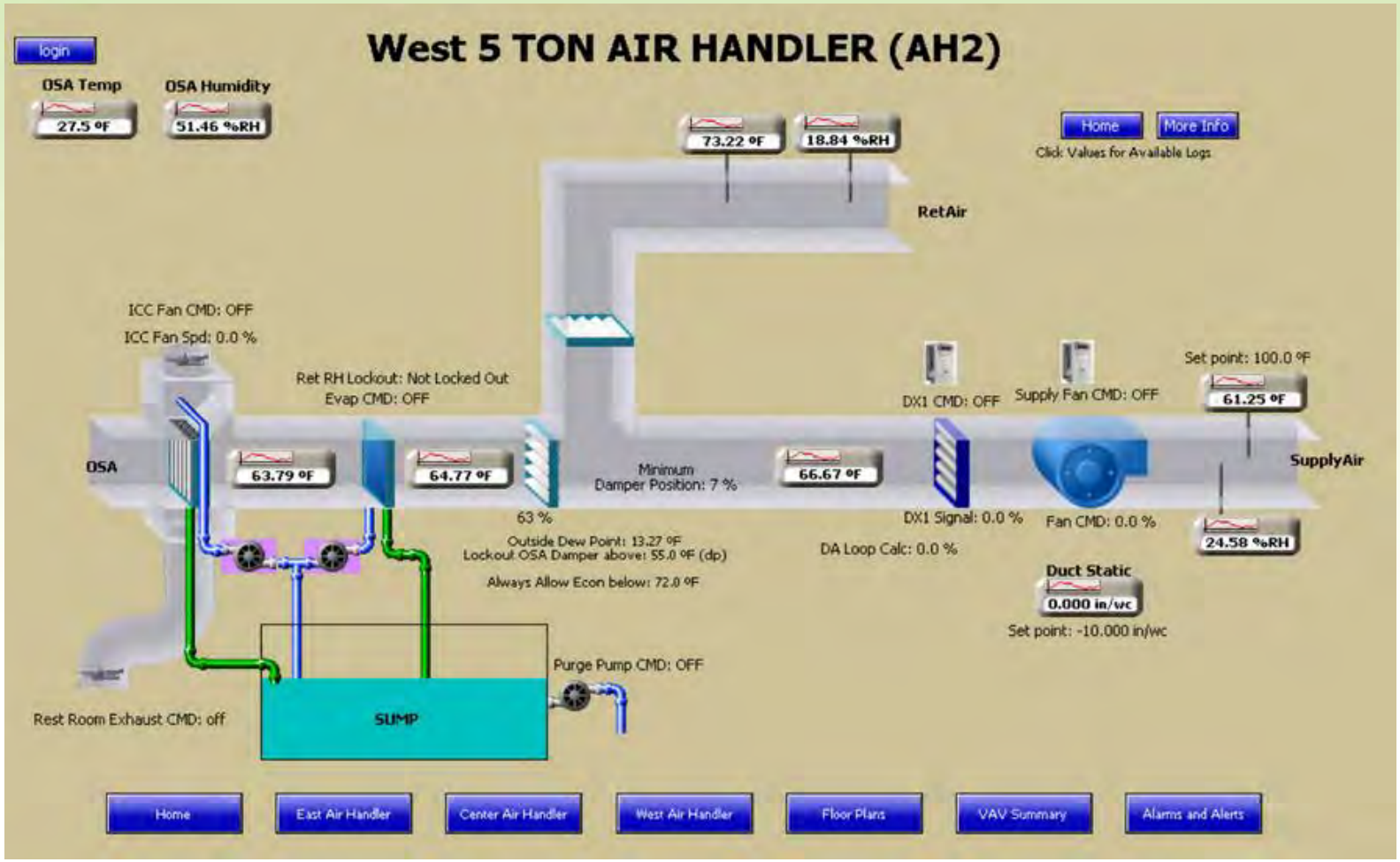
Energy/Water Use Efficiency Initiatives

- Our Atkinson Electronics office building reuses the evap. cooling blow down water for landscape irrigation
- The water drains whenever it is available and with no irrigation control, some areas receive way too much water
- Needs to be connected to work with the irrigation system control


West 5 TON AIR HANDLER (AH2)
login
OSA Temp
27.5 °F
OSA Humidity
51.46 %RH
73.22 °F
18.84 %RH
Home
More Info
Click Values for Available Logs
RetAir
ICC Fan CMD: OFF
ICC Fan Spd: 0.0 %
Ret RH Lockout: Not Locked Out
Evap CMD: OFF
DX1 CMD: OFF
Supply Fan CMD: OFF
Set point: 100.0 °F
61.25 °F
OSA
63.79 °F
64.77 °F
Minimum
Damper Position: 7 %
66.67 °F
SupplyAir
63 %
Outside Dew Point: 13.27 °F
Lockout OSA Damper above: 55.0 °F (dp)
Always Allow Econ below: 72.0 °F
DA Loop Calc: 0.0 %
DX1 Signal: 0.0 %
Fan CMD: 0.0 %
24.58 %RH
Duct Static
0.000 in/wc
Set point: -10.000 in/wc
Purge Pump CMD: OFF
Rest Room Exhaust CMD: off
SUMP
Home
East Air Handler
Center Air Handler
West Air Handler
Floor Plans
VAV Summary
Alarms and Alerts

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Opportunities For BAS Irrigation Integration

- Properties that are most likely to integrate BAS and landscape irrigation
  - Owner-occupied buildings
  - Building or campuses with landscape departments under the building engineer/facility manager
  - Large enterprises with multiple properties (they already have or are planning to have across country central automation systems)
  - K-12 schools (usually have a common district automation system)
  - Parks departments with building facilities above and beyond landscape irrigation

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Suggestions For Expanding The Market For Both BAS And Landscape Irrigation Control

- Two kinds of players in building automation
  - Larger corporations with legacy systems they want to protect
  - Smaller companies with mfg. representatives in individual territories (usually more progressive)
- Those building “green” or zero-energy buildings are most interested in energy and water conservation systems
  - LEED Points
  - USGBC
  - Promote a “green” corporate image

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Suggestions For Expanding The Market For Both BAS And Landscape Irrigation Control

- "Green" buildings usually follow an integrated design process where all the relevant consultants are in the planning process from the beginning
- Optimizing each design specialty and compromising for the most energy or resource utilization efficiency--impossible without integrated design
- Integrated design means that the owner/architect or developer is making all design decisions at the beginning, usually for life cycle costing
- ASHRAE members and BAS designers are at the table from the beginning along with the architect and other design professionals
- **How do Landscape Architects and Irrigation Consultants get a seat at the same table?**

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Conclusion

- **Integrating building automation and landscape irrigation for all of the benefits involved MUST be specified right from THE BEGINNING**
  - Vendors and system design must be selected and flat specified with sufficient system detail for scope and purpose in the bid documents
  - Integrated irrigation control probably won't happen if left to the irrigation subcontractor to pick a less-expensive "clock"
  - Legacy BAS manufacturers and irrigation control manufacturers are probably more interested in protecting their "turf" than embracing new technologies that require substantial investment.
  - New players in the market are likely to be the most progressive.

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John Fordemwalt, President & CEO, Baseline Inc. Boise, ID

April 27, 2015

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Agenda

- ASHRAE and Water, USGBC, IgCC
- Why integrate irrigation with BAS?
- BAS perspective on irrigation controls
- BAS system manufacturers and protocols
- Issues and challenges with integration
- Case studies, example applications

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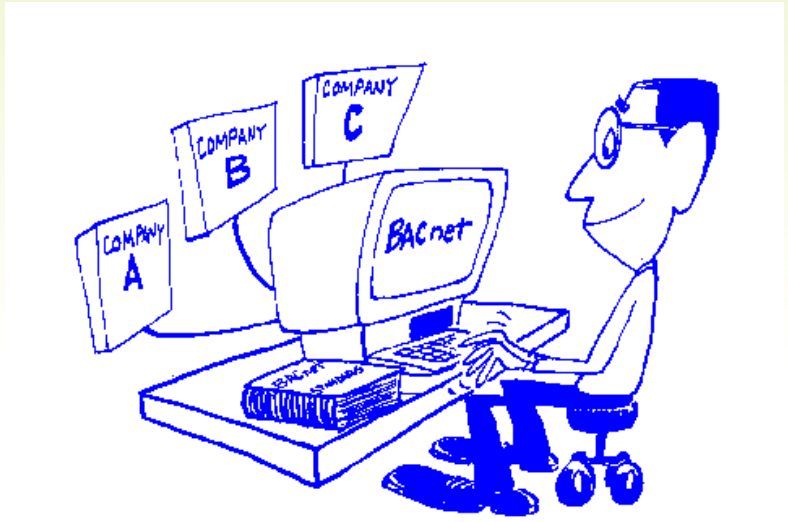
Purpose of Building Automation Systems:



Use Protocol and Communication Standards to allow a single building automation system to support multiple vendor subsystems

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ASHRAE taking interest in water

- 189.1 Initiative, collaboration with USGBC & IgCC
- ASHRAE Technical Committees 1.4 (Controls) and 3.6 (Water Quality) active
- ASHRAE provides standards definition, best practices documentation, and commissioning standards
- Standard definition process is multi-year – working now on content for 2019 Handbook

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Not just water, but energy

- Energy cost of water is significant - supply, conveyance, treatment, distribution
  - A recent study shows that 19.2% of all electricity use in CA is water related
- Some estimates are that up to 40% of water cost is “embedded energy cost”
- In most areas, saving end-use water also saves electrical “source water”

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Why integrate with BAS?

Property owners & managers request (priority order):

1. Unified water use/efficiency reporting
2. Integration of alarms & monitoring
3. Integrated use scheduling
4. Water harvesting solutions
   - Integrated management
5. Integration of in/on-building plantings:
   - Green roofs, green walls, containers

Why integrate with BAS?

Property owners & managers request (cont):

6. Cross-system integration
   - Security
   - Fire control systems
7. Sharing measurement devices and communications:
   - Flow and water use
   - Liquid level measurement

Why integrate with BAS?

Irrigation alarm examples:

- Flow errors – unexpected high flow, low flow, or no-flow
- Valve solenoid short or open circuit
- Device communication failure
- Rain Pause or delay initiated
- Controller in off position

…“Anything that will stop irrigation”

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Irrigation Controls – BAS perspective

Control Devices

- Valves
- Flow sensors
- Pressure sensors
- Moisture sensors
- Liquid level sensors
- Pumps & pump controllers
- Weather stations
- More…

Irrigation Controls – cont

Controllers with “business logic”

- Timers
- “Programs”
- Rain pause
- Flow management
- Smart Controller features
- Data logging/memory

= “Application controllers” or
“Programmable logic controllers”
in BAS terminology

Irrigation Controls – cont

Common Communication Technologies

Wired

- RS-232/485/Serial
- Ethernet & Fiber
- Proprietary
  - “Two-wire”
  - Other comm

Standard transport, largely proprietary protocols

Wireless

- Cellular
- WiFi
- Spread Spectrum
- Licensed Frequency
- Proprietary
- Zigbee
- *Bluetooth*

Major Manufacturers

- Siemens
- Johnson Controls
- Honeywell
- Alerton
- Automated Logic
- Delta Controls
- Schneider
- Tridium

Communication Protocols

- BACnet & BACnet/IP
  - ASHRAE and ANSI international standard
- Modbus
  - Oldest standard (1979)
- LonWorks & LonTalk
  - Former proprietary protocol, ANSI standardized in 1999

Most systems provide cross-protocol modules for better interoperability

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Issues and Challenges with Irrigation

1. Integration of irrigation is non-standard
   - Early adopter customers are starting to integrate
   - Many BAS integration contractors are nervous about killing plant material
   - Roles & responsibilities for all phases of install are not always clear (who is supposed to do what.)
   - Customization is normal on BAS projects, but not for irrigation.

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Issues and Challenges with Irrigation

2. Installation and Commissioning

- Install quality is an industry-wide issue driven by lack of standards and lowest bidder economics
- Generally little or no inspection or commissioning (some states starting to apply rules)

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Issues and Challenges

3. IT Integration and network security

- Irrigation controllers are yet another IP addressable device for IT
- Control SW (Application specific controls) must fit IT requirements (security, behavior)
- Irrigation contractors & facilities teams do not have expertise to install or resolve issues

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Issues and Challenges

4. Landscape maintenance personnel and workflows
   - Groundskeepers and Maintenance Contractors are tech challenged
   - Workflows include fixing plumbing, wiring, head & distribution issues, modify programming
   - Don’t have access to BAS infrastructure
   - Need systems that are familiar & intuitive

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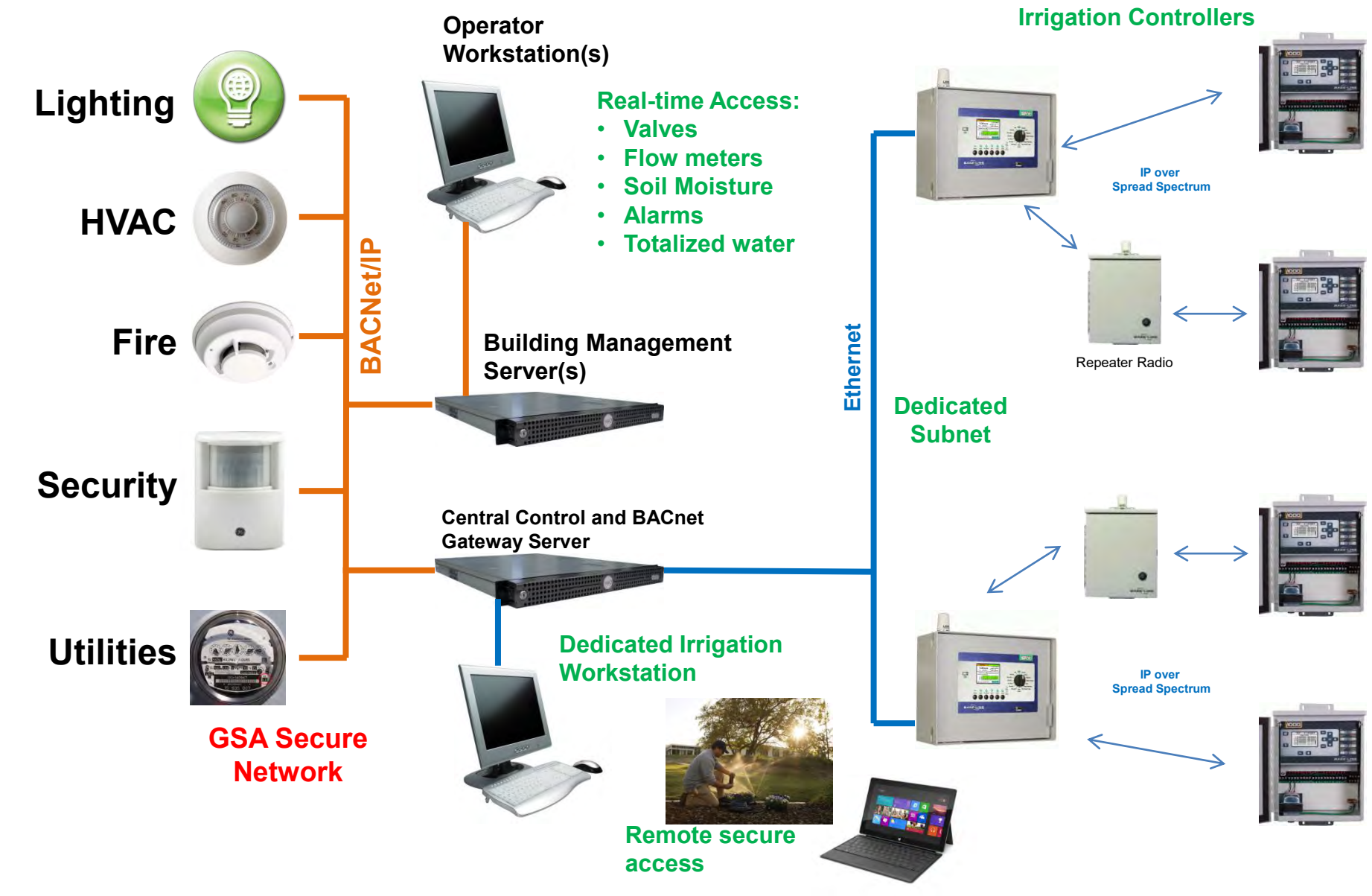
Case Study

Denver Federal Center

- 633 Acres
- 39 Irrigation controllers
- 5 Points of Connection
- Ethernet + Radio
- BACnet/IP Integration
- Dedicated servers
- Secure subcontractors access

Denver Federal Center Block Diagram



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Example Application

Retail – New construction standard

- Dry contact relay to irrigation alarm output
- Custom list of irrigation alarms
- Single standard alarm notification

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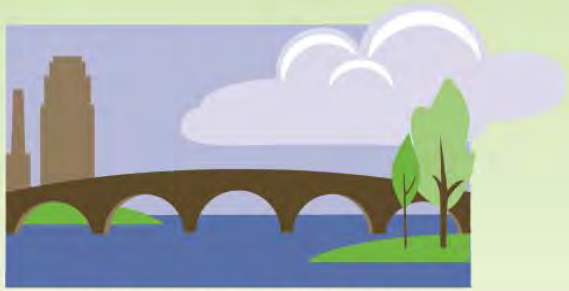
Example Application

V.A. Medical Center

- BACnet/IP implementation
- Custom site map & graphics
- Real-time status and water use

Conclusions

- There is growing market demand for integration of water use into BAS
- Integration of irrigation with BAS has real advantages, but also challenges
- Significant opportunity for designers to expand practice and get a seat at the table



Questions?

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IRRIGATION WORLD MEET STORMWATER WORLD! Are You Ready?

Peter MacDonagh FASLA PLA ISA
Kestrel Design Group
University of Minnesota
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www.kestreldesigngroup.com

“Where is the water going Dad?”

OUTLINE

….In the City….

I. WHAT'S STORMWATER WORLD?

A. What is Stormwater? Waste
B. What Makes up Stormwater? Small/Dirty vs. Large/Clean
C. Why is Stormwater Important? Green Water & Lakes
D. What's the Harm With Managing Stormwater as Before? Cost$/1972 CWA
E. What's the Answer? LID/GI

II. WHAT'S IRRIGATION WORLD?

A. Irrigation World's Potable Water Future? Overdependence
B. Stormwater vs. Gray Water vs. Recycled Water? Most Available
C. Will Irrigation & Stormwater World's Collide? Not Necessarily
D. Could we do it Differently? Case Studies: Trees & Green Roofs

Where & How Does it Rain? Stormwater Management

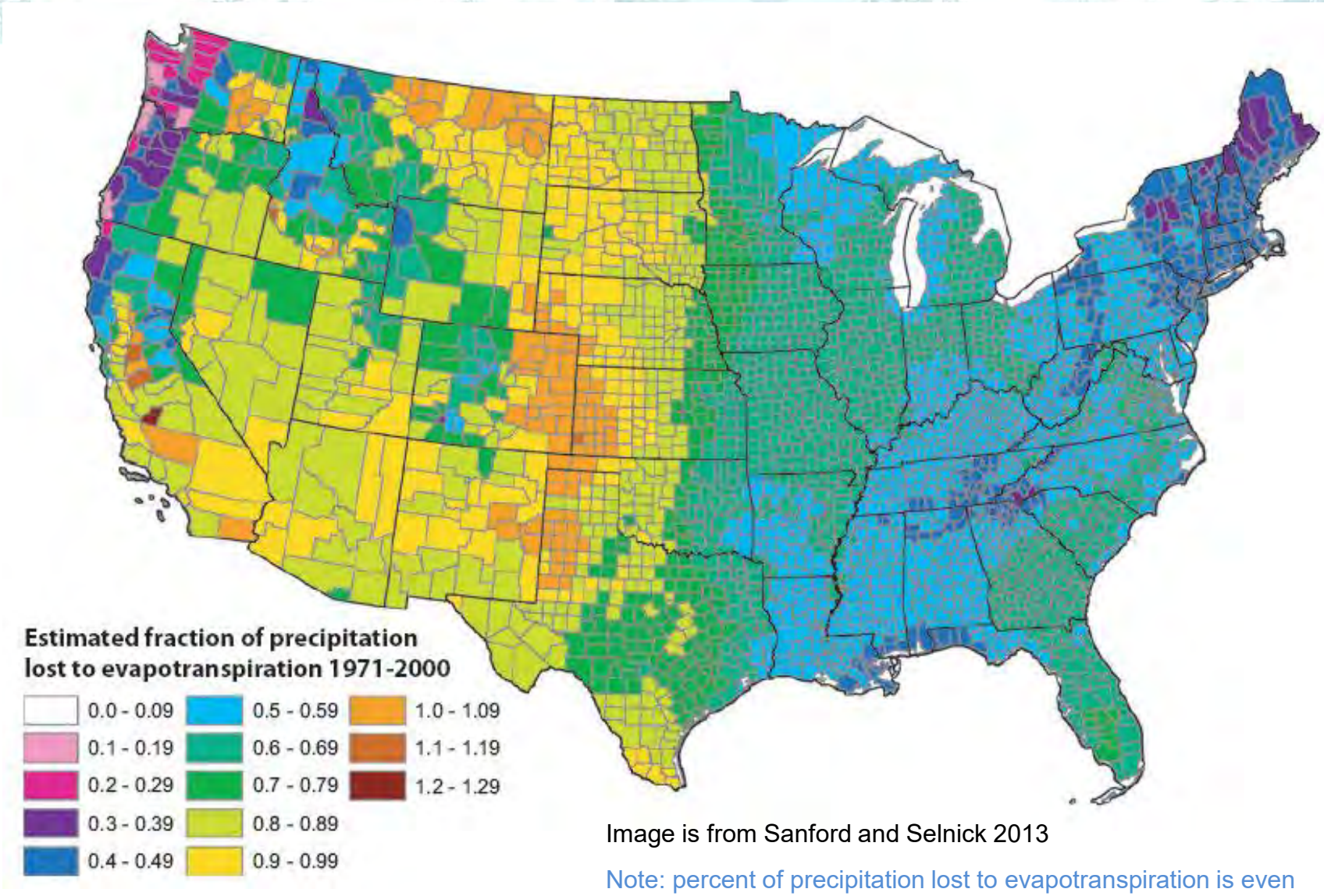

Image is from Sanford and Selnick 2013

Note: percent of precipitation lost to evapotranspiration is even more than 40% in most of the US

Beaker: Water + Sand + Soil
10 Drops

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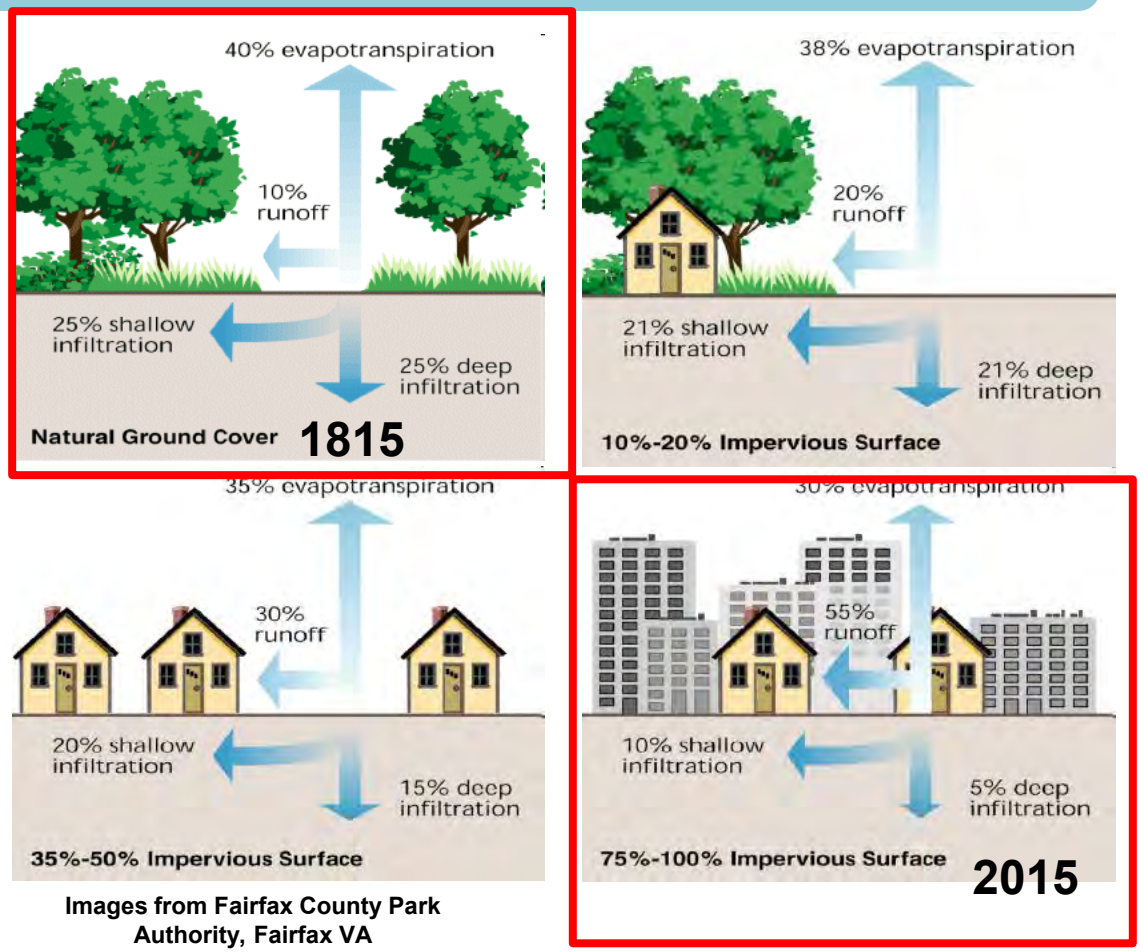
Stormwater:

An Upside Down World
Where Did it Go?
Where Does it Go?



Images from Fairfax County Park Authority, Fairfax VA

"Nearly all of the associated problems result from one underlying cause: loss of the water-retaining and evapotranspirating functions of the soil and vegetation in the urban landscape."

EPA - 2008

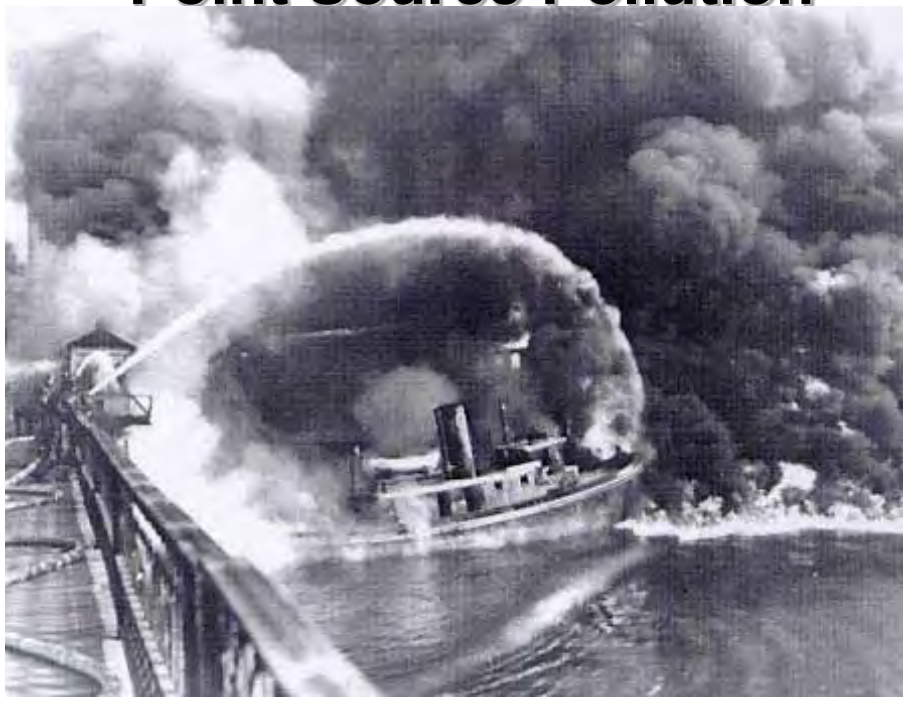
Dime/Plate/Barrel
Suitcase Clay
N/275 + P/500 = Algae

An Upside Down World

The Clean Water Act

NPDES: Phase I, Phase II, Phase III?

