



Key Considerations for Choosing Underground Detention and Manufactured Water Quality Solutions

2018 KSA Conference

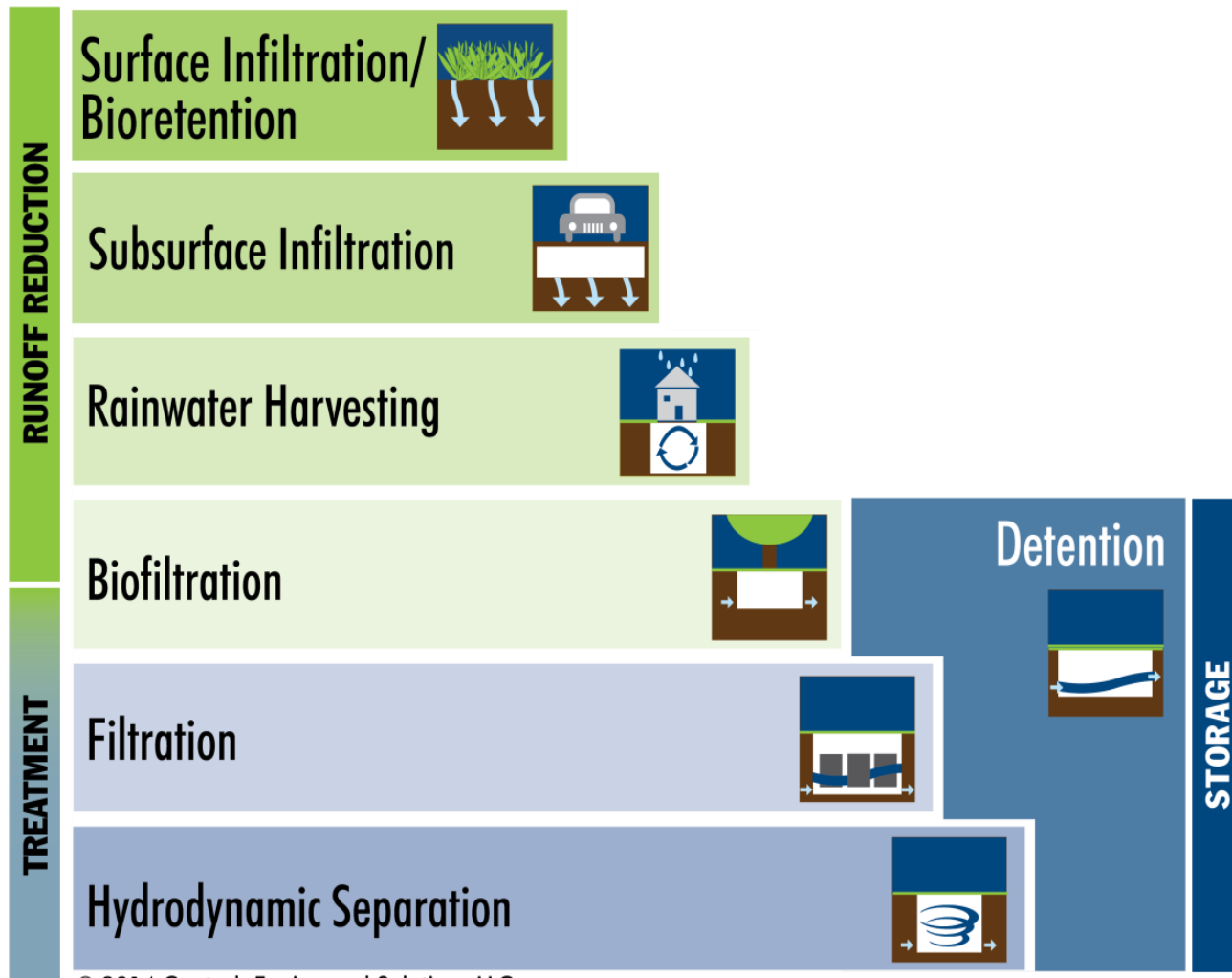
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Agenda

- **Underground Detention Solutions**
 - Cost-Effectiveness
 - Site considerations
 - Maintenance
- **Hydrodynamic Separation (HDS)**
 - Site considerations
 - Maintenance
 - Case study
- **Filtration**
 - Proper sizing
 - Site considerations
 - Maintenance
 - Case studies

Stormwater Solutions Staircase



Detention & Subsurface Infiltration



CMP



Plastic

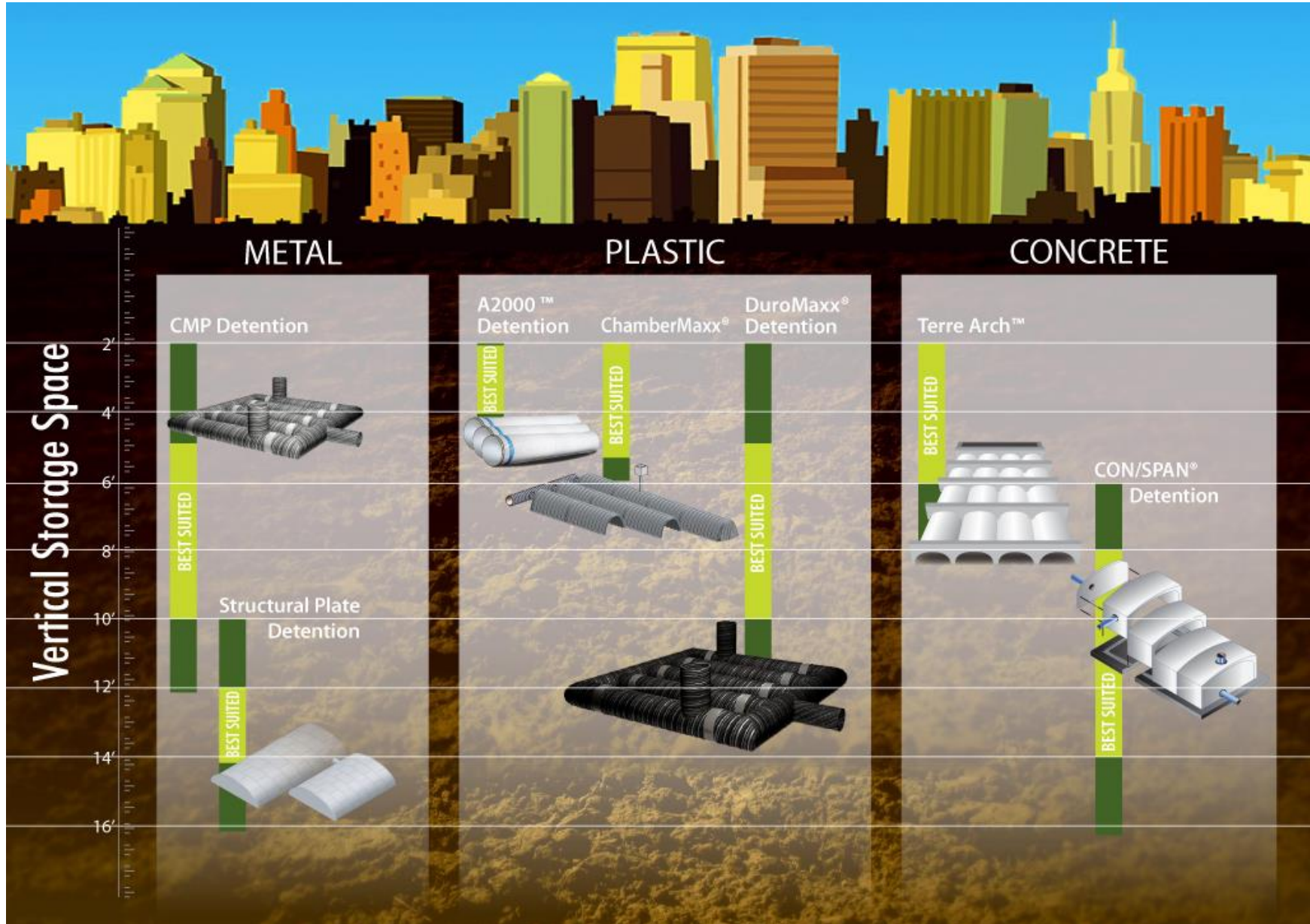


Concrete

Key Considerations

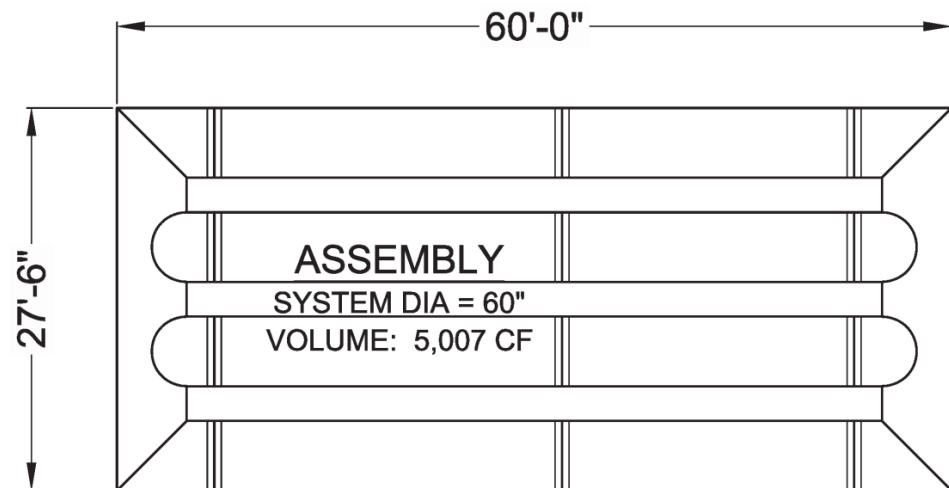
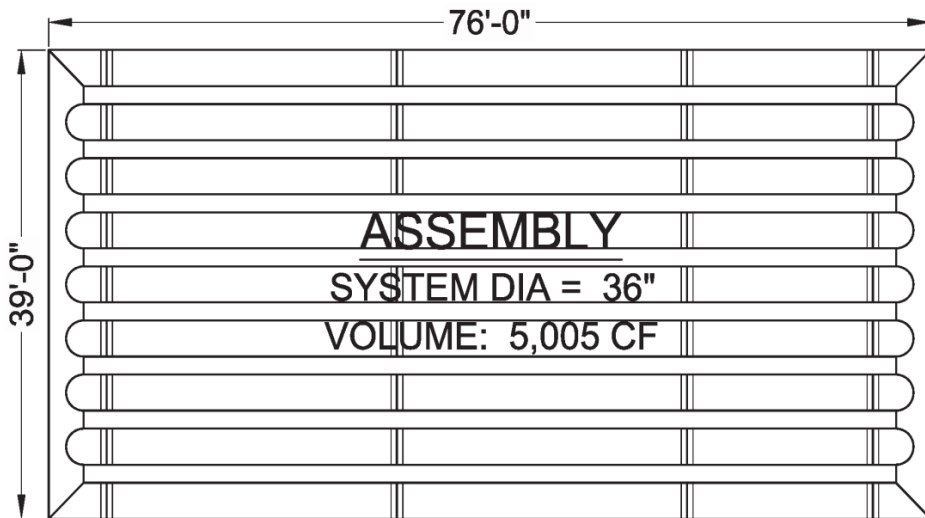
- Effective depth
- Limiting widths/lengths
- Infiltration opportunities /
Minimizing footprint
- Maintenance



