



Performance Update for Three Stormwater Treatment Approaches for Three Linked Industrial Sites

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Discussion Topics

- ▶ Sites & Operational Descriptions
- ▶ Stormwater Characteristics
- ▶ Treatment Evaluation and Selection
- ▶ Construction Costs
- ▶ Performance Summary
- ▶ Lessons Learned



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Three Linked Industrial Sites

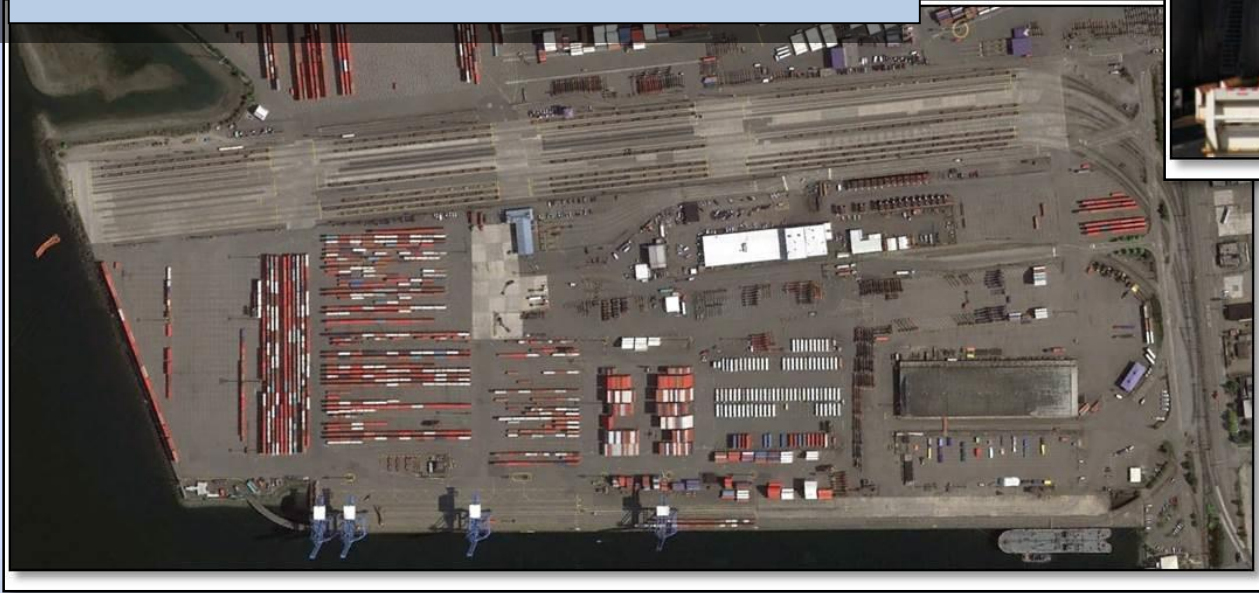


- ▶ General Peninsula Project
- ▶ Olympic Container Terminal (OCT)
- ▶ North Intermodal Yard (NIM)
- ▶ South Intermodal Yard (SIM)
- ▶ Heavy Industrial Maritime Property
- ▶ Containerized Cargo
- ▶ Difficult Meeting ISGP Benchmarks



Olympic Container Terminal (OCT)

- ▶ 56 acres
- ▶ Ship to Rail or Truck and Back
- ▶ 5 Drainage Basins
- ▶ Outfalls Under Pier