EASY PART
Point Source Pollution



Cuyahoga River Fire, 1969, Assoc. Press
= 1972 Clean Water Act: Phase I

HARD PART
Non-Point Source Pollution

Mississippi River Dead Zone 2008 NASA

= CWA: Phase II 2003

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Pollutant Wheel
Paper Cut = Ambulance

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RCP $ 4’/5’/6’
Philly $1.5 B vs. $15 B

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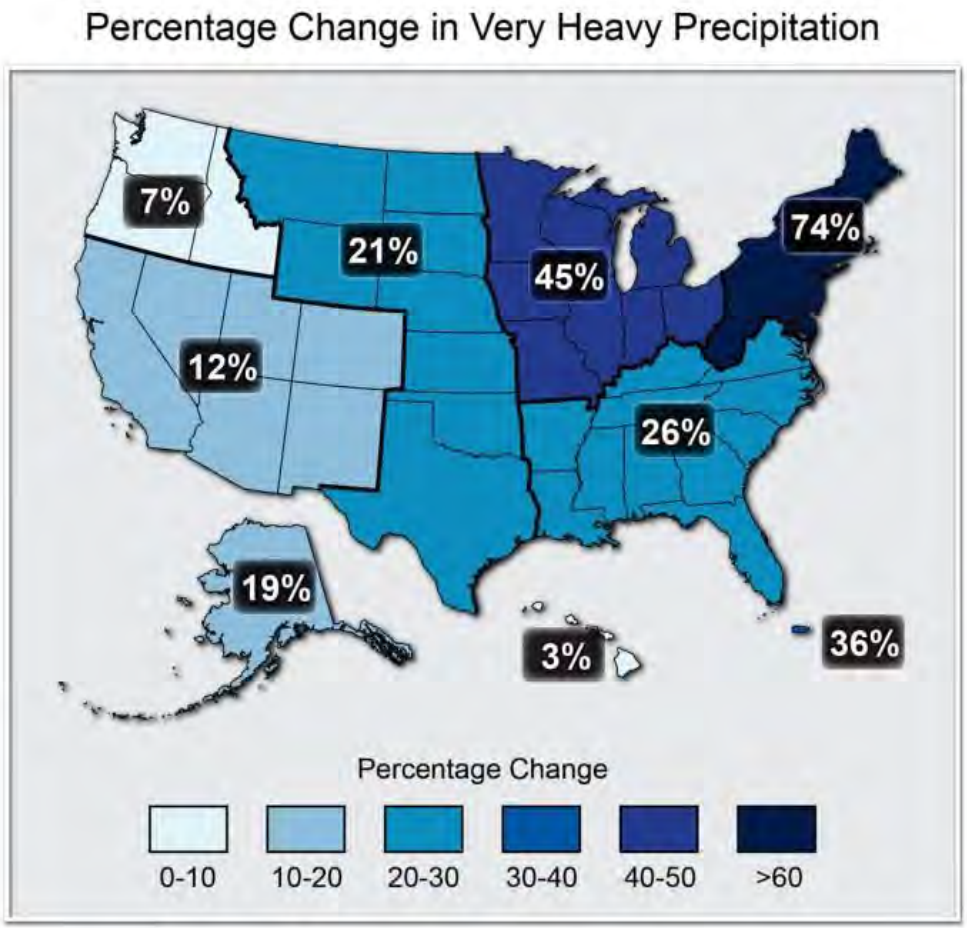


Figure 2.16: Percentage Change in Very Heavy Precipitation
Caption: The map shows percent increases in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events) from 1958 to 2011 for each region. There are clear trends toward a greater amount of very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.
(Figure source: updated from (Karl et al. 2009) with data from NCDC)

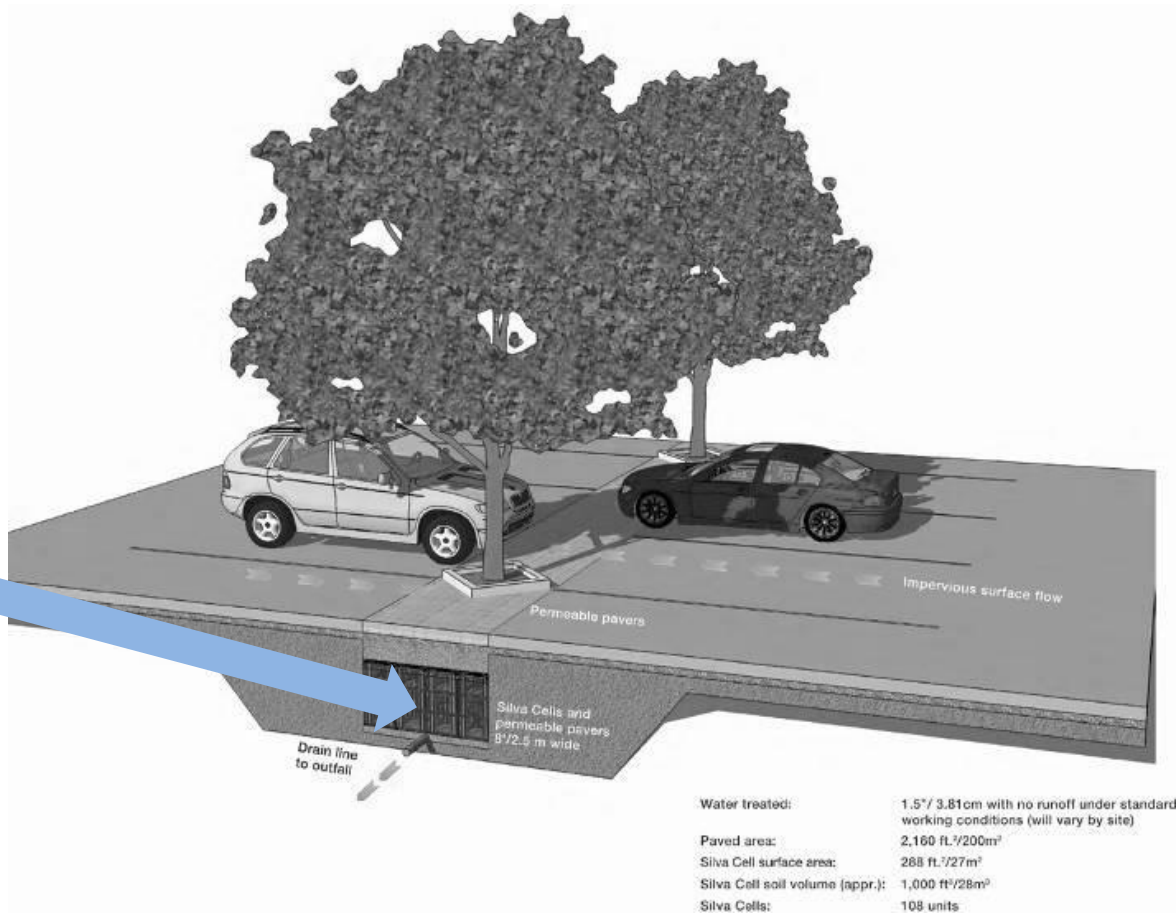
Source: National Climate Assessment Draft January 2013; http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap2-climate.pdf

The average annual rainfall for Minneapolis is 32.16 inches.

•In 2014, between January and June, Minneapolis received 27.26 inches of rain.

H2O + Sand + Cup > Swirl

LID/GI For Stormwater Management? YES



From Waste to Asset: Trees & LID Thrive with Nutrient Rich Water (Stormwater)

MSP 1.1”/24h <90% >50%
10y/24h 6.1” > 7.1”

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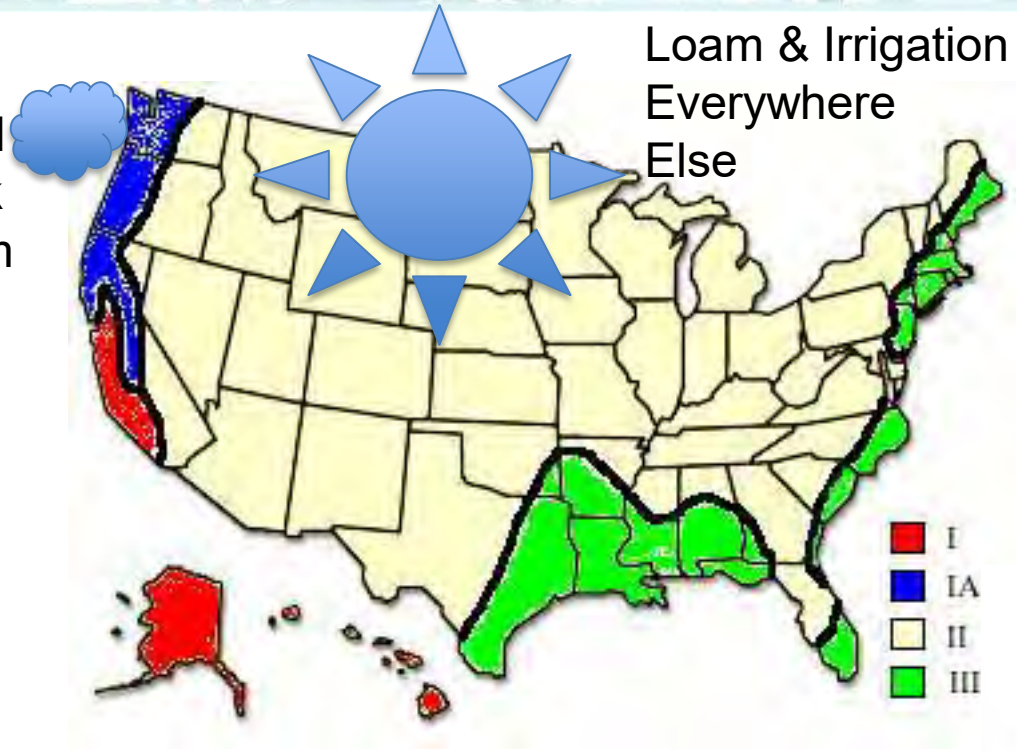
SW yOgA

Where's Rains & Storms? Loam/Sand/Rock? LID/GI & Irrigation?

Sand
Rock
Loam
Here

Loam & Irrigation
Everywhere
Else



USA & North America
Mainly Storms

Europe
Mainly Rain

Sand or Rock or Loam
No Irrigation
Everywhere North of the Alps

Loam & Irrigation Here

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SW = 50% Dirty & 50% Clean

LID/GI & Irrigation For Stormwater Management? YES

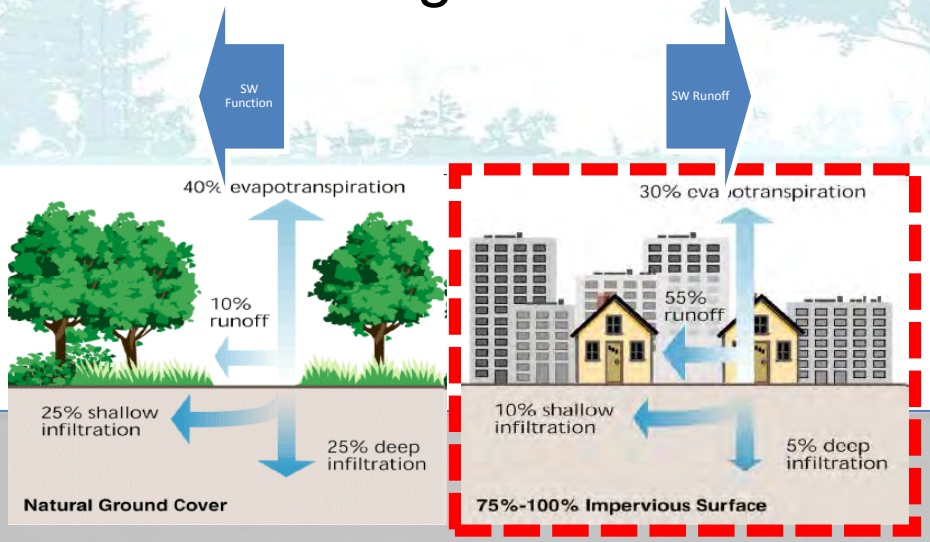


Image from Fairfax County Park Authority, Fairfax VA

"Nearly all of the associated problems result from one underlying cause: loss of the water-retaining and evapotranspirating functions of the soil and vegetation in the urban landscape."

EPA - 2008

OLD PARADIGM

Huge Pipe = **Localized Flood Control**

EMERGING PARADIGM

Medium Pipe +  + O = **Flood Control Volume Rate Water Quality**

MINNEAPOLIS GREEN & BLUE INFRASTRUCTURE

1. Wildlife Skyscrapers (Cormorant Platforms) at Lake Harriet Micropool Mirror Minneapolis Skyscrapers

2. Minnehaha Creek Streambank Soil Bioengineering Stabilization approach to enhancing wildlife, recreation, and surface water infrastructure

3. Marcy-Holmes Neighborhood Rain Gardens aregreen infrastructure that collect stormwater runoff from adjacent roofs and parking lot

4. Green roof at the Phillips Eco-Enterprise Center: creating stormwater & wildlife infrastructure

5. Lake Nokomis Stormwater Wetlands: Pre-settlement landscape informing stormwater and wildlife infrastructure design

INTRODUCTION

Big Trees for Stormwater Management

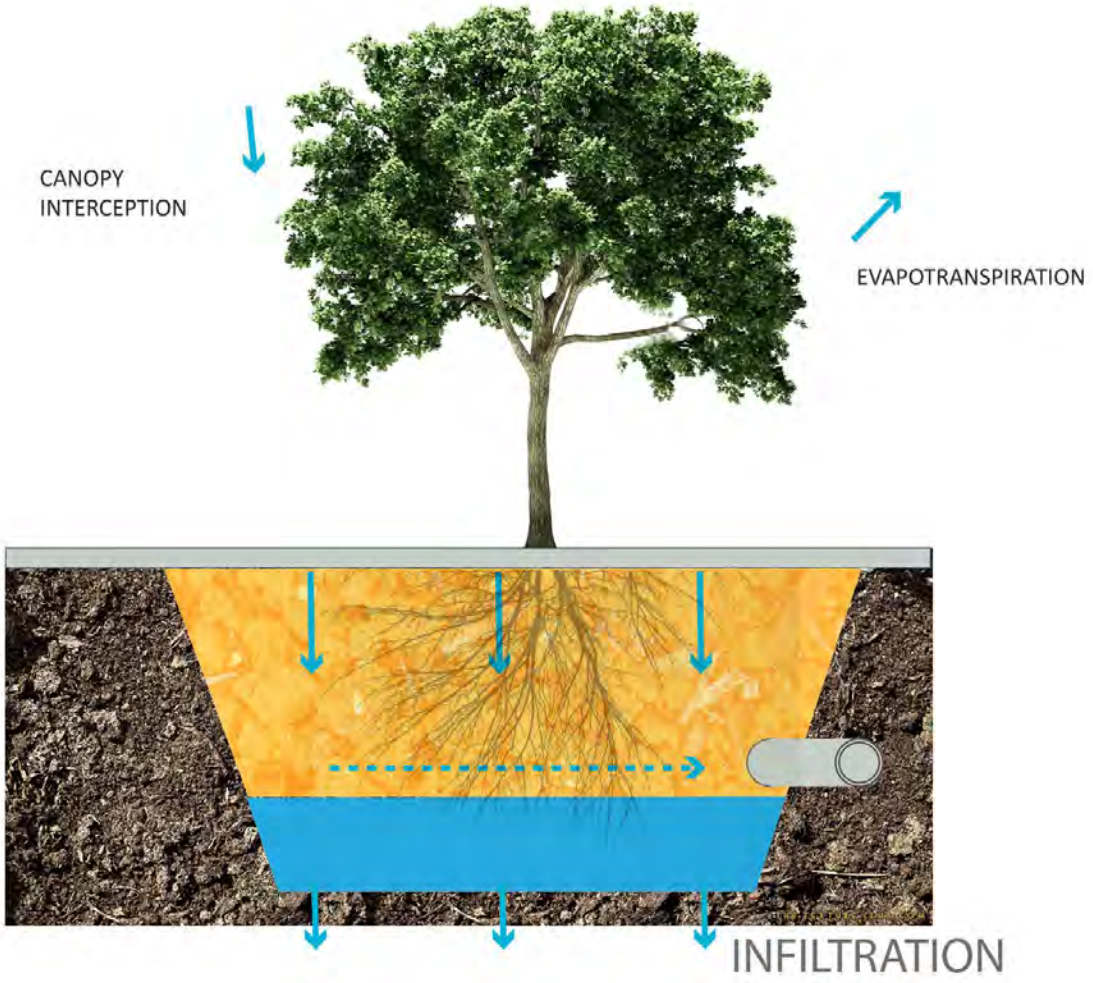
Rua Goncalo, Porto Alegre, Brazil

LATEST RESEARCH DEVELOPMENTS

European Beech (Fagus sylvatica) Avenue, Antrim, Ireland

2014 Minnesota Stormwater Manual: Tree & Green Roof & BioInfiltration Chapters

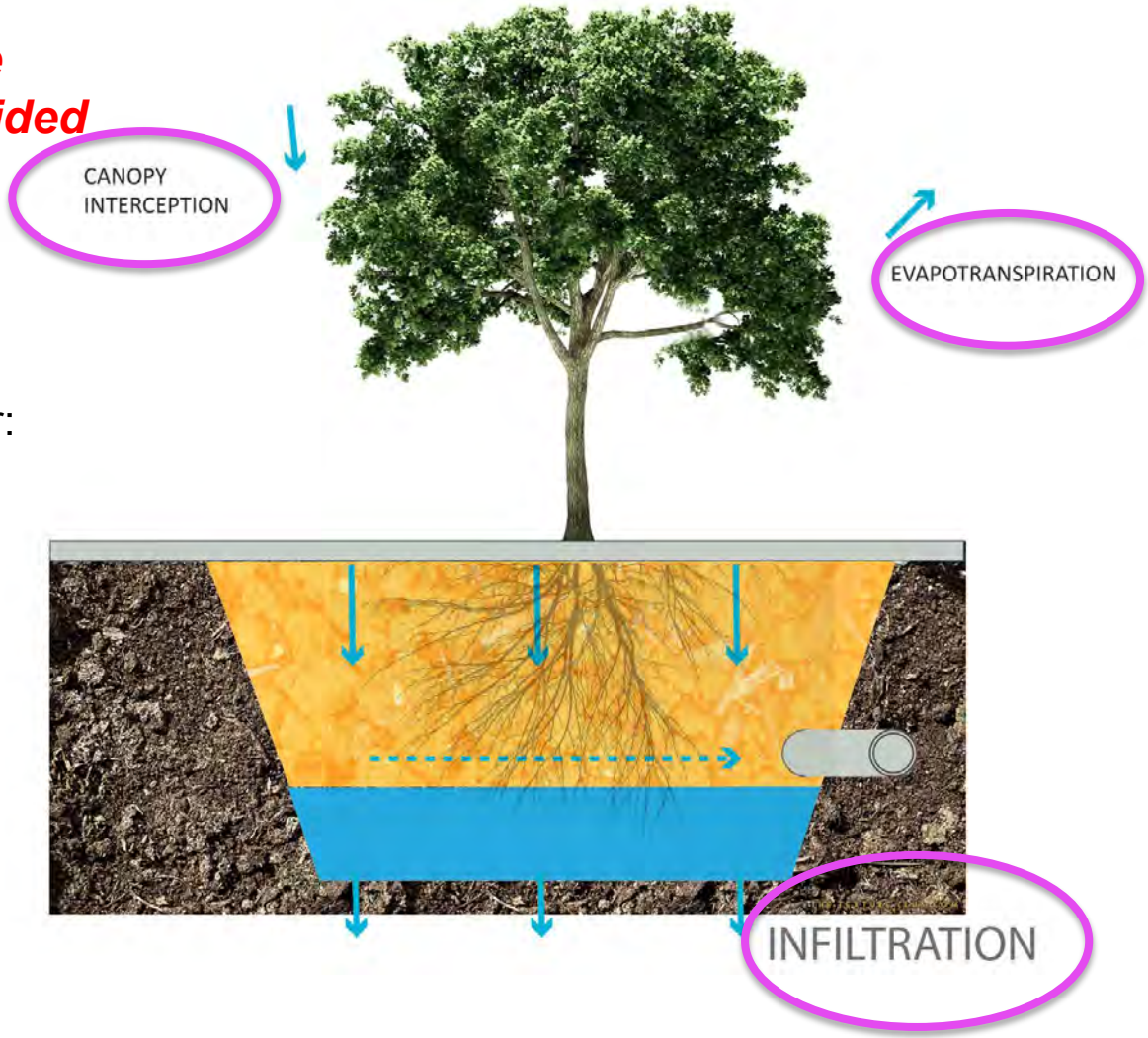
- Tree quality and planting
- Soil quality
- Minimum soil volume
- Techniques available to provide rootable soil under load bearing surfaces.
- Species list for tree SCMs
- Maintenance
- Inspection form
- Monitoring



Stormwater Credits for Using Properly Planted Trees for Stormwater : Minnesota 2014 - http://stormwater.pca.state.mn.us/index.php/Trees

1) Infiltration + 2) Evapotranspiration (ET) + 3) Interception

Full ET credit for a mature tree is given IF 2 c.f. of soil is provided per s.f. of canopy

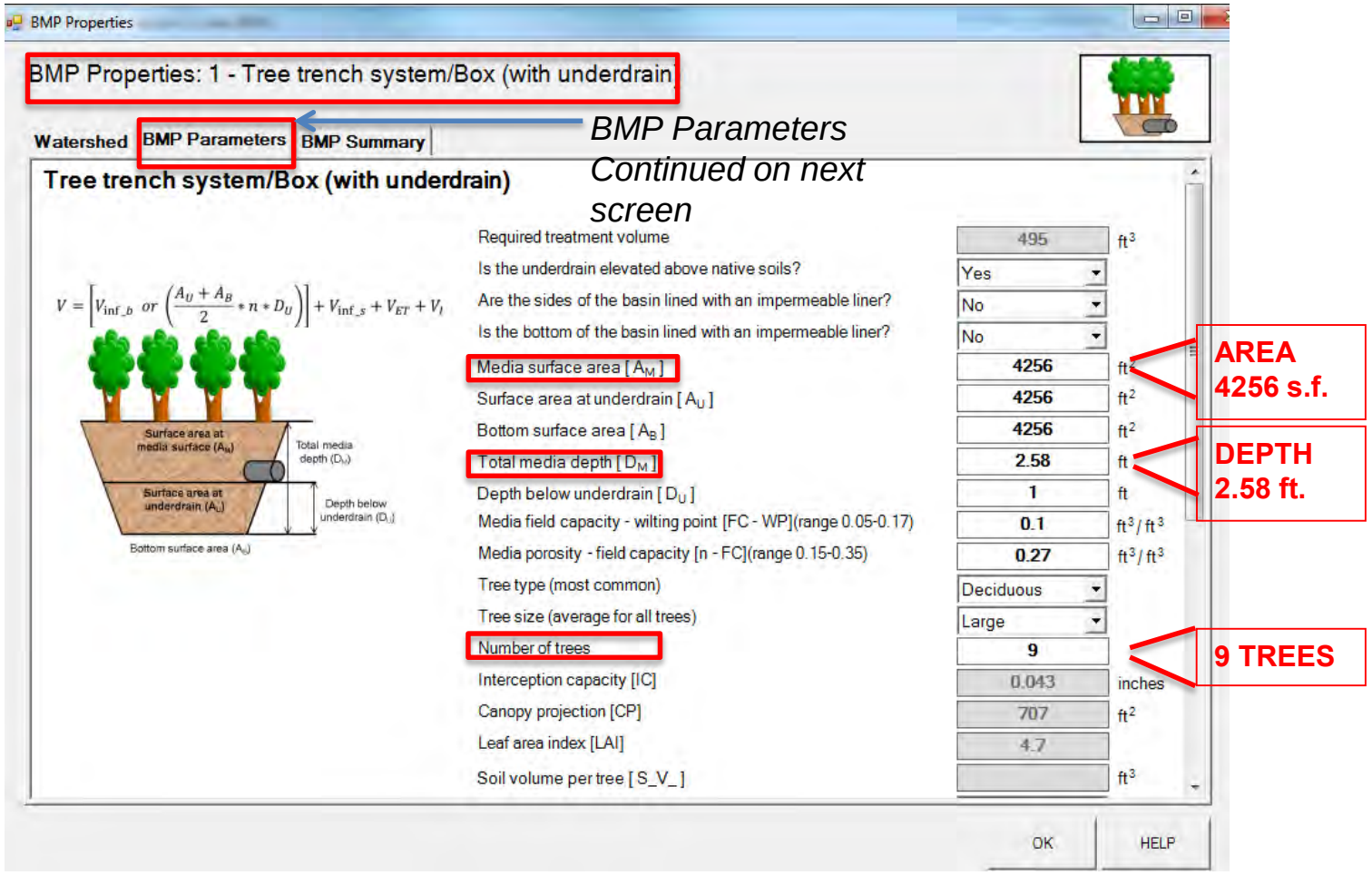


Volume based performance goals for:

- New development
- Redevelopment
- Linear Development
- Sites with Restrictions

Example Tree
Credit Calculation Sample Scenario

- Watershed: 270’ long x 20’ wide sidewalk (0.12396 acres)
- Tree SCM: 266’ long x 16’ wide x 2.58’ deep
- Silva Cells with 9 large trees, 30’ oc



Green Water/Lakes/Trees

deeproot

Relationship of Tree Species Diversity and Water Quality

http://caseytrees.org/resources/publications/treereportcard/2012web/

http://www.gvsu.edu/rmsc/interchange/may-2008-science-and-math-update-158.htm

Exploring the CORRELATION of Tree Canopy Loss with Decrease in Water Clarity

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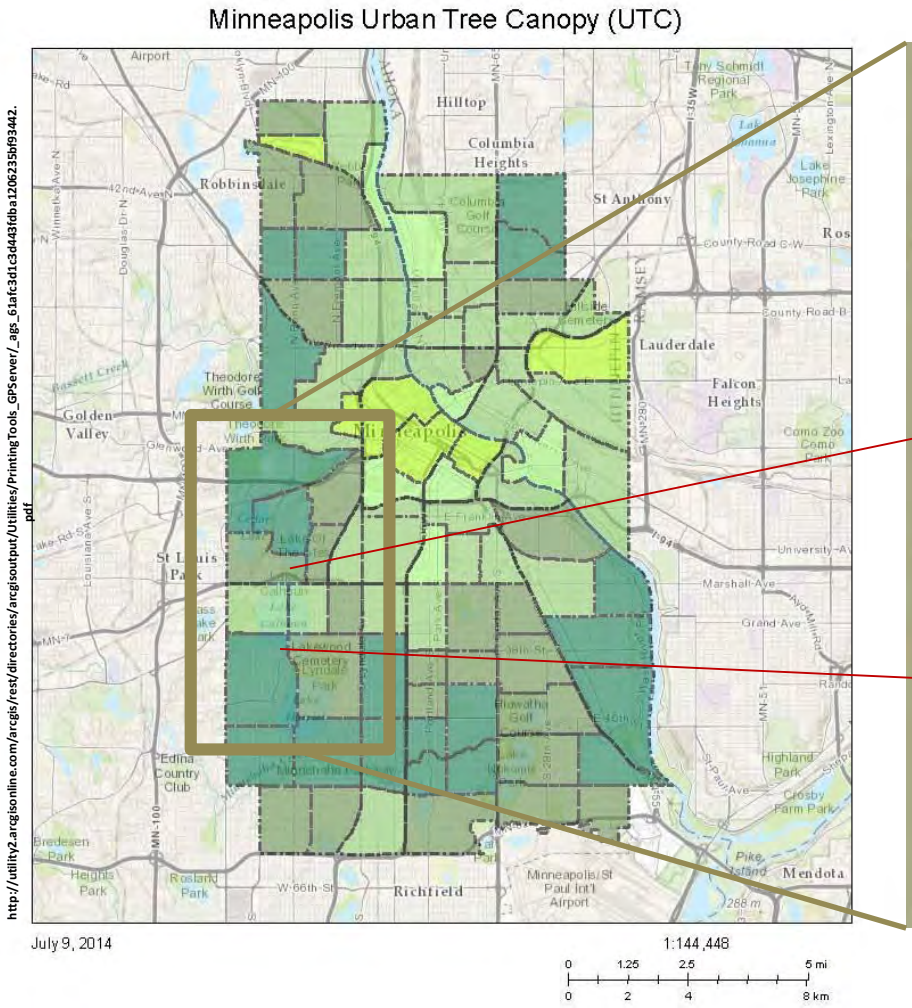
Relationship of Tree Species Diversity and Water Quality



Minneapolis is 58.4 square miles (37,376 acres), 6% of which is water.
This equates to 3.504 square miles (2,242 acres) of water.

KestrelDesignGroup

Relationship of Tree Species Diversity and Water Quality

http://www.homesmsprealestateblog.com/2012/09/chain-of-lakes-part-of-the-50-mile-minneapolis-grand-rounds-national-scenic-byway.html

http://www.panoramio.com/photo/18205519

Focus on data from Lake Calhoun, the largest, deepest lake in the Chain of Lakes system - At 87 feet deep, 401 Acres

KestrelDesignGroup

In the Late 1800s, American Elm made up 90% of the boulevard trees in Minneapolis

- 1963: First Dutch Elm Disease Detected in Trees
- **1977: 31,000 Elm Trees Removed**
- **1978: 20,000 Elm Trees Removed**
- 2004: 10,000 Elm Trees Removed
- 2005-2015: 2,700 Elm Trees Removed Annually

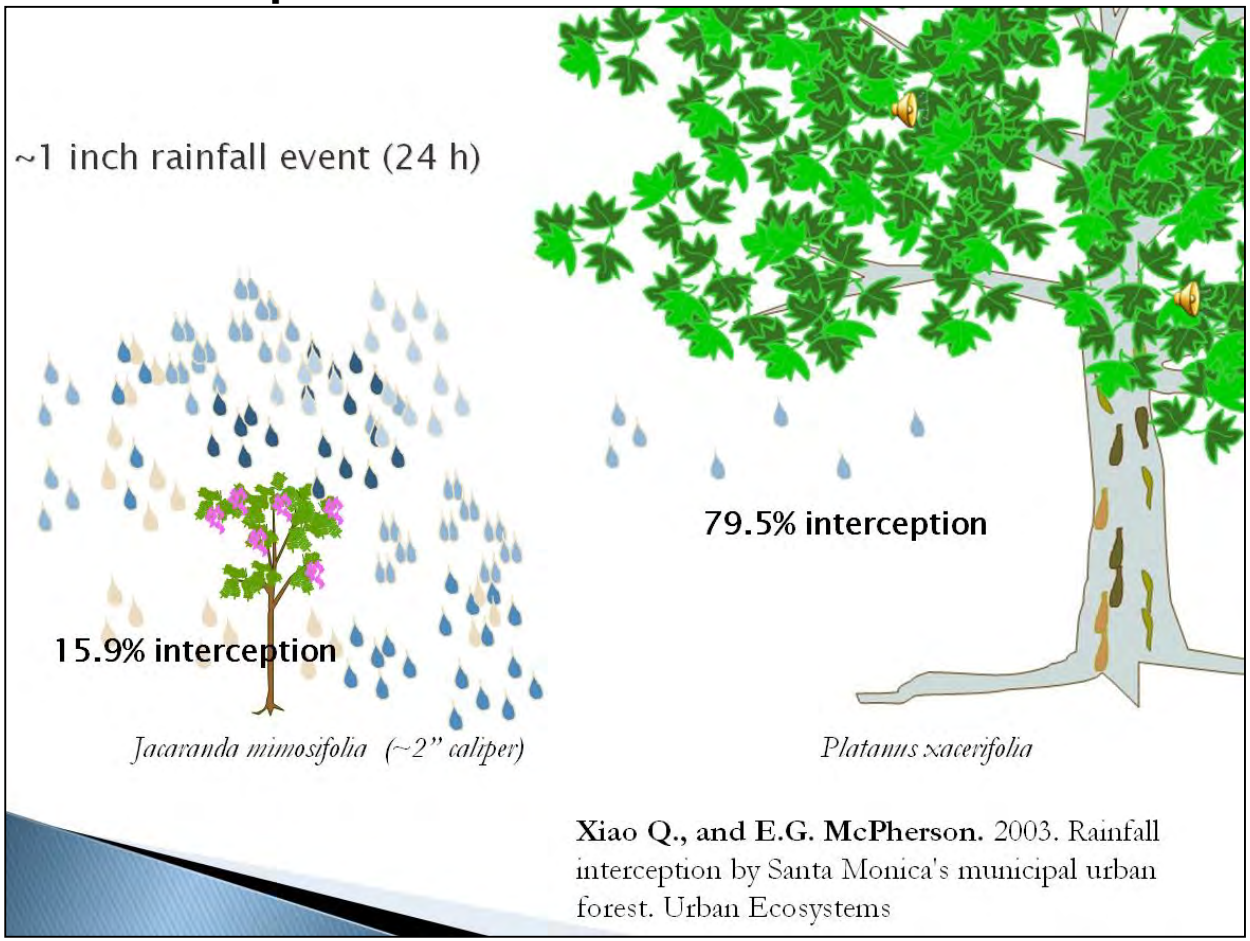
the entire City, with an average DBH of >30 inches.