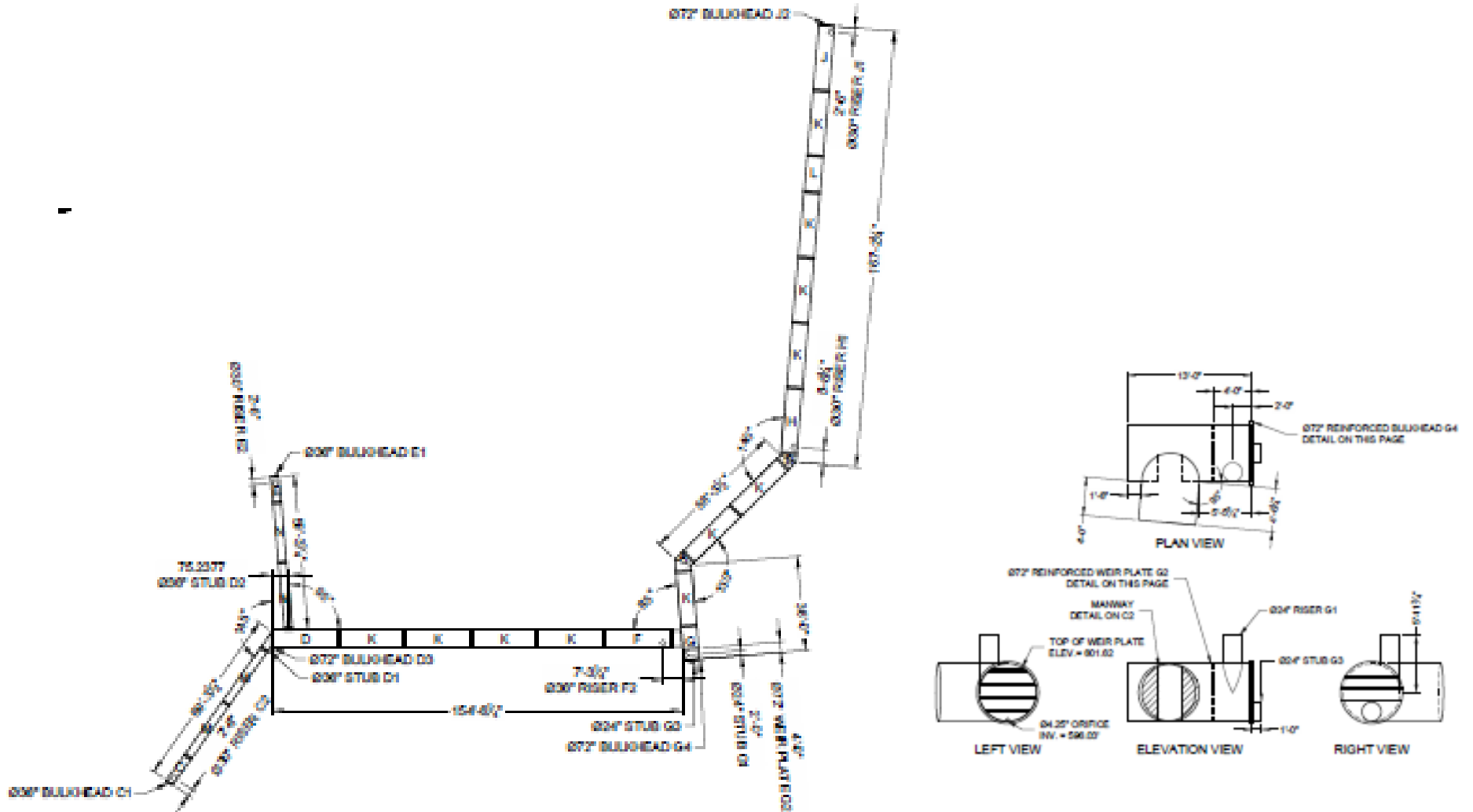


Maximizing Depth

- Factors that save cost
 - Maximizing Depth
 - Minimizing excavation / footprint of the system



In-line Detention



Open Systems: Using Stone for Storage

- Utilize void space of the stone backfill to store water
- Generally accepted: 40% void space
 - Some municipalities are decreasing allowable void space
 - Some requiring additional volume for sediment storage

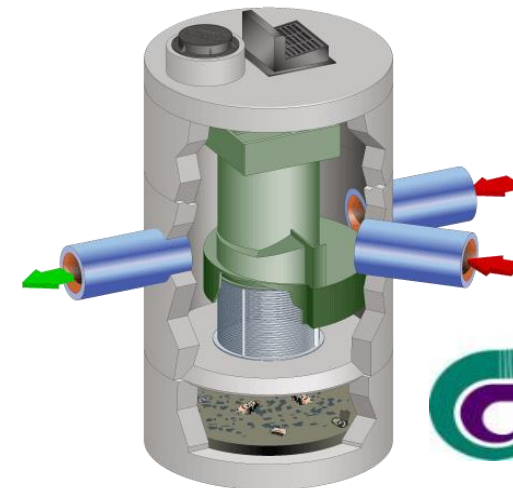
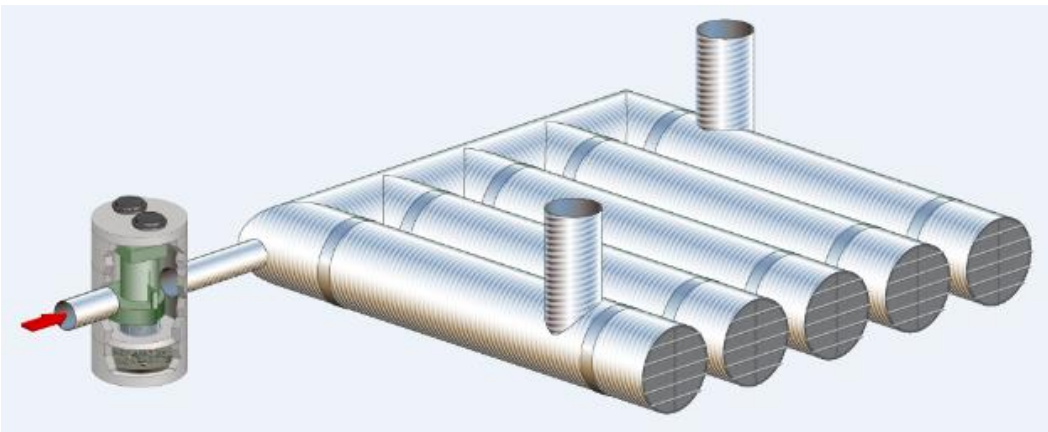
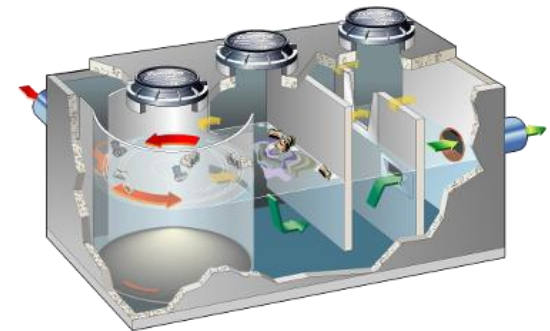


Open Systems: Using Stone for Storage

	Reading High School		Winchester Pike	
	<ul style="list-style-type: none"> • 19,000 cf • 42" CMP 		<ul style="list-style-type: none"> • 34,850 cf • 48" CMP 	
	Perforated	Solid	Perforated	Solid
Material Cost	\$68,000	\$81,500	\$92,800	\$125,000
System Footprint	170' x 35'	195' x 51'	437' x 21'	553' x 26'

Pretreatment

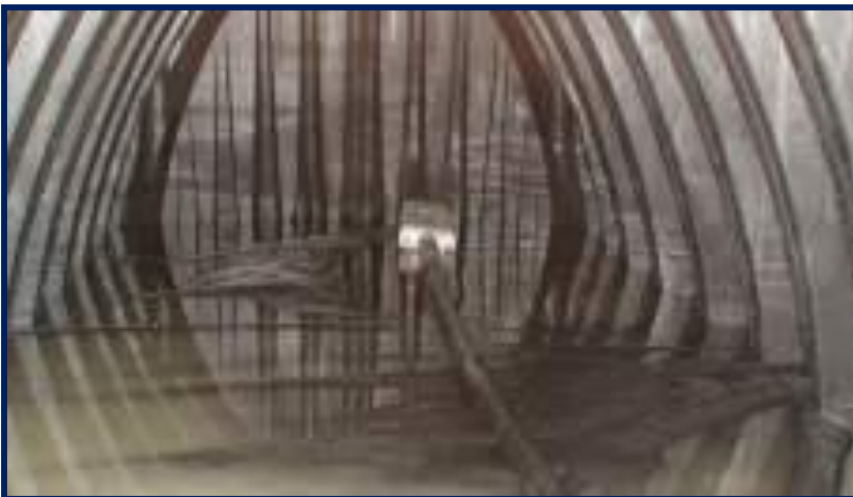
- Protects outlet control structures
- Remove sediment prior to entering system
- Consolidate sediment in one location
 - Water Quality Structures are easier to maintain
- Maintain stone voids in perforated system
- Increase service life of system
- Meet local regulations



Inspection & Maintenance

- Address during design
- Inspection Protocol
 - How will the system be visually inspected?
 - Are ample access points provided?
 - Can someone physically access the system if needed?
 - Inspection frequency – quarterly, semi-annual, annually
- Maintenance
 - Determine appropriate maintenance frequency based on inspections
 - Determine appropriate maintenance methods

Inspection & Maintenance



Case Study: Churchill Downs, Louisville, KY

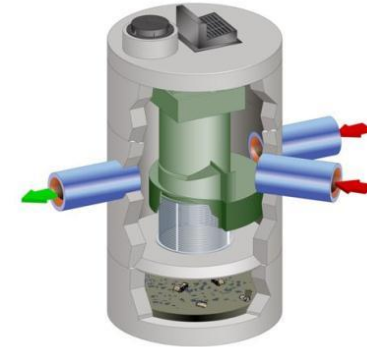
Project Features:

- 96” diameter perforated CMP retention system
- Provided water quality and quantity control
- Included additional volume for partial flood mitigation in surrounding areas
- HDS units sized to 50% TSS removal as pretreatment



So Many Choices...