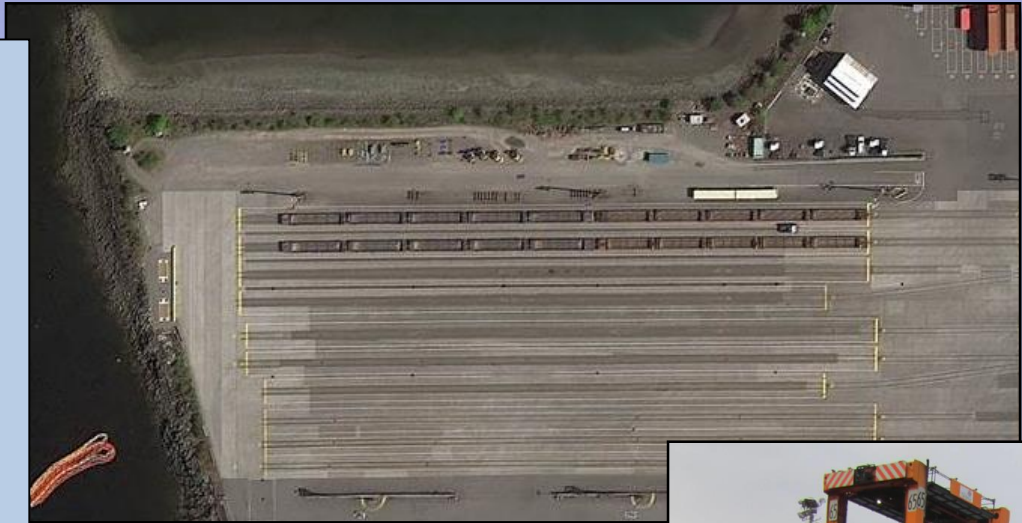


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North Intermodal Yard (NIM)

- ▶ 12 acres
- ▶ Containers moved between terminals
- ▶ Efficient means of ship to inland or inland to ship transport
- ▶ 24 hour operations
- ▶ Small strip of unpaved land available





South Intermodal Yard (SIM)

- ▶ 22 acres
- ▶ Operating rail facility
- ▶ 2 drainage basins
- ▶ Long rectangular configuration
- ▶ Perforated storm drain piping underneath track ballast





Stormwater Characteristics

- ▶ Zinc – Main pollutant of concern
- ▶ Occasional turbidity exceedances throughout
- ▶ Copper at SIM
- ▶ Larger particulate at SIM
(perforated storm drains along tracks)



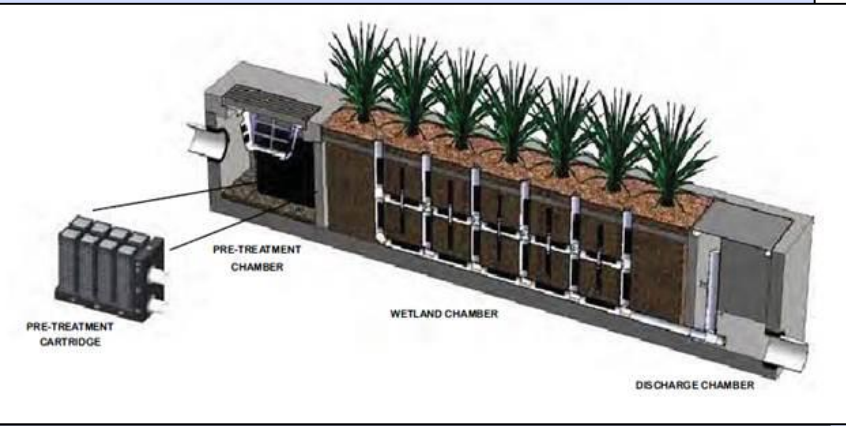
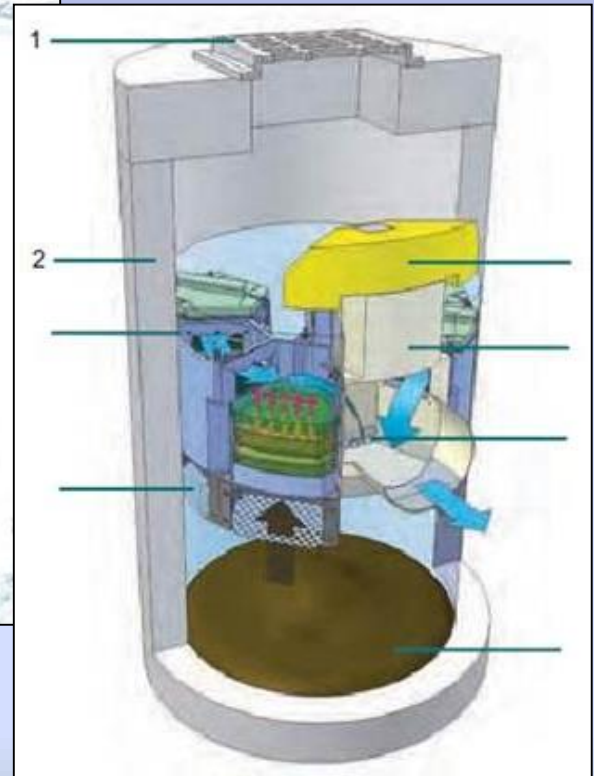
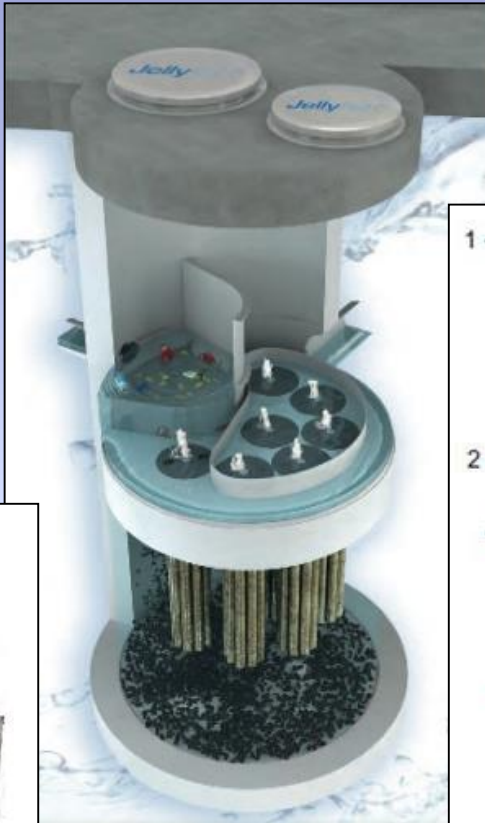
	Turbidity	pH	Zinc	Copper
OCT Average	23.0	7.0	150.0	5.0
OCT Maximum	74.0	7.9	275.0	8.8
NIM Average	16.0	7.0	115.0	5.0
NIM Maximum	22.0	7.8	189.0	12.3
SIM Average	21.0	7.0	124	9.0
SIM Maximum	44.3	7.8	281.0	17.6
Benchmarks	Turbidity	pH	Zinc	Copper
	25	5 to 9	117	14