Since 1977, 63,700 Elm trees have been removed in the boulevards of Minneapolis

http://princetonamericanelm.blogspot.com/

Stormwater Interception Volumes

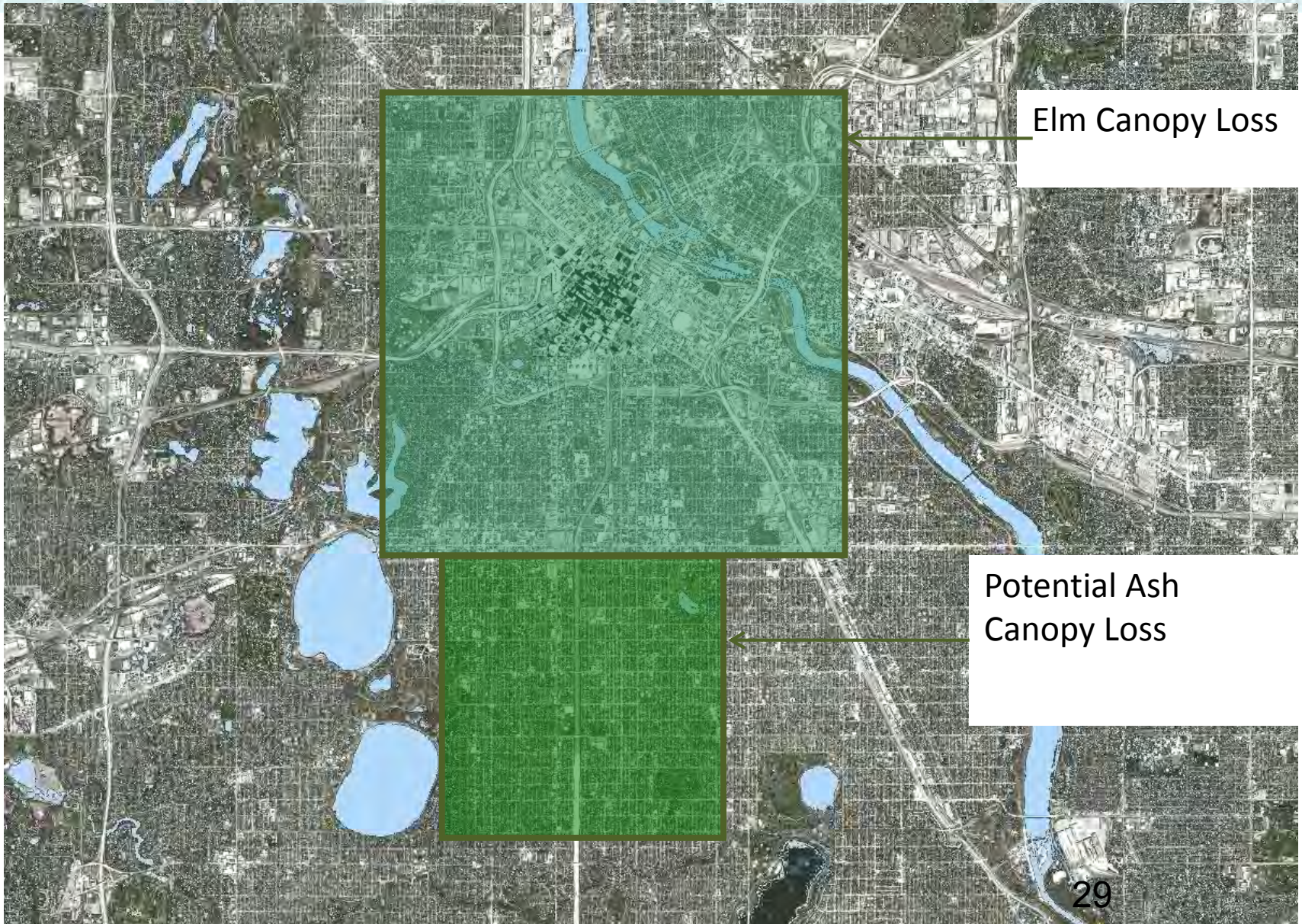
2”/50mm Caliper Jacaranda versus 22”/560mm DBH Plane Tree



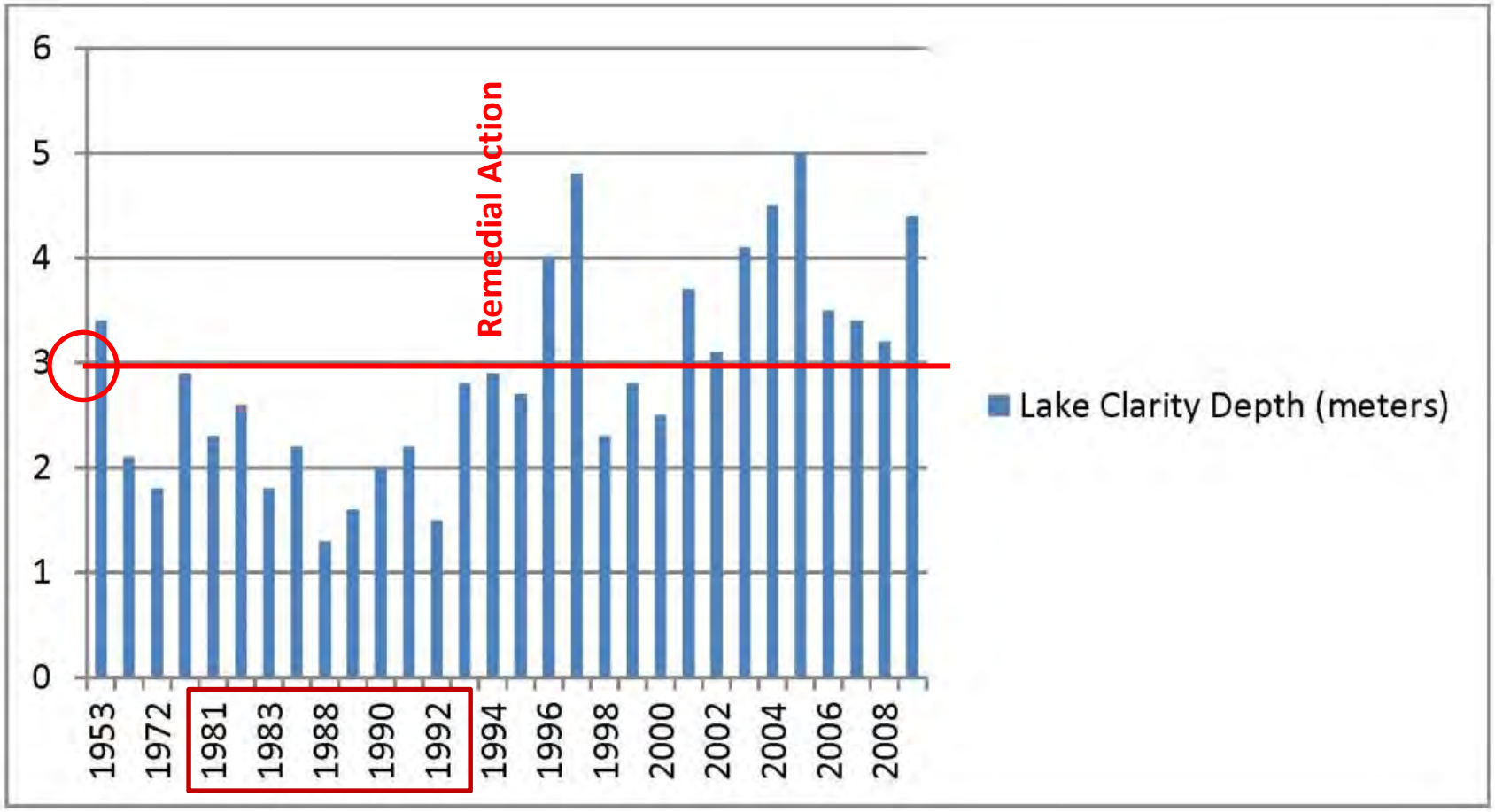
Source: Based on data from McPherson et al 2003

deeproot

Relationship of Tree Species Diversity and Water Quality



Lake Calhoun Lake Clarity Depth Over Time



Data Collected from the Citizen Lake Monitoring Program for Lake Calhoun, Minnesota Pollution Control Agency

There IS A CORRELATION to loss of tree canopy and water clarity

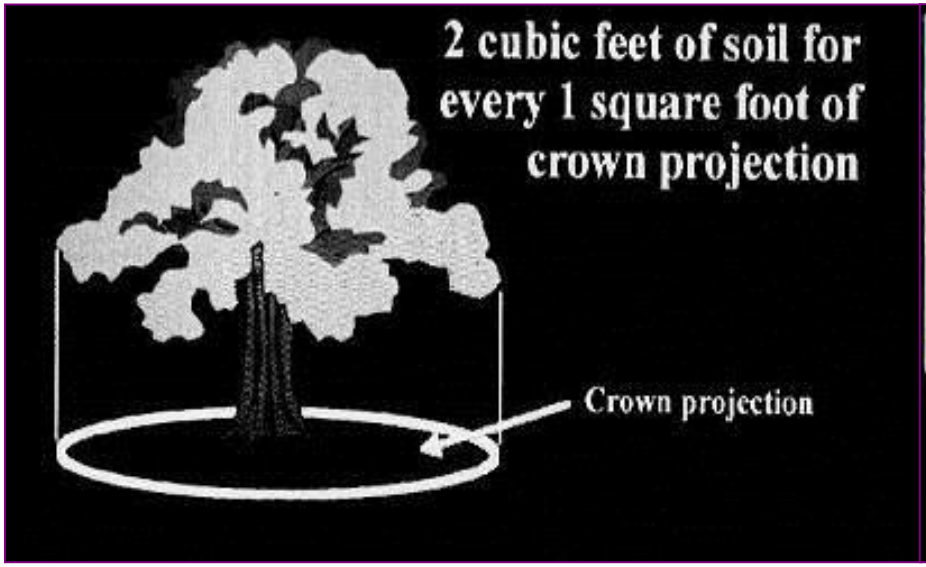
Following the removal of Elm trees (during the late 1970s and early 1990s), there was a marked decrease in water clarity depth in the Chain of Lakes, yet building development remained constant throughout the contributing sub-watershed around Lake Calhoun.

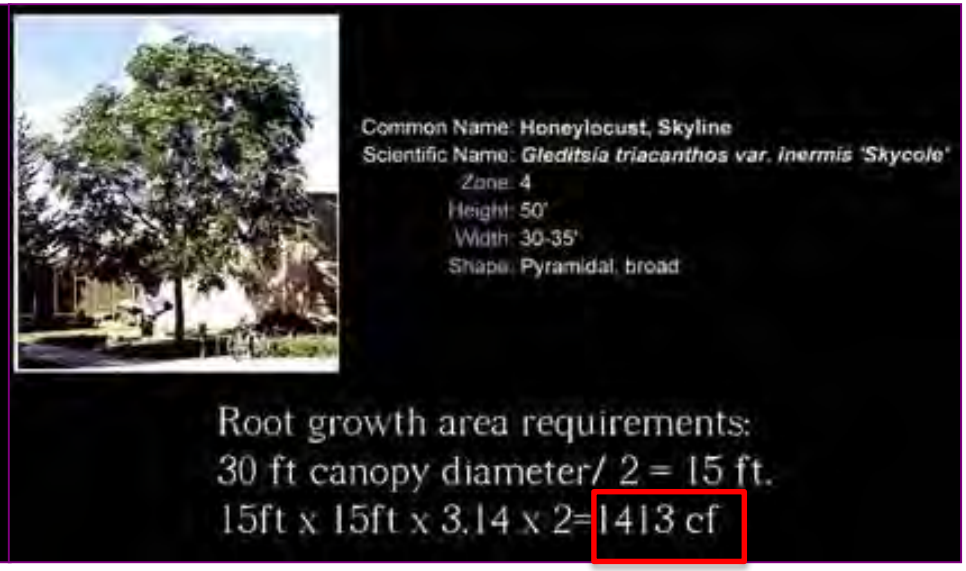

Soil Volume and Canopy Size?
Germany

What do Trees Need to Get Big? Will We Ever Know? YES We Know

Trees Need Large Volumes of Oxygenated Soil

"Ideal" Conditions





Grabosky, Trowbridge and Bassuk (2002)

1 in the AIR.
2 in the GROUND.

What Happened to this Tree?

Spilled Diesel?
Hours of Idling Machines?
Concrete & Sheetrock Soil Amendments?
String Trimmer Bark Treatments?
Deep Trunk Immersion?
Once Yearly Watering?
Salt Spray Foliar Feedings?
&
Ran out of Money?

Actual conditions: Average street tree only has access to **between 1.4 m^3 (50 ft^3) and 2.8 m^3 (100 ft^3) of soil.**

Directly Connected Impervious Drainage Area (DCIA)

Monitoring Trees Treating Street Stormwater: Field Monitoring of Two Silva Cell Installations in Wilmington, NC
J.L. Page, R.J. Winston, W.F. Hunt III. January 27, 2014.

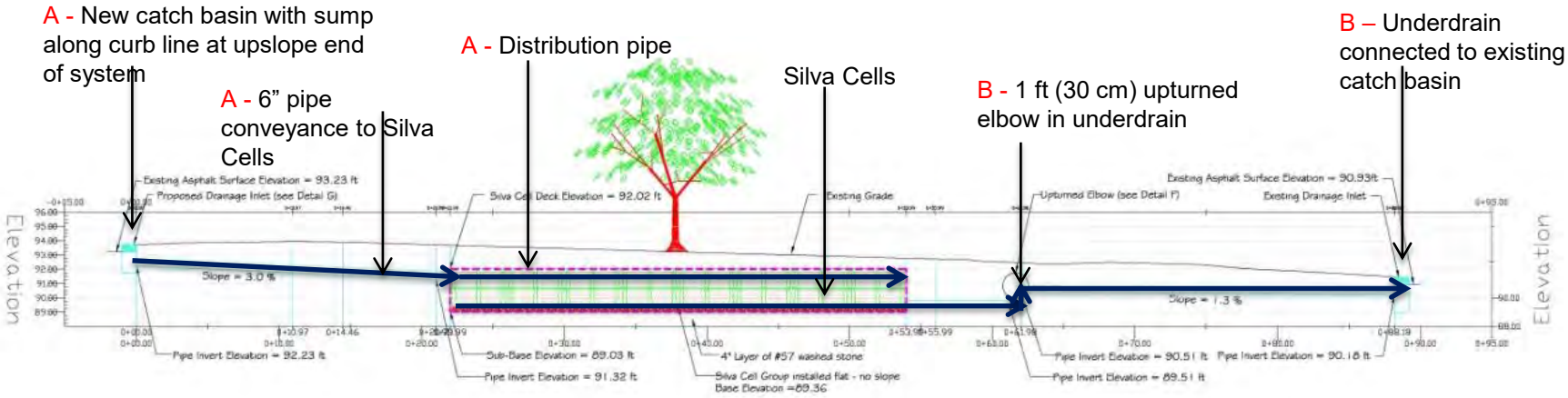
- **Two Tree/Soil/Silva Cell systems installed and monitored**
- **Both are Crape Myrtle Trees**
- **2 different media: differ in organic matter content**
- **Wilmington, NC: 1 on Orange Street, and 1 on Ann Street**
- **59 storms above 0.10 inches**
- **47.6 inches during 11 months monitoring period,**
- **Collected 19 sets of paired water quality samples each site**

BEFORE SOIL

AFTER SOIL

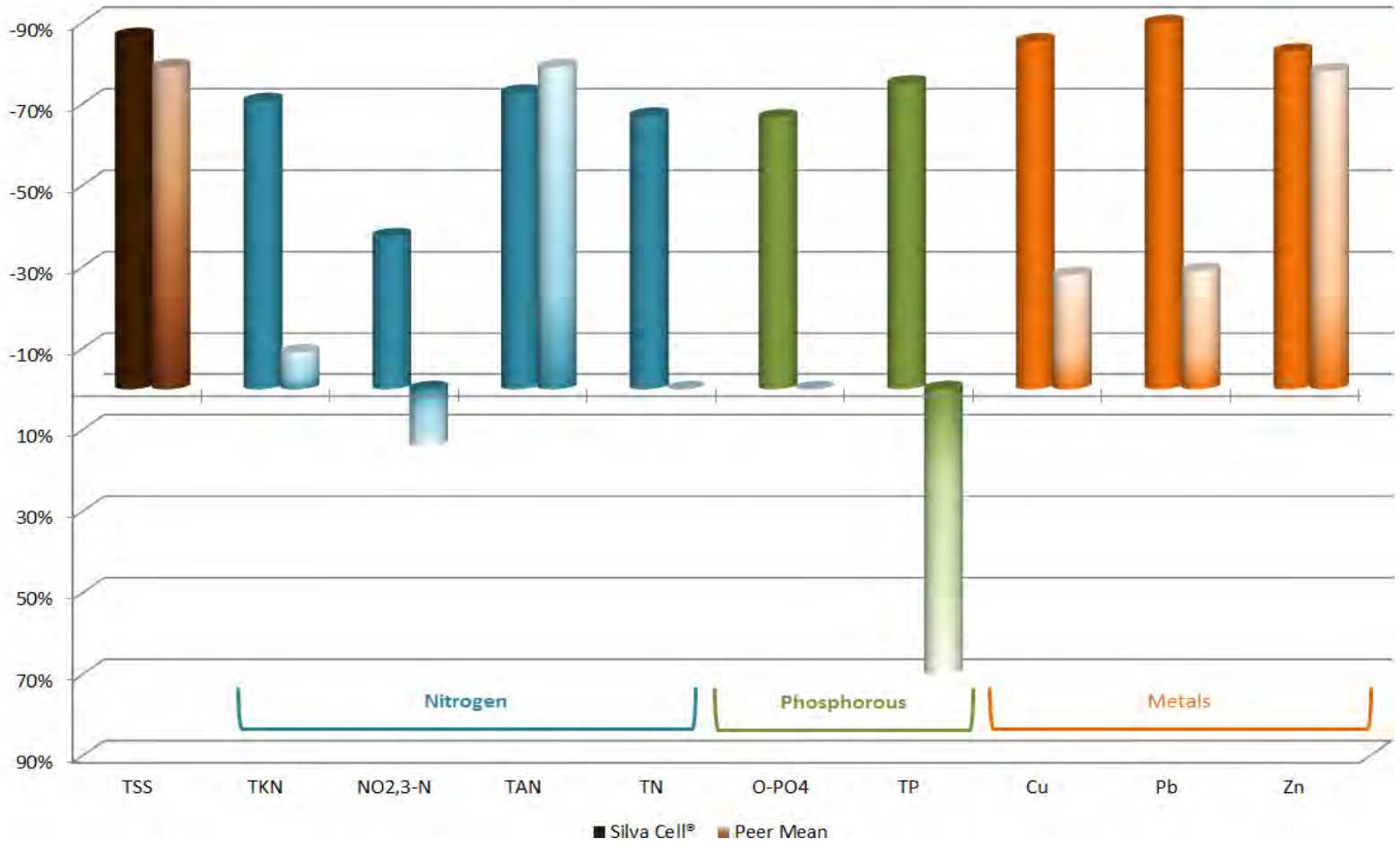
Images by Deeproot, 2012

- Pond liner
- Runoff from street directed via a catch basin & sump into distribution pipe into the Silva Cells (see A)
- Underdrains with upturned elbows slow water, denitrify, then direct runoff into the Wilmington's MS4 (see B)
- Profile by Jonathan Page, NCSU Biological and Agricultural Engineering



Water Quality Results

Silva Cells at Wilmington vs.
Mean Traditional Bioretention Results From Peer Reviewed Literature

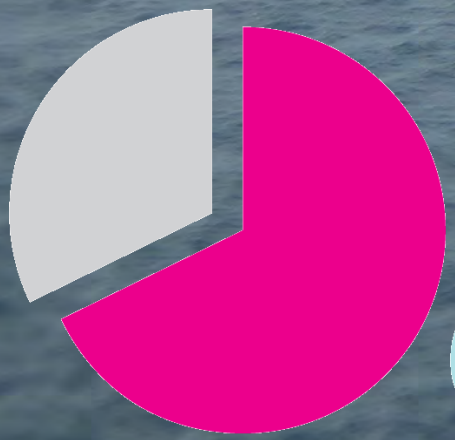


Volume Results

Volume benefits at typical Silva Cell installations are expected to be significantly greater because:

1) Pond liner was used so no exfiltration was possible – for typical Silva Cell installations pond liner is NOT so exfiltration is possible.
2) Drainage area to these Silva Cell systems (1 tree per 0.1 acre) was significantly greater than typical installations

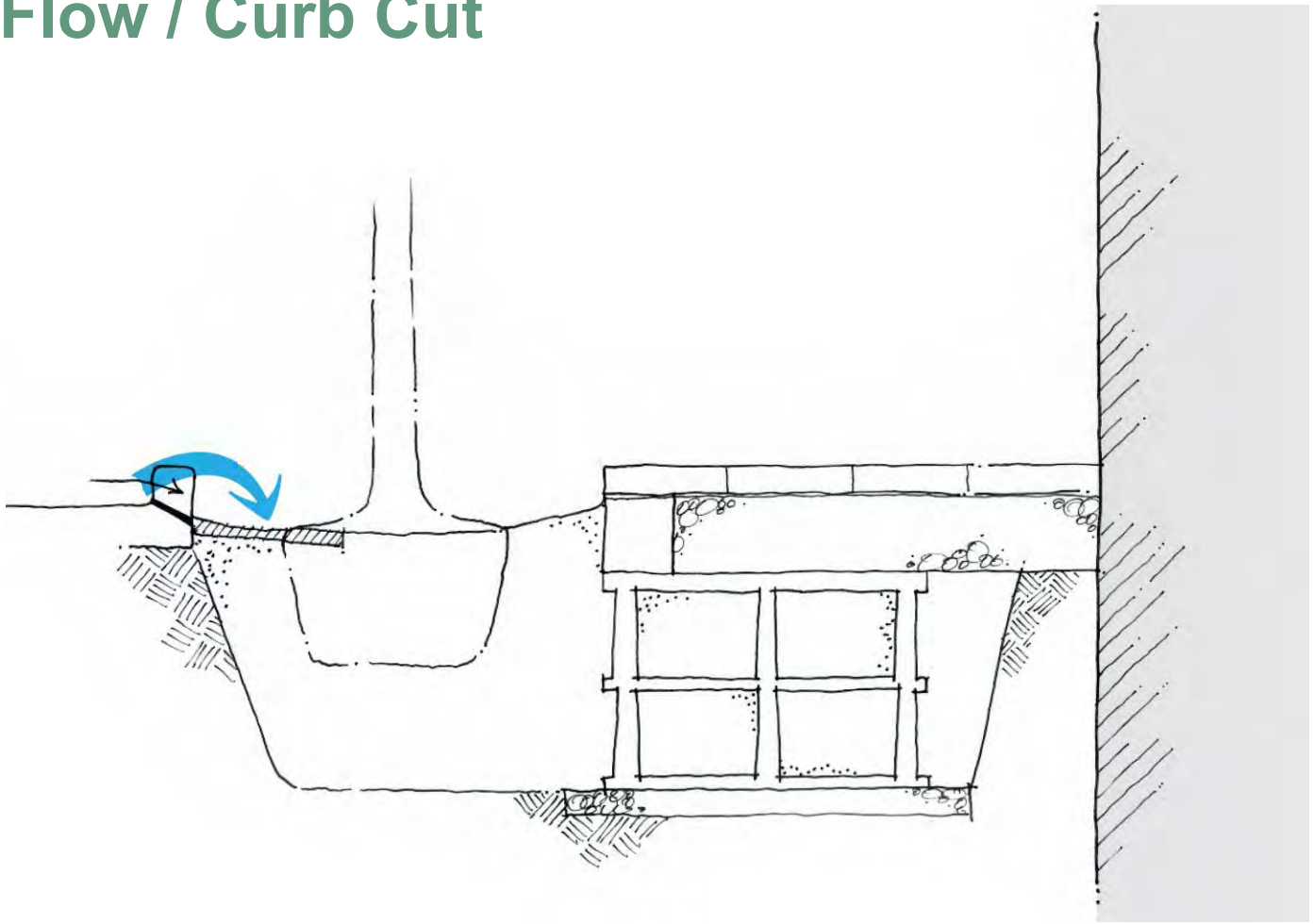
Despite pond liner and large drainage area, peak flow storms did not generate bypass: mean peak flow decreased 62% from 0.13 cfs to 0.05 cfs



68% of the runoff was treated by the Ann St Silva Cell system

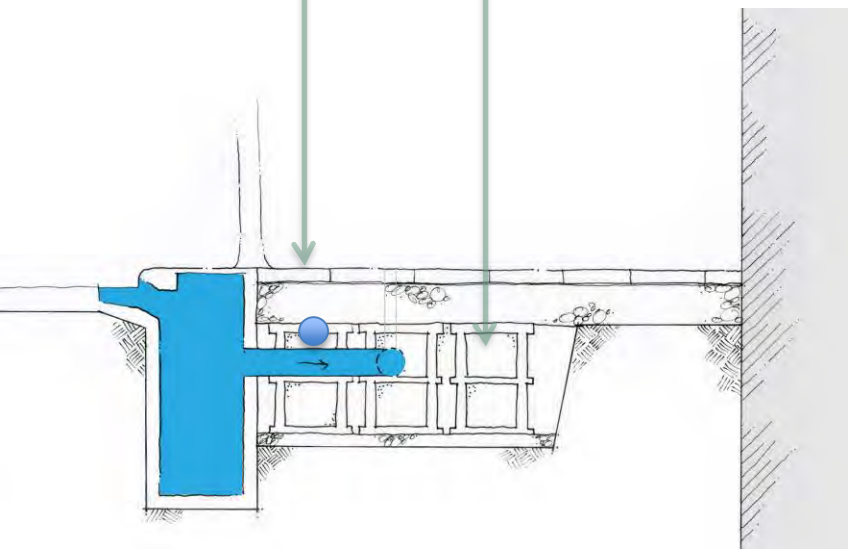
KEY #3: DIRECT STORMWATER TOWARDS TREES & LID

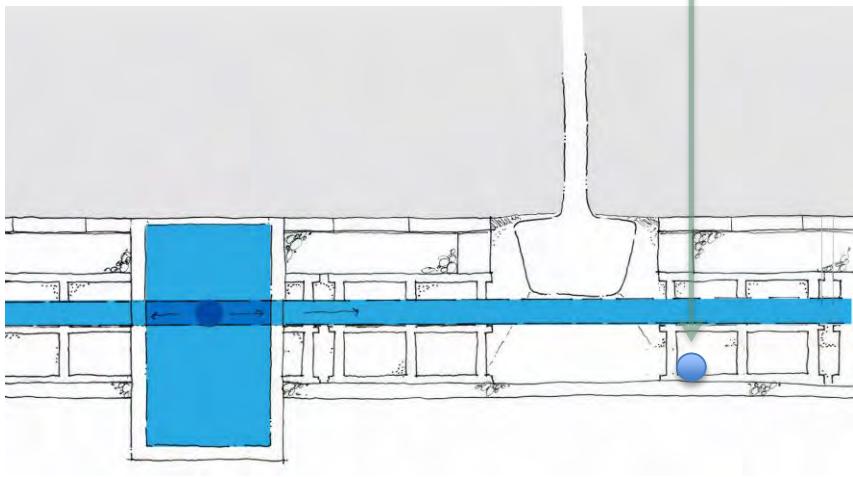
Sheet Flow / Curb Cut



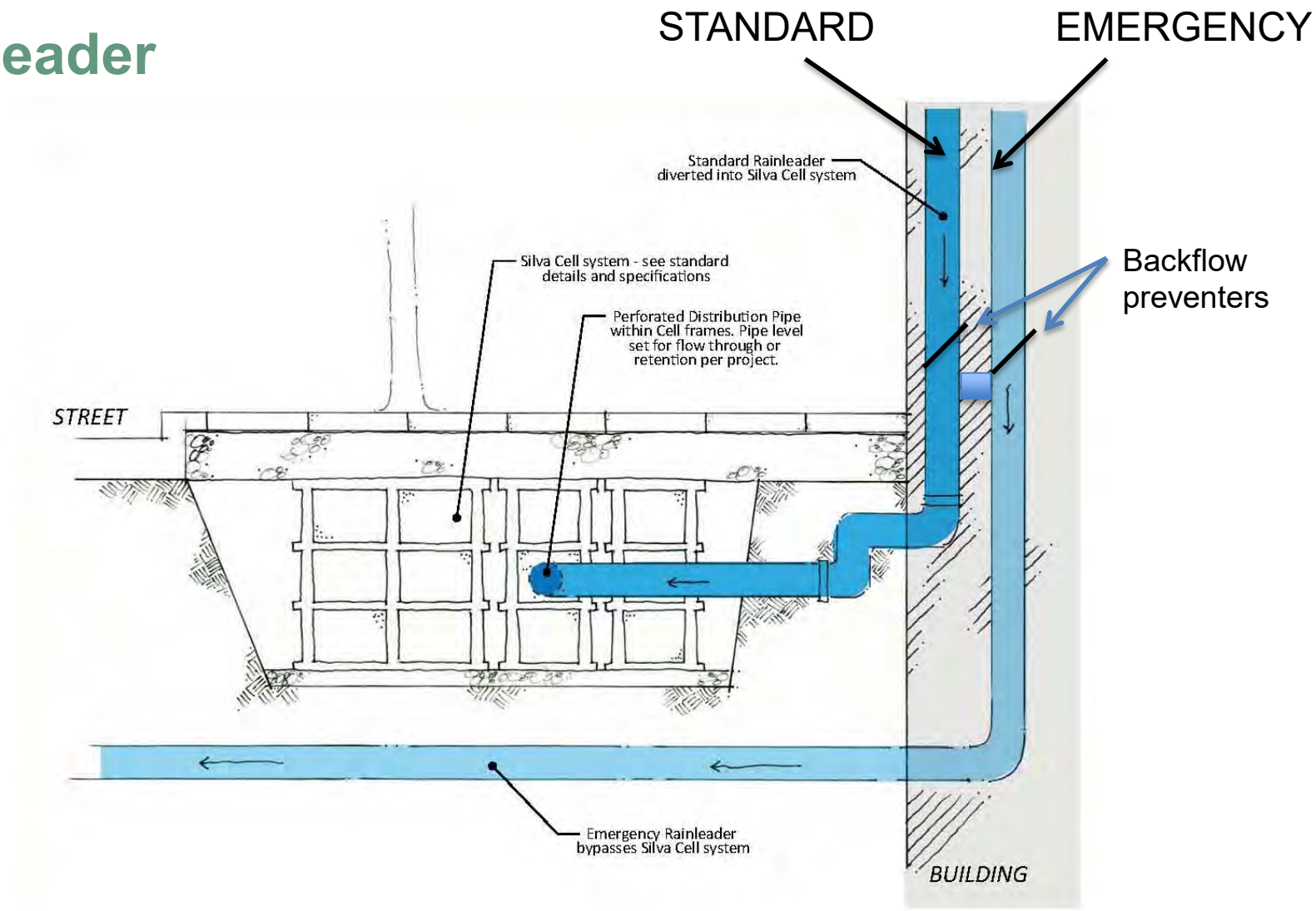
Catch Basin

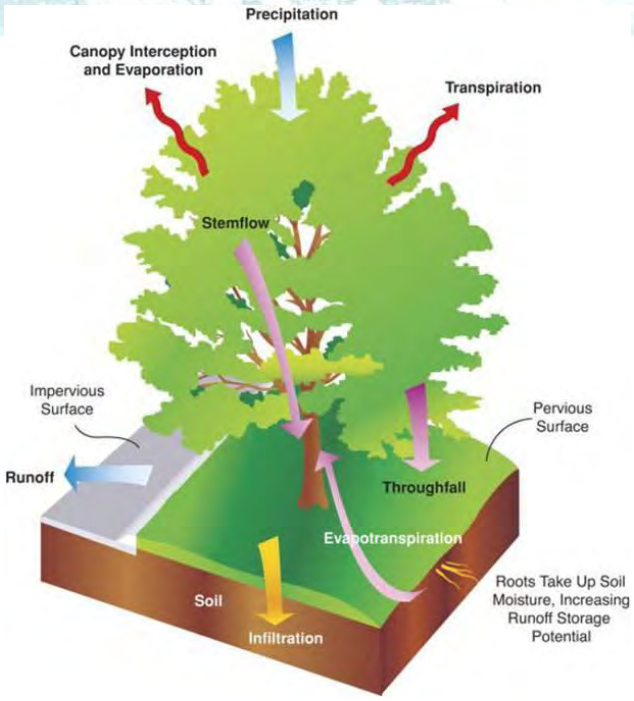
Pretreatment
Distribution
Overflow

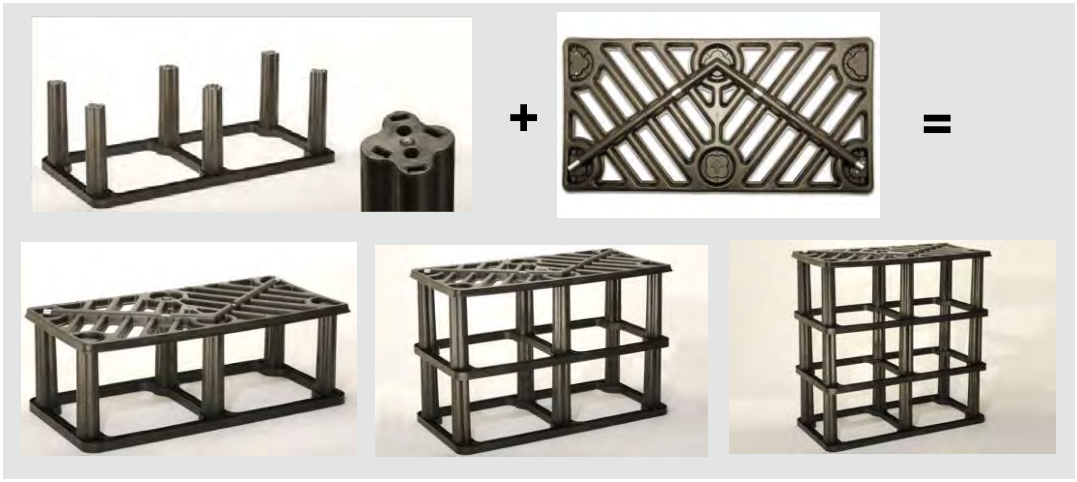




Rain Leader


STANDARD
EMERGENCY
Standard Rainleader diverted into Silva Cell system
Backflow preventers
Silva Cell system - see standard details and specifications
Perforated Distribution Pipe within Cell frames. Pipe level set for flow through or retention per project.
STREET
Emergency Rainleader bypasses Silva Cell system
BUILDING