	Hydrodynamic Separation	Filtration
Pollutants of Concern	TSS	TSS, Nutrients, Metals
Targeted Particle Size Distribution	> 50 micron	< 50 micron
Recognized Testing Protocol	<ul style="list-style-type: none"> • Lab Testing: NJDEP • Field Testing: TARP Tier II 	<ul style="list-style-type: none"> • Lab Testing: NJDEP • Field Testing: TAPE or TARP Tier II
Placement Relative to Detention	<ul style="list-style-type: none"> • Upstream for effective performance 	<ul style="list-style-type: none"> • Upstream or downstream



Hydrodynamic Separator Fundamentals

..... Organize inflow energy & turbulence into a
stable flow pattern



Swirl Concentration



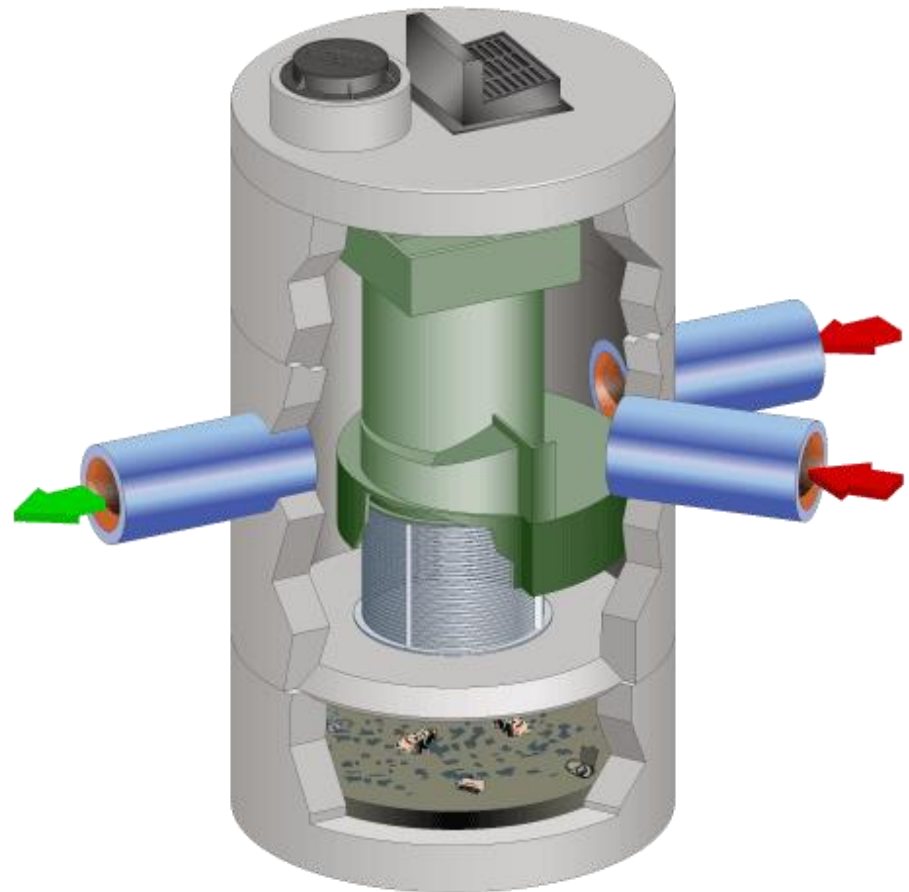
Gravity Separation



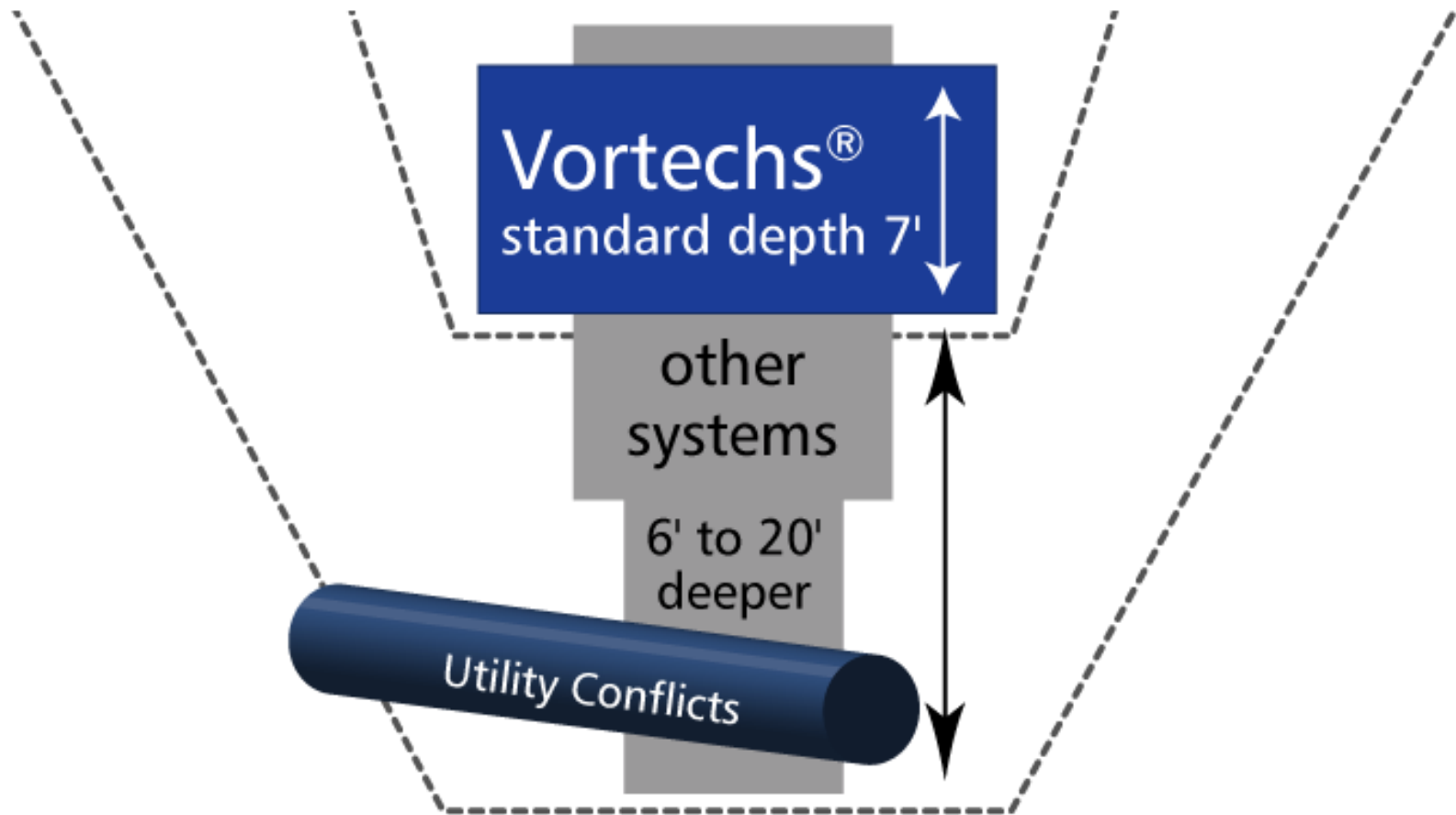
Flow Controls

Site Considerations for Selection – Footprint & Other POCs

- Additional features in some HDS devices:
 - Junction Structure
 - Catch Basin
 - Hydrocarbons, FOGs
 - Trash/Neutrally Buoyant Materials

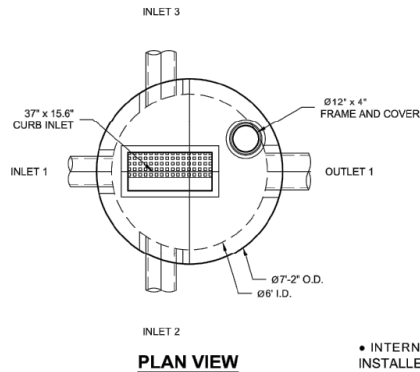


Site Considerations for Selection - Depth

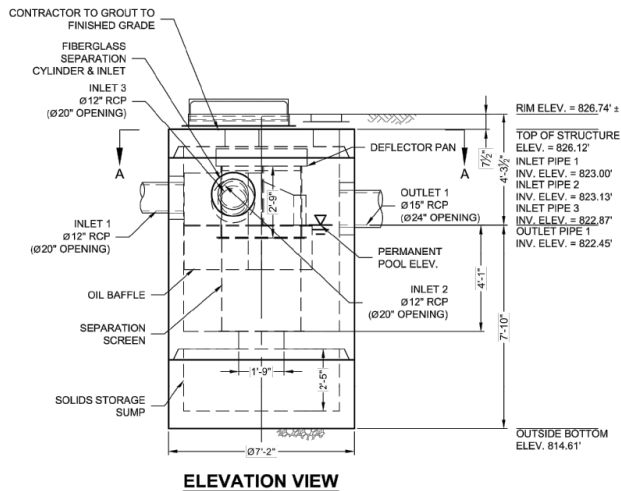


Layout: Online vs. Offline Positioning

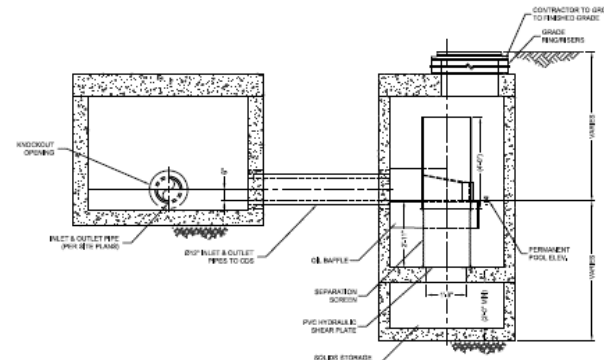
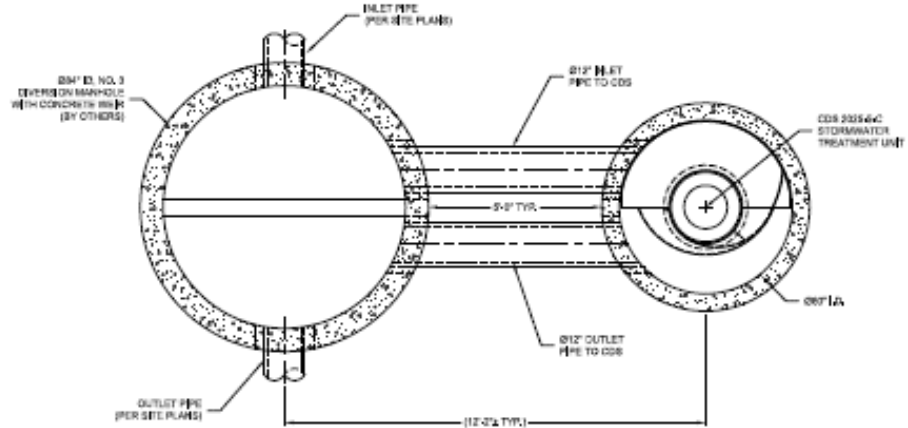
Online configuration



