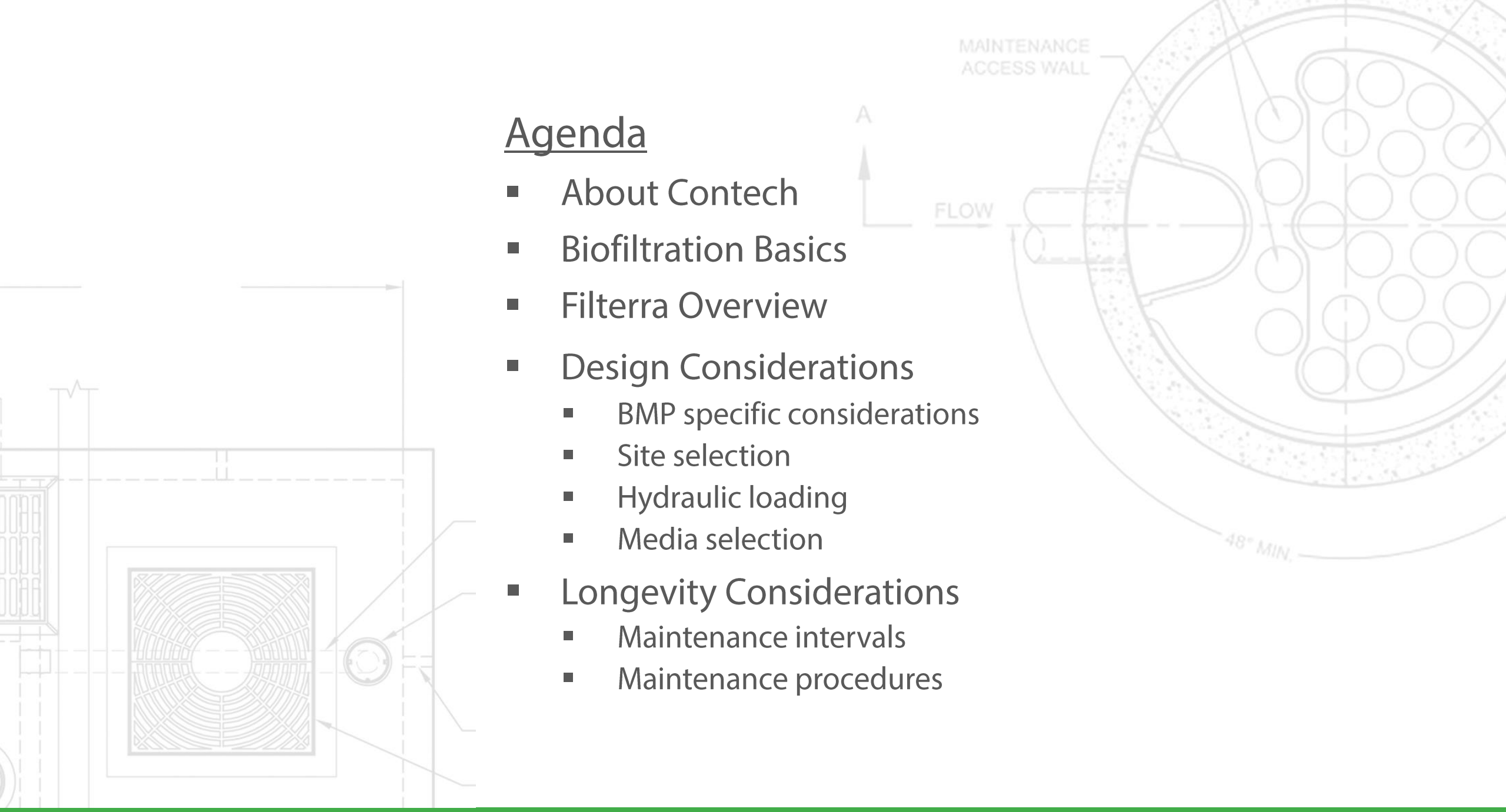
Biofiltration: Design Considerations for Performance and Longevity