CASE STUDIES

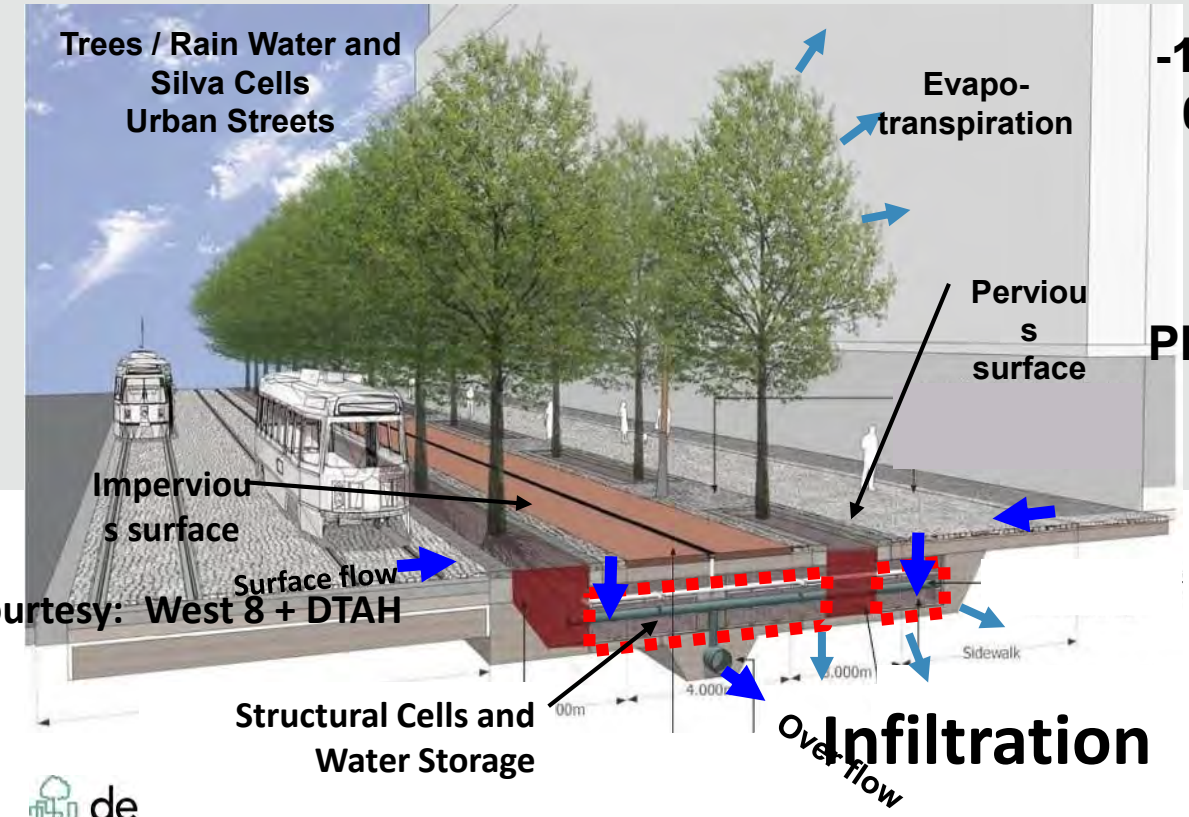
TYPE 2 STORMS e.g. West & Midwestern North America

Minneapolis MN: MARQ2, Central Library, Mdewwakanton Sioux, City Hall, Target Arena – USDA Zone 4

Toronto ONT Canada: Toronto Waterfront – USDA Zone 5

Green Infrastructure at Scale

Let's Make Livable Cities: Waterfront Toronto: 2100 Acres On Lake Ontario; Largest Waterfront Project in the World

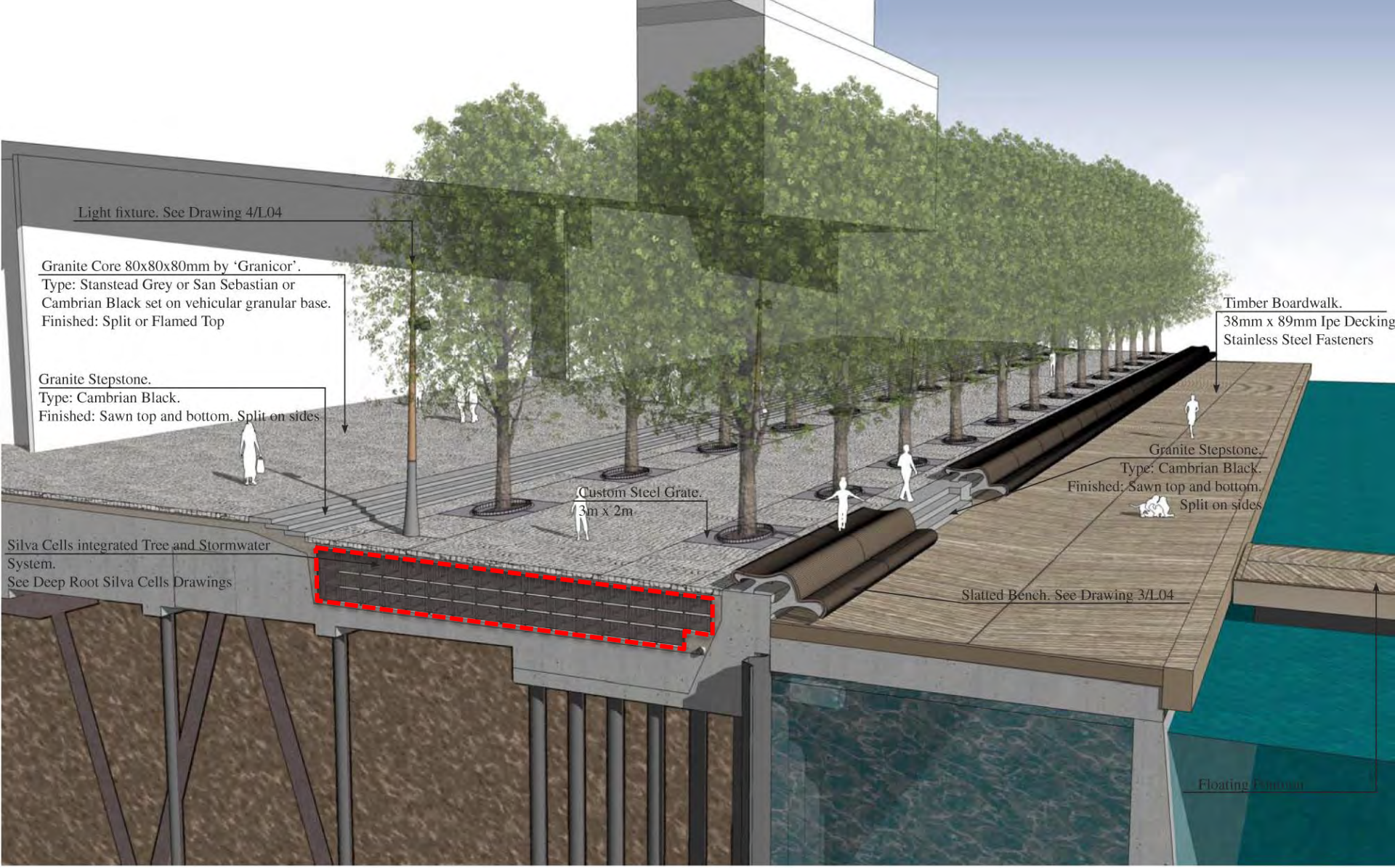


16 trees per acre capture
-1"/24 hour storm in: Soil

-16 trees @ 22" DBH capture
0.8"/24 hour storm in: Soil
& Interception
-No EVT

Phase 1 Installed: 1,300 trees
All Phases: 10,000+ trees

1.8" (44mm) for
7.0 Million sf = 161 acres
= 64 hectares



PERSPECTIVE/SECTION. WATER PROMENADE

Courtesy: West 8 + DTAH

West 8 + DTAH

Waterfront Toronto - Promena

Case Study:
Marquette & 2nd Avenues (MARQ2) Busway Minneapolis, Minnesota

Stormwater Trees with Sidewalk Runoff to Pervious Pavers

- **Average soil volume per tree: 650 ft3**
- **Catchment: 5.15 acres**
- **167 Trees**
- **Total Silva Cells: 4,909 decks, 9,818 frames**
- **Installation: 2008-2009**
- **USDA Zone 4**
- **Type II Storms**
- **Annual Precipitation 1981-2010: 31.16” (791.5 mm)**
- **No Dry Season**
- **13 Days >90F, 11 Days <0F**
- **Cloud Cover 52% - 92%**
- **Project Designer: SEH and URS**
- **Technical Consultant: Kestrel Design Group**

Photo taken summer 2012, Kestrel Design Group

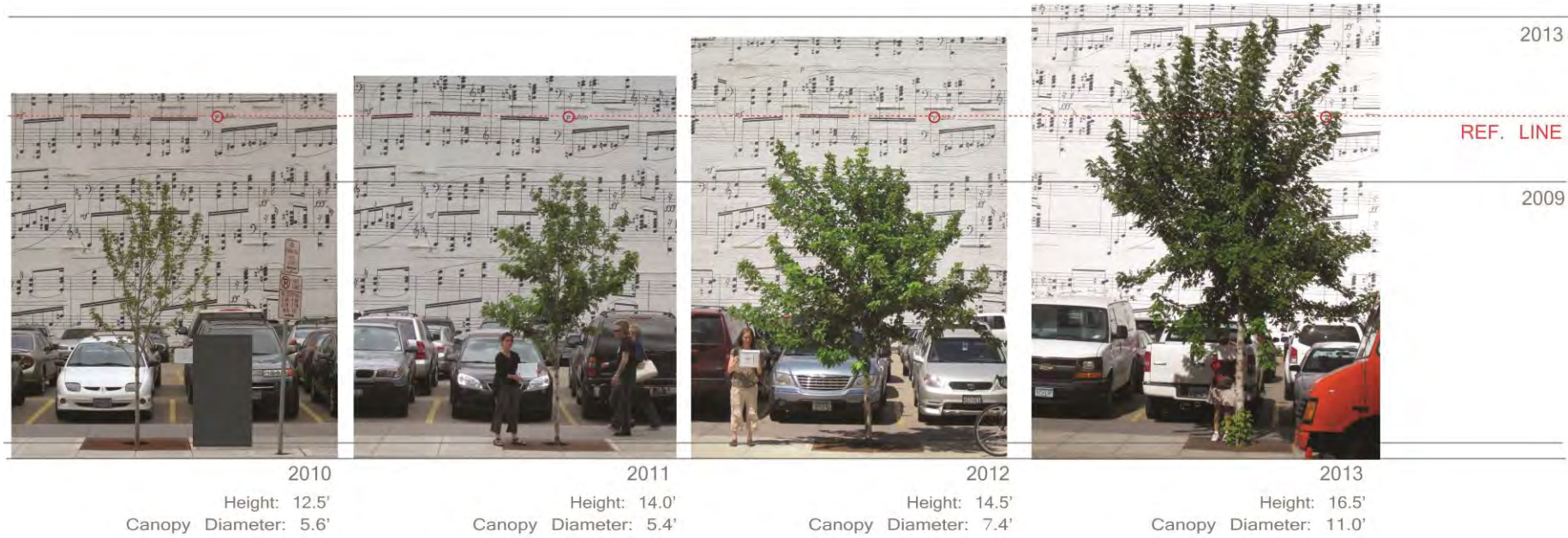
Case Study: Marq2, Minneapolis, Minnesota

Installation: Fall 2009

deeproot

Case Study: MARQ2 Busway, Minneapolis, Minnesota

Stormwater Trees with Sidewalk Runoff to Pervious Pavers



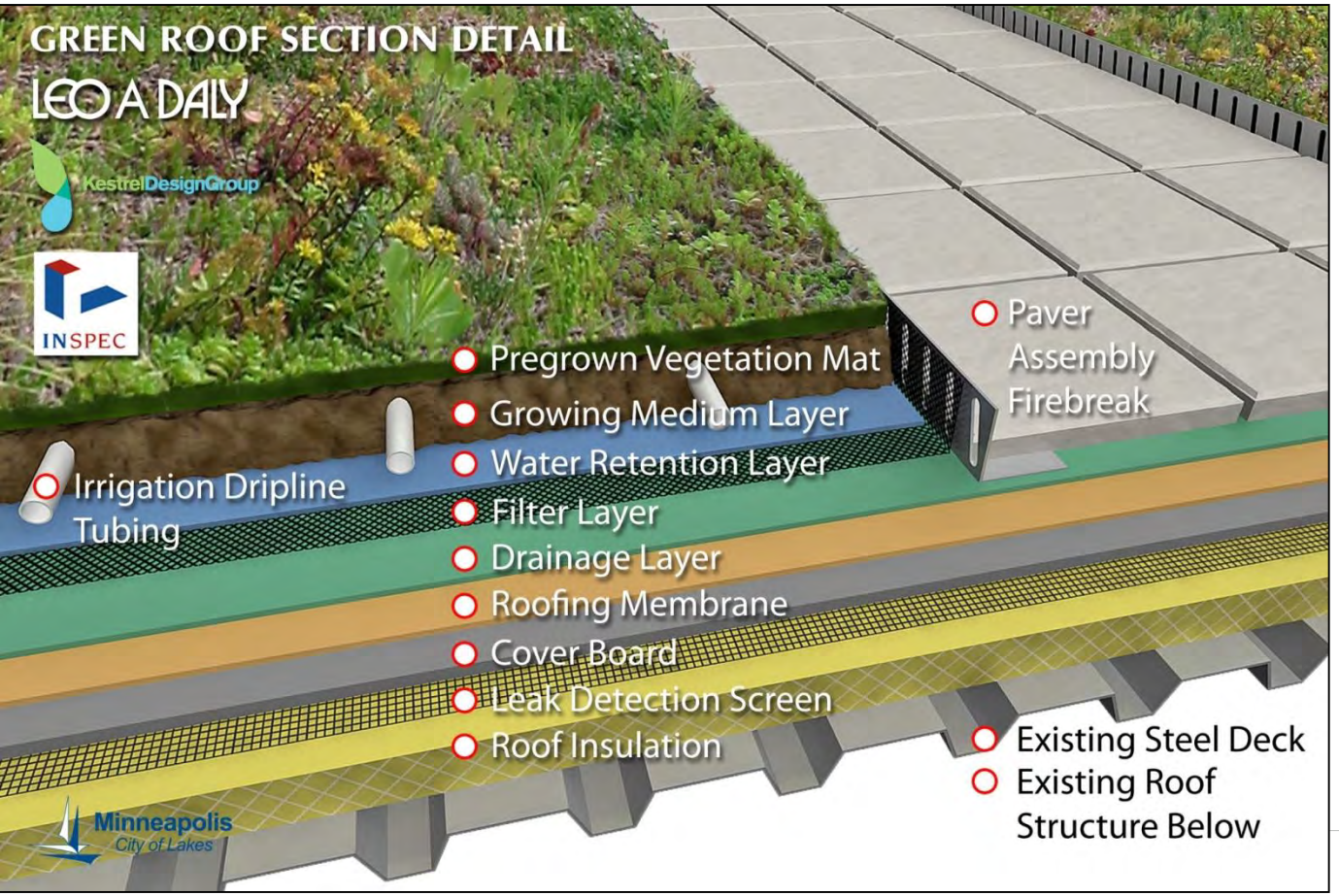
Overview of Yearly Growth:
2010-2013: 4' taller, 5.4' wider

Marq2 Silva Cell Installation, tree monitoring images by Kestrel Design Group

GREEN ROOFS

a) Description and Different Types

Combination of waterproofing and green roof layers that create an environment suitable for plant growth on top of buildings without damaging the underlying roof system.

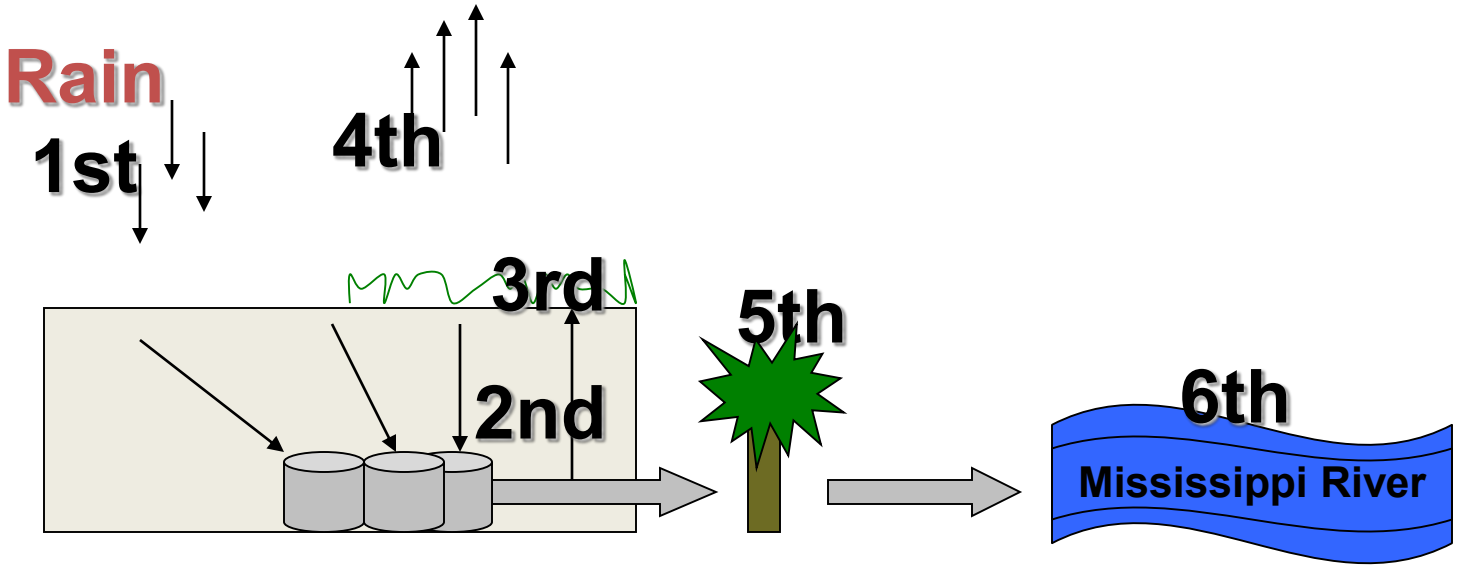


Example Green Roof Section: Target Center Green Roof, Minneapolis MN

WATER HARVESTING SYSTEMS

g) Case Studies

Minneapolis Central Library
Green Roof



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Green Roof Cisterns & Irrigation

Minneapolis Central Library

Case Studies: Lot

Minneapolis Central Library

Green Roof Cisterns & Irrigation
Minneapolis Central Library

Case Studies: Lot

Minneapolis Central Library

Green Roof Cisterns & Irrigation
Minneapolis Central Library

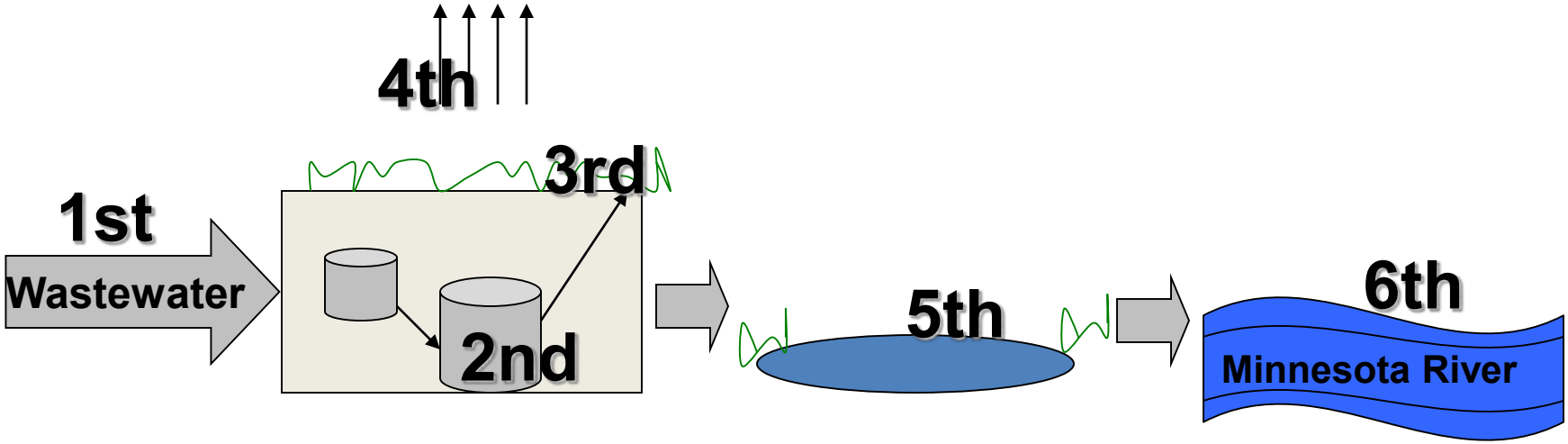
Top Roof: sunny

Lower Roof: sunny

Lower Roof: part shade

Case Studies: Lot
Minneapolis Central Library

Mdewakanton Sioux WWT Green Roof Tertiary Wastewater



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Wastewater Wetland Technology

The biggest waste of water in the country by far. You spend half a pint and flush two gallons.
--Prince Philip, Duke of Edinburgh, speech, 1965

- **Peck Farm Park**

18” media
2nd Step WW:
1 sf of WWTW
1 gallon per day
5 day residence

deeproot

Case Study: Mdewakanton Sioux WWT Green Roof

deeproot

Design Assumptions:
Dynamic Loading = GRT 35 psf

Stormwater:
30,000 square feet @ 4” media:
0.1 GPD per square foot
3,000 GPD @ 100 days per year
= 0.3 million gallons per year

Performance:

1 day residency
@ 0.3 gpd per 1 sf
= 0.9 mill gpy

Case Study: Minneapolis City Hall (MBC) Green Roof

Dynamic Loading:
GRT 35 psf
Snow 35 psf

Design Assumption
Cistern: 10,000 gals
Catchment: 1 acre
GRT: 6,000 sf
@ 4” media
@ 0.1 gpd
= Tank empties
Every 17 days
60,000 gals per year
= 8,000 cf/225 cu ms

Minneapolis City Hall Green Roof

Target Arena
Green Roof

- largest extensive vegetative roof installed on an existing building.
- first extensive vegetative roof on an arena.
- fifth-largest extensive vegetative roof in North America.
- tenth-largest extensive vegetative roof in the world

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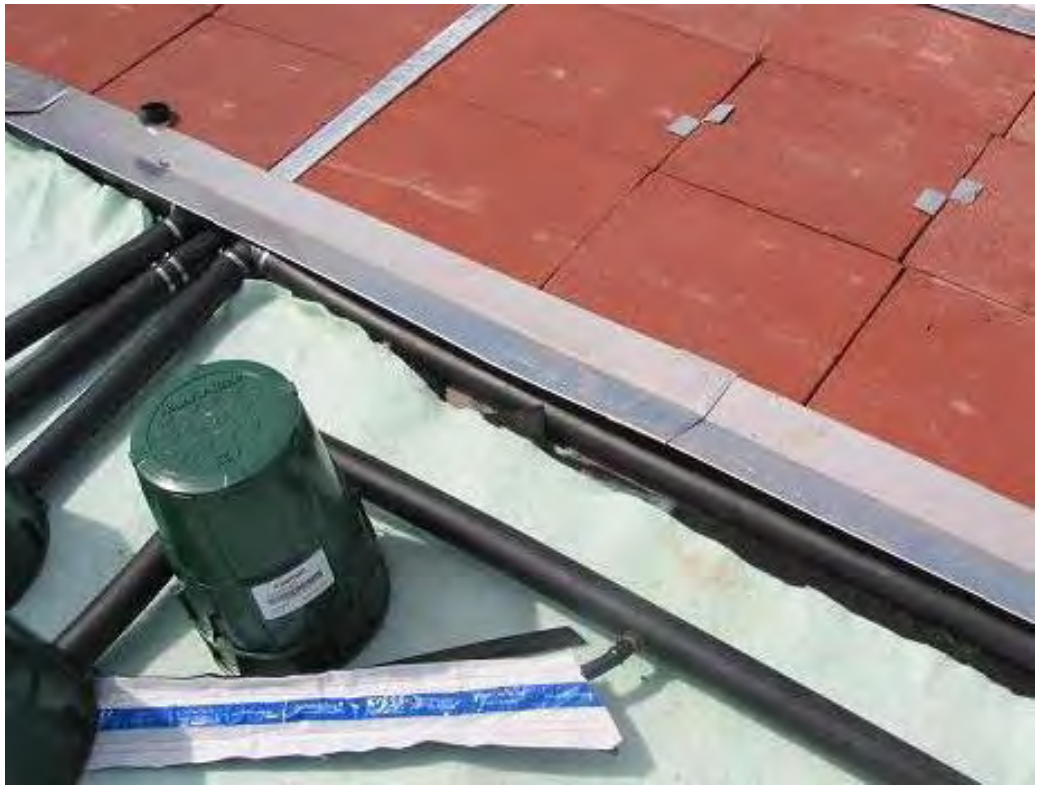
Target Arena Green Roof

Drip Irrigation System

- A permanent irrigation system was needed due to the limited water holding capacity of the shallow soil
- the drip irrigation system is the most efficient system available in terms of water usage
- the system includes a controller with moisture sensors to deliver precise irrigation of the roof



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Target Arena Green Roof

Growing Medium

- it contains porous aggregate materials, such as crushed clay brick, expanded shale, and crushed pumice
- the growing medium was specifically designed to retain water, provide aeration and allow for proper drainage

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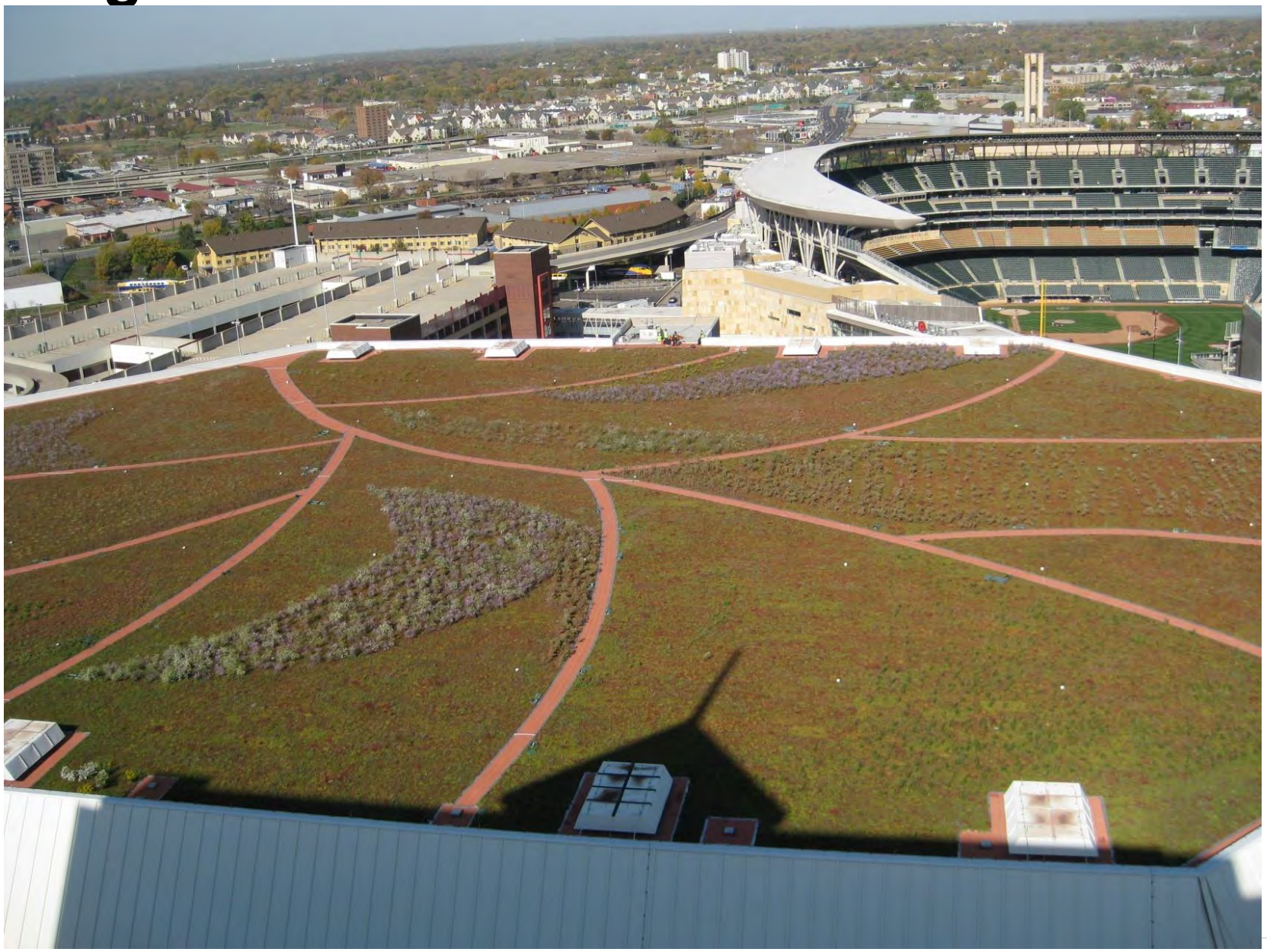
graves 601 hotel

TARGET CENTER GREEN ROOF, Minneapolis MN

Target Center Green Roof - 2010



Target Center

Beaker Clarity Check

IRRIGATION WORLD MEET STORMWATER WORLD! Are You Ready?