• INTERNAL COMPONENTS TO B INSTALLED BY CONTECH ON SIT

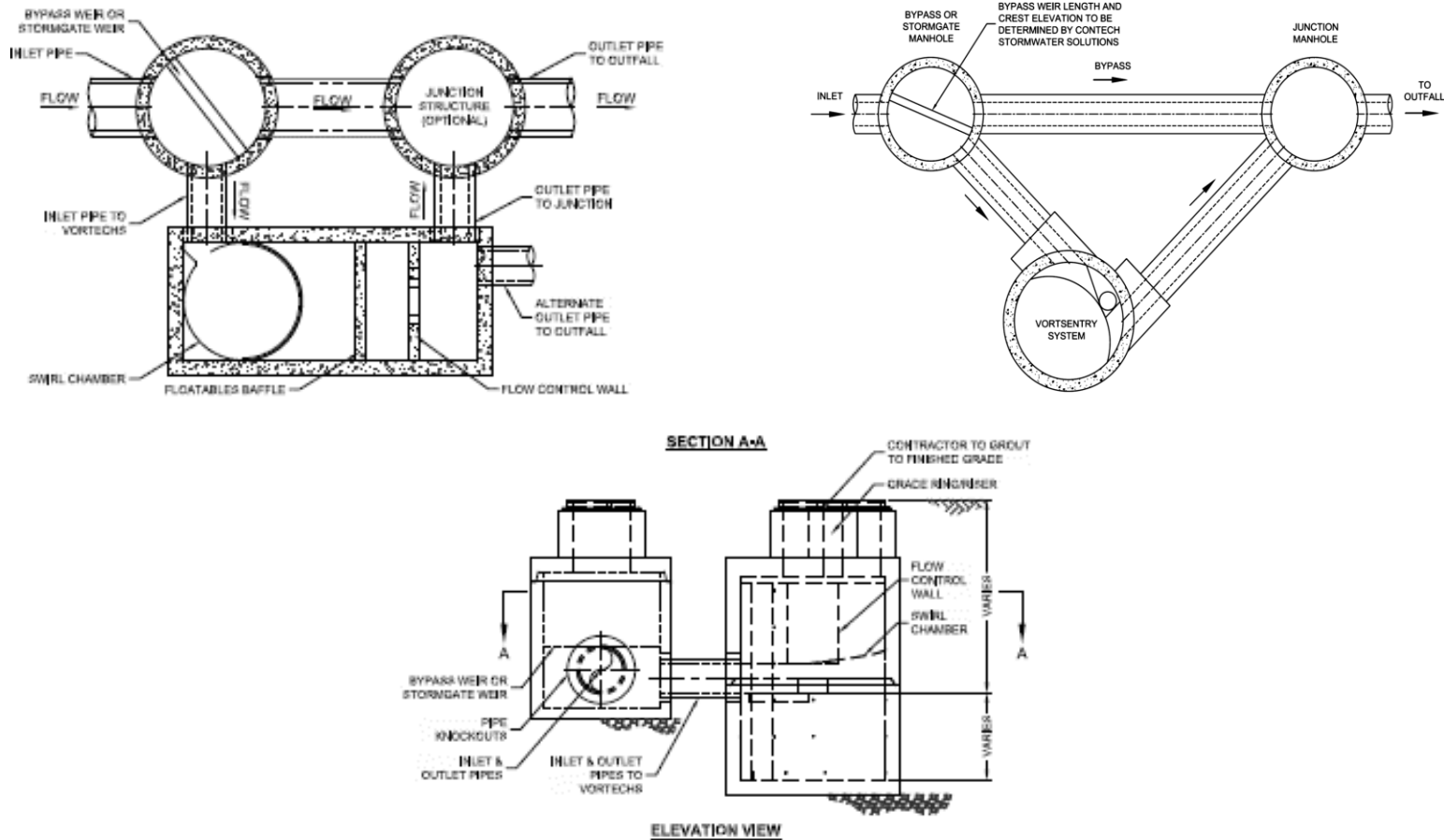


Offline configuration – Single Diversion/Junction Structure



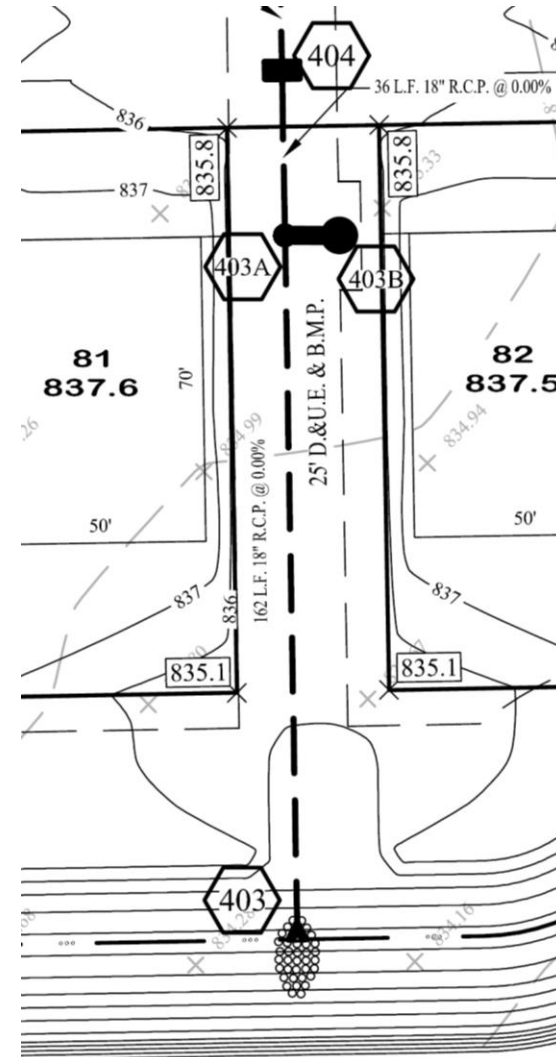
Layout: Alternate Offline Positioning

Offline configuration – Separate Diversion and Junction Structures



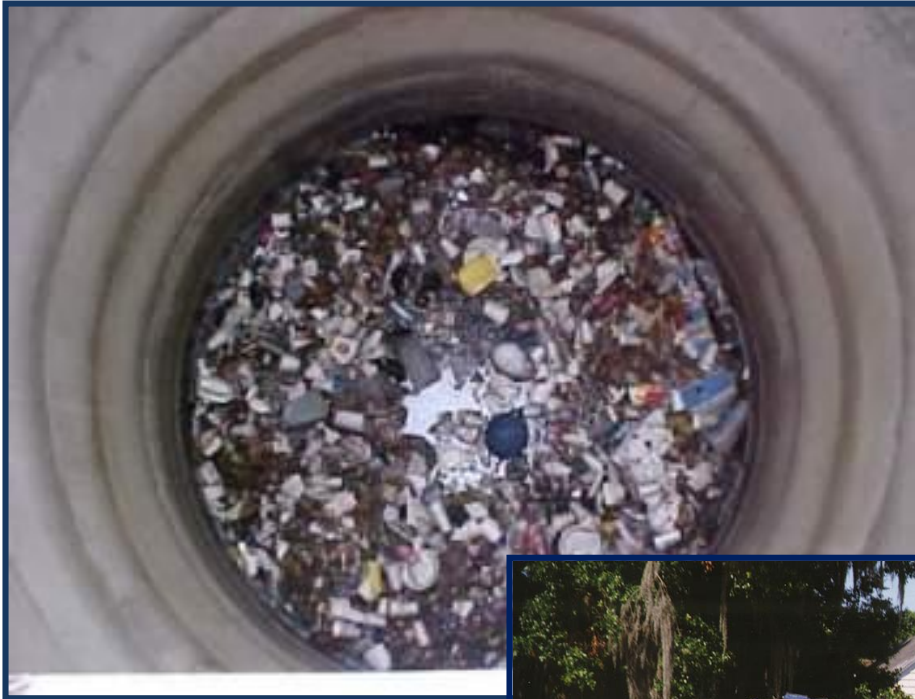
Layout – Access and Easements

- Many communities require easements
 - Dimensions vary
 - May be linear or square
 - Units may be required to be within a given distance from the edge of pavement



Inspection & Maintenance: HDS

Start



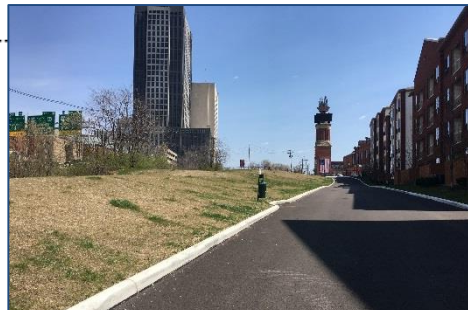
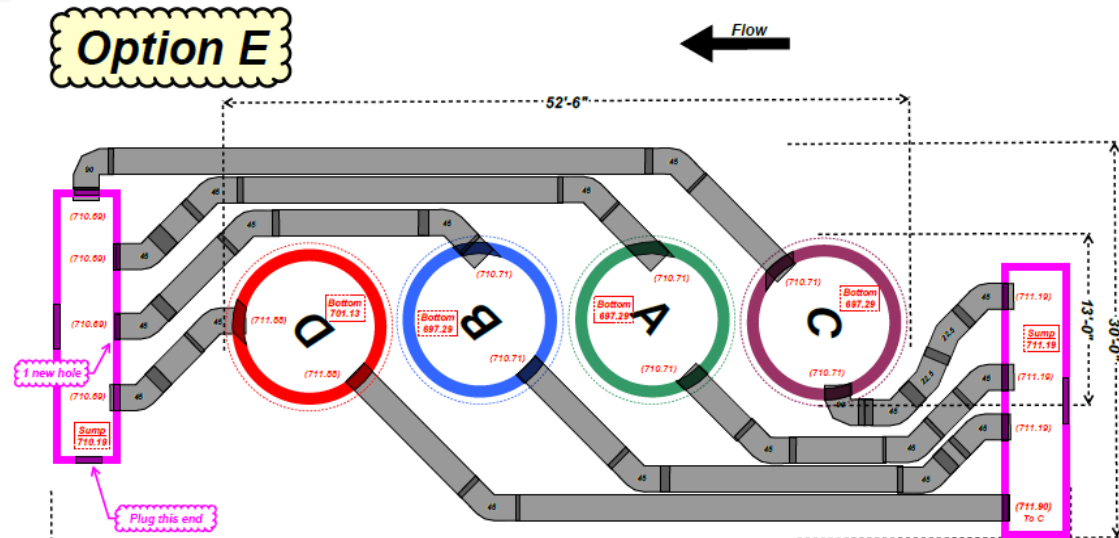
Finish



Case Study: ODOT I-71/70 Interchange

Project Features:

- 4 – 10ft diameter CDS units
- Provided water quality for 75 cfs
- HDS units sized to ODOT QPL – OK110 particle size distribution
- Footprint and site utilities were major constraints