Kerry Symanski– Stormwater Consultant

Chris Allen – Region Regulatory Manager



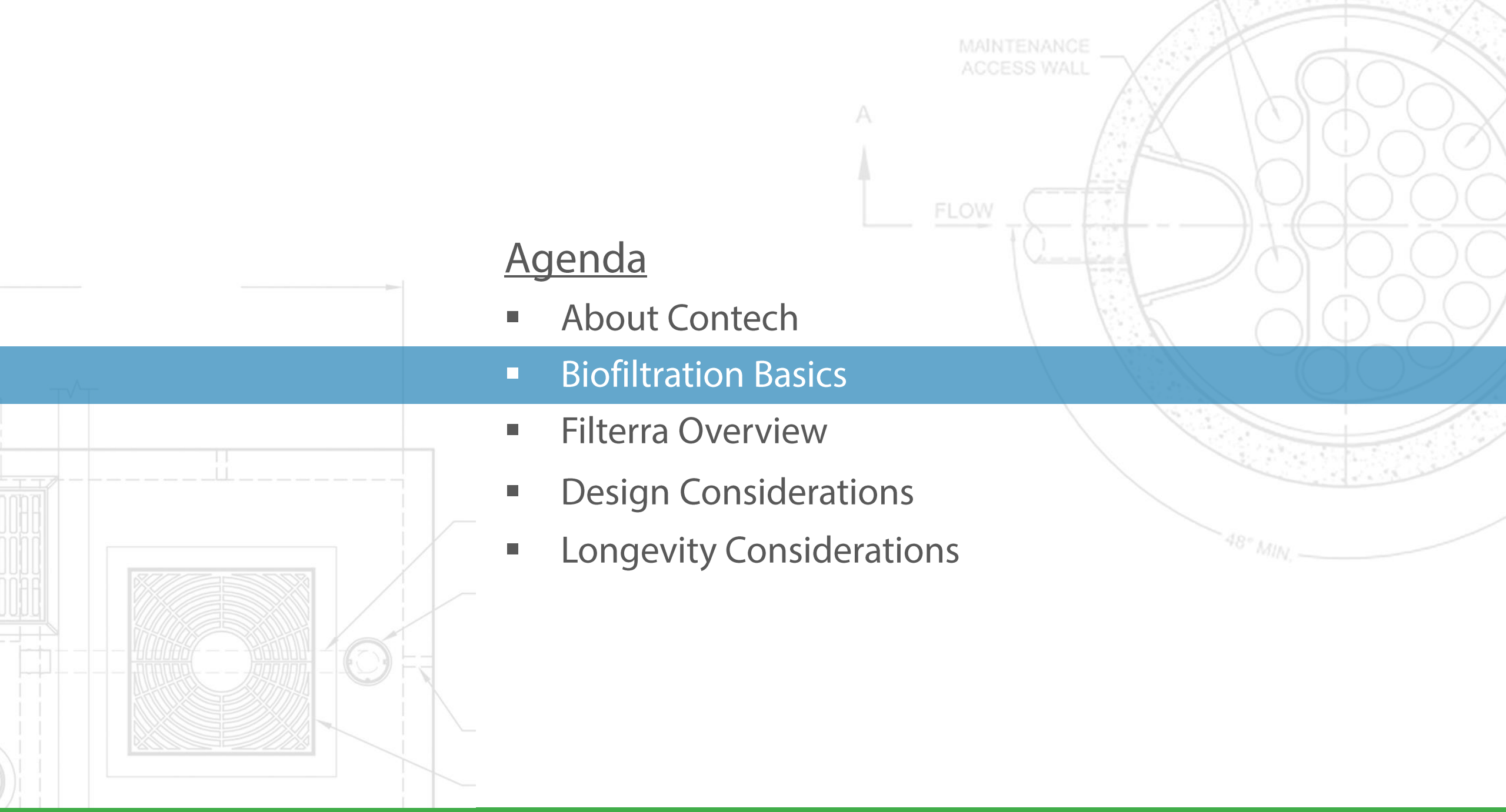
Agenda

- About Contech
- Biofiltration Basics
- Filterra Overview
- Design Considerations
  - BMP specific considerations
  - Site selection
  - Hydraulic loading
  - Media selection
- Longevity Considerations
  - Maintenance intervals
  - Maintenance procedures

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects for over a century.

CONTECH ENGINEERED SOLUTIONS



Agenda

- About Contech
- Biofiltration Basics
- Filterra Overview
- Design Considerations
- Longevity Considerations

Bioretention

A BMP by many names

- Biofilter/ bioretention
- Rain garden
- Bioswale
- Vegetated soil filter
- Vegetated filter strip
- Micro-bioretention

Common Attributes

Bioretention

A BMP by many names

- Biofilter/ bioretention
- Rain garden
- Bioswale
- Vegetated soil filter
- Vegetated filter strip
- Micro-bioretention

Common Attributes

- Vegetated
- Infiltrates where feasible
- Blend of sand, soil, and organic media
- Typically built into a landscape/ surface
- Used primarily to address water quality