Peter MacDonagh FASLA PLA ISA
Kestrel Design Group
University of Minnesota
(952) 928-9600
peter@tkdg.net
www.kestreldesigngroup.com

"Where is the water going Dad?"

KestrelDesignGroup

Love Tunnel Railway, Klevan, Ukraine
Case studies:

http://www.deeproot.com/products/silva-cell/case-studies

Urban Trees MN Manual:
http://stormwater.pca.state.mn.us/index.php/Trees

Q & A

Contact Information:
peter@tkdg.net

KEYS

Heerstrasse, Bonn, Germany

LATEST POLICY DEVELOPMENTS

MINNESOTA STORMWATER MANUAL
HTTP://STORMWATER.PCA.STATE.MN.US/INDEX.PHP/MAIN_PAGE
Jacaranda Bomenalleen, Johannesburg, South Africa

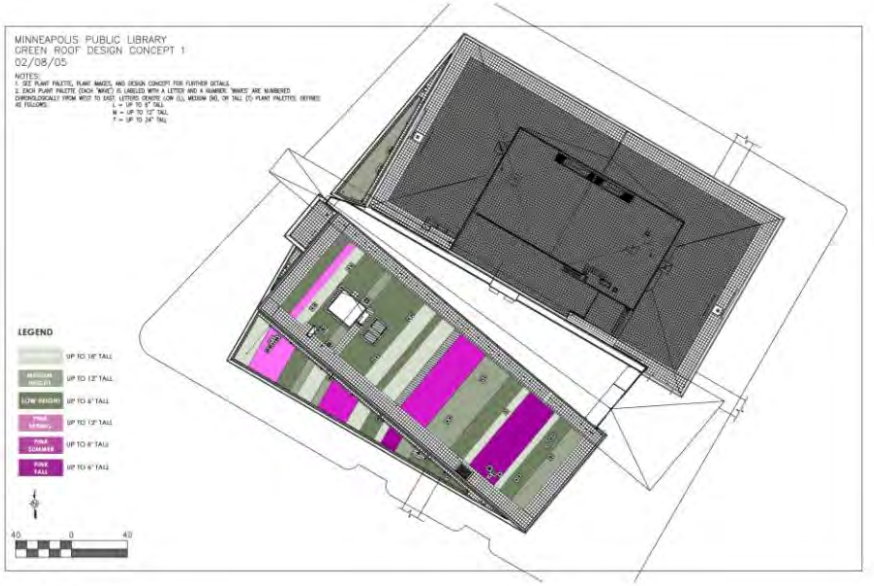
Green Roof Cisterns & Irrigation
Minneapolis Central Library

5th Floor Sunny

Scientific Name	Common Name
Aster ericoides	Heath Aster
Cassia fasciculata	Partridge Pea
Dalea purpurea	Purple Prairie Clover
Sedum spp.	Sedums
Schizachyrium scoparium	Little Bluestem

2nd Floor Sunny

Scientific Name	Common Name
Allium schoenoprasum	'Chives'
Aster ericoides	Heath Aster
Cassia fasciculata	Partridge Pea
Coreopsis palmata	Stiff Tickseed
Dalea purpurea	Purple Prairie Clover
Liatris aspera	Rough Blazing Star
Sedum spp.	Sedums
Viola pedata	Birds Foot Violet



2nd Floor Partial Shade

Scientific Name	Common Name
Aquilegia canadensis	Columbine
Fragaria vesca	Wild Strawberry
Heuchera richardsonii	Alum Root

Notes:

•Each of the roofs has many species; dominant species represent only a small fraction of total # of species on each roof

•Roofs are irrigated

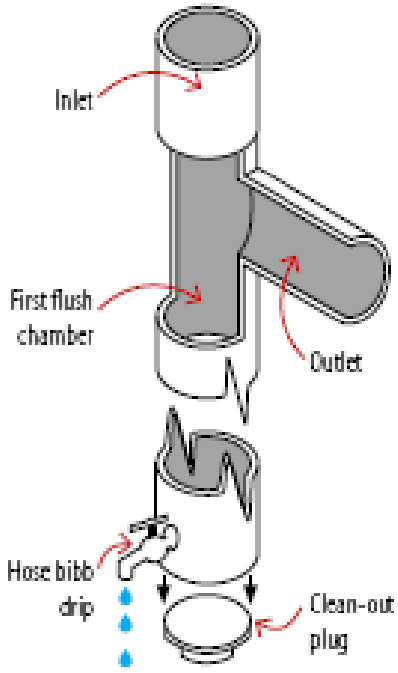
WATER HARVESTING SYSTEMS

a) Description and Types:

COLLECTION SYSTEM PRETREATMENT

- **Collection System – Can Include Water Treatment**
  - **Often includes a first flush div**
  - **Often includes some type of**
  - **Examples of At Grade Filte**
    - **Sumps and screens in catch**
    - **Filter socks at catch basin**
    - **Proprietary products such as**

Commerci
Comm erci al
Comm erci al



Source: HKGi. *First Flush Diverter.* Graphic adapted from Texas Development Board, Texas Manual on RainWater Harvesting, 2005.

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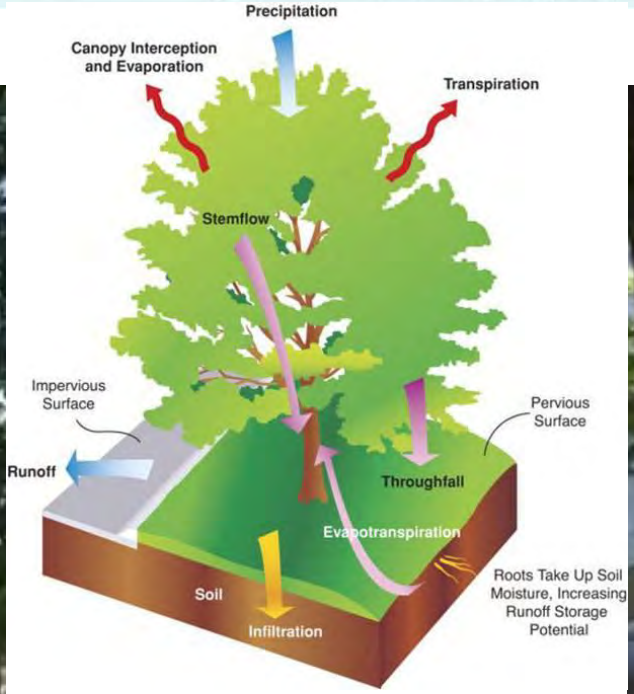
Image from Metropolitan Council Stormwater Re-Use Guide, 2011.

International Ideas for Big Trees in Texas
Good & Bad



Presentation Overview:

I. Introduction: Why Use Trees for Stormwater
II. Keys
III. Latest Policy Developments
IV. Latest Research Developments
V. Case Studies
   - Marq2 Streetscape, Minneapolis MN
   - Lidl Grocery Store, New Milton, UK
   - 2nd Ave Streetscape, Calgary, Canada
VI. Questions & Answers

Redwood Park, San Francisco, CA

CONNECTING THE BUILT AND NATURAL ENVIRONMENT

ASIC | 2015 | MINNEAPOLIS | MINNESOTA

Specs: The Good, The Bad and the Ugly

The Ugly

- The majority of people who work in Contract Documents do not know what they are doing.

The Bad

- Most conflicts on a project come from lack of knowledge, communication and collaboration.

The Good

- You can fix that!

Basic Stats – about me

- Cherise Schacter, Standards Coordinator/Project Team Coordinator, Interface Engineering
- My job includes Specifications, Standards, QA/QC, Contract Administration, Project Administration
- 30 years in AEC (Construction, Architecture & now MEP Engineering)
- 3-1/2 years in CSI:
  - President, Portland Chapter
  - Chair, Institute Certification Prep Committee
  - CSI Academies Planning Team

Think there is no box

Go Big or Go Home

CSI PORTLAND

Home of the Original

KRAKEN COMMITTEE

The Fun stuff

- Blog – The Voices in my Head, on LinkedIn or at cheriseschacter.com

- They call me The #CSIKraken – www.CSIKraken.com

- or #Peaches

- I am passionate about project delivery education and better coordination/collaboration!

BREW CREW

#ASIC2015

@CHERISESCHACTER

#CSIKraken

Discussion Topics

- Advantages to obtaining CSI Certifications
- Common Specifying Conflicts/Mistakes
- The Anatomy of a Specification
- Best Practices (The Good)

Who is here?

- Architects? Engineers? Consultants? Contractors? Subcontractors? Product Reps? Owners?

How many of you prepare Construction Documents or are involved in Contracts?

CSI

- Single Most Important Thing:
  - **CSI welcomes all disciplines as equal members**

Certification Structure

- Entry Level:
  - CDT - Construction Documents Technologist
- Advanced:
  - CCS: Certified Construction Specifier
  - CCCA: Certified Construction Contract Administrator
  - CCPR: Certified Construction Product Representative

CSI Certification - CDT

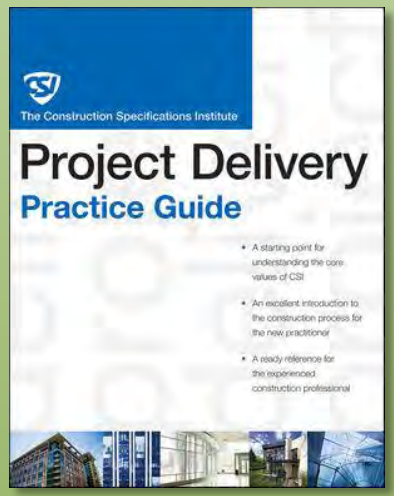
- CDT: Construction Documents Technologist Certificate is the basic foundation in industry knowledge:
    - Construction Processes
    - Contractual Relationships
    - Document Procedures and Organization

- Getting your CDT Means:
    - Understanding how a project unfolds from conception to delivery.
    - Understanding the documentation involved.
    - Understanding contractual roles and responsibilities.

CSI Certification - CDT

- Candidates may have any level of:
  - Education
  - Years/experience in Construction Industry

- Source Material:
  - Project Delivery Practice Guide
  - MasterFormat
  - Uniformat
  - SectionFormat/PageFormat
  - GreenFormat
  - Sustainability/Green Building: US EPA
  - General Conditions



Facts

- No higher education is typically offered for AEC professionals in project delivery, contract requirements or specifications.
- Your first real education in Contract Documents will likely happen as a result of a conflict on a specific project.
- Consultants & others typically do not get a full copy of the contract documents until the project hits the streets, if even then. This includes the General Conditions, Supplementary Conditions and Division 01.
- Design firms often do not have trained specification writers. Sometimes, multiple staff members in one firm are working on different parts of the same spec.
- Manufacturers typically write specs for the end user. These usually contain a lot of conflicts with a standard design contract.

Whaaaaaaat?

So where are AEC professionals learning about contract requirements and specifications?

THEY'RE NOT!

THIS IS WHY WE HAVE CONFLICTS!

The CONTRACT

One of the biggest reasons for conflict is inadequate/poorly coordinated documents.

The Drawings and the Specs

ARE THE CONTRACT!

AIA Best Practices

"AIA Best Practices – Quality Control: Managing the Top 5 Risks"

"No matter how desirable a program of in-house loss prevention might be, such a program will not function if it imposes **unrealistic burdens or unobtainable goals**. **It must, therefore, be implemented with little or no increase in general overhead expenses**."

This original article was published by Schinnerer & Co. in 1973. **Since 1973, the five areas within architecture practice that most frequently give rise to claims have remained the same.**

1. Failure to supervise inexperienced employees.
2. **Inadequate project coordination and in-house coordination.**
3. **Failure to communicate between the prime professional and the consultants.**
4. Lack of quality control on design changes.
5. **Poorly worded contract documents.**

Spearin Doctrine

A U.S. Supreme Court decision in 1918, *United States v. Spearin*, is a key case that has far-reaching implications for the design professions and construction industries.

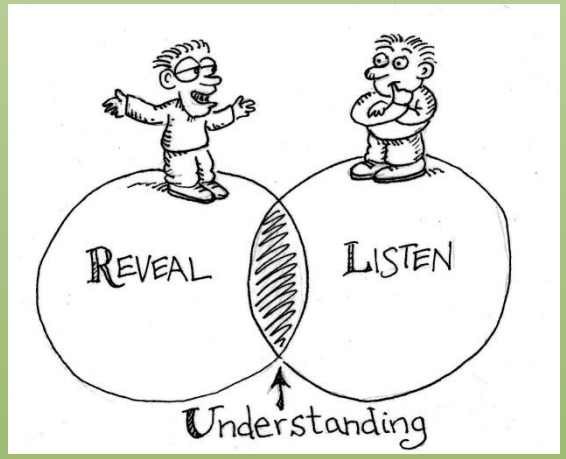
Basically, *Spearin* holds that a **contractor is entitled to rely on the construction documents** provided by the Owner to be **sufficient for their intended purpose** and **is not responsible for the consequences of defects** (errors, inconsistencies, or omissions) in the contract documents.

Contract Documents

- Your drawings AND Specifications are the Contract Documents and are **complementary**.
- Contrary to popular belief, one does not take precedence over another.
- In case of a conflict, what is “reasonably inferred” will prevail.
- Treat your documents like you would treat a contract because they are.

Common Problems/conflicts between the architect and Consultants

- Duplications
- Omissions
- Contract or Bid Requirements
- Lack of Division 01 Knowledge
- Standard Format/Language Differences
- Open Communication/Exchange
- Owner's Role
- Timing of Decisions
- Terminology



Common Areas needing Coordination/Communication

- Architect/Owner Agreement – Requirements
- General & Supplementary Conditions
- Seismic and Geotech Data
- Existing Conditions/Owner Requirements
- Unit Prices/Alternates/Allowances
- Contract Modification Procedures
- Submittal Procedures
- Location Specific Regulatory Requirements
- Special Project Requirements
- Meetings
- QA/QC Procedures

Common Areas needing Coordination/Communication

- Temporary Facilities/Utilities
- Access Panels
- Warranty Requirements
- LEED Requirements
- Cutting and Patching
- Delivery, Storage and Handling
- Substitution Requirements and Procedures
- Substantial Completion/Final Acceptance
- Startup/Commissioning/Training/Demonstration
- Cleaning/Closeout/Maintenance

- Division Specific Items that may require cross coordination (i.e. Civil and Plumbing)

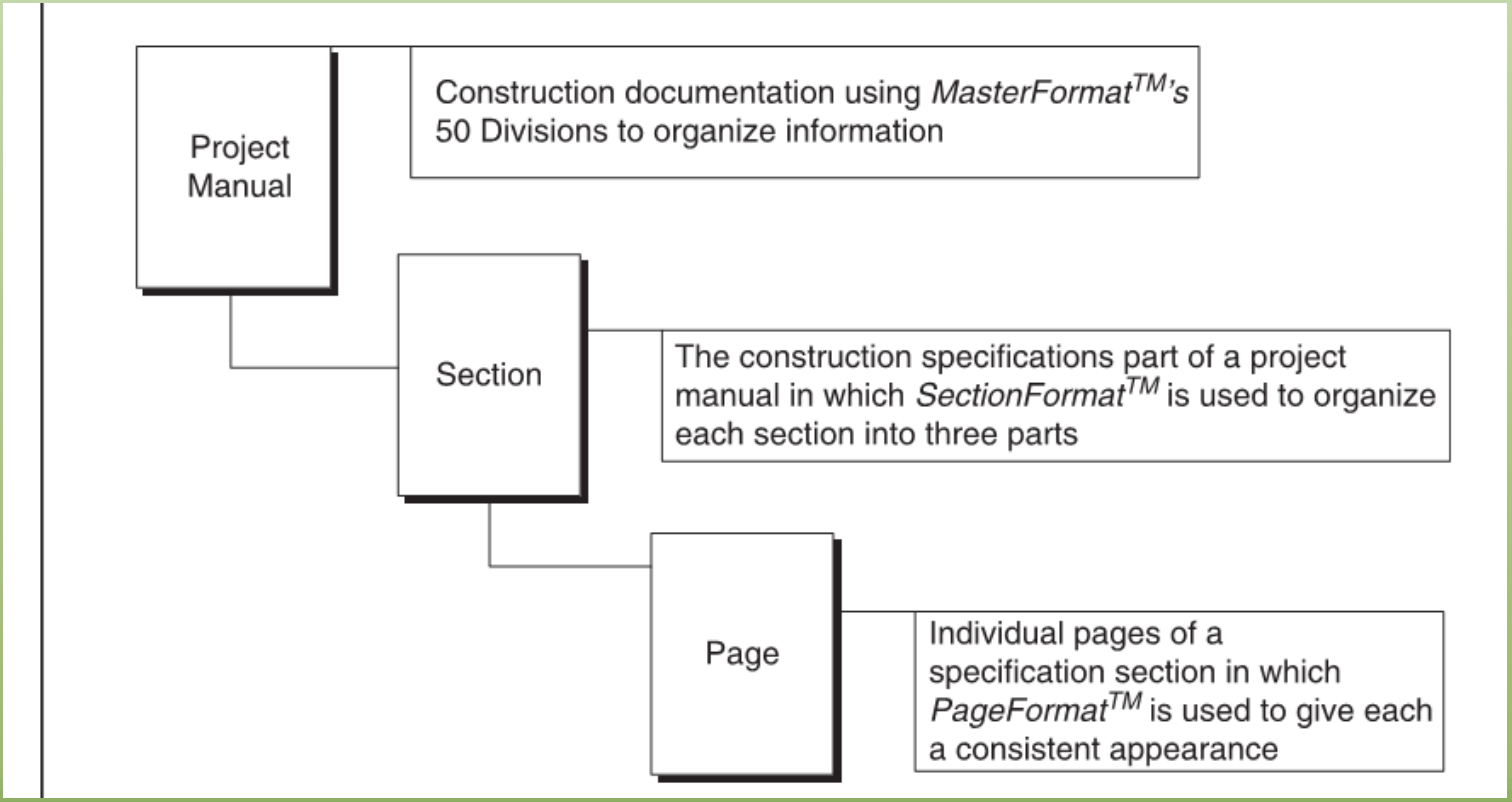
Possible Consequences from Lack of Coordination

- Loss of valuable time during CA dealing with conflicts
- Excessive RFI's/Change Orders
- Construction Budget Overrun
- E & O Claims
- Mediation/Arbitration/Litigation
- Loss of Client

If you can't afford to take the time to coordinate your project then you can't afford the time it will take to deal with the issues.

Project manual

The Architect is typically responsible for assembling the specifications from all applicable disciplines (i.e Civil, Landscape, MEP, etc.)



MasterFormat

"MasterFormat is a master list of numbers and subject titles classified by **work results** or construction practices used for **organizing information** into a standard sequence."

MasterFormat

- MasterFormat organizes the information by WORK RESULTS
- MasterFormat does not follow the sequence of construction but does provide logical groupings.
- The work is divided into logical DIVISIONS.

MasterFormat

- Groups (2)
- Subgroups (5)
- Divisions (49) numbered with titles
- Sections, numbered with titles and are organized using SectionFormat and formatted using PageFormat

MasterFormat

Procurement and Contracting Requirements Group

Procurement and Contracting Requirements: Division 00

Basically everything the Contractor needs to prepare a bid and understand the roles & responsibilities on the project.

Specifications Group

General Requirements Subgroup:

Division 01 General and Administrative Requirements (more on this later)

Facility Construction Subgroup: Divisions 02 – 19

02 Existing Conditions
03 Concrete
04 Masonry
05 Metals
06 Wood, Plastics, and Composites
07 Thermal and Moisture Protection
08 Openings
09 Finishes
10 Specialties
11 Equipment
12 Furnishings
13 Special Construction
14 Conveying Equipment
15-19 Reserved

MasterFormat

Facility Services Subgroup: Divisions 20 - 29

20 Reserved
21 Fire Suppression
22 Plumbing
23 Heating, Ventilating, and Air Conditioning (HVAC)
24 Reserved
25 Integrated Automation
26 Electrical
27 Communications
28 Electronic Safety and Security
29 Reserved

Site and Infrastructure Subgroup: Divisions 30-39

30 Reserved
31 Earthwork
32 Exterior Improvements
33 Utilities
34 Transportation
35 Waterway and Marine Construction
36-39 Reserved

32 80 00	**Irrigation**
32 82 00	**Irrigation Pumps**
32 84 00	**Planting Irrigation**
32 84 13	Drip Irrigation
32 84 23	Underground Sprinklers
32 86 00	**Agricultural Irrigation**

MasterFormat

Process Equipment Subgroup: Divisions 40 - 49

40 Process Integration
41 Material Processing and Handling Equipment
42 Process Heating, Cooling, and Drying Equipment
43 Process Gas and Liquid Handling, Purification, and Storage Equipment
44 Pollution and Waste Control Equipment
45 Industry-Specific Manufacturing Equipment
46 Water and Wastewater Equipment
47 Reserved
48 Electrical Power Generation
49 Reserved

Anatomy

- Within the DIVISIONS are the individual SECTIONS
- Section numbers are generally 6 digits using MasterFormat
- Each Section is organized into 3 parts using SectionFormat.
  - Part 1 – General
  - Part 2 – Products
  - Part 3 - Execution

General Conditions/Requirements

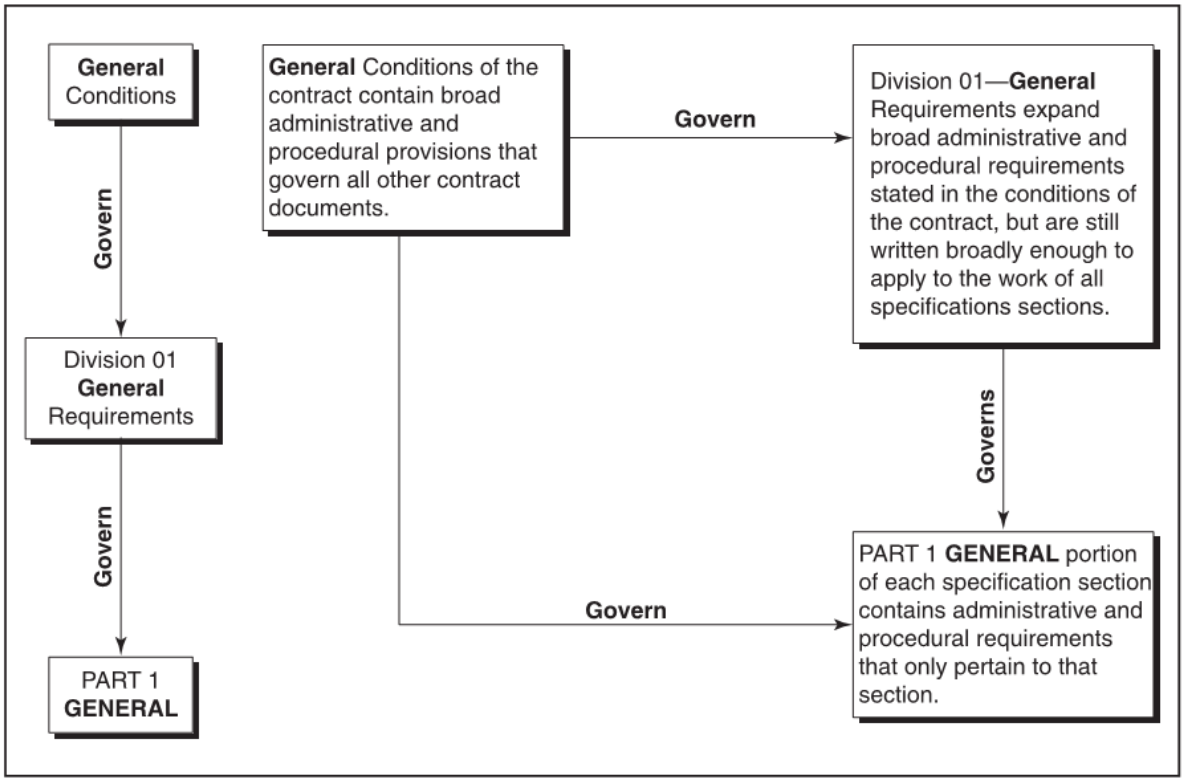


Figure 11.17
Hierarchy of General Administrative and Procedural Requirements

General Conditions/Requirements

- General Conditions –Typically Industry Standard Document – Very Broad – Applies to Entire Project
- Supplementary Conditions – Expand on and Revise General Conditions for Specific Project
- Division 01 – General Requirements further expand the Broad Administrative Requirements but still Apply to All Sections.
- Part 1 of the Specification Section defines administrative requirements specific to that section

Example

- General Conditions:
  - Contractor purchases and maintains insurance to protect from claims resulting from operations under Contract at limits specified or required
    - Worker's compensation
    - Bodily injury or death of Contractor's employees
    - Bodily injury or death of other than Contractor's employees
    - Personal injury liability
    - Damages because of injury or destruction of tangible property
    - Use of motor vehicles
    - Damage arising out of completed operations
    - Contractual liability

Supplementary Conditions

- Supplementary Conditions:
  - Acts as an Addenda to the industry standard General Conditions. For Example:
    - Worker's compensation - $1,000,000 limit
    - Bodily injury or death of Contractor's employees $10,000,000 limit
    - ~~Bodily injury or death of other than Contractor's employees~~
    - ~~Personal injury liability~~
    - ~~Damages because of injury or destruction of tangible property~~
    - Use of motor vehicles - $500,000 per occurence
    - Damage arising out of completed operations - $5,000,000 aggregate
    - ~~Contractual liability~~

Division 01 – General Requirements

- Division 01: General Requirements:
  - Expand on General Conditions to the specific project but still broad enough to apply to entire project.
    - For Example:
      - Section 01 50 00 – Temporary Facilities and Controls – Provide additional liability insurance covering temporary facilities located at adjacent property.

Part 1 - general

- Specific Specifications Sections – Part 1:
  - Administrative requirements specific to that section. For Example:
    - Section 26 31 00 – Photovoltaic Collectors – Part 1 under article for Insurance: Any special insurance requirements specific only to photovoltaic collectors.

Specification Sections – Where does it Belong?

- Spec Sections consist of 3 Parts (See CSI SectionFormat$_{tm}$):
  - Part 1 – GENERAL
    - Administrative Requirements specific to that section. Things like:
      - Submittals
      - Quality ASSURANCE (testing prior to construction)
      - Reference Standards
      - Testing prior to construction
      - Warranty Requirements
      - Etc.

Specification Sections – Where does it Belong?

- Spec Sections consist of 3 Parts:
  - Part 2 – PRODUCTS
    - Articles related to the manufacture and fabrication of products, including:
      - Type of Product
      - Manufacturer of Product
      - Assembly or Fabrication Tolerances
      - Source Quality Control
      - Tests during manufacture
      - Inspections during manufacture
      - Nonconforming Work
      - Manufacturer Services

Specification Sections – Where does it Belong?

- Spec Sections consist of 3 Parts:
  - Part 3 - EXECUTION
    - Covers work performed at the project site as well as:
      - Installation requirements
      - Tolerances
      - Field or Site Quality Control
      - Field or Site Tests
      - Field or Site Inspection
      - Nonconforming Work
      - Manufacturer’s Services

Language

- As legally enforceable contract documents, construction specifications should be prepared with concern and respect for their legal status.

- Always use the four principles of effective communication:
  - Clear: Use correct grammar and simple sentence construction.
  - Concise: Eliminate unnecessary words, but not at the expense of clarity.
  - Correct: Present information accurately and precisely.
  - Complete: Do not leave out important information.

Writing Style

- Good writing style is characterized by accuracy, brevity, and clarity:
  - Use simple sentences. Long, complex sentences and stilted language do not contribute to effective communication.
  - Avoid complicated sentences where inadvertent omission or insertion of punctuation could change meaning or create ambiguity.
  - Use words and terms that are simple and clearly understood.

Sentence Structure

- The “Imperative Mood” is the recommended method for instructions covering the installation of products and equipment.
  - Imperative Mood: The verb that clearly defines the action becomes the first word in the sentence.
  - For example: **“Spread adhesive with notched trowel.”** The imperative sentence is concise and readily understandable.

Sentence Structure

- The “Indicative Mood”, passive voice, requires the use of shall in nearly every statement. This sentence structure can cause unnecessary wordiness and monotony. This is not recommended.

Abbreviations, Symbols & Numbers

- Abbreviations, while sometimes effective on Drawings, should generally be avoided in Specifications.

- When numbers are used to define both size and quantity, use the symbol for the number, spell out the quantity
  - For example: Use 2-inches not 2”
  - 50 degrees F.
  - 20 percent
  - Five 2 by 4s

Capitalization, Punctuation

- Capitalization should be consistent throughout the Construction Documents. Capitalize specific nouns and proper names defined in the Conditions of the Contract.

- Sentences should be constructed so that the misplacement or elimination of a punctuation mark will not change the meaning.

Grammar – Subject/Verb Agreement

- Use singular verbs with singular subjects and plural verbs with plural subjects.
  - Incorrect: One of the elongated central fasteners are to be placed around the eye of the panel and bolted.
  - Correct: One of the elongated central fasteners shall be placed around the eye of the panel and bolted.
  - **Preferred:** Bolt one elongated central fastener to panel eye.

Inappropriate Terms

- Inappropriate Terms:
  - As approved; as indicated; as required
  - Herinafter; herinbefore; herewith
  - Any or all
  - Etc.
  - As per
  - In a workmanlike manner
  - To the satisfaction of the architect/engineer
  - Also
  - Minimize or avoid use of pronouns, avoid “which”

Avoid Unnecessary Words

- For example, use of the word “all” is usually unnecessary.
  - Poor:
    - Store all millwork under shelter.
  - Better:
    - Store millwork under shelter.
  - It is implied, using the 2nd sentence, that all of the millwork is to be stored under shelter.

Prepositional Phrases - Streamlining

- Sentences may be shortened in specification language by using modifiers in place of prepositional phrases.
  - Correct:
    - Top of platform.
  - Preferred:
    - Platform top.
  - Attempt to reduce verbiage. Former CSI Prez told me, K.I.S.S. – Keep it Simple Stupid. Good examples:
    - Adhesive: Spread with notched trowel.
    - Equipment: Install plumb and level.
    - Portland Cement: ASTM C 150, Type 1.

Vocabulary

- Use “amount” when talking about money, “quantity” when writing about number, measurement, area, or volume.
- Do not use the word “any” – It is imprecise
- “Either” implies choice, “Both” is all inclusive
- Flammable and Inflammable mean the same thing
- Use the Right One:
  - Furnish = Supply and deliver to project, ready for installation.
  - Install = Place in position for service or use.
  - Provide = Commonly accepted to mean furnish and install., complete and ready for intended use.

Vocabulary

- Shall = Required
- Will = Optional
- Avoid “must” and “is to”

- Do not give instructions to specific entities.
  - Incorrect: Subcontractor to install 12-feet of pipe.
  - Correct: Install 12-feet of pipe

Design professionals, contractually, **are not responsible** for the Contractors means and methods. It is up to the Contractor to decide who does what and when.