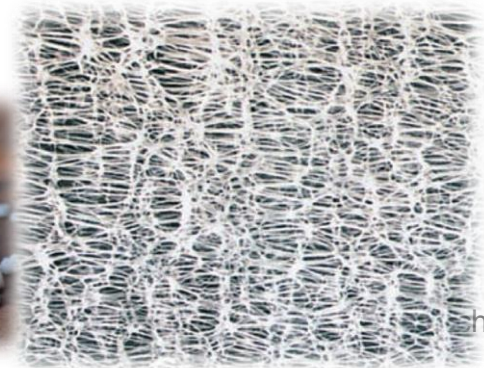
Filtration Fundamentals

Filter Capabilities

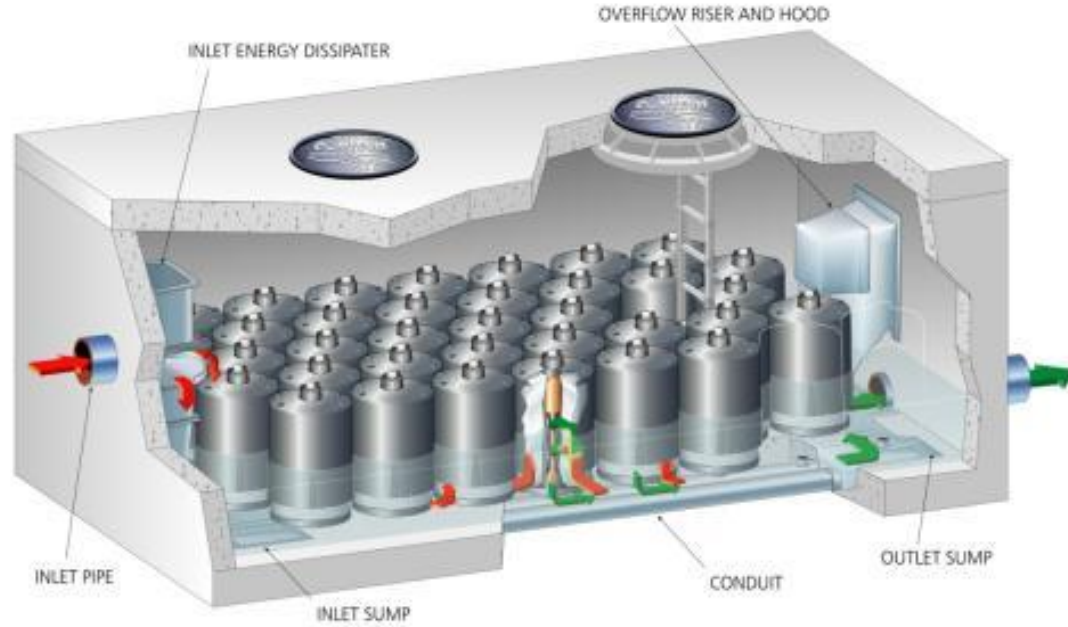
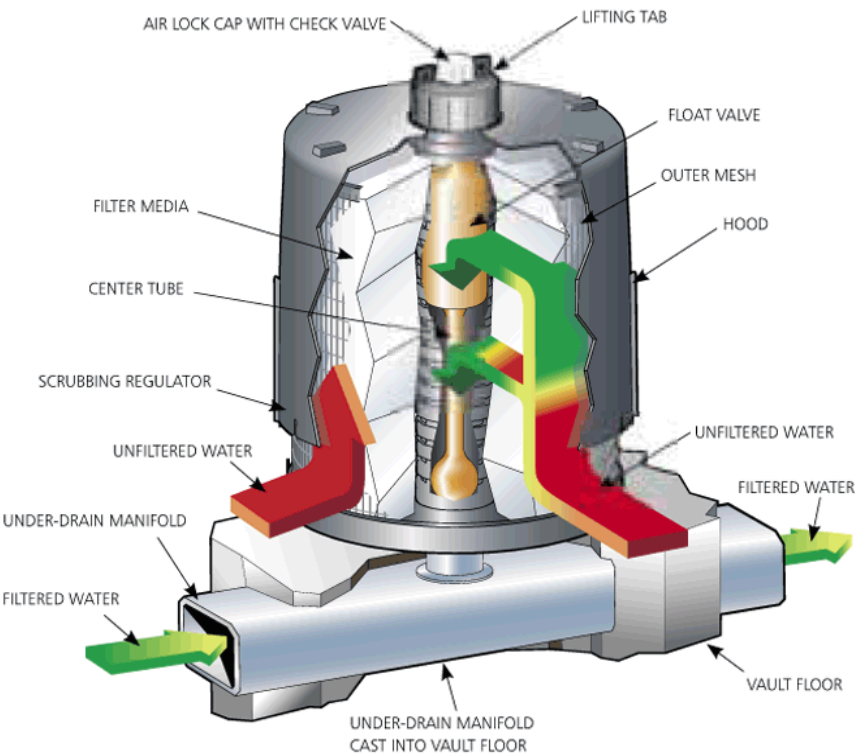
- Fine particle removal (<50 microns)
- Dissolved pollutant removal
- Customizable media to target specific pollutants

Typical Filter Applications

- Standalone Treatment
 - New Development
 - Redevelopment
- LID Pretreatment
 - Subsurface Infiltration
 - Rainwater Harvesting
- Polishing Treatment
 - Downstream of Detention



Innovative Media Filtration



Innovative Membrane Filtration



Evolution of Filter Technology
Maximum Surface Area in
Compact System



Pleated Membrane Filter

Jellyfish Filter

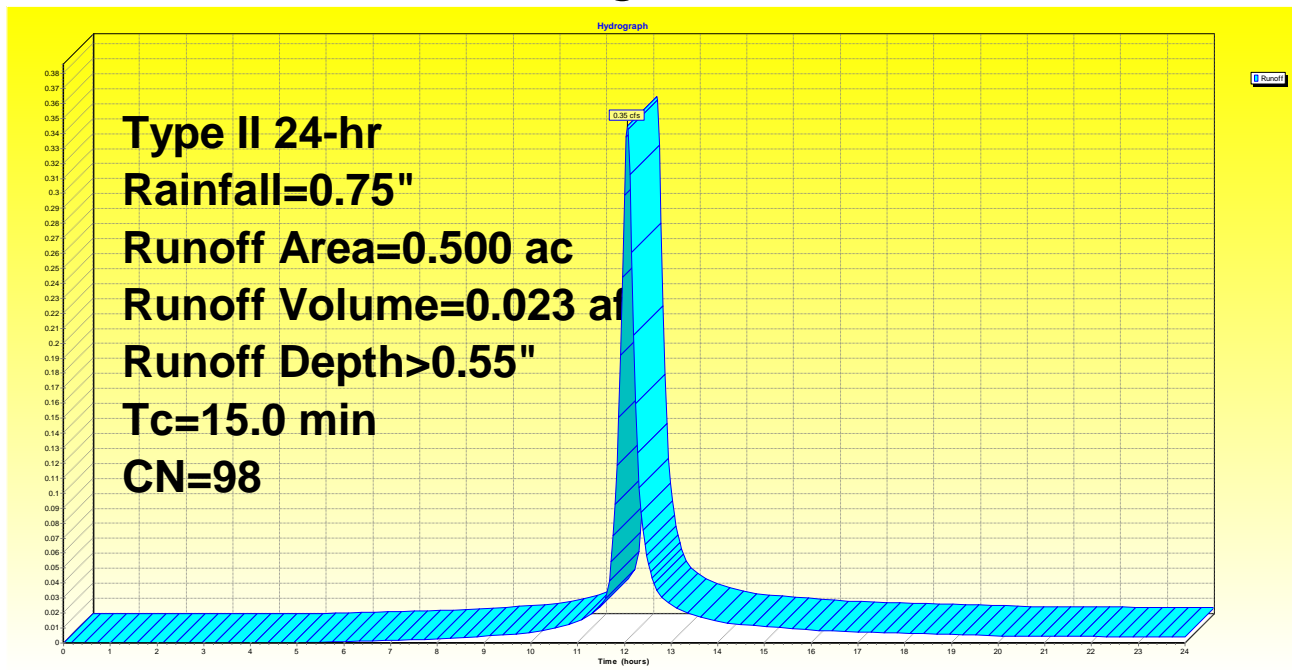
Basic Filter Properties

- Peak flow conveyance (ex: 0.05 cfs)
- Pollutant capacity prior to maintenance (ex. 54 lbs)
- Headloss and driving head required for filter to flow at published flow rate



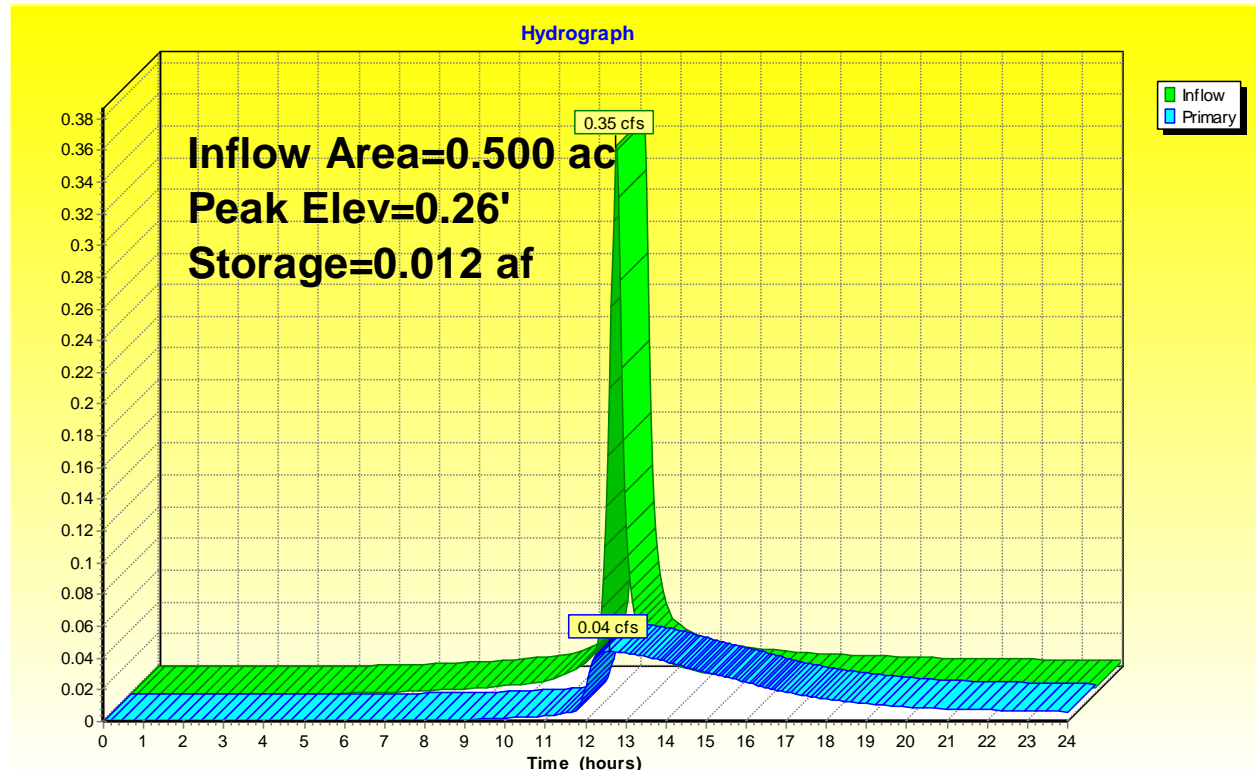
Flow Based Filtration

- Example:
 - Drainage Area: 0.5 acres
 - WQ Flow: 0.36 cfs
- Use: 8 StormFilter cartridges to treat 0.36 cfs