Bioretention

Rain Garden

Source: 2014 Metro Blooms Blog

Compact Parking Island

Source: 2018 Riverside Co Flood Control District LID Handbook

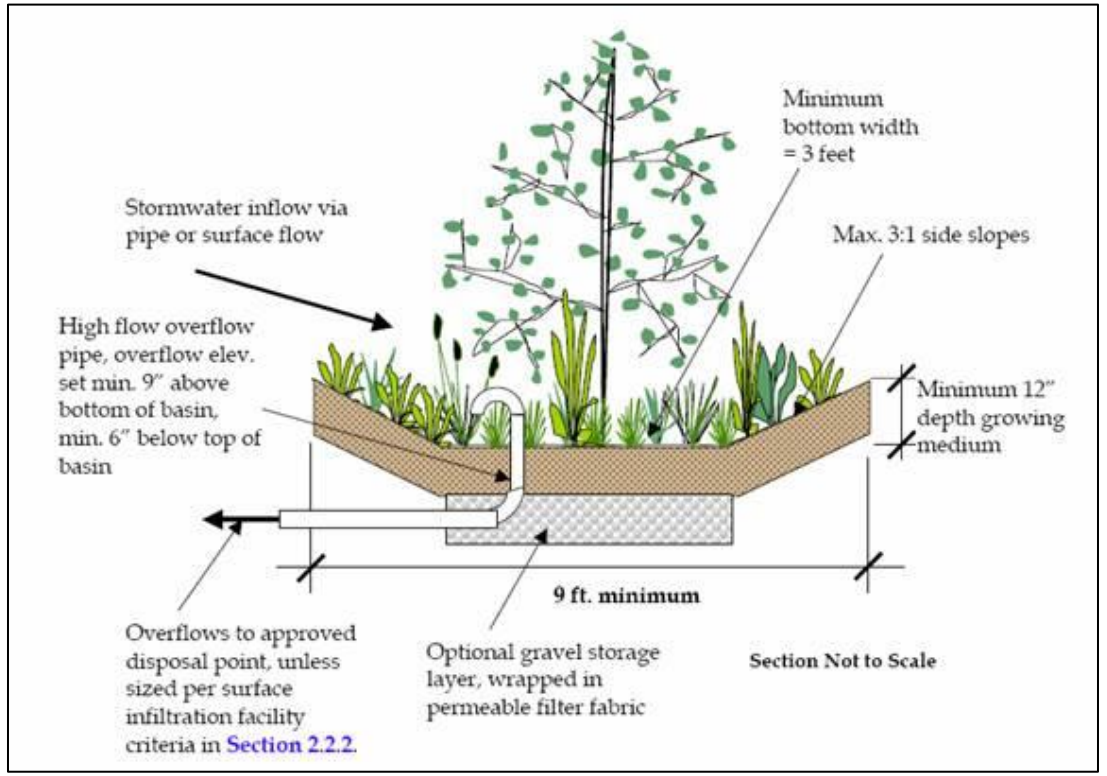
Bioretention

Benefits

- Provides volume reduction, detention and water quality benefits
- Adaptable to nearly every site
- Provides ancillary benefits like habitat, aesthetic appeal, heat island effect mitigation

Challenges

- Opportunities for failure abound
- Media sourcing and composition critical but QC often lacking
- Can be maintenance intensive



Bioretention Performance

Common pollutant removal ratings

- TSS: 80-90%
- TP: 50-65%+
- Metals: 50%+

Challenges in variable design

- Varying media specs
- Limited quality control
- Construction Issues
- Variable amounts of runoff reduction

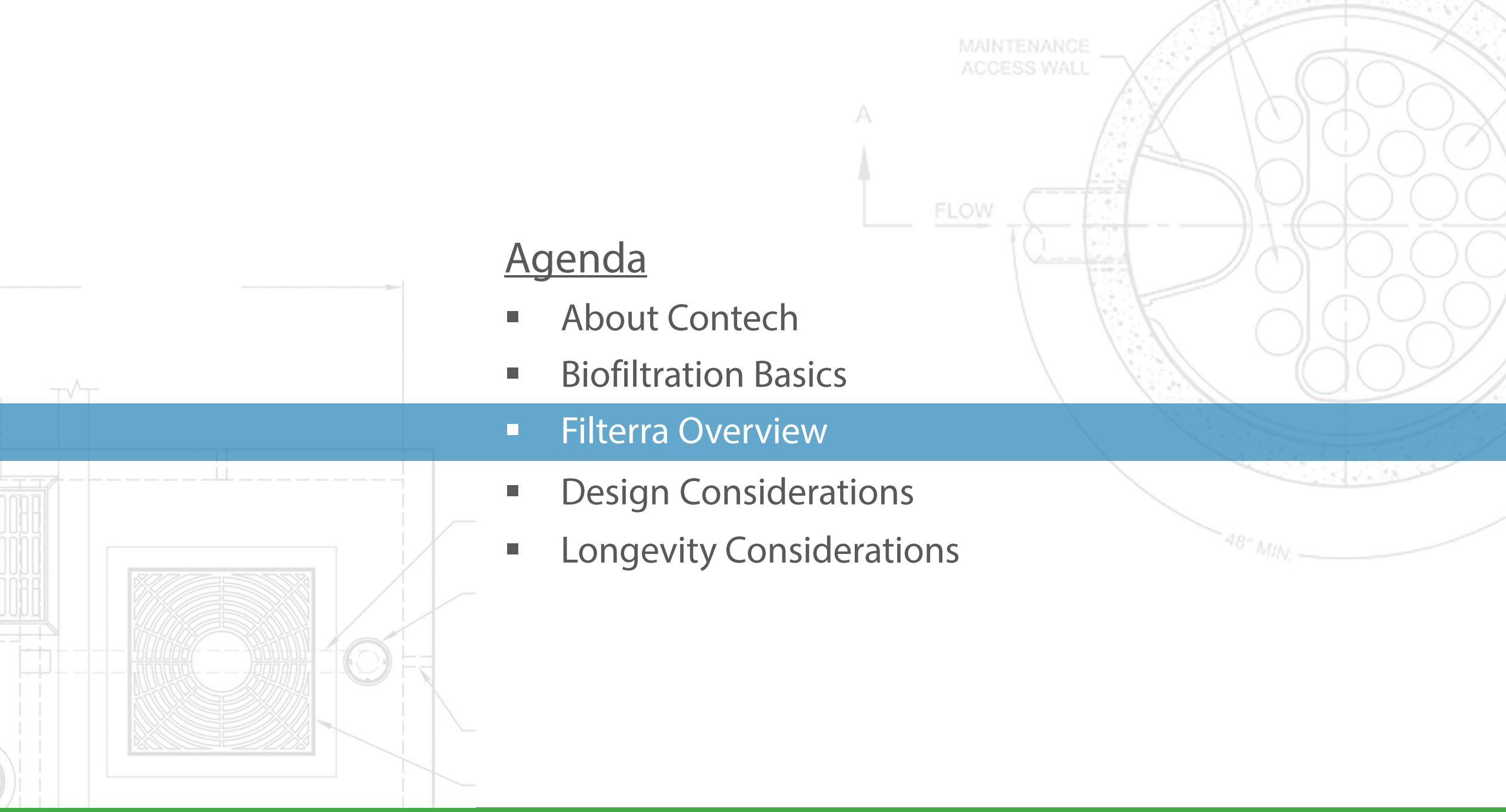
Bioretention considered among the most effective BMPs for many pollutants especially when combined with infiltration