Note:
Bold red text indicates exceedance of the parameter benchmark.



Treatment Alternatives Selected

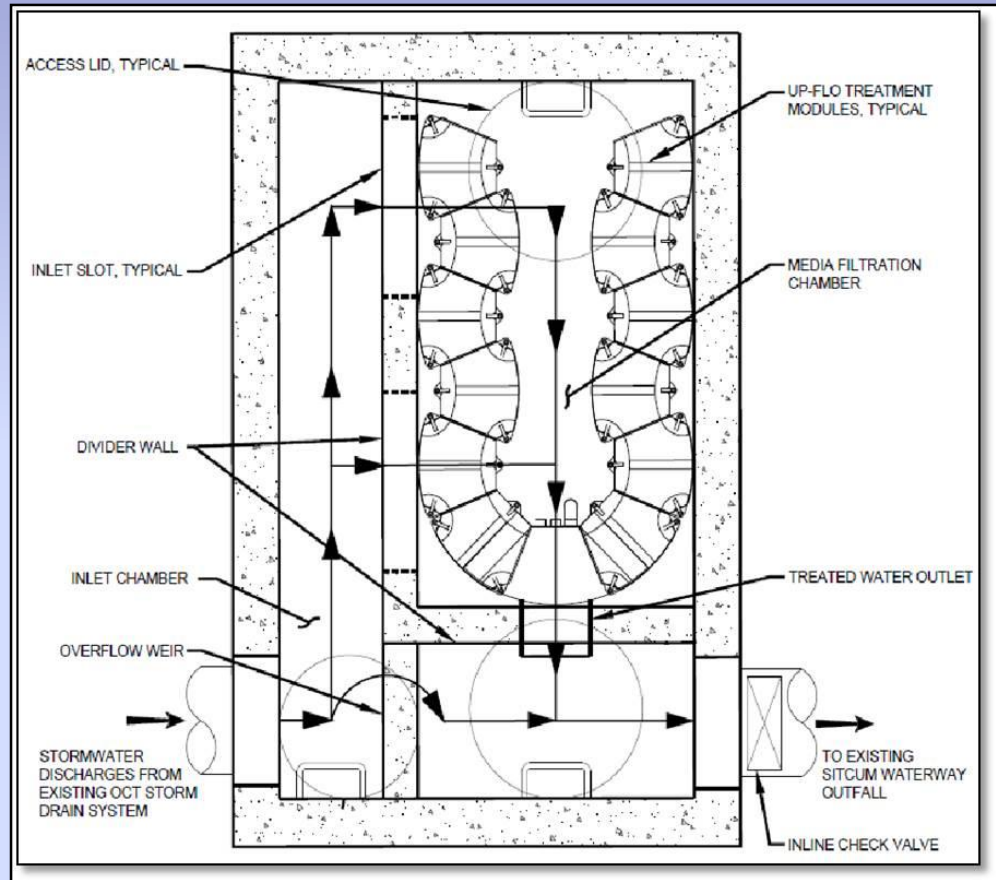
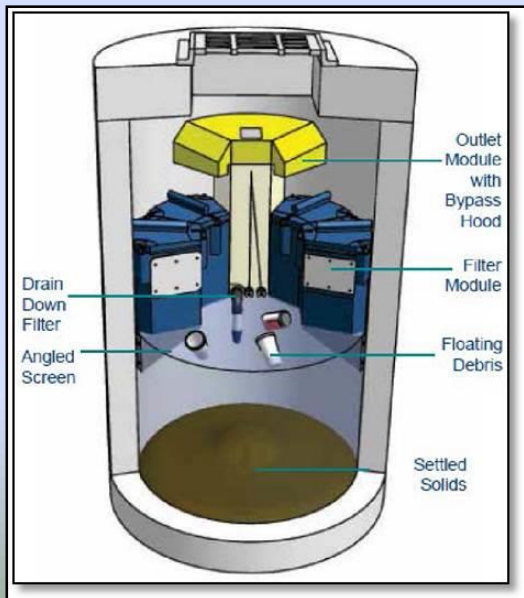
- ▶ 2 up-flow type
- ▶ 1 lateral flow