Volume Based Filter Sizing

- Post detention flow rate 0.04 cfs
 - Still treating the same runoff volume at a lower flow rate.
- Use: 1 StormFilter cartridge to treat 0.04 cfs

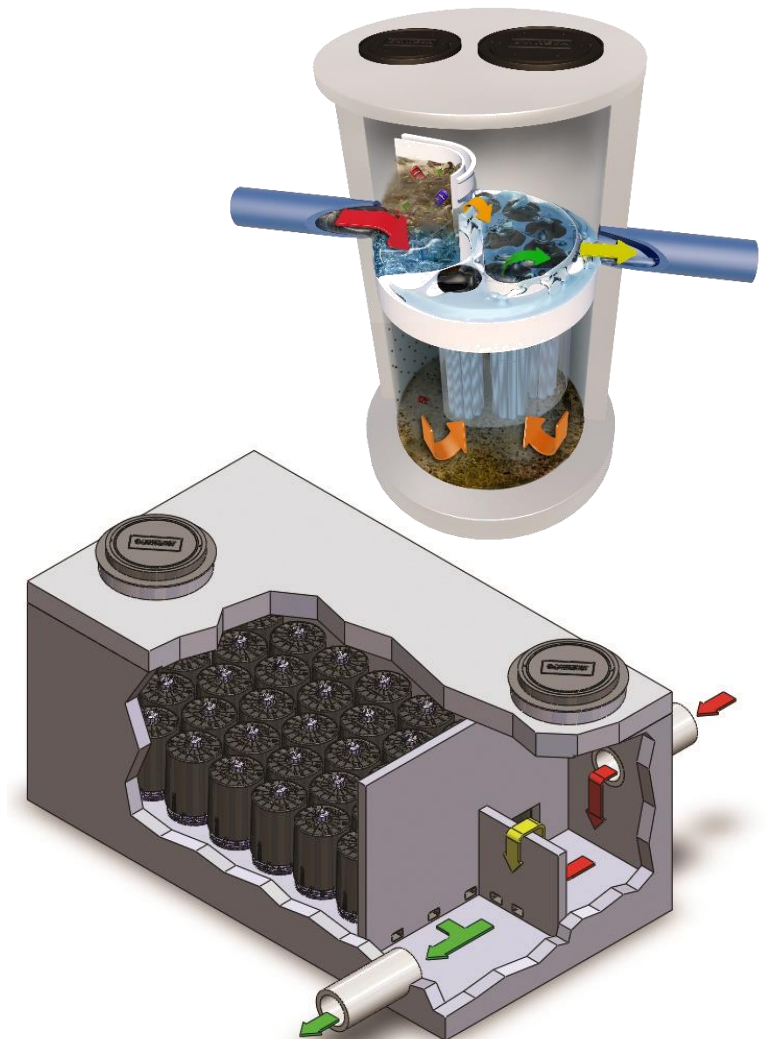
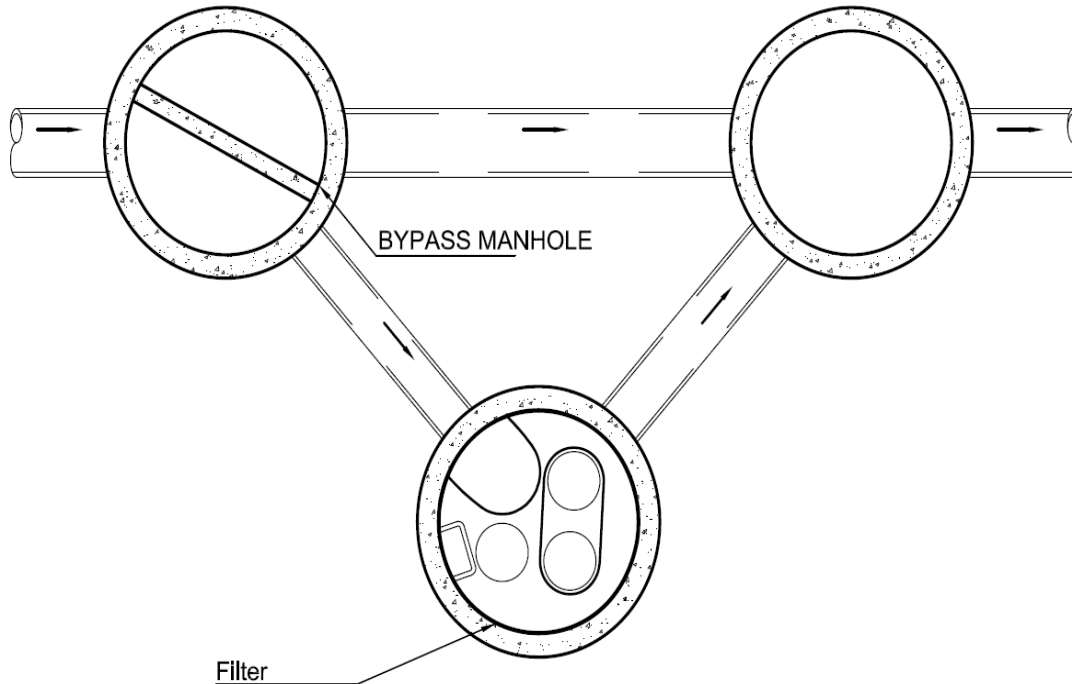


Mass Based Filter Sizing

- Same Site (0.5 acres)
 - 36 inches of rain annually (assumed)
 - Event mean concentration of pollutants (70 mg/l)
- 36" over 0.5 acres → 65,340 cf of water annually
- 65,340 cf of water with a pollutant concentration of 70 mg/l
→ 285 lbs of pollutants annually
- $\frac{285 \text{ lbs}}{54 \text{ lbs/cartridge}} \rightarrow 6$ StormFilter cartridges