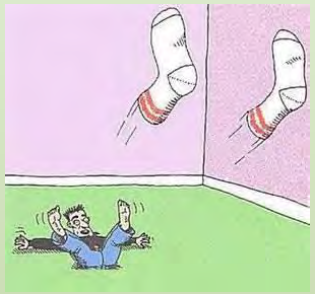
Say it once and say it in the Right Place

- Know where it belongs:
  - Drawings = Quantity & Spatial Relationships
  - Specifications = Quality
  - Example:
    - Drawings should show how many toilets, where they are located and spatial relationships.
    - Specs should define materials, sizes, components, etc.
    - Do not write or repeat specs on your drawings.
    - **Say it once and say it in the right place.**

Tips

- Educate yourself. There is no excuse for not understanding the documents for which you are legally bound.
- We can't begin the dialogue on coordination until all disciplines have this knowledge. You can't protect yourself without it.
- There are cost effective ways to get this training. See me after class, I will tell you.
- Don't be afraid to communicate and ask the right questions.
- Invite a qualified architect or CSI Member to lunch. Bribe them with food and ask if they will look over a few of your sections and get you started in the right direction and in closing the gaps.
- Anyone you work with will be really impressed that you are proactively trying fix these coordination issues. TRUST ME!
- Pay a qualified person to go through your documents and provide advice. The time and money you will save in the long run will far outweigh the cost.
- If you are a young professional, find a Mentor!

Tips

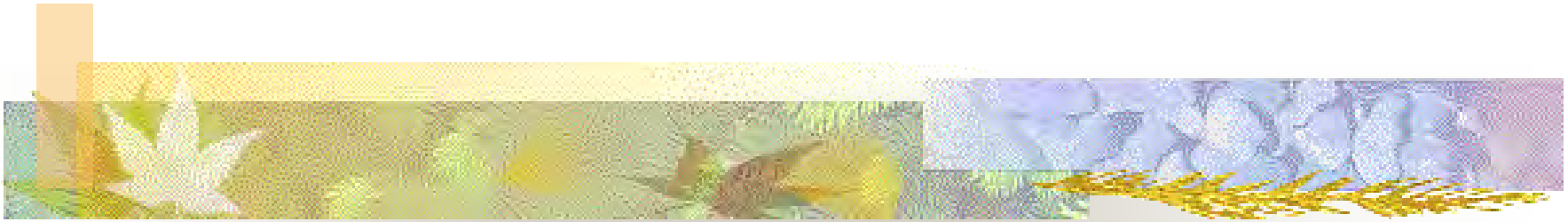


- Don’t let just anyone write specs or administer your Contract.
- If they don’t have the education, they shouldn’t touch the specifications. Remember, the drawings and specs are the CONTRACT!
- Educate your support staff. There are many ways your support staff (admin, drafters, etc.) can help you catch mistakes. Get them CDT certified.
- **If you are not the Architect**, ask for a copy of the Owner/Architect Agreement, General and Supplementary Conditions, Division 01, and any other important documents you need to do your job that you would typically not see until the end.
- If you are the Design Professional, make your own list, in the same order it appears in your documents, of all the items/areas that typically need to be coordinated or have potential for conflict and COORDINATE WITH YOUR CONSULTANTS!
- Go over your list with all parties to the contract and share the information. Get them on the same page.

Questions?

CIT Update

ASIC 2015 NATIONAL CONFERENCE
Minneapolis, Minnesota



David F. Zoldoske, Director
Center for Irrigation Technology
California State University, Fresno

California Drought Response

(Effective April 1, 2015)

a) Achieve a statewide 25% reduction in potable urban water usage through February 28, 2016

b) Requires commercial, industrial and institutional users to implement water efficiency measures

c) Prohibits irrigation with potable water of ornamental turf in public street mediums

d) Prohibits irrigation with potable water outside newly constructed homes and buildings that is not delivered by drip or microspray systems

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End User Requirements

- Eliminate the application of potable water to outdoor landscapes that flows to:
  - ✓ Adjacent property
  - ✓ Non-irrigated areas
  - ✓ Private and public walkways, roadways, or parking lots

End User Requirements

- Eliminate waste of potable water by:
  - ✓ Use of hose with shut-off nozzle
  - ✓ Not washing down driveways and sidewalks
  - ✓ Eliminating non-recycled water in fountains and water features
  - ✓ Must request water at restaurants and bars
  - ✓ Suspend outdoor landscape for 48 hours after measurable rainfall

Metropolitan Water District

MWD has recently increased its total funding in southern California to $60 million to buy-back turf grass at $2.00 per square foot and higher.

MWD Turf Removal Program

BEFORE: Photo of a narrow strip of turf with a fence on the left and street on the right as reference.

MWD Turf Removal Program

AFTER: Photo of the same area with permeable decomposed granite path, drought tolerant plants, and mulch to retain water.

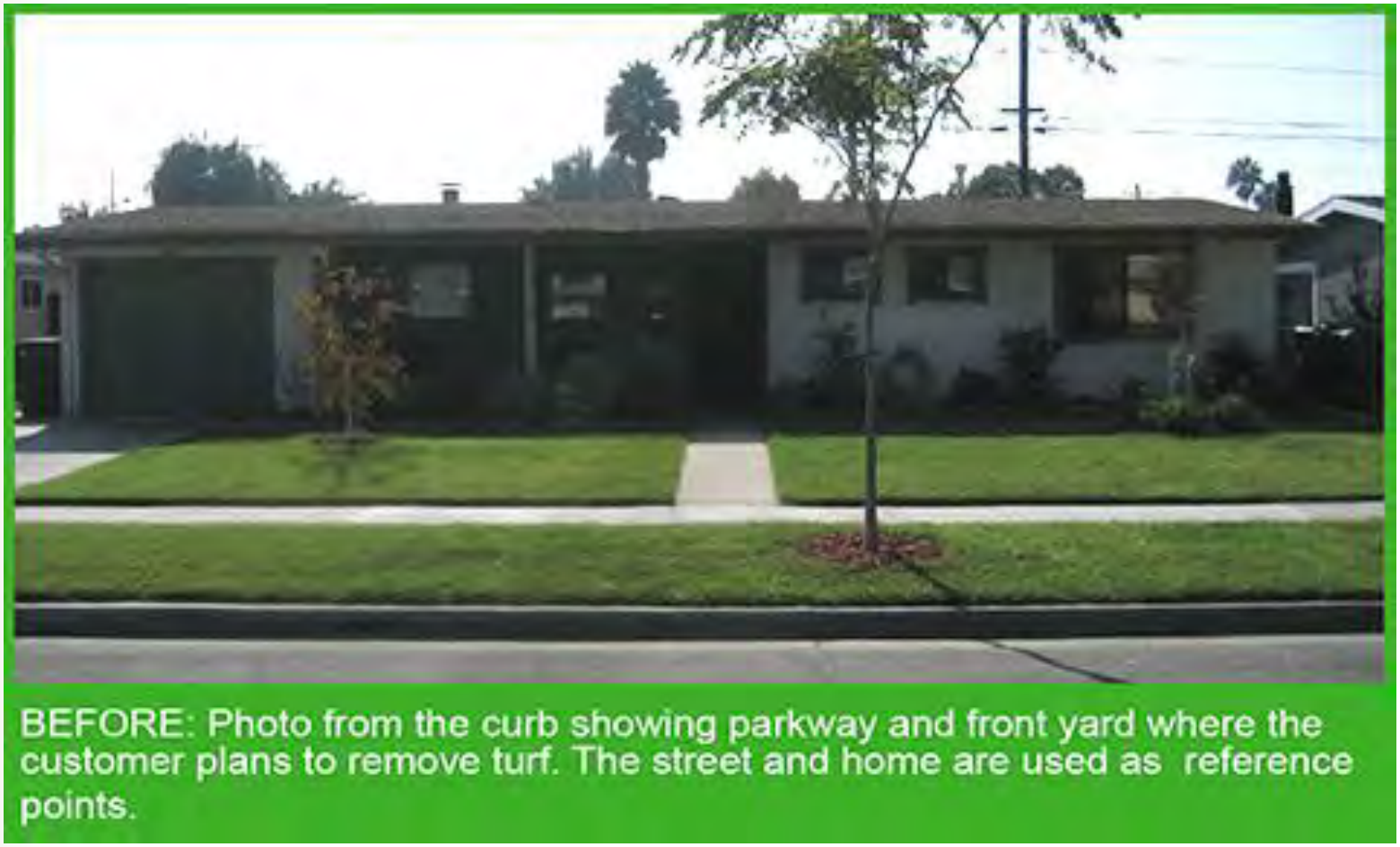
MWD Turf Removal Program

BEFORE: Color photo of the area customer plans to remove turf. The home, sidewalk, and street are included as reference points.

MWD Turf Removal Program

AFTER: Color photo of the same area from the same angle after the customer has completed their project. Turf has been replaced with drought tolerant plants and mulch to retain soil moisture.

MWD Turf Removal Program



BEFORE: Photo from the curb showing parkway and front yard where the customer plans to remove turf. The street and home are used as reference points.

MWD Turf Removal Program

AFTER: Photo from the same vantage point after the project is completed. Turf has been replaced with California Friendly plants.

Conclusion

Sprinkler Irrigation Methods

Maybe Doomed by the DROUGHT in California!

How to Respond/Letter to Governor

a) Agree to be a partner in solving the "crisis"
b) Explain what the ASIC **is**, and what it can **due!**
c) Explain "efficient" irrigation
   - ✓ Design
   - ✓ Parts and equipment
   - ✓ Installation
   - ✓ Maintenance
   - ✓ Management

How to Respond/Letter to Governor

d) Agree to promote "alternate" sources of water
   - ✓ Capture and reuse rainwater/stormwater
   - ✓ Utilize gray water
   - ✓ Use recycled water (purple pipe)

e) Agree to have ASIC members engage in the process

f) Promote education, Certification and Professionalism

g) Note California based companies

h) Signed by membership

Going Forward

a) Letter needs to be two-pages (printed back to back)

b) Available online for all members

c) Each California member should contact their elected representative(s)
   - ✓ Meet and explain solutions and expertise
   - ✓ Leave ASIC letter with business card attached

d) Volunteer to assist as needed

e) Become a valuable resource for the State

Keep Engaged- Change the World


Questions ?
Thank You !

Injecting Polymers Horizontally Below the Rootzone-*Update!*

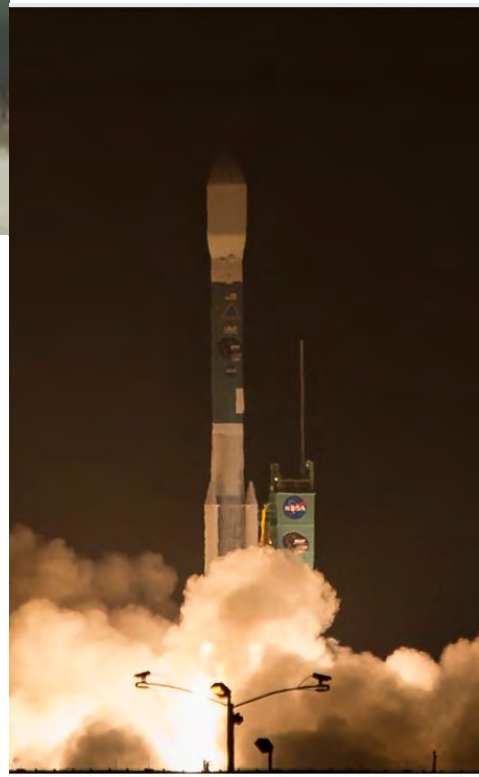
- Polymers are injected horizontally six (6) inches below the surface
- Forms both a barrier and reservoir of available water for the turf grass
- Initial studies suggest a significant savings for water (*and energy*) savings based on conventional practices
- Needs to be cost effective!


Water Only @ 50% ET
@ 40% ET
Aqua Cents @ 50% ET
AC @ 40% ET
Water Only @ 50% ET
@ 40% ET
Water Only @ 100% ET
@ 100% ET

Remote Sensing of Commercial Turf and Golf Courses

Proposed Unmanned Aerial Vehicle (UAV) equipped with sensors to determine soil moisture (4-6 inches) and crop stress

NASA Launches SMAP Groundbreaking $300M Soil Moisture Mapper



Voyager UAV

Optimizes ***water*** *usage and improves* ***turf quality*** *by delivering* ***3D maps*** *of soil moisture and 2D maps of crop stress for use in commercial landscape & golf*

25

Voyager Capabilities

Voyager Sensors	Resolution
Soil moisture	3D: 1M-30M step size
Crop Spectroscopy	Very high res
Canopy Temperature	HD
Topo Map capability	HD
Availability	On Demand
User Interface	GIS map

End to End Solution

CONNECTING THE BUILT
AND
NATURAL ENVIRONMENT

ASIC | 2015 | MINNEAPOLIS | MINNESOTA

Certification Update

ASIC

ASIC Strategic Plan – Adopted 4/26/10

Vision Statement

ASIC strives to represent the most experienced and responsible irrigation professionals in the world. Its members facilitate successful water resource management through design expertise, client advocacy, public service, education, *accreditation*, and the promotion of allied green industry partnerships.

ASIC

ASIC Strategic Plan

Objective #1

Position/Brand ASIC as *the top-tier body* representing water resource development, design and management professionals with a commitment to environmental stewardship and the responsible use of water.

ASIC

ASIC Strategic Plan

Tactic #3

Adopt an *optional certification program* that demonstrates stringent professional standards and expectations to the marketplace. The certification process will entail clear, unambiguous requirements.

- Time Frame: Immediate
- Resources: Board of Directors subcommittee and Staff

ASIC

Recent History

- Discussions with membership - no progress...
- Board realization that we can't do this on our own
  - Third-party assistance
  - Experienced entity – Irrigation Association
    - Proposal submitted to ASIC at BOD Meeting November 2014

ASIC

2015 Proposal Background

Certification Program requires process

Design & implementation requires:

- Strong organizational commitment
- Financial investment to launch and maintain the program
- Expertise of many experienced professionals to help develop program

ASIC

2015 Proposal Background

- Certification provides proof that an individual has mastered knowledge, skills and abilities to perform a specific job and requires:
  - Establishment of clear goals up-front
  - Market research and analysis
  - Determine mission, goals and objectives for the program.

ASIC

Three phases in developing a *legally defensible* certification:

- Phase 1: Defining Need
- Phase 2: Development
- Phase 3: Evaluate, Monitor and Maintain

ASIC Sub-committee:

- Co-chairs:
  - Carey June, Doug Macdonald
- Committee Members:
  - Jim Barrett
  - Tom Shannon
  - Jim Laiche

ASIC

Phase 1 – Defining Need

- Identify need for certification (Strategic Plan)
- Determine financial resources to build program (Board of Directors)

This is where we are today…

ASIC

Phase 2 - Development:

Step 1 - Job Analysis First (most important) aspect and key to *legally defensible* certification

- Objective; determine key aspects of job and related knowledge, skills & abilities to be measured by testing.
  - Focus group and/or survey to ensure broad review and participation by all stakeholders.

ASIC

Job Analysis

- Ensures testing on key information needed to complete the job correctly
- Develop content outline for exam to establish standards for questions (items).
  - All items must go through editorial, technical and *psychometric* review.

ASIC

Job Analysis Process

- Utilize 3rd Party with Job Analysis experience to direct process and ensure end results meet our organization's goals
  - Psychometrician ensures that Job Analysis process provides measurable and definable content outline at the conclusion of the process

Job Analysis Process

- Psychometrics = Mental Measurement (testing of intelligence, not really psychology)
- IA / ASIC Collaboration for Job Analysis
  - Leon Gross (Psychometrician) - PhD in statistics, 30 years experience, NCCA Commission for Accreditation
  - Sherrie Schulte – IA Director, Professional Development, >7 years experience inc. 3 formal/2 informal Job Analyses
  - ASIC “Blue Ribbon Panel” (up to 10 members) – TBD

Job Analysis Results

- Regardless of moving forward with certification or not, this process will provide benefits for the organization and members:
  - Help Create Awareness of ASIC and Profession
  - Allow us to key in points that differentiate us from others (marketing)

ASIC

Step 1: Job Analysis

- ASIC Sub-committee recommended to BOD to proceed with Job Analysis/Preliminary Content Outline stage; approved during April 2015 Board Meeting this week.
- Contract negotiations will commence in the immediate future.
- Upon completion of Job Analysis BOD will determine if we proceed beyond Step 1 (Job Analysis)

ASIC

Phase 2 - Development:

- **Step 1: Job Analysis**

BOD will determine whether to proceed beyond this point based on results

- Step 2: Item Writing
- Step 3: Beta Testing and Item Performance Analysis
- Step 4: Exam Delivery and Maintenance

ASIC

QUESTIONS AND COMMENTS?

AQUATIC INVASIVE SPECIES

KEEGAN LUND

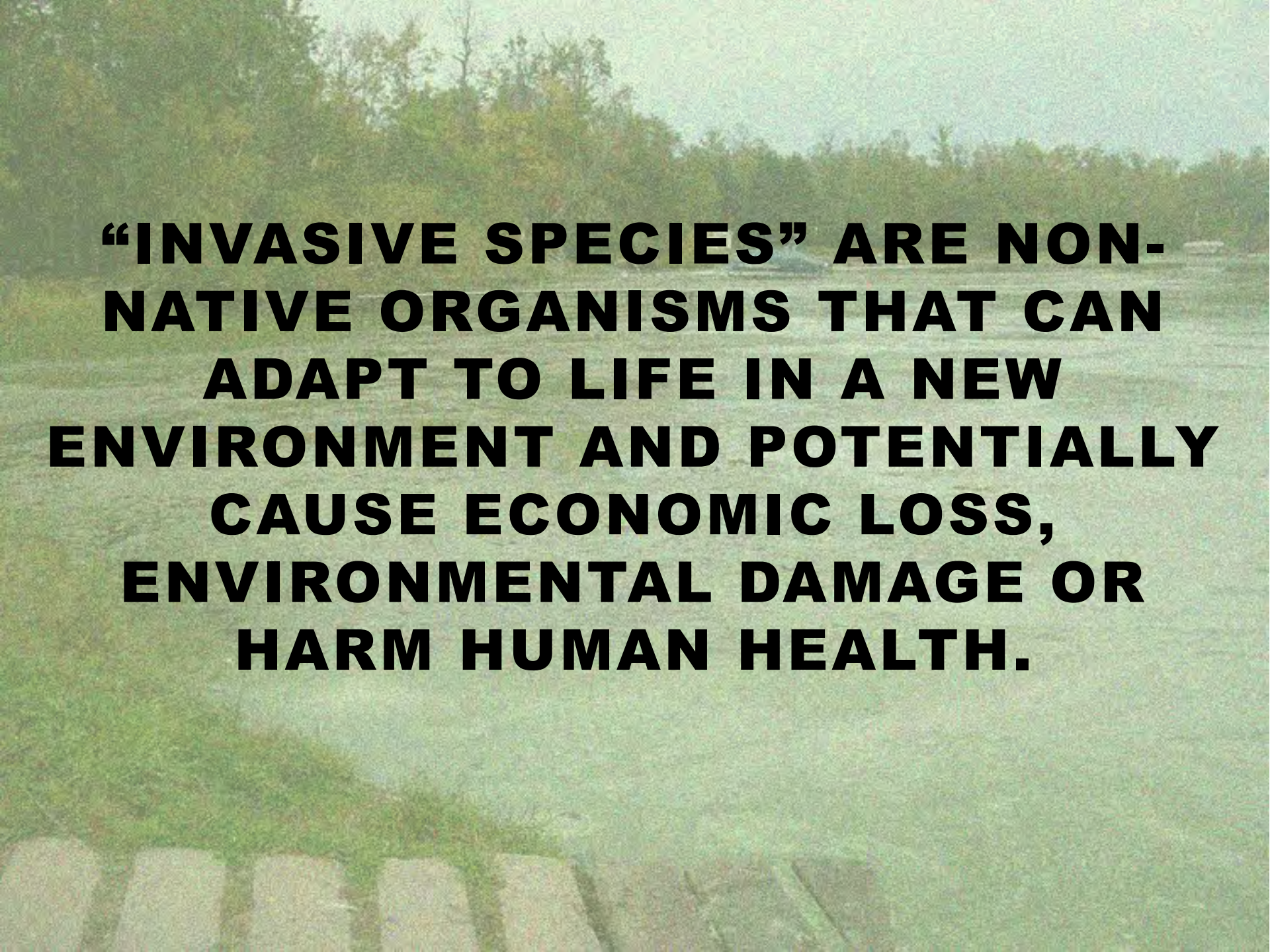
Aquatic Invasive Species Program

Minnesota Department of Natural Resources

PRESENTATION OUTLINE

1. Define invasive species & effects
2. MnDNR Invasive Species Program
3. AIS examples and problems
4. Possible control options
5. Best Practices to prevent spread
6. Discussion & questions

WHAT ARE INVASIVE SPECIES?


“INVASIVE SPECIES” ARE NON-NATIVE ORGANISMS THAT CAN ADAPT TO LIFE IN A NEW ENVIRONMENT AND POTENTIALLY CAUSE ECONOMIC LOSS, ENVIRONMENTAL DAMAGE OR HARM HUMAN HEALTH.

WHAT DOES THAT MEAN?

- **NATIVE** –Species living where it is found naturally

- **NON-NATIVE** – Species introduced, or moved, by human activities to a location where they do not naturally occur

- **INVASIVE** – Non-native species invades lands or waters causing ecological or economic problems

CHARACTERISTICS OF INVASIVES

1. High reproductive rates
2. Generalist (tolerate a variety of habitats)
3. Compete aggressively for resources
4. Lack natural enemies in the new ecosystem

EFFECTS OF AIS

1. **ECOLOGY**: compete with & may displace native species, reduce quality/quantity of habitat, alter ecosystem processes
2. **RECREATION**: can degrade water quality, interfere with recreation, and disrupt fisheries
3. **ECONOMICS**: terrestrial & aquatic invasive species costs the U.S. an estimated $120 billion a year through damage & control costs

HOW ARE AIS MOVED?

1. **HUMAN ACTIVITY**
   - Intentional
   - Unintentional
2. **ANIMAL ACTIVITY**
   - Feeding
   - Travel pathways (migration)
3. **WEATHER RELATED ACTIVITY**
   - Floods
   - Storms

MN DNR INVASIVE SPECIES PROGRAM & GOALS

1. **PREVENT** introductions & spread of AIS in Minnesota (watercraft inspection program, enforcement, EDRR, etc.)
2. **MANAGE** and reduce the impacts caused by AIS to Minnesota's ecology, society, and economy through control efforts and research (Control Grants, IAPM permitting, AIS permits, lake monitoring, etc.)
3. **EDUCATE** the public of AIS laws and best practices through training and outreach (public outreach, drain pug laws, Lake Service Provide Training, etc.)

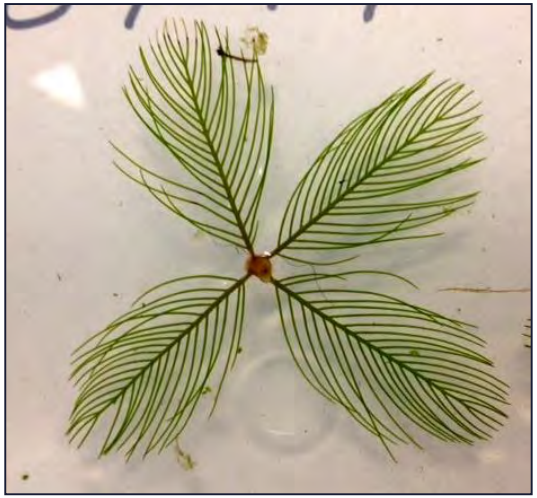
AQUATIC INVASIVE SPECIES IN MINNESOTA AND BEYOND

- Eurasian watermilfoil
- Curly-leaf pondweed
- Purple loosestrife
- Spiny water flea
- Zebra mussel
- Carp (common & Asian)

EURASIAN WATERMILFOIL

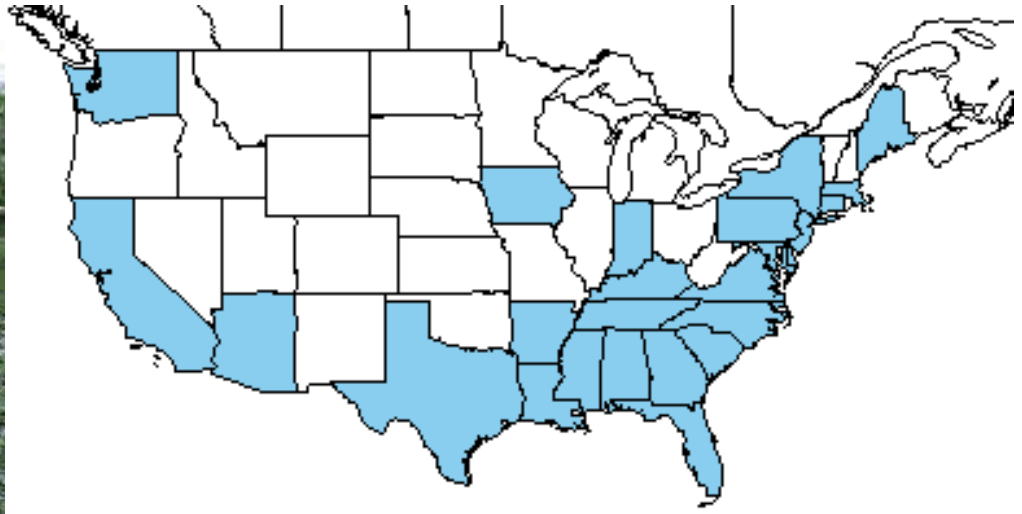
(Myriophyllum spicatum)

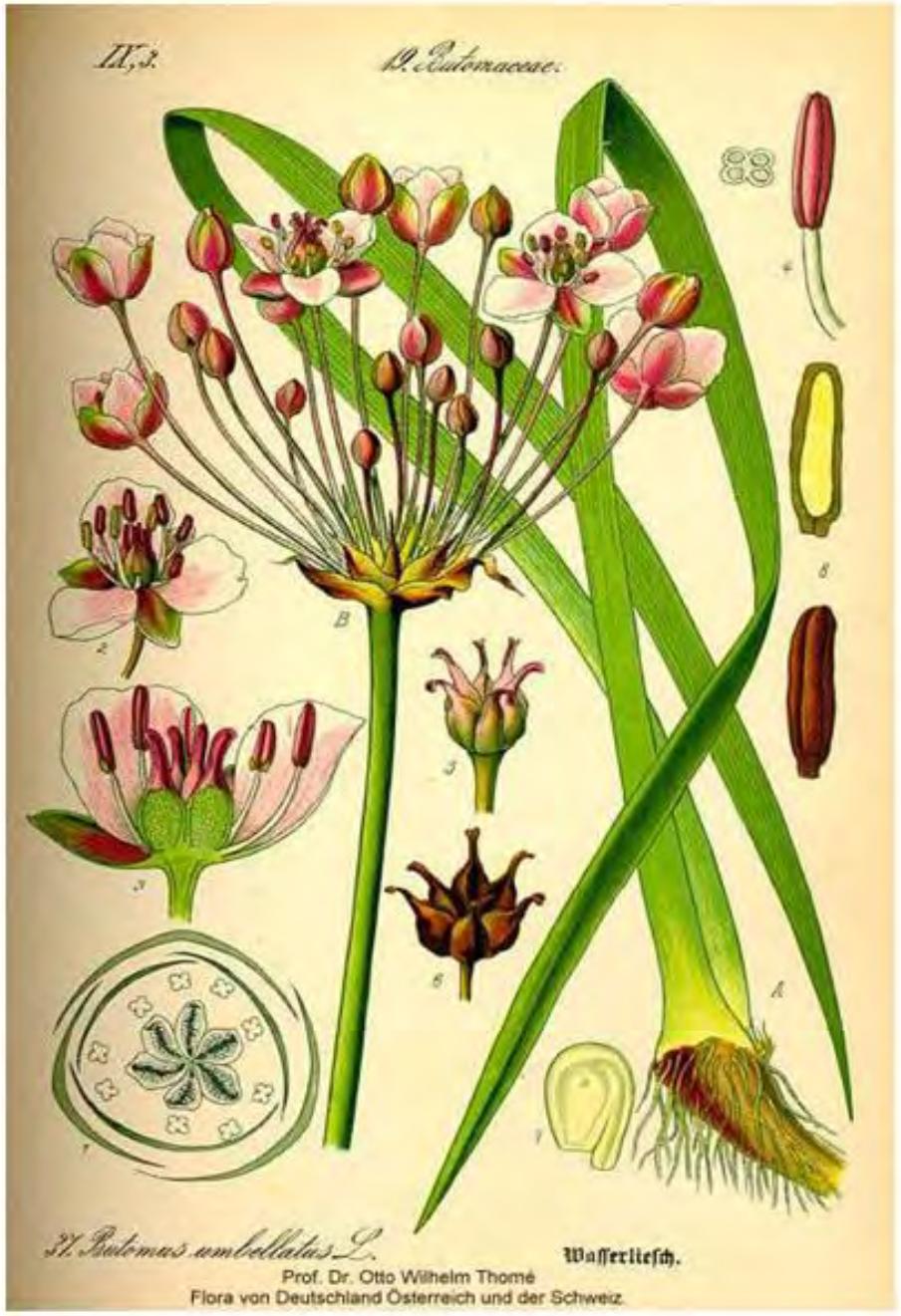
- Discovered in MN in 1987
- 12-21 leaflets
- Reddish stem
- Forms dense surface water mats impeding native plants and recreation
- Presently in over 270 water bodies in MN



HYDRILLA
(Hydrilla verticillata)

- Introduced in the 1950s through the aquarium trade
- Impedes irrigation, recreation, industry
- Forms dense surface water mats





FLOWERING RUSH

(Butomus umbellatus)

- Emergent perennial
- More problematic in western MN counties
- Different strains of the plant, some flower and others do not
- Managed either through chemical or mechanical means depending on substrate type – difficult to ID

CHINESE MYSTERY SNAILS

(Bellamya (Cipangopaludina) chinensis)

- Native to Asia
- Can transmit parasites
- Can invade bass nests and cause mortality
- Commonly spread through illegal aquarium dumping

FAUCET SNAILS

(Bithynia tentaculata)

- Native to eastern Europe, introduced through ballast water to the Great Lakes
- Snail is an intermediate host for three intestinal trematodes (parasites) which kill scaup and coots
- Outcompete native snails
- Found in the Mississippi Crow Wing, and Shell Rivers
- Difficult to ID correctly