Bioretention vs. Biofiltration

In general, these terms are often used interchangeably. For this presentation, the following distinctions will be used:

Bioretention – stormwater filters through the media and is infiltrated

Biofiltration – stormwater filters through the media and is discharged via underdrain



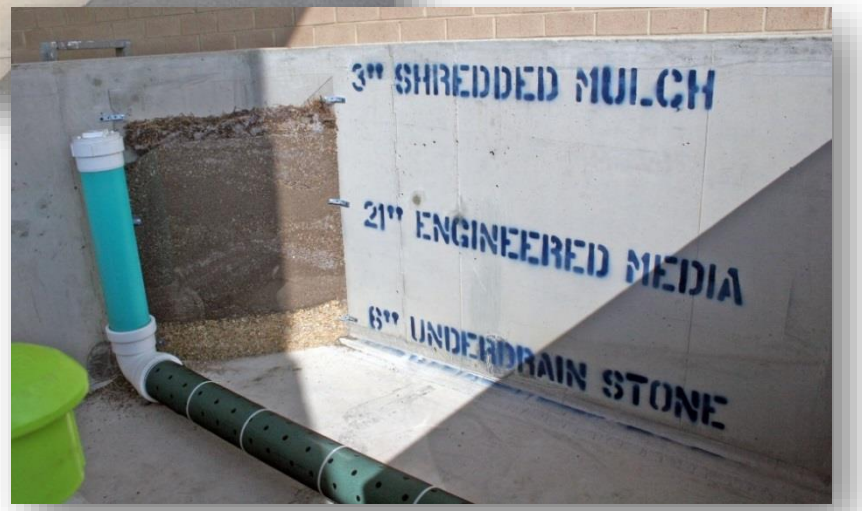
Agenda

- About Contech
- Biofiltration Basics
- Filterra Overview
- Design Considerations
- Longevity Considerations