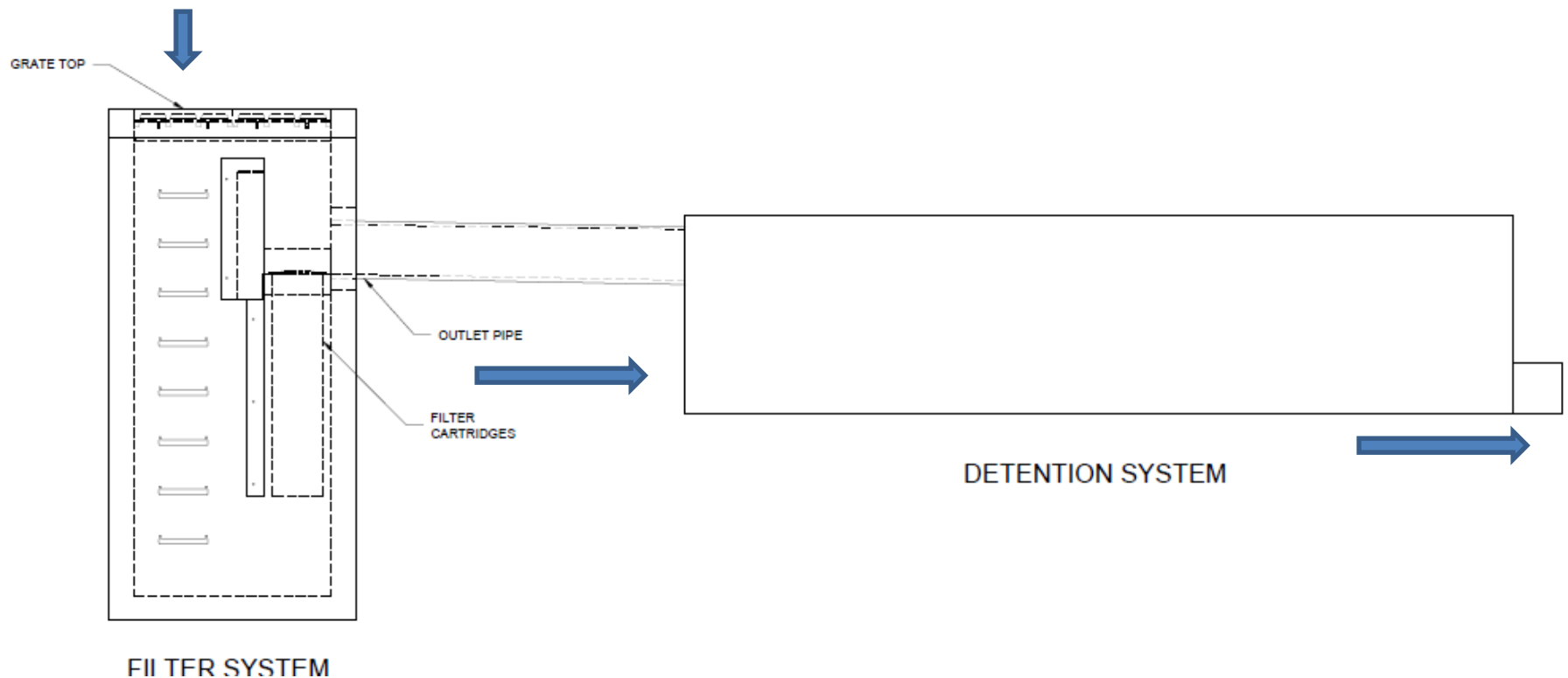
Filter Layouts

- Online/ Offline



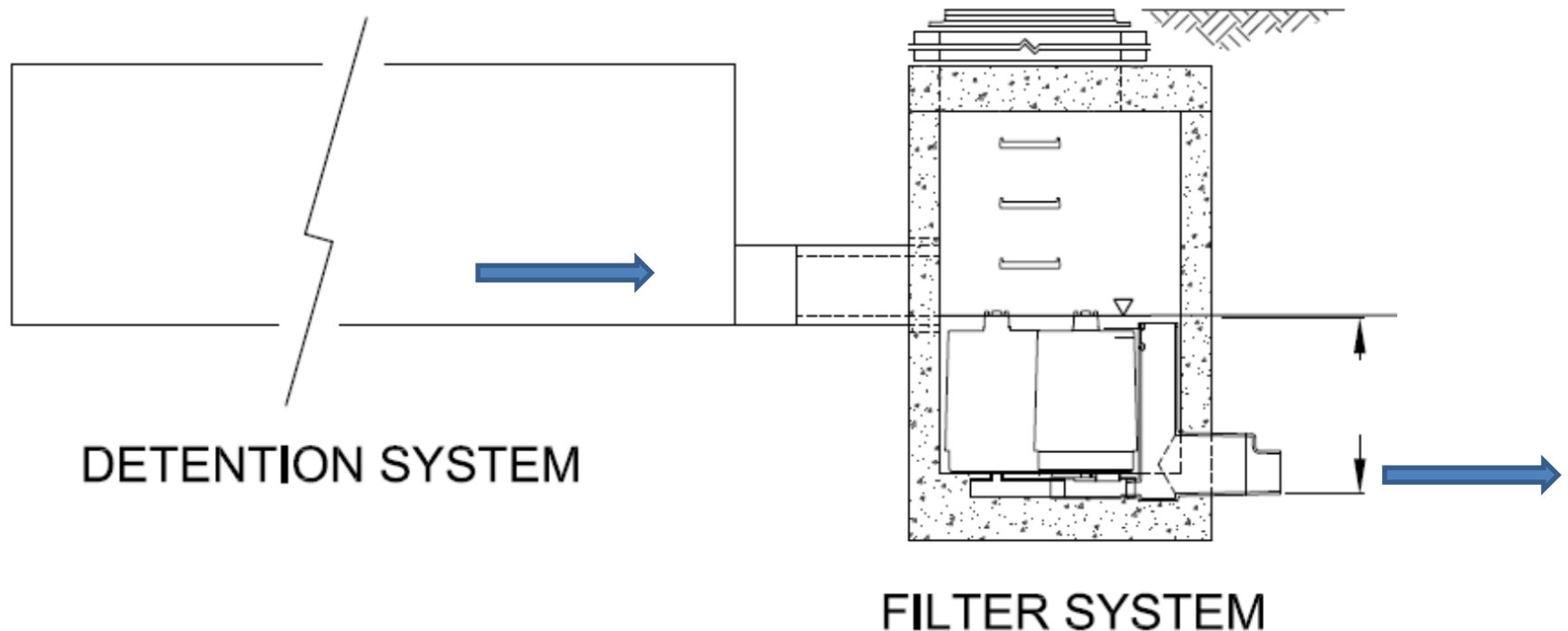
Filter Layouts

- Upstream of Detention
 - Pretreatment
 - Flow based



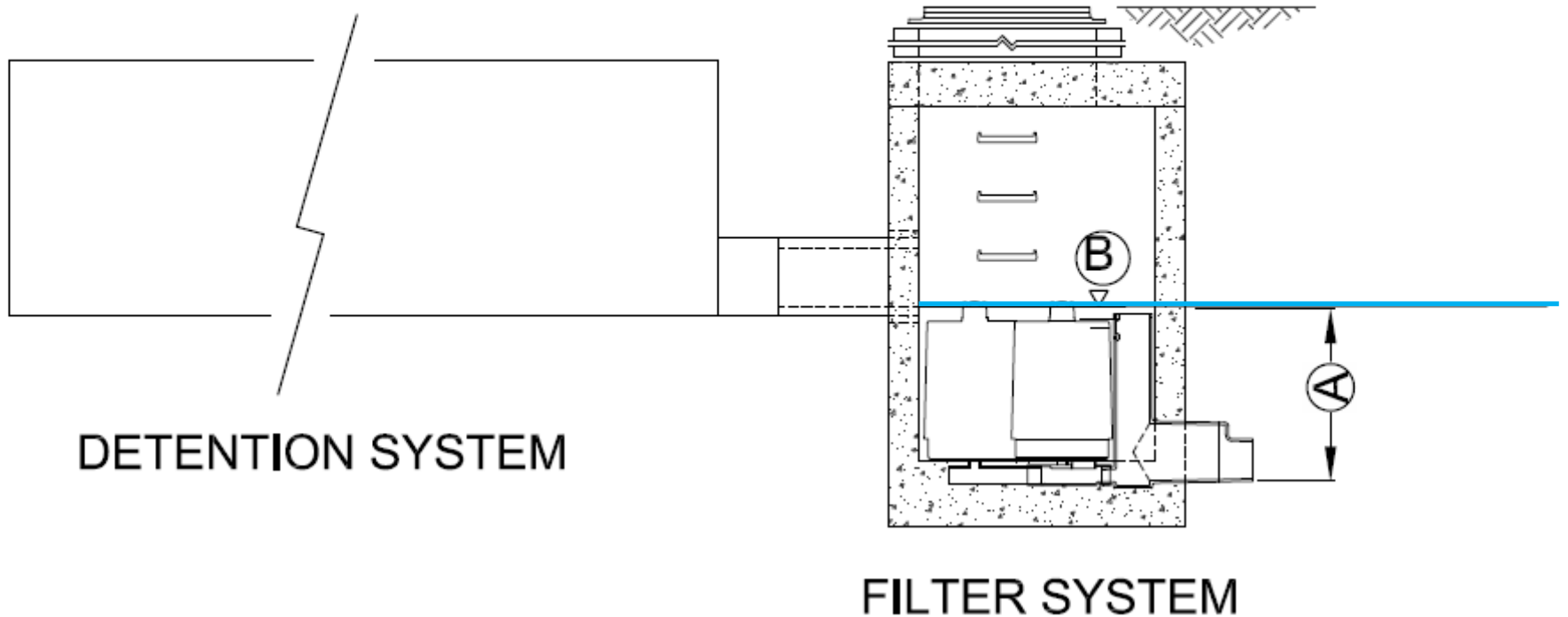
Filter Layouts

- Downstream of Detention
 - Decreased flow rate
 - Volume/Mass based sizing
- Consider headloss associated with Filter



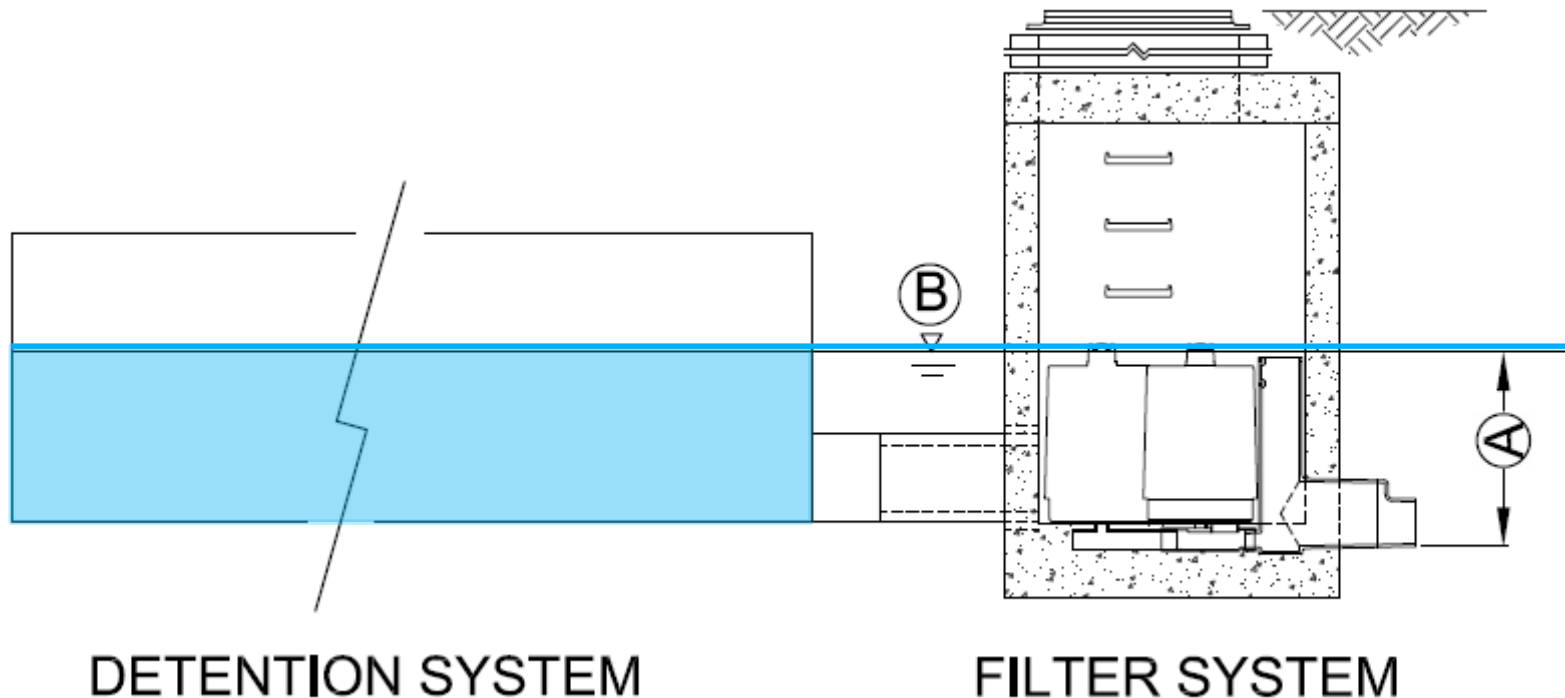
Filter Layout Downstream of Detention

- A) Head required for filter to operate at published flow rate
- B) Water surface elevation during water quality storm



Filter Layout Downstream of Detention

- A) Head required for filter to operate at published flow rate
- B) Water surface elevation during water quality storm



Filter Maintenance

- All filters will clog eventually!
- Things to consider:
 - Is the filter system easily accessible with a vac-truck?
 - Is there direct access to filter trough top slab openings?
 - Are the filter components easily replaceable without excavation of entire system.

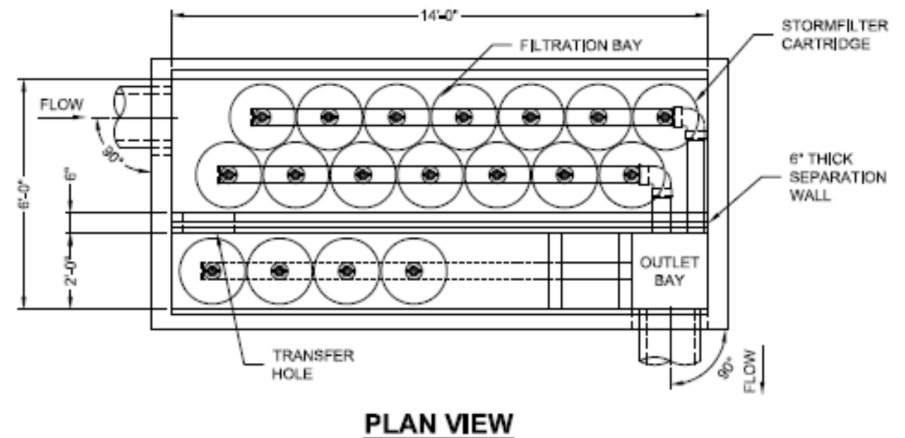


Filtration Maintenance

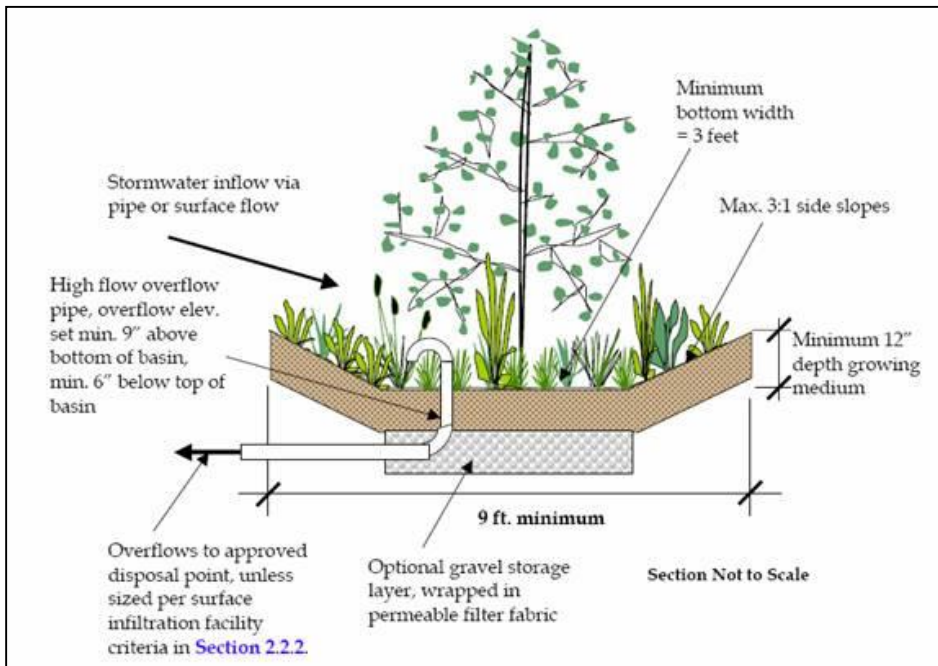


Case Study: Alliance Hospitality Cleveland, OH

- Project Requirements
 - Treat 0.75" first flush storm
 - Meet OEPA standards
 - Work around depth and footprint constrictions
- Solution
 - Shallow StormFilter vault design with internal bypass
 - Grated top to eliminate upstream catch basin
 - (18) 18" tall cartridges