OCT - Upward Flow Media Filtration

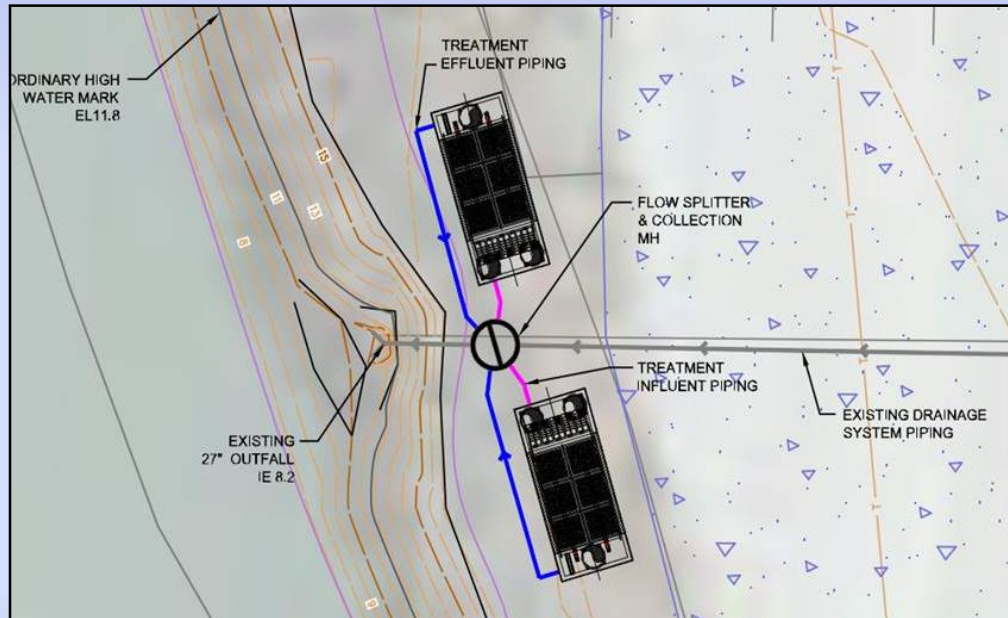
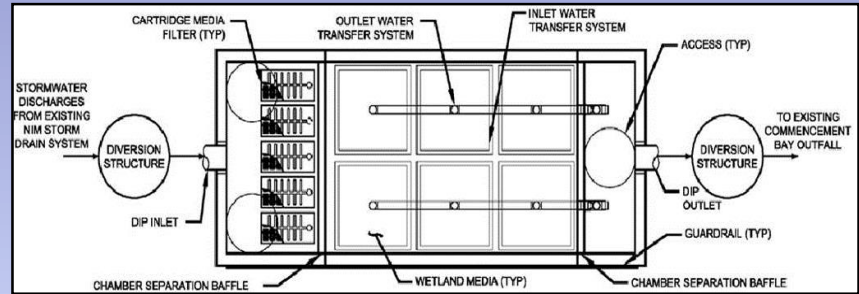
- ▶ Subsurface vault
- ▶ Fluidized media filtration technology
- ▶ Bags of media Inside filter modules