RUSTY CRAYFISH

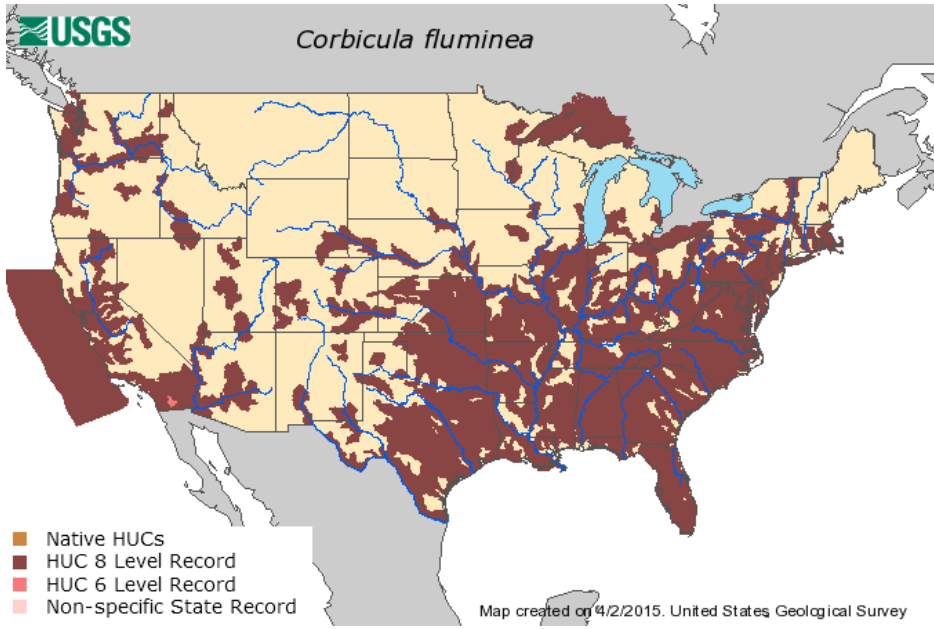
(Orconectes rusticus)

- 5 inches long, rusty-colored spots on carapace; claws with black tips
- Native to Ohio River valley, discovered in Minnesota around 1960
- Feed on fish eggs and young, destroy vegetation
- Outcompetes native crayfish

ASIAN CLAM

(Corbicula fluminea)

- Small bivalve, lightly colored
- Filter feeder common through Asia
- Low temp tolerance (2-30° C)
- Outcompetes native bivalves
- Biofouling – power plants and industrial water systems
- Problem in irrigation canals
- Bio-control – none
- **Chemical – oxidizing or non-oxidizing compounds**



ZEBRA MUSSEL

(Dreissena polymorpha)

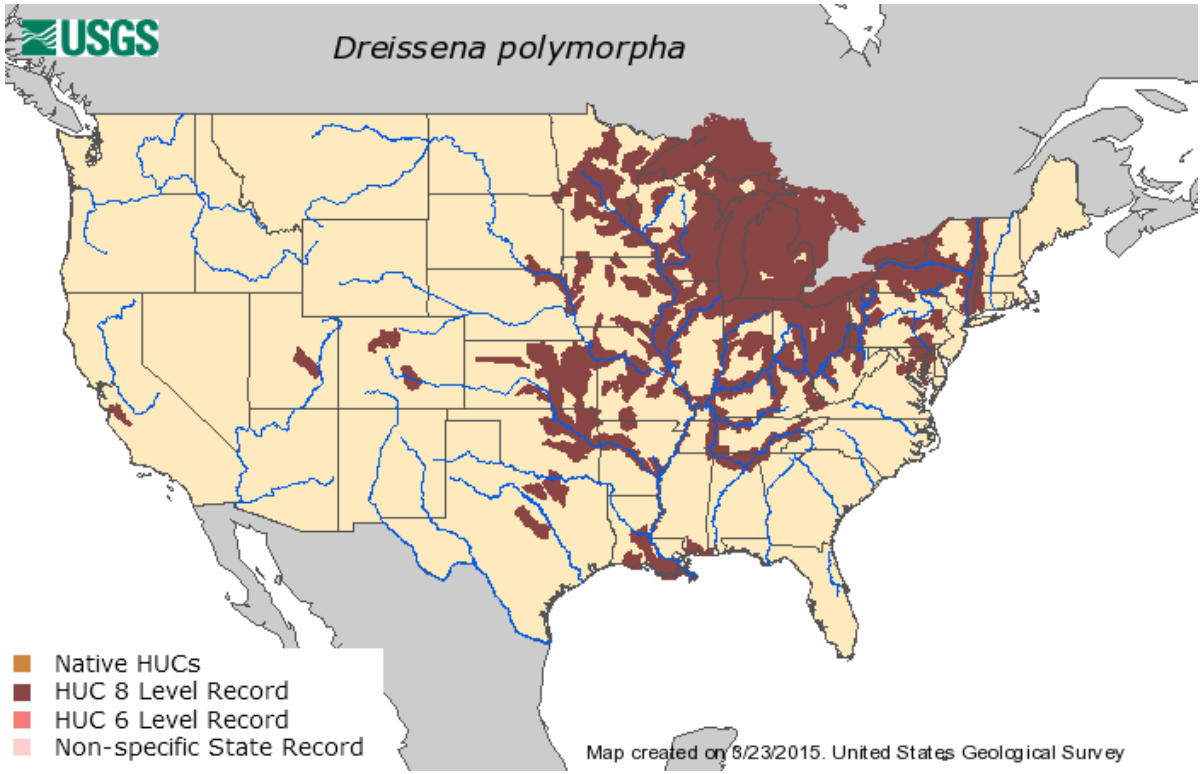
- Freshwater mussel native to eastern Europe
- Microscopic to 2 inches
- “D” or shaped shell with brown & yellow stripes
- Has a free-floating veliger stage
- Lives 3 to 5 years
- Byssal threads that can attach to nearly anything

ZEBRA MUSSEL IMPACTS

- Encrust nearly anything including native mussels
- Filter plankton from water – food chain disruptor
- Sharp shells
- Concentrate blue green algae

ZEBRA MUSSEL DISTRIBUTION

- Introduced in 1988 to Great Lakes
- First in MN in 1989
  - Duluth Harbor



TO KILL OR NOT TO KILL?

1. Do you have a problem?
2. What are the desired goals and how are they achieved (measured)?
3. What control options exist and are feasible?
4. How long you in it for?

ASIAN CLAM CONTROL

(Corbicula fluminea)

- Bio-control – none
- Physical - screens
- Chemical – oxidizing

  chlorine, potash or potassium permanganate
- Chemical - non-oxidizing

  Endothall (mono amine salt), copper sulfate, niclosamide (Bayluscide)

Few federally approved products by the EPA

REFER TO STATE REGULATIONS FOR PERMITS!!!

ZEBRA MUSSEL CONTROL EFFORTS IN MN

Year	Location	Treatment Type	Results
2014	Lake Independence (Hennepin County)	EarthTec QZ (copper product)	Data currently under review
2011	Rose Lake (Otter Tail County)	Cutrine Ultra (Chelated copper product)	In 2012, three adult zebra mussels were found in treated area. No additional zebra mussels found since then.
2011	Irene Lake (Douglas County)	Cutrine Ultra (Chelated copper product)	Adult zebra mussel found after treatment (~1 mile away from treated area)
2004-2005	Ossawinnamakee (Crow Wing County)	Cutrine Ultra (Chelated copper product)	Zebra mussels found after treatment
2000	Zumbro Lake (Olmsted County)	Mussels exposed to air by lowering water levels	Zebra mussels found after treatment

ZEBRA/QUAGGA CONTROL

- Bio-control – Zequanox
- Physical – screens, mechanical removal
- Chemical – oxidizing

  chlorine, potash or potassium permanganate
- Chemical - non-oxidizing

  Endothall (mono amine salt), copper sulfate, niclosamide (Bayluscide)

Few federally approved products by the EPA

REFER TO STATE REGULATIONS FOR PERMITS!!!

WHAT CAN YOU DO?

1. **Educate yourself**
   - Know what waters are infested and how to identify AIS
   - Understand Minnesota's AIS laws
   - Follow laws, clean equipment, get permits
2. **Best Practices**
3. **Inform (educate) others**

KNOW STATE REGULATIONS

Minnesota has several state laws intended to minimize the introduction or spread of invasive species of wild animal, insect, and terrestrial or aquatic plants in the state.

- These laws apply to construction activities, and you should be familiar with them.

MN AIS LAWS

- **REQUIRED BY LAW**
  - **CLEAN**– All plants and animals off water-related equipment (boats, docks, etc.)
  - **DRAIN**– All water *before* leaving the access
  - KEEP– All draining devices open during travel
  - **21 day dry time for docks** & other equip.

REGULATIONS ON WATER TRANSPORT

Drain all water from equipment where water may be trapped. Remove drain plugs, drain hoses prior to transport.

M.S. 84D - *"When leaving waters of the state a person must drain water-related equipment holding water before transporting the water-related equipment off the water access site or riparian property."*

BEST PRACTICES

- Rinse- with water at least 140˚F for 10 seconds or 120˚F for 2 minutes
- Spray- water at high pressure to remove anything that may be attached
- Dry- watercraft for at least 5 days between waters

STOP AQUATIC HITCHHIKERS!™

Prevent the transport of nuisance species.
Clean all recreational equipment.

CONSTRUCTION RELATED BEST PRACTICES

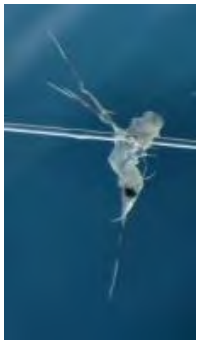
- Prior to transportation along roads into or out of any worksite, or between water bodies within a project area, all equipment must be free of any aquatic plants, water, and prohibited invasive species.
- **Drain** all water from equipment where water may be trapped, such as tanks, pumps, hoses, silt curtains, and water-retaining components of boats/barges, and,
- **Remove** all visible aquatic remnants (plants, seeds, and animals). Removal of mud & soil is not required, though is encouraged as a Best Practice.

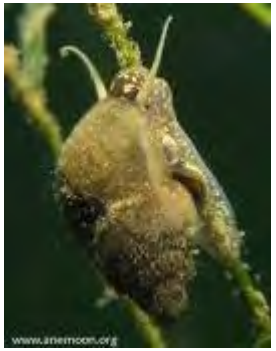
Drain all water from equipment where water may be trapped.
Remove drain plugs, drain hoses prior to transport.

Removal of aquatic remnants is required before transporting on public roads.

REPORT SIGHTINGS OF AIS

- Collect a sample
  - Ideally, use a baggie, some water, and put in the fridge
- Bring to invasive species specialist or DNR office
- Other information to collect
  - Where/when collected
  - Name and contact information of collector



QUESTIONS? THANK YOU!

Integrating Flow Sensors

On Projects with Multiple Water Supplies and Controllers

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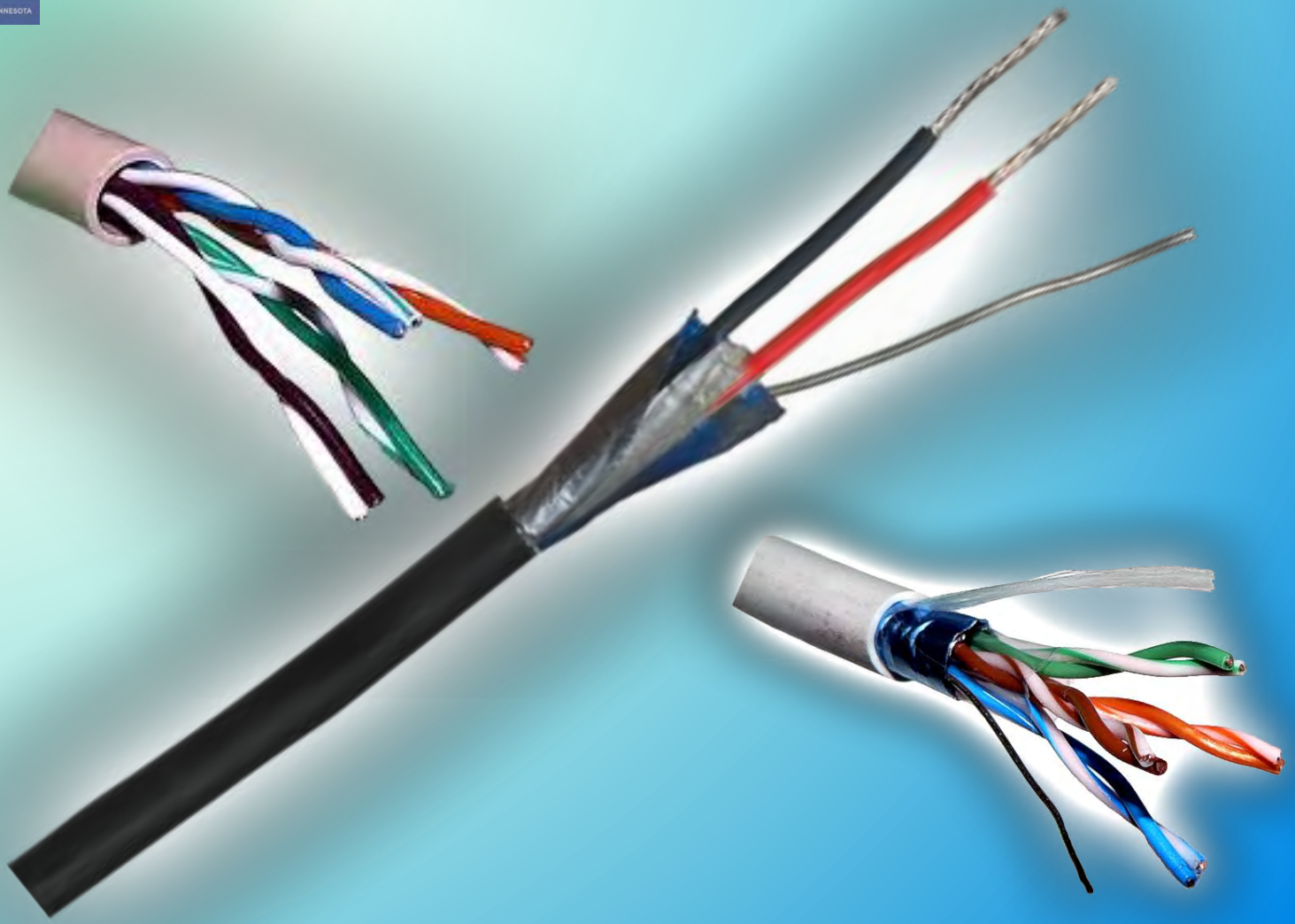
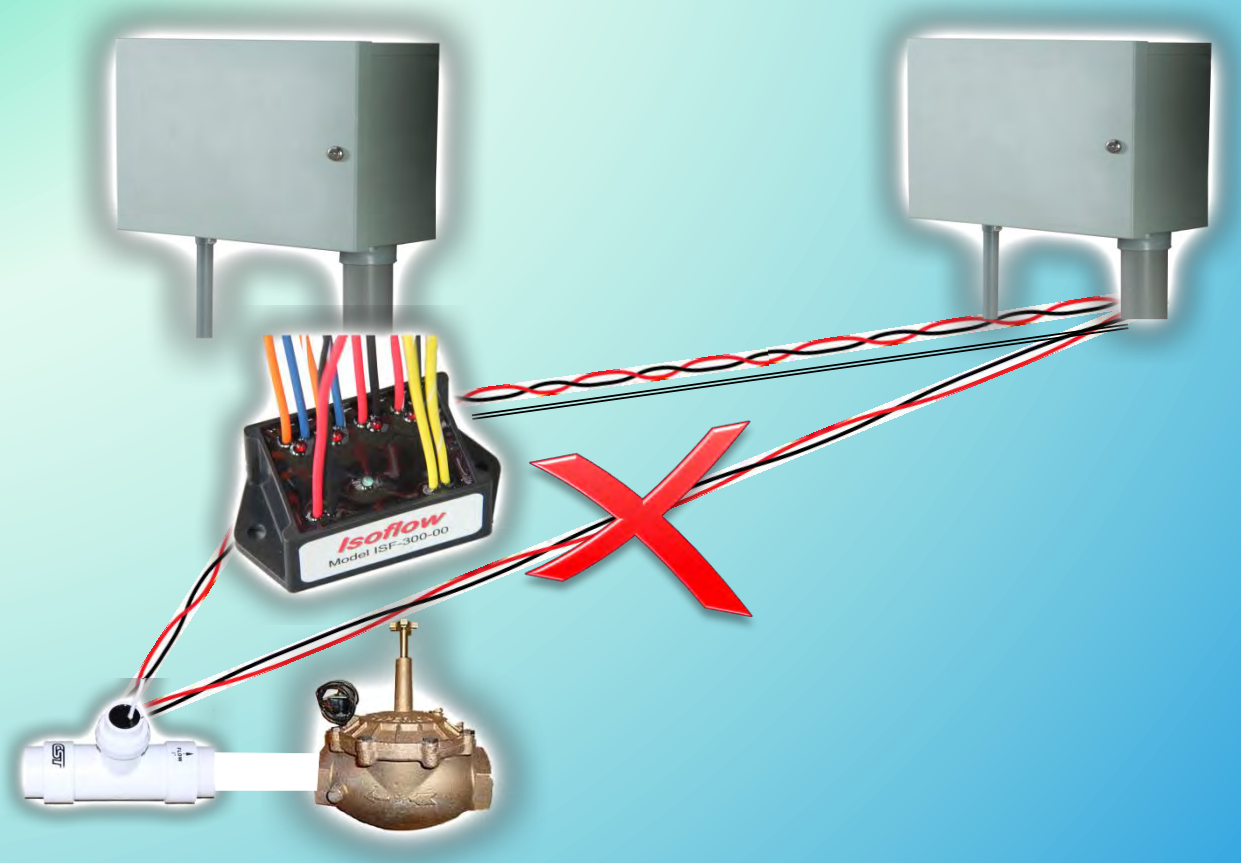
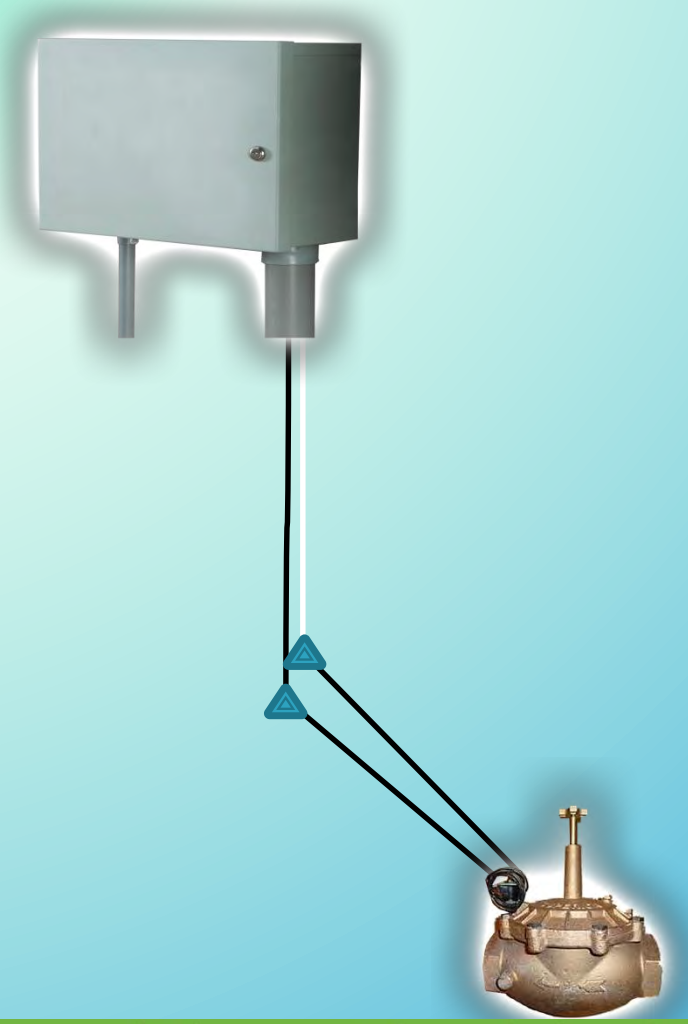
Flow sensor wiring