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

High Performance Biofiltration

- High Flow Media
 - Same principles as traditional biofiltration
 - 100+ inches/hr flowrate
 - Reduced footprint – typically 1% of tributary drainage area
 - Quality control of media composition

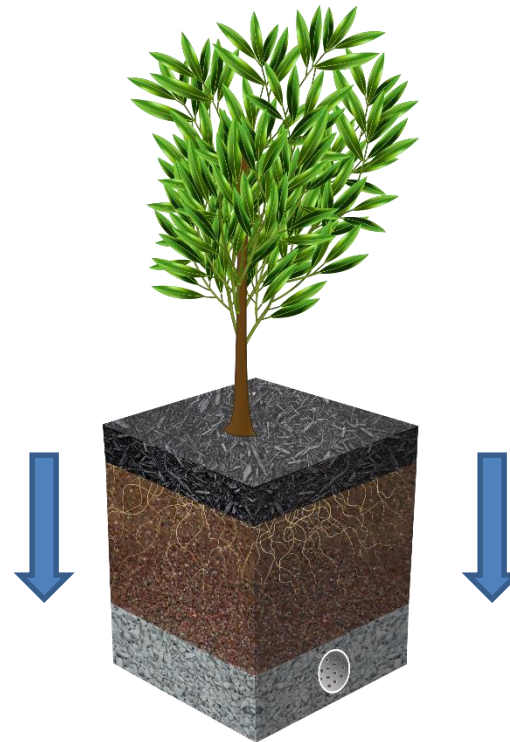


Bioretention Sizing

- FSA: DA (Filter Surface Area : Drainage Area)
 - Volume based sizing
 - Example: 0.463%



- Flow Based
 - Example: 140 in/hr



Bioretention Configuration

- Traditional



Bioretention Configuration

- Filterra BioScape



- Offline Filterra



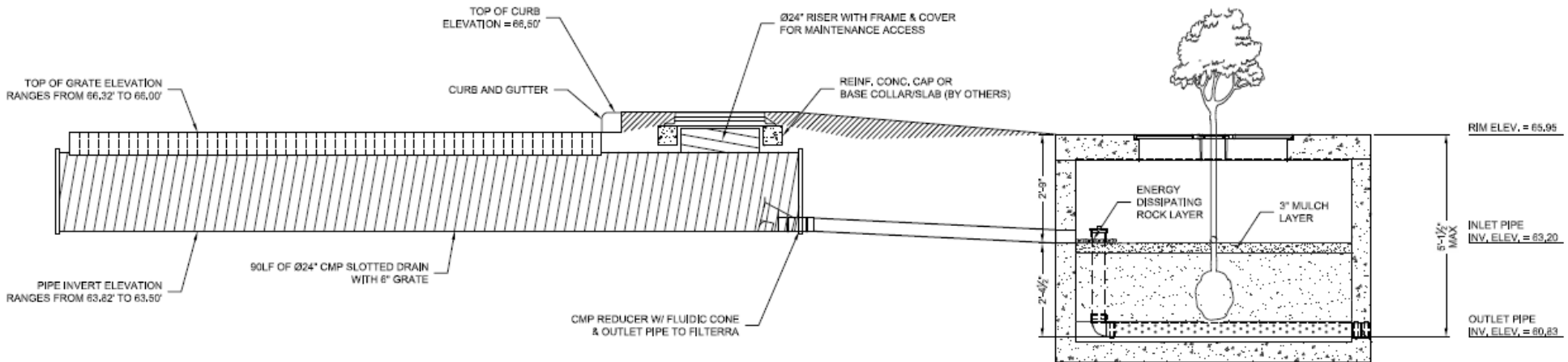
Bioretention Configuration

- Pretreatment



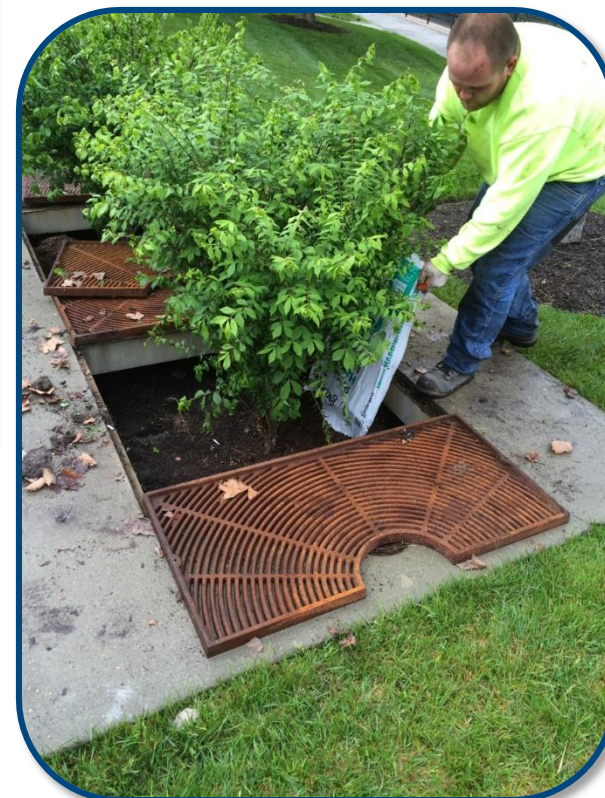
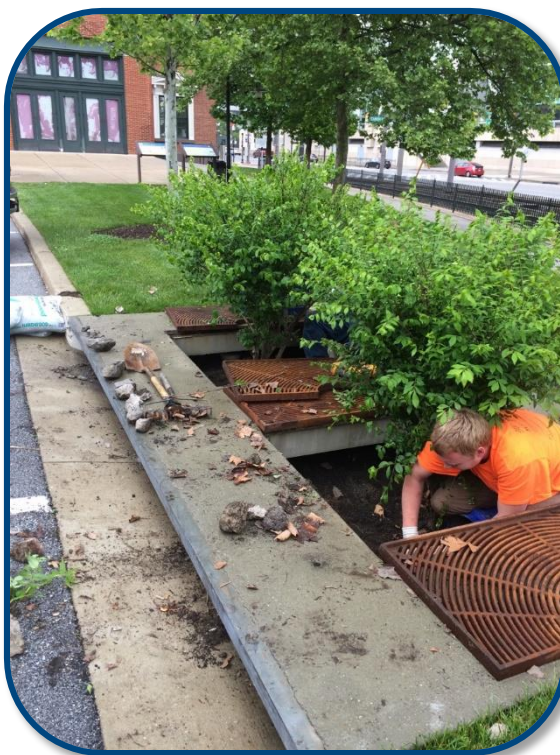
Bioretention Configuration

- Downstream of slotted drain / detention pipe



Maintenance

- Remove Tree Grate
- Remove debris, trash & mulch
- Replace mulch



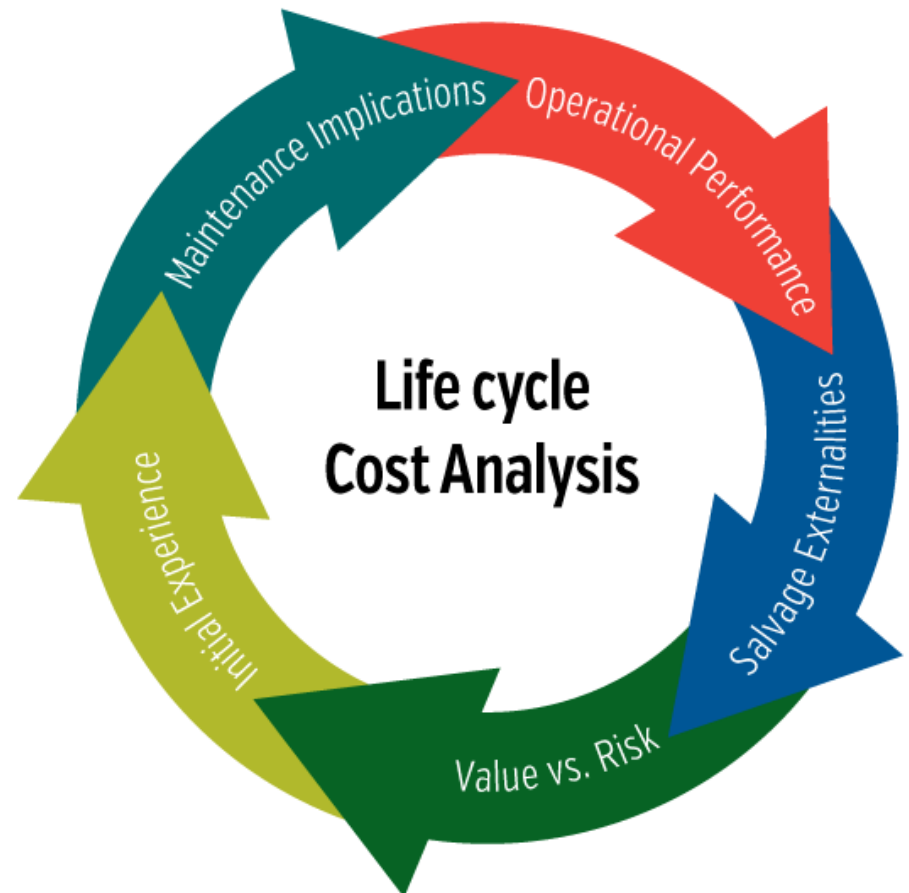
Case Study: Promedica Toledo, OH

- Project requirements
 - Treat first 0.75” water quality volume
 - Meet OEPA treatment standards
- Solution
 - 12 Offline Filtrerras
 - Sized using FSA:DA ratio (Volume based)



The Value of MTDs

- Business case where ponds are an amenity
 - May make sense for quality control, if not for quantity
- Costs for consideration in life cycle analysis
 - Material
 - Installation
 - Inspection
 - Maintenance
 - Maintenance intervals
 - Replacement
- Verified performance



Questions

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