Lateral Flow Media Filtration

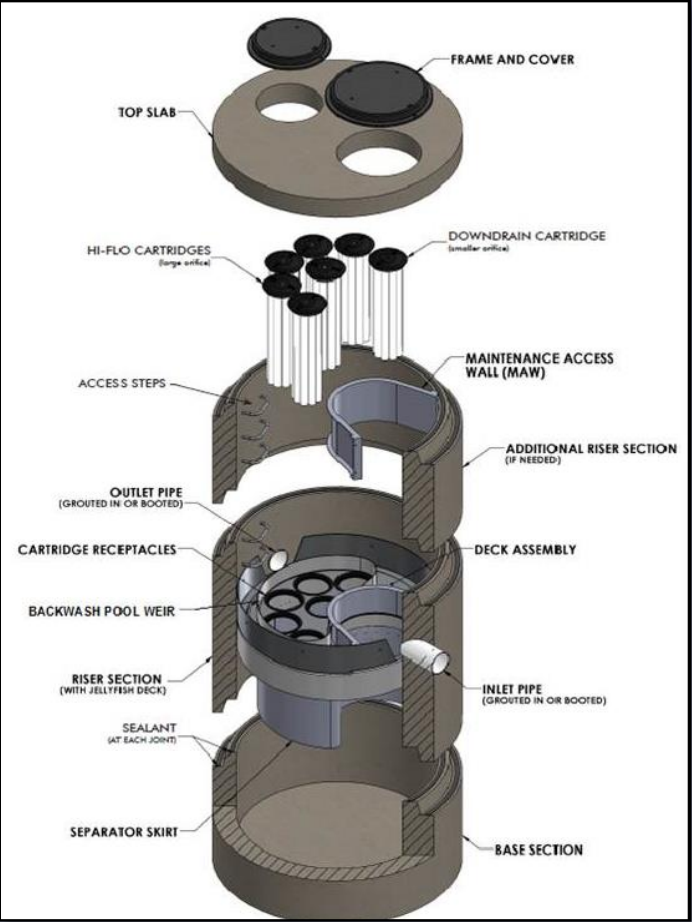
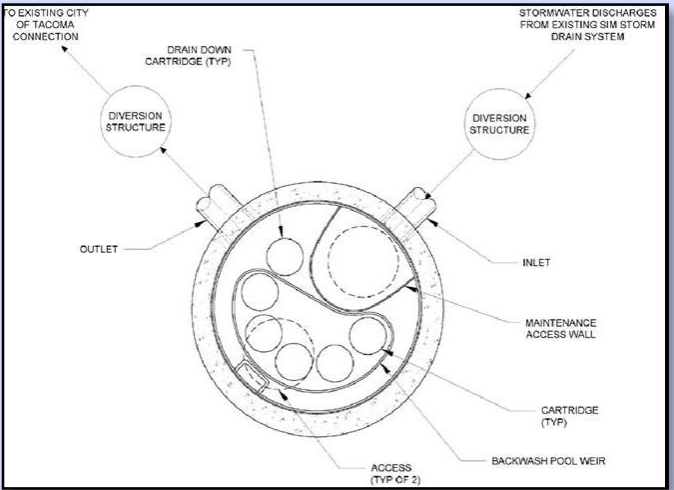
- ▶ At-grade system
- ▶ Front end settling
- ▶ Pre-filtration cartridges
- ▶ Media filtration
- ▶ Perforated collection piping