High Performance Biofiltration

High Flow Media

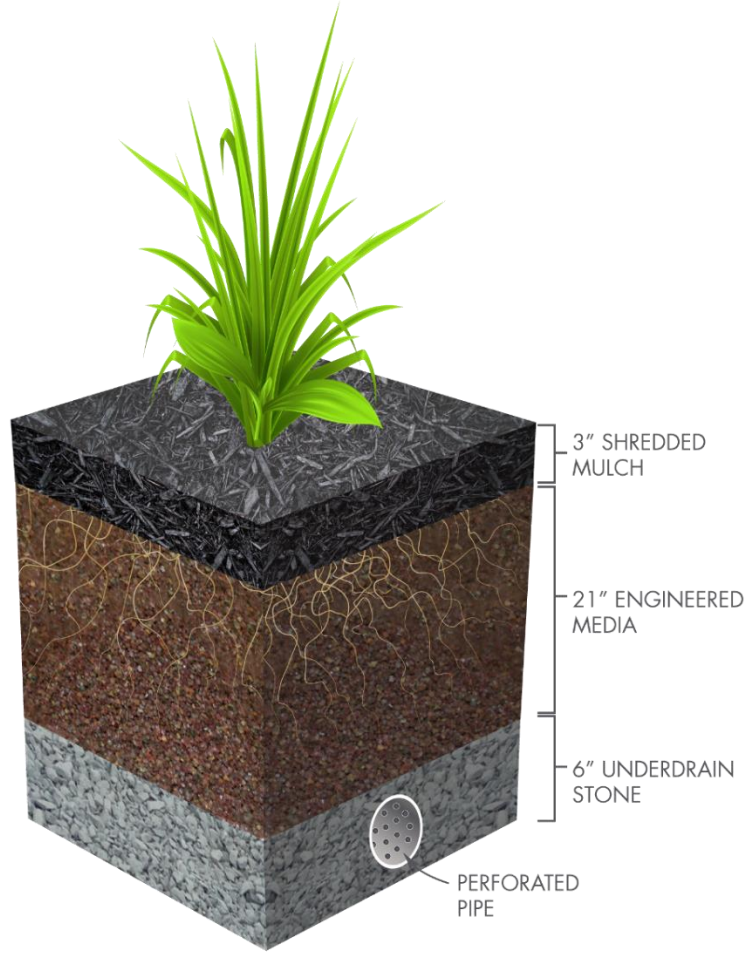
- Same principles as traditional bioretention/biofiltration
- 140+ in/hr flow rate
- Reduced footprint
- Media quality control



High Performance Biofiltration

Pre-engineered packaged stormwater biofiltration:

1. Pretreatment top layer (mulch)
2. Engineered high flow biofiltration media (140+ in/hr)
3. Underdrain system
4. Landscape vegetation