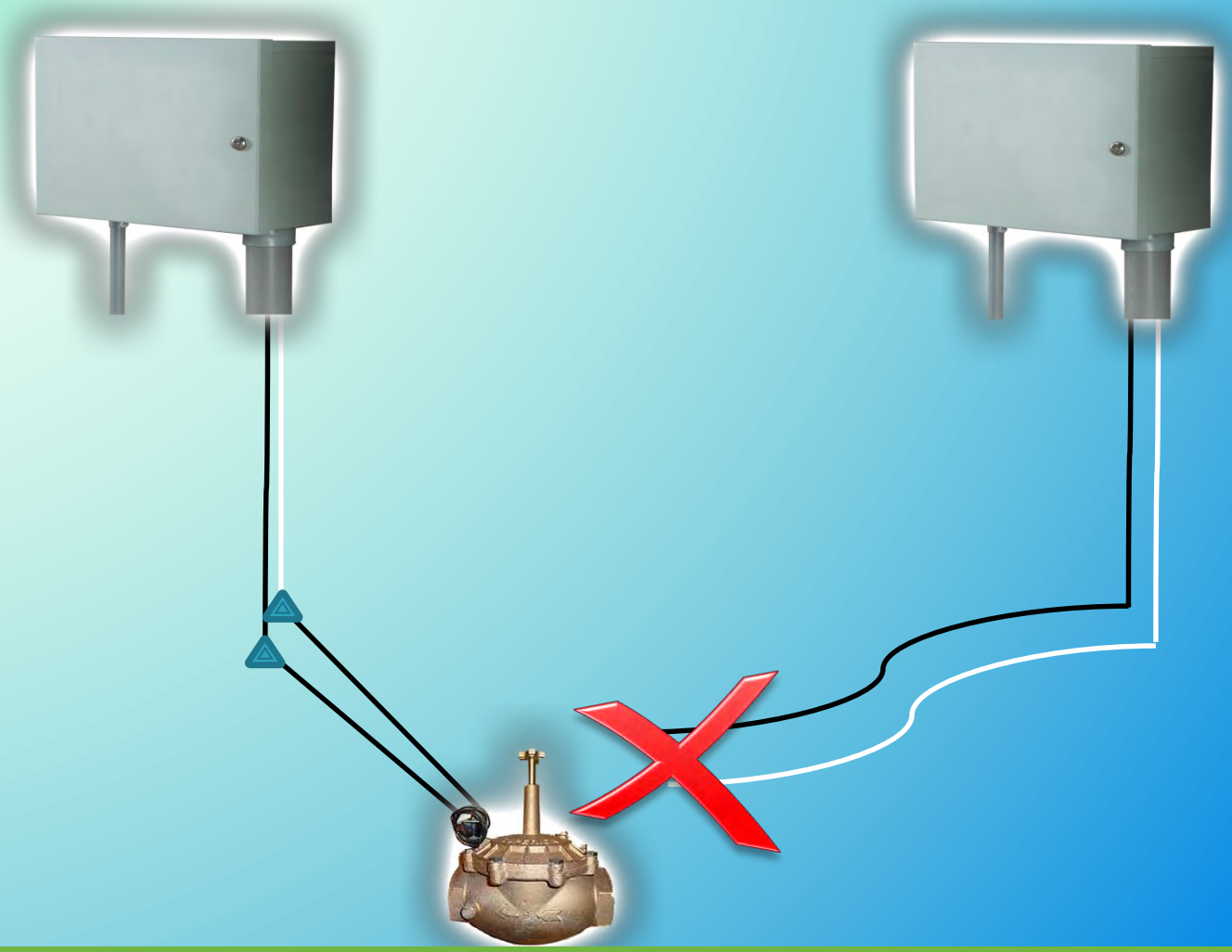
Isolating Flow Sensors



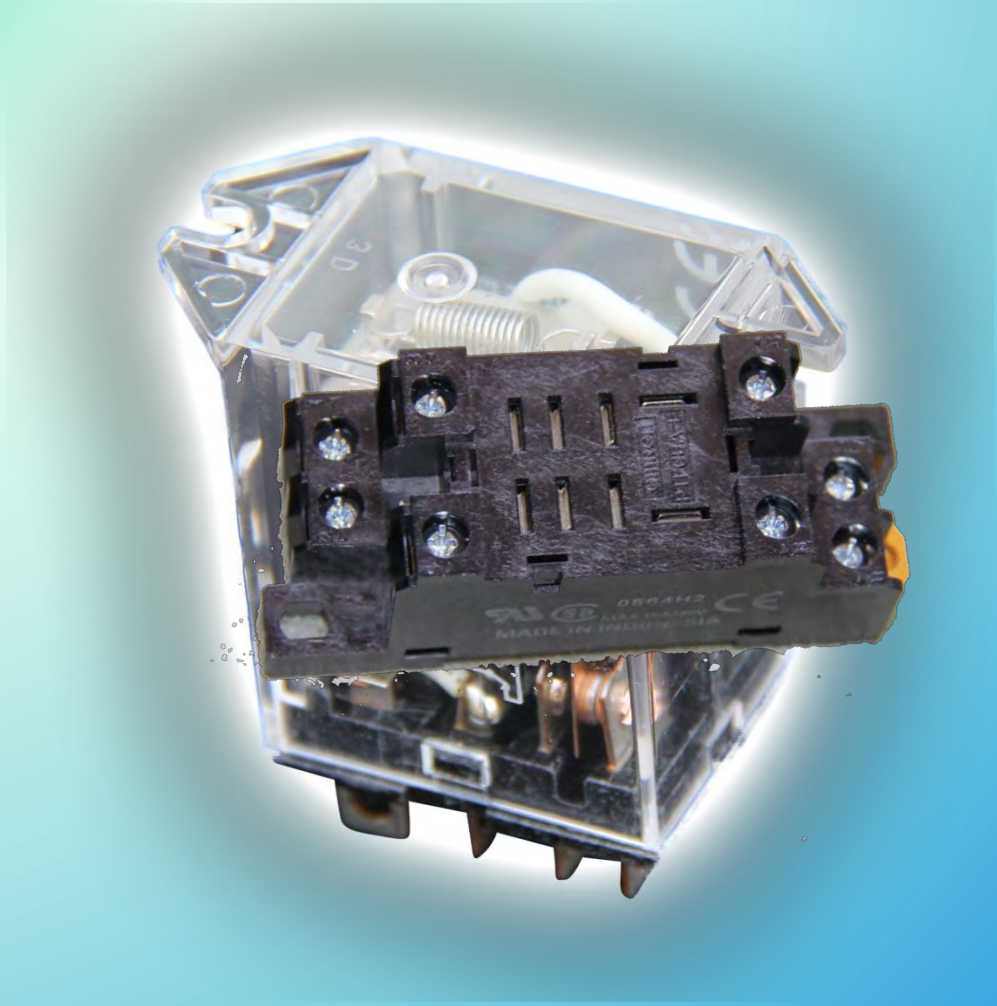
Isolating master valves



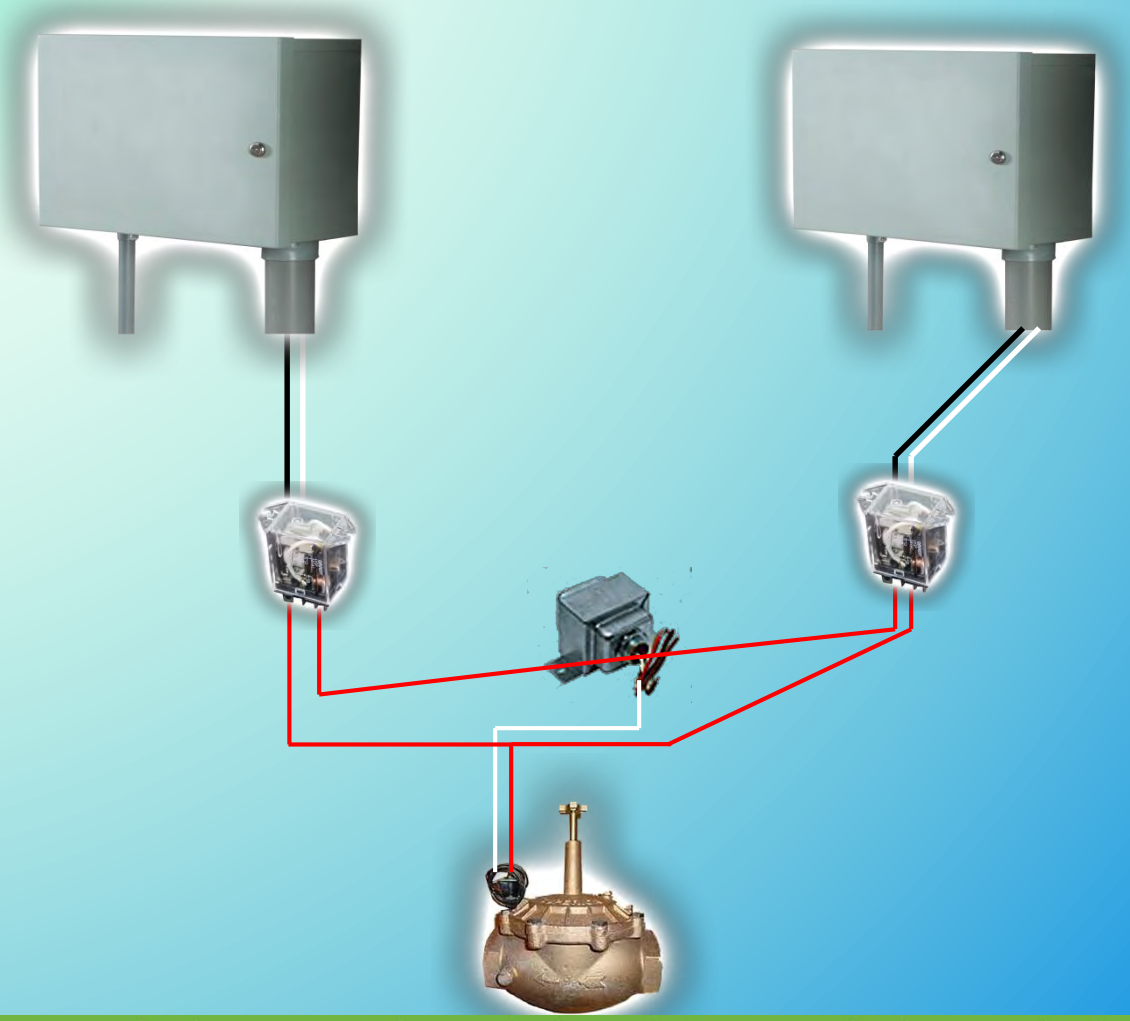
Isolating master valves

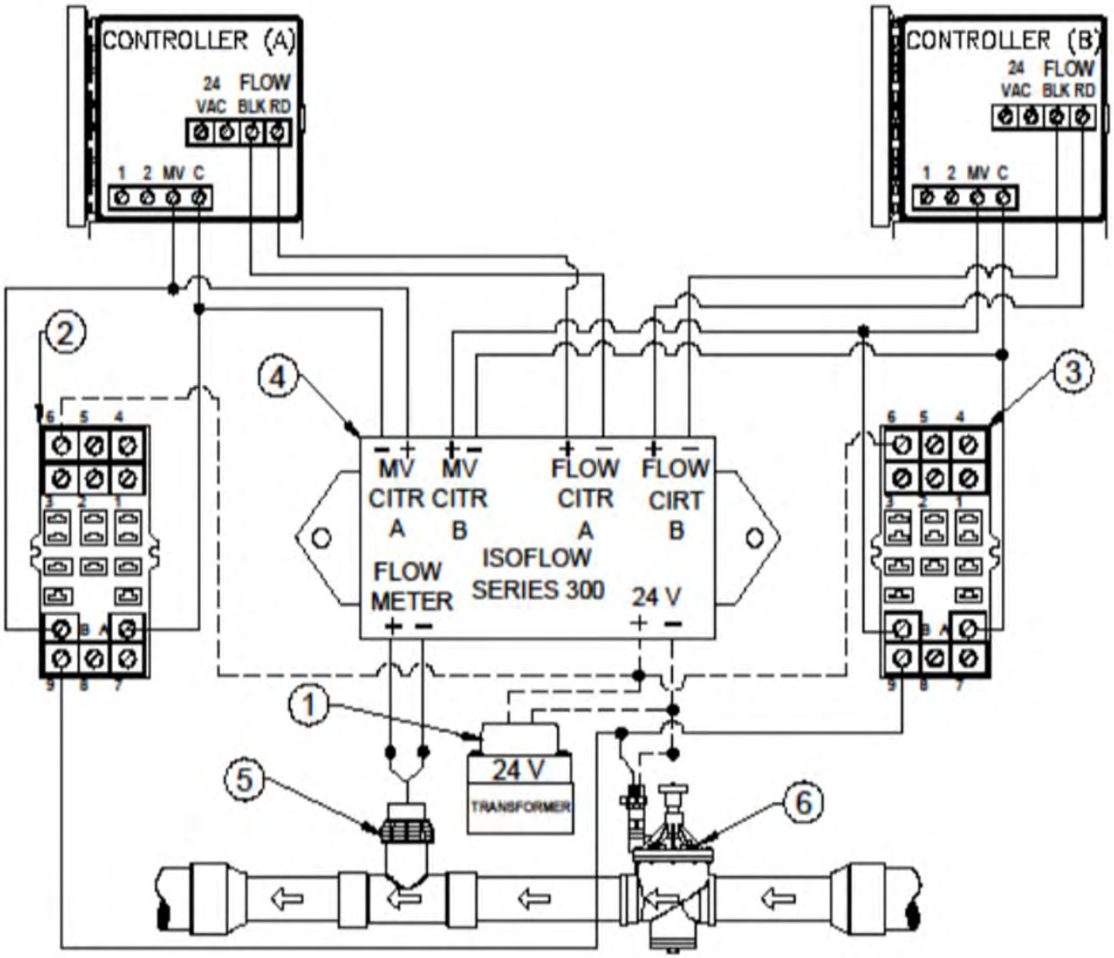


Isolating master valves



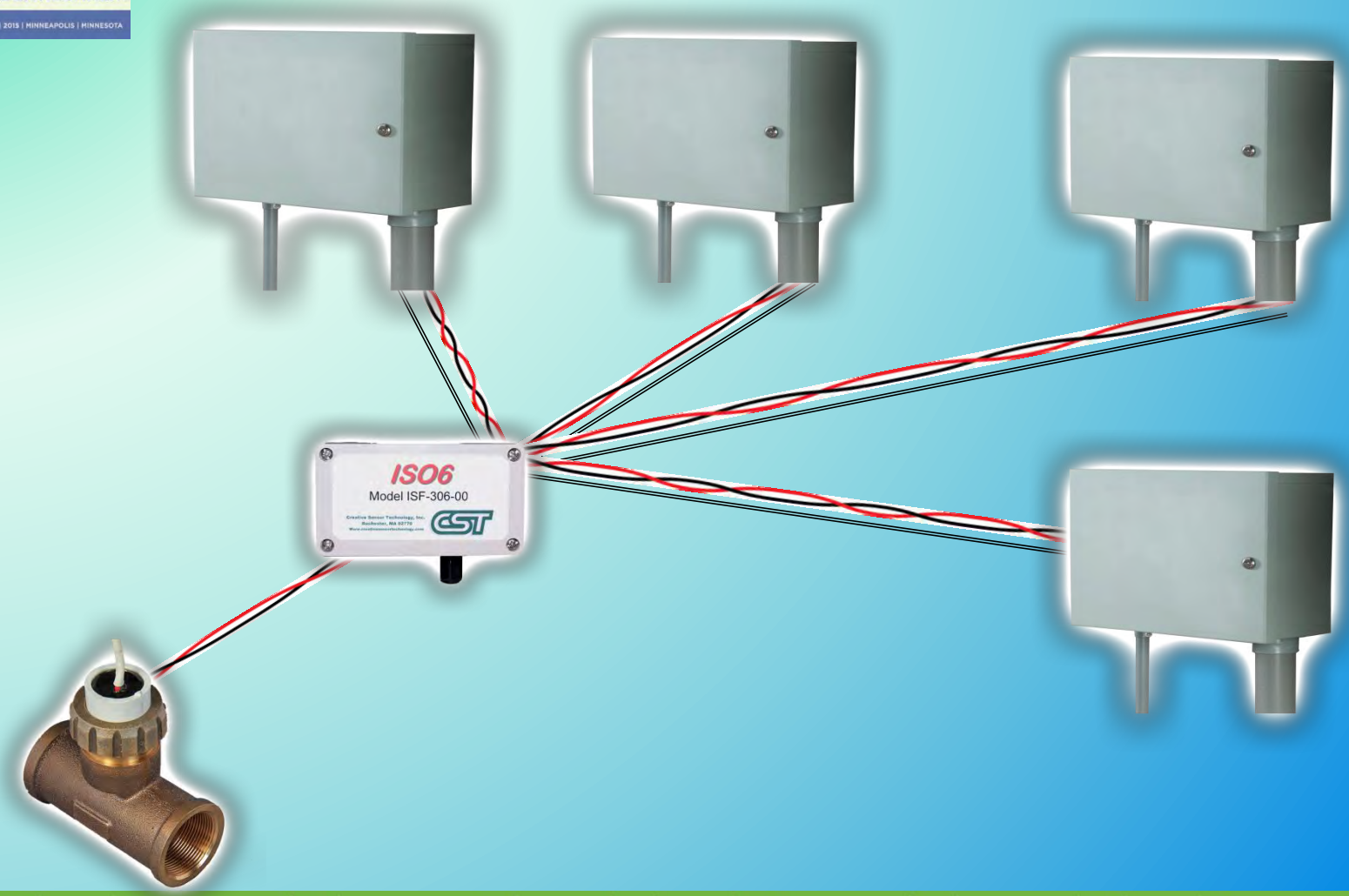
Isolating master valves





1. SECONDARY STEP DOWN TRANSFORMER 110V TO 24V POWER SUPPLY REQUIRED.
2. ISOLATION RELAY #1
3. ISOLATION RELAY #2
4. ISOFLOW MODEL ISF-300
5. FLOW SENSOR
6. MASTER VALVE (NORMALLY CLOSED).

Isolating flow sensors



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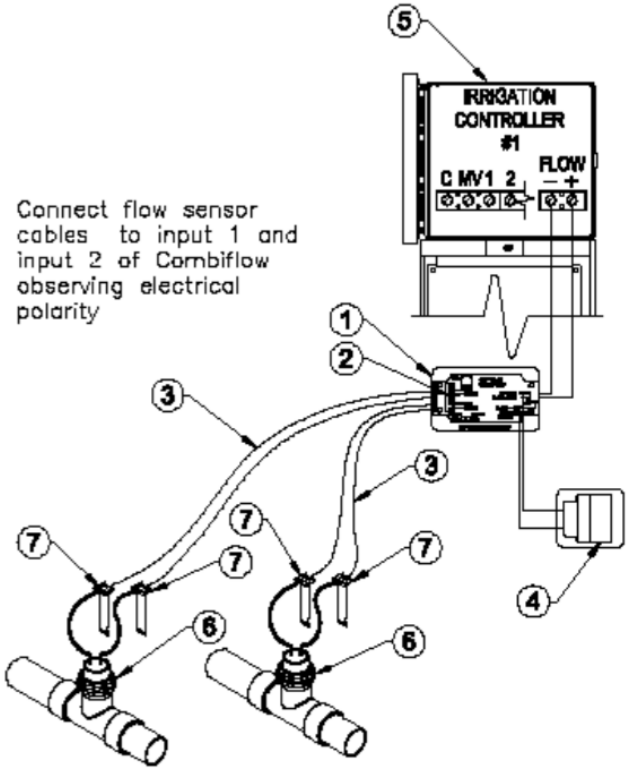
Combining flow sensor signals



1. MOUNT COMBIFLOW EITHER INSIDE THE CONTROLLER ENCLOSURE PEDESTAL USING SHEET METAL SCREWS OR DOUBLE SIDED FOAM TAPE, OR ADJACENT TO THE CONTROLLER IN A NEAR BY LOCATION.
2. CONNECT FLOW SENSOR CABLES TO INPUT 1 AND INPUT 2 OF COMBIFLOW OBSERVING ELECTRICAL POLARITY.
3. DIRECT BURIAL 1 PAIR, TWISTED SHIELDED CABLE—MINIMUM CONDUCTOR SIZE 20 AWG. DO NOT EXCEED 2,000 FEET IN LAYING DISTANCE FROM FLOW SENSOR TO COMBIFLOW.
4. 12–24 VOLT AC OR DC POWER SUPPLY OR AUXILIARY POWER TERMINALS ON CONTROLLER.
5. IRRIGATION CONTROLLER.
6. CST FLOW SENSOR.
7. WATERPROOF WIRE SPLICE, 3M SCOTCHPACK OF EQUIVALENT.

NOTE:
FLOW SENSORS INSTALLED IN FIELD PIPING ACCORDING TO FLOW SENSOR DETAIL.

SENSORS MAY BE THE SAME OR DIFFERENT SIZES.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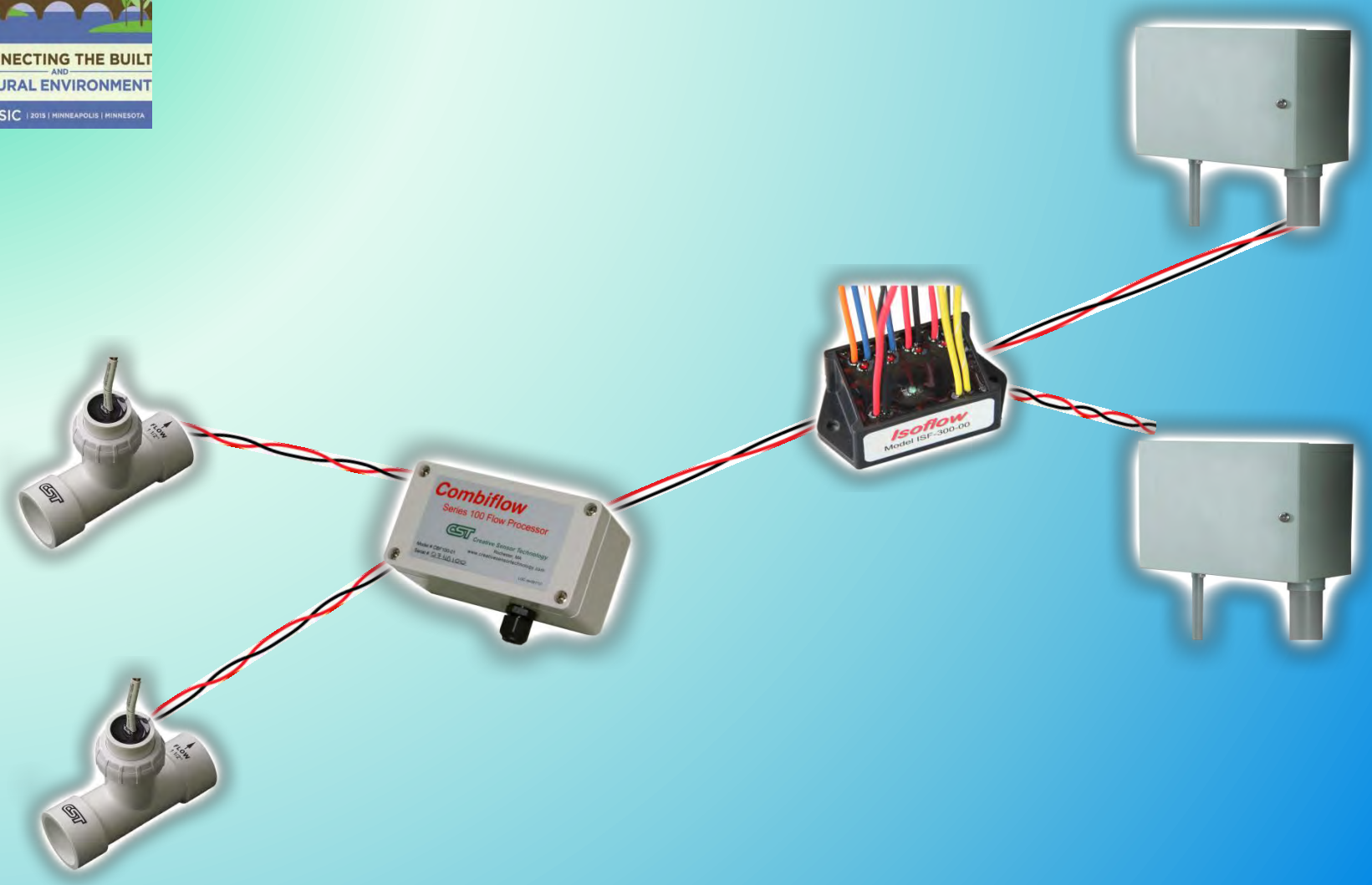
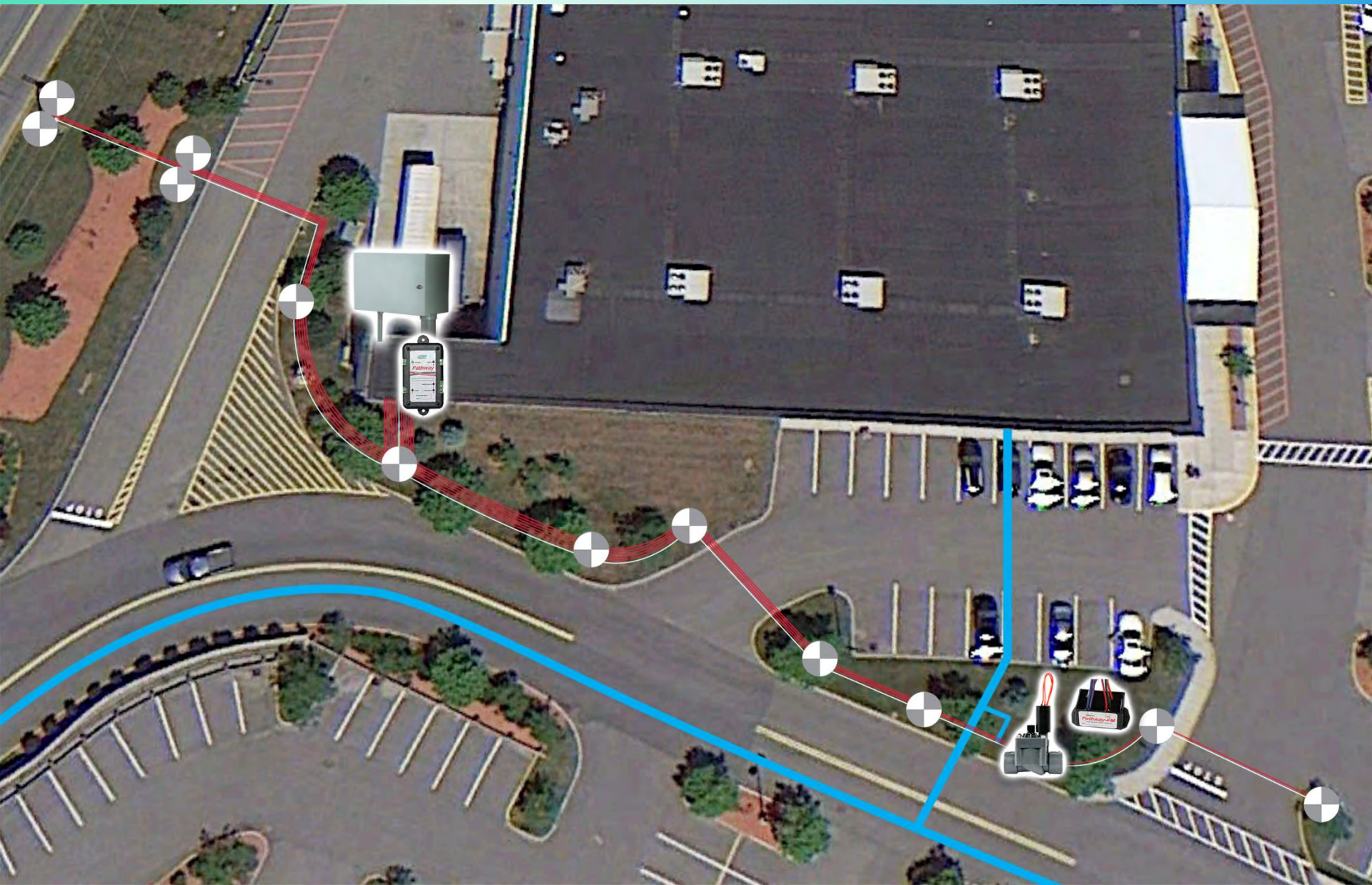

Combiflow
Series 100 Flow Processor
Isoflow
Model ISF-300-00

Retrofit Applications



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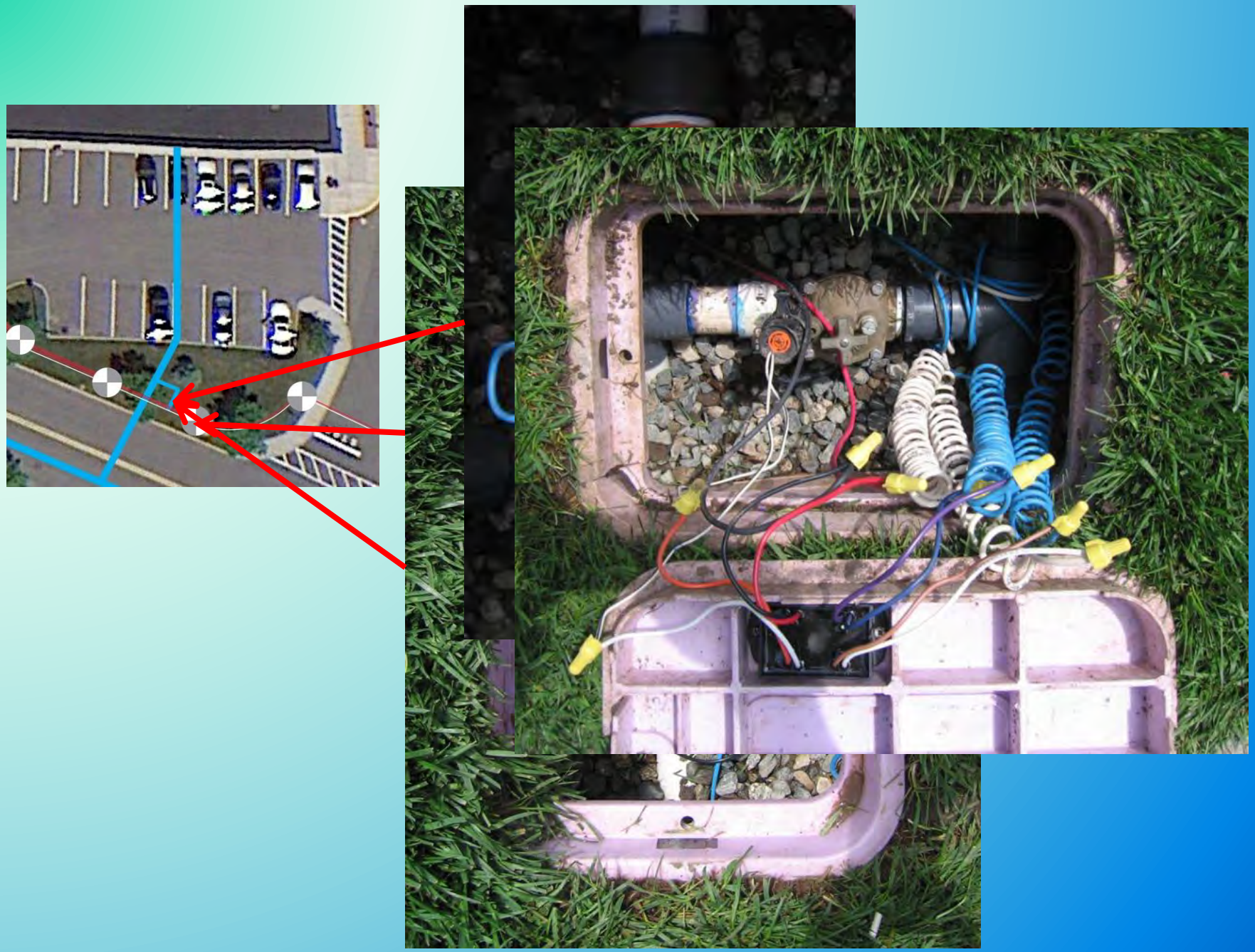
Qualify site




CST

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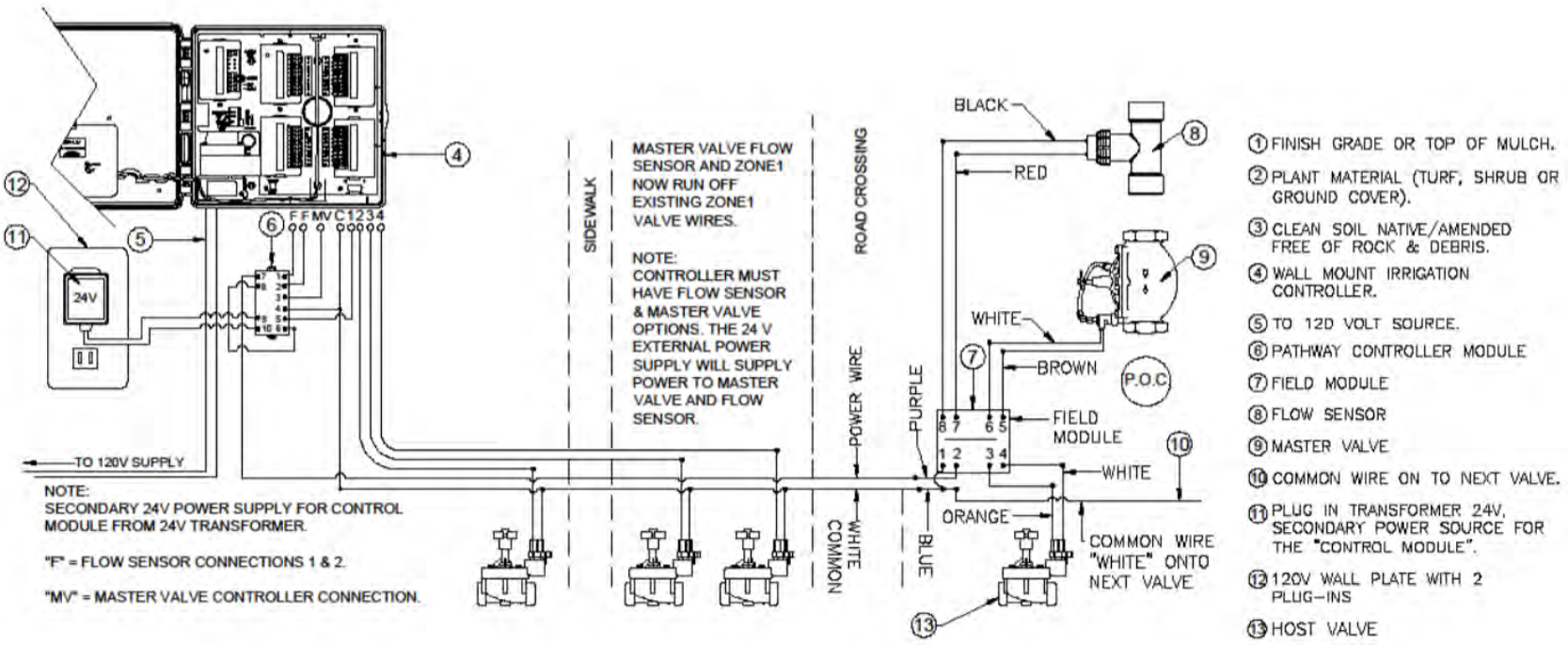

Multiple POCs

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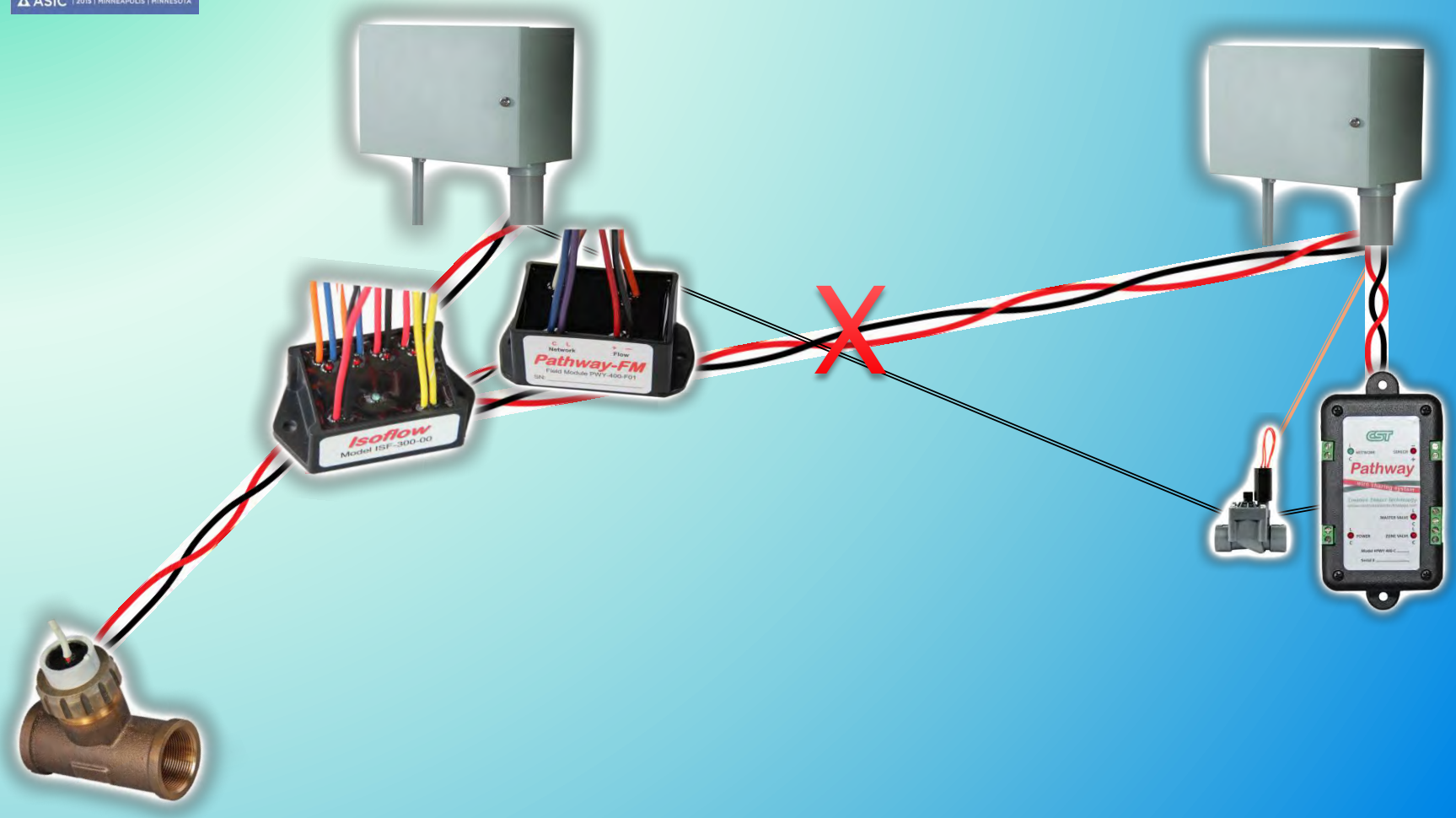
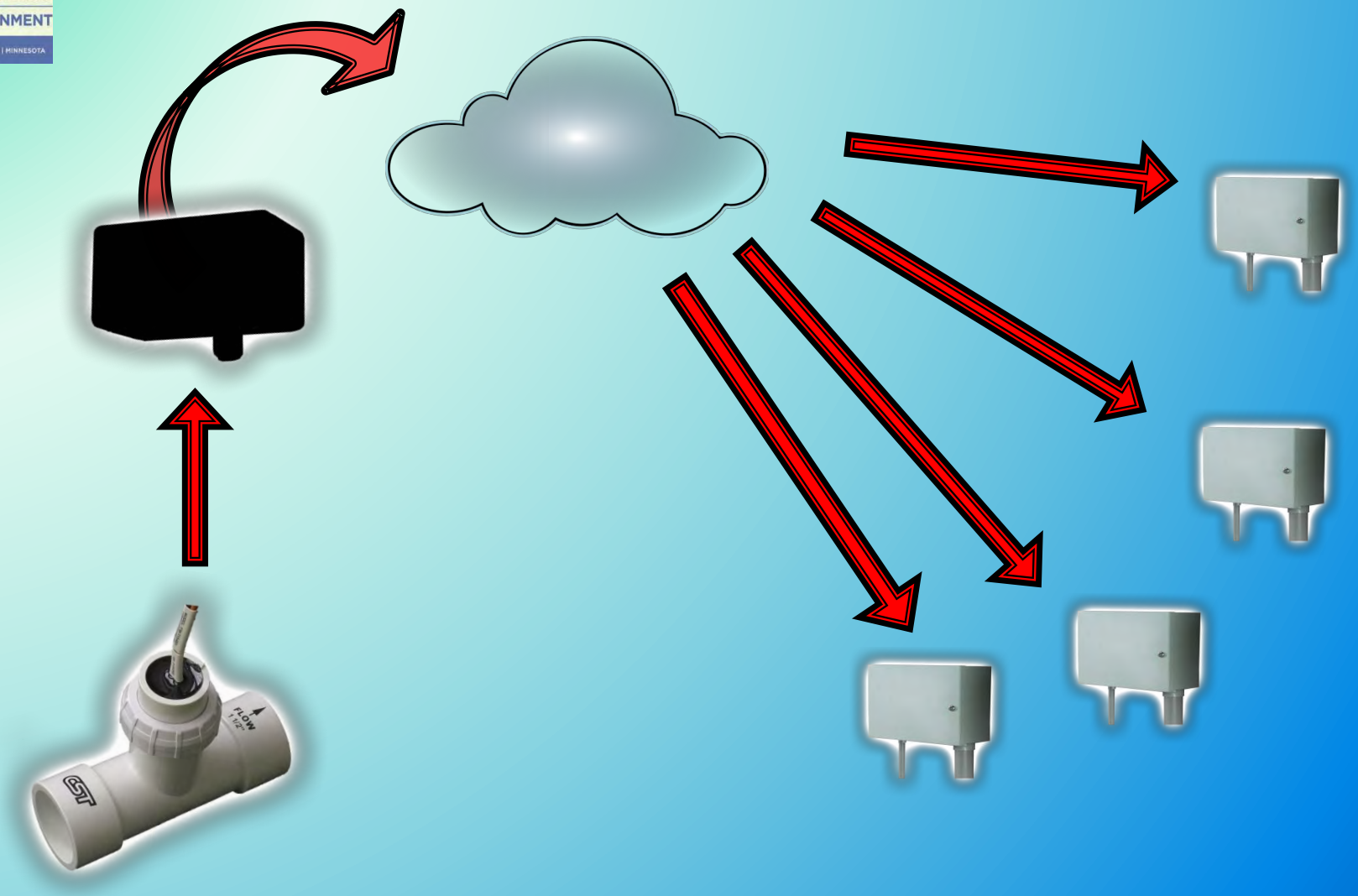
Transmitting flow data between controllers



What's next ?

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Questions ?