Upward Flow Cartridge Filtration

- ▶ Subsurface manhole
- ▶ Up-flow configuration
- ▶ Membrane filters
- ▶ Passive backwash



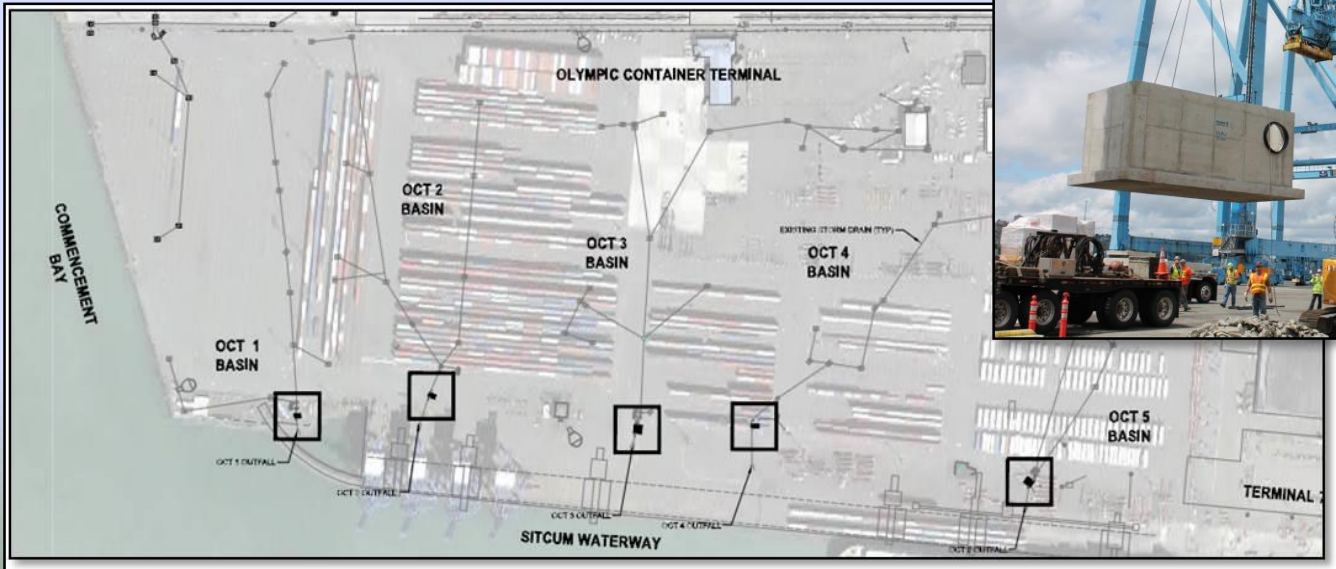
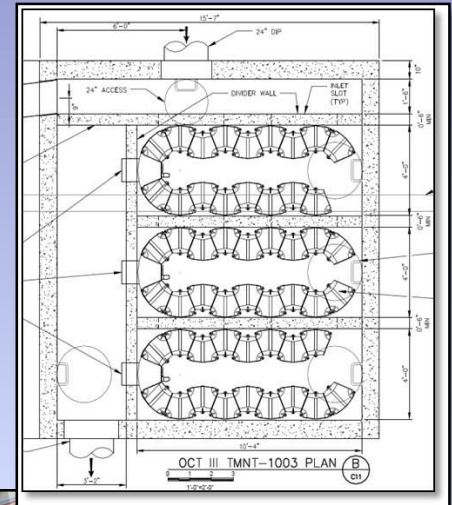
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OCT Final Design/Cost

- ▶ 5 subsurface vaults
- ▶ From 8' x 12' to 16' x 17'
- ▶ 15 feet deep
- ▶ Accommodates 125 Kip wheel loads

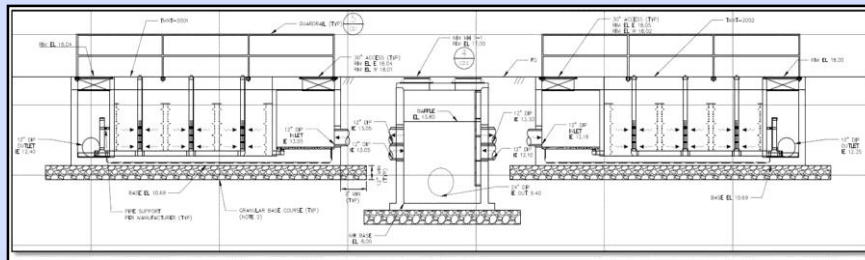
Project Costs:
 Final Construction Cost: \$1,033,614
 Cost per acre treated: \$18,457