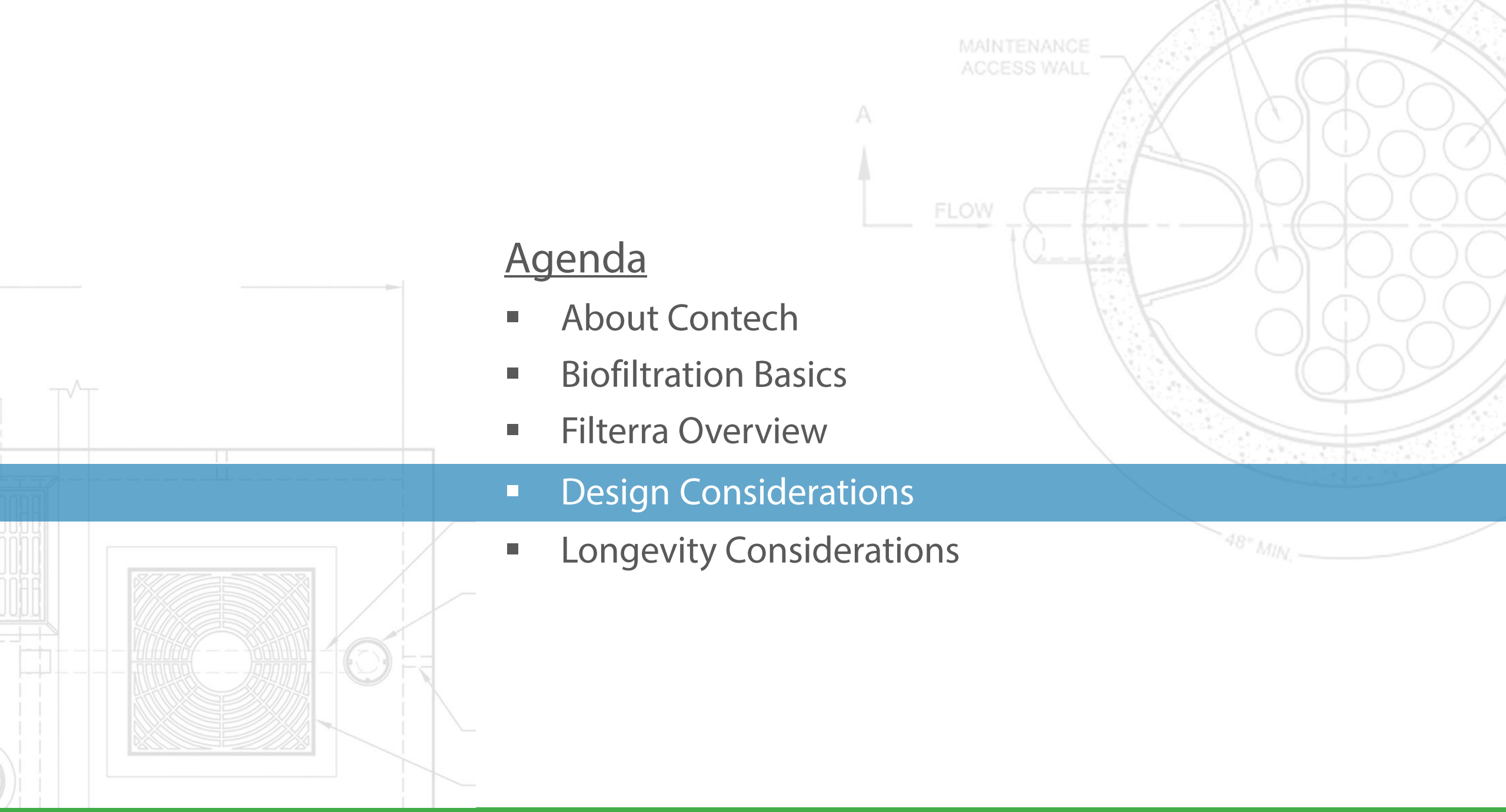
Multiple Configurations

- Filterra BioScape

- Offline Filterra

Multiple Configurations

- Pretreatment



Agenda

- About Contech
- Biofiltration Basics
- Filterra Overview
- Design Considerations
- Longevity Considerations

Conventional Bioretention

- Typical Bioretention Media flow = <20 in/hr
- 5-20% of contributing impervious drainage area
- Individual components designed by engineer and sourced by contractor:
  - Mulch
  - Soil
  - Stone
  - Underdrain Piping
  - Plants
- Installation by contractor
- Maintenance by landscape crew

Traditional Bioretention
Courtesy: NCDEQ Stormwater BMP Manual

How is Filterra different?

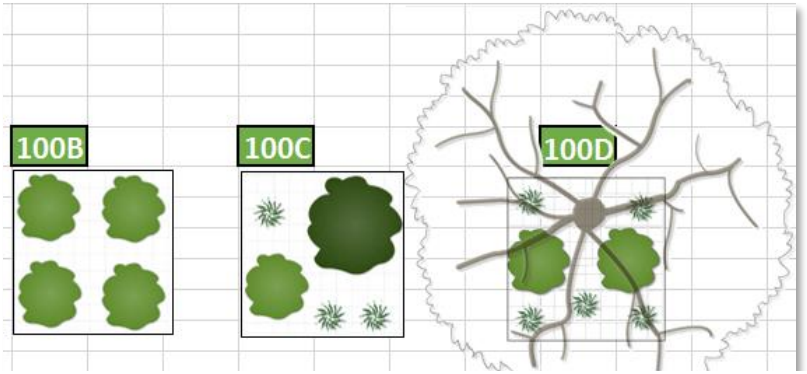
- High flow rate = reduced footprint
- High long term pollutant removals
  - Verified testing
  - Rigorous QA/QC processes
- Packaged design
  - Quality control
  - Easy installation
  - Easy maintenance

Filterra Offline (with sidewalk inlet flume)
Buena Vita - Pierce County, WA

BMP Specific Considerations

- Sizing & Shape
  - Minimum size / width
  - Drainage area considerations
  - Side slopes
- Hydraulic Design
  - Bypass, flow routing and distribution
  - Energy dissipation
- Pretreatment recommended for systems >300 sf
- Vegetation
  - Species selection, count & spacing

Filterra Bioscape
(Point Defiance Regional Treatment Retrofit – Tacoma, WA)



Filterra Bioscape Plant Calculator

Filterra Site Selection

- Sites that want green infrastructure without the room to accommodate it
  - Sizes are typically less than 1% of the drainage area
- Areas with poor soils for infiltration
- Urbanized areas that need decentralized treatment
  - Ideal for urban retrofit and treatment at the surface
- Sites with difficult maintenance access
  - No special equipment or access required

Filterra Internal Bypass Pipe
Well 27 - Orange, CA

Media Selection

Biofiltration media specs vary widely

- Too much or unstable organic matter leads to leaching
- Clogging can result in anoxic condition
- Lack of quality control can lead to improper media blend

You mean it's not all just dirt?

What does the data say?

Table 4-3. Influent/Effluent Summary Statistics for Total Phosphorus as P (mg/L).

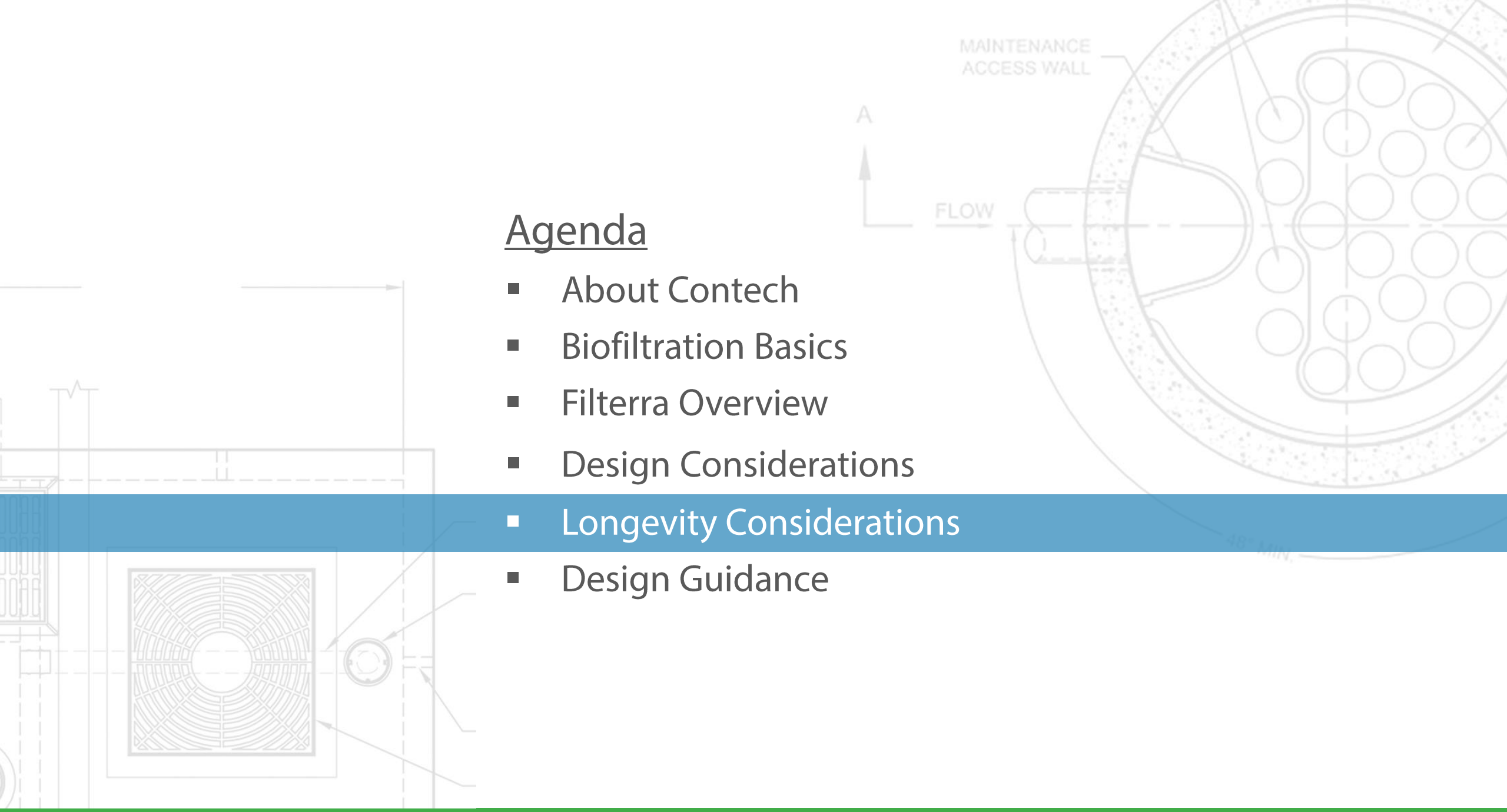
BMP Category	Study & Sample Count (% ND)		Interquartile Range (25th – 75th %tiles)		Median (95% Conf. Interval)*		In vs Out**
	In	Out	In	Out	In	Out	
Detention Basin	43; 542 (1.5%)	44; 577 (1.7%)	0.138 - 0.428	0.107 - 0.320	0.250 (0.216; 0.262)	0.186 (0.170; 0.200)	▼▼▼
Retention Pond	71; 1161 (0.9%)	75; 1138 (2.0%)	0.0996 - 0.542	0.0500 - 0.263	0.246 (0.220; 0.268)	0.120 (0.104; 0.129)	▼▼▼
Wetland Basin	27; 690 (0.3%)	27; 647 (1.4%)	0.106 - 0.319	0.0660 - 0.222	0.170 (0.151; 0.177)	0.122 (0.108; 0.133)	▼▼▼
Wetland Channel	15; 256 (0.4%)	13; 214 (0.0%)	0.129 - 0.372	0.120 - 0.338	0.201 (0.179; 0.230)	0.184 (0.160; 0.207)	◇◇▼
Grass Swale	34; 574 (0.3%)	39; 671 (0.3%)	0.0700 - 0.270	0.104 - 0.300	0.129 (0.118; 0.140)	0.180 (0.165; 0.190)	△△△
Grass Strip	50; 893 (8.2%)	50; 666 (3.2%)	0.0800 - 0.300	0.120 - 0.460	0.185 (0.160; 0.190)	0.230 (0.206; 0.240)	△△△
Bioretention	47; 850 (4.8%)	44; 667 (3.1%)	0.0800 - 0.460	0.0900 - 0.553	0.190 (0.170; 0.210)	0.240 (0.190; 0.270)	◇△△
Media Filter	32; 494 (1.4%)	35; 525 (5.1%)	0.0900 - 0.285	0.0490 - 0.147	0.165 (0.150; 0.180)	0.0900 (0.0800; 0.0973)	▼▼▼
HRBF	6; 100 (0.0%)	6; 100 (8.0%)	0.0640 - 0.157	0.0377 0.0848	0.0990 (0.0854; 0.112)	0.0500 (0.0409; 0.0600)	▼▼▼
HRMF	19; 349 (1.7%)	19; 351 (3.1%)	0.0680 - 0.500	0.0496 - 0.277	0.120 (0.100; 0.130)	0.0800 (0.0703; 0.0900)	▼▼▼