NIM Final Design/Cost

- ▶ 2 At-grade systems
- ▶ Each 10' x 20'
- ▶ 1 flow splitter and collection MH
- ▶ Located clear of container traffic, on strip of unpaved area



Project Costs

Final Construction Cost: \$301,104

Cost per acre treated: \$25,092



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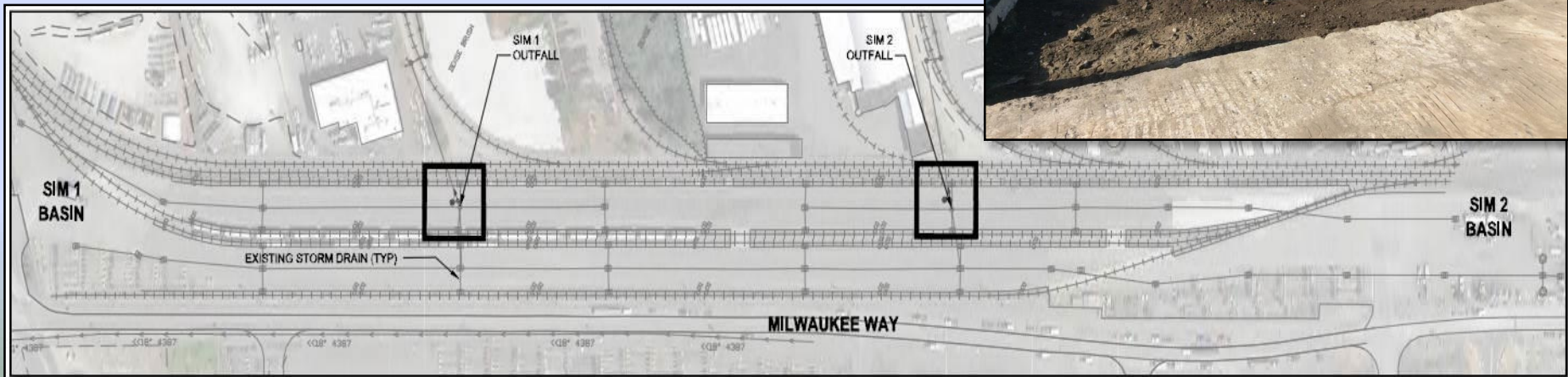
SIM Final Design/Cost

- ▶ **2 Subsurface 6" ID Filter Systems.**
- ▶ **Upstream Flow Splitter MH and Downstream Collection MH for each**
- ▶ **Accommodates 125 Kip Wheel Loads**

Project Costs:

Final Construction Cost: **\$418,603**

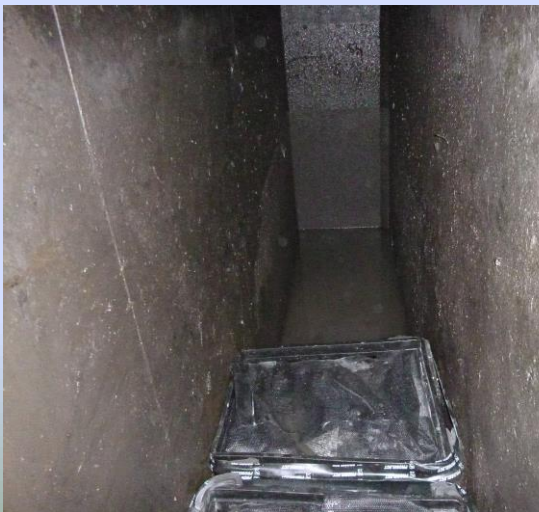
Cost per acre treated: **\$11,674**





OCT Modifications

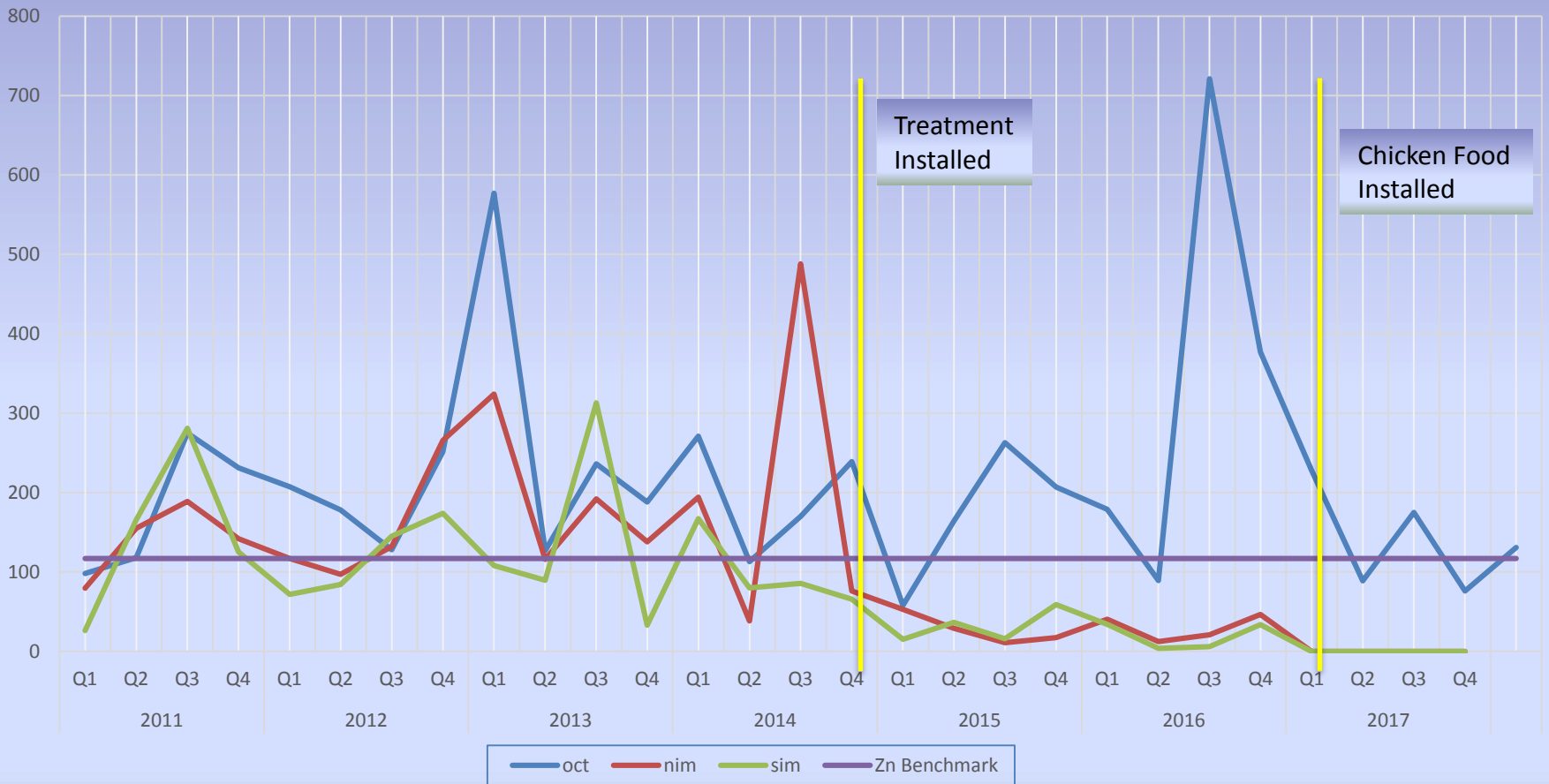
- ▶ Chopping check valves
- ▶ Sealing the modules
- ▶ Installing sampling Tee
- ▶ Varying media
- ▶ Losing the bags
- ▶ Resorting to milk crates, VPS, & chicken feed





You Have No Idea How Long it Took to Make This Chart

OCT NIM SIM Zn Data



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Conclusions/Questions?

- ▶ There is NO SILVER BULLET
- ▶ Know your pollutant characteristics
- ▶ Always, wait... Never, trust the vendor
- ▶ Don't be afraid to get in the hole
- ▶ Never give up, sometimes what you need is in your shed