Source: International BMP Database 2020 Performance Summaries

Another Common Concern: Media Occlusion

The Value of Engineered Biofiltration Media

- Optimized media yields higher hydraulic loading rate
  - Smaller footprint
- Robust long term testing is essential
  - Proven Performance (TAPE, NJDEP)
  - Must also consider longevity
- Rigorous Media QA/QC Essential
  - Consistent media every time
  - Eliminate risk of construction issues



Agenda

- About Contech
- Biofiltration Basics
- Filterra Overview
- Design Considerations
- Longevity Considerations
- Design Guidance

Maintenance Intervals

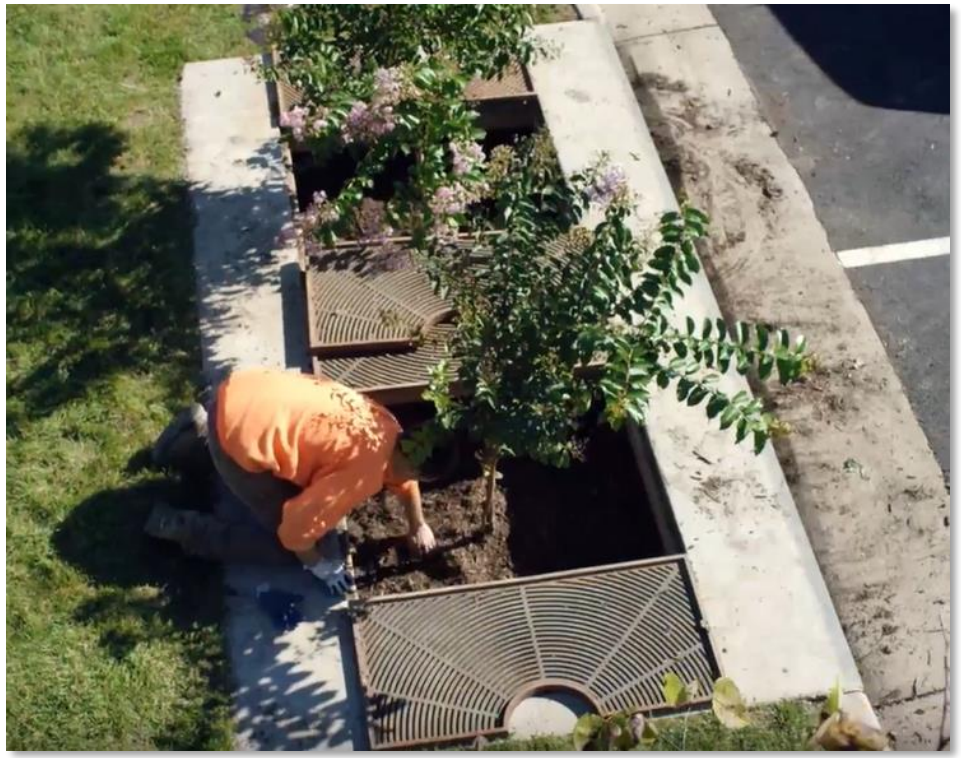
Can vary based on type of practice installed and what the data recommends

- All stormwater control measures / BMPs should be inspected regularly and maintained accordingly
- Most require some form of maintenance annually
- Bioretention/ biofiltration practices require more frequent maintenance when captured pollutants are visible
- Filterra maintenance is recommended biannually

Aesthetic Issues Driving Maintenance

Maintenance Procedures

- First year maintenance included
- Remove trash/ replace mulch twice a year
- Easy access – no confined space
- No specialized equipment
  - Step 1: Open grate & inspect
  - Step 2: Remove mulch & trash
  - Step 3: Add new mulch
  - Step 4: Sweep & replace grate



Filterra Offline
5th Street Station – Scottsville, VA

About 1/2 Hour Per Visit Per Plant

(Excluding Travel)

Top 5 take-aways

1. Consider your site constraints (size, hydraulics, infiltrative capacity)
2. Consider your pollutant reduction goals (TSS, nutrients)
3. Evaluate your media blend and component sources
4. Consider installation impacts on long term performance
5. Establish maintenance plans

Kerry Symanski
Stormwater Consultant – N. IL, WI

Kerry.Symanski@ContechES.com
(312) 805-4346

Chris Allen
Regional Regulatory Manager

Chris.Allen@ContechES.com
(614) 531-9420

Thank you!

Questions?