Meeting Stringent Effluent Limits in Stormwater Discharges from Utilities

MD-DC Utilities Association Conference

Cambridge, Maryland

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Outline

Objective: To discuss technical approaches and challenges in meeting metals limits and present preliminary results from a case study

- Background
- Sources of Metals
- Pollution Prevention
- Performance of Traditional BMPs
- Modular Filters Treatment Option
- Case Study
- Conclusion

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Background

- According to USEPA, metals in stormwater runoff is the second leading cause of water quality impairment
- Historically, compliance within National Pollutant Discharge Elimination System (NPDES) permits relied on Best Management Practices (BMPs)
- Use of numerical limits (e.g., Water Quality Based Effluent Limits) for management of metals is on the rise
- Metals issues are not unique to utilities; but when required by permits they present a great challenge

Background

Typical Levels of Metals in Stormwater Runoff

(Source: International Stormwater BMP Database, 2011)

Metal	Stormwater Median (90th Percentile)[a]	Mean (sd)[b]	Median (Cov) Urban Stormwater[c]	Range for Highway Runoff[d]	Range for Parking lot Runoff[e]
Arsenic	n/a	5.9 (2.8)	3.3 (2.42)	0-58	n/a
Cadmium	n/a	1.1 (0.7)	1.0 (4.42)	0-40	0.5-3.3
Chromium	n/a	7.2 (2.8)	7.0 (1.47)	0-40	1.9-10
Copper	34 (93)	33 (19)	16.0 (2.24)	22-7033	8.9-78
Lead	144 (350)	70 (48)	15.9 (1.89)	73-1780	10-59
Mercury	n/a	n/a	0.2 (1.17)	0-0.322	n/a
Nickel	n/a	10 (2.8)	9.0 (2.08)	0-53.3	2.1-18
Silver	n/a	n/a	3.0 (4.63)	n/a	n/a
Zinc	160 (500)	215 (141)	112.0 (4.59)	56-929	51-960

Sources of Research Cited by Shaver et al. 2007:
[a]NURP, 1983. [b]Schiff et al., 2001. [c]Pitt et al., 2002. [d]Barrett et al., 1998. [e]SCCRP, 2001

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Background

Example Permit Limits for Metals

Metal	Conc. Limit (ppb)
Cadmium	2 – 5
Chromium	200
Copper	5 – 13
Iron	1000
Lead	56 – 65
Zinc	75 - 120

Copper and Zinc are most prevalent in stormwater discharges and are of particular interest

Sources of Metals

Copper	Zinc
Building materials	Galvanized metal surfaces
Algaecides	Roofing and gutters
Paints	Paints
Wood preservatives	Rust inhibitors
Brake pads and shoes	Tires
Outside storage of piping and other equipment	Galvanized piping and electrical equipment
Metal finishing operations	Metal finishing operations

Pollution Prevention

- Good housekeeping
- Dry sweeping
- Eliminating exposure of stored equipment/materials to rain
- Periodic monitoring and cleaning of storm drains
- Sediment and/or metal removal filters in storm drains

Example Drain Products

Ultra-Filter Sock®

Ultra-Drain Guard®

(Source: Ultra-Tech International, Inc. website)

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Performance of Traditional BMPs

Source: Washington State Stormwater Center Study, 2011

BMP Assessed	Dissolved Cu Removal (%)	Dissolved Zn Removal (%)
Biofilter – Grass Strip	6 – 44	18 - 80
Biofilter – Grass Swale	6 – 54	18 – 77
Sand Filter	6 - 33	10 – 89
Wet Pond**	8 – 9	22 – 23
Storm Filter – ZPG**	4 – 9	2 – 8
Recommended Design Goal:	30%	60%

***** Limited dataset***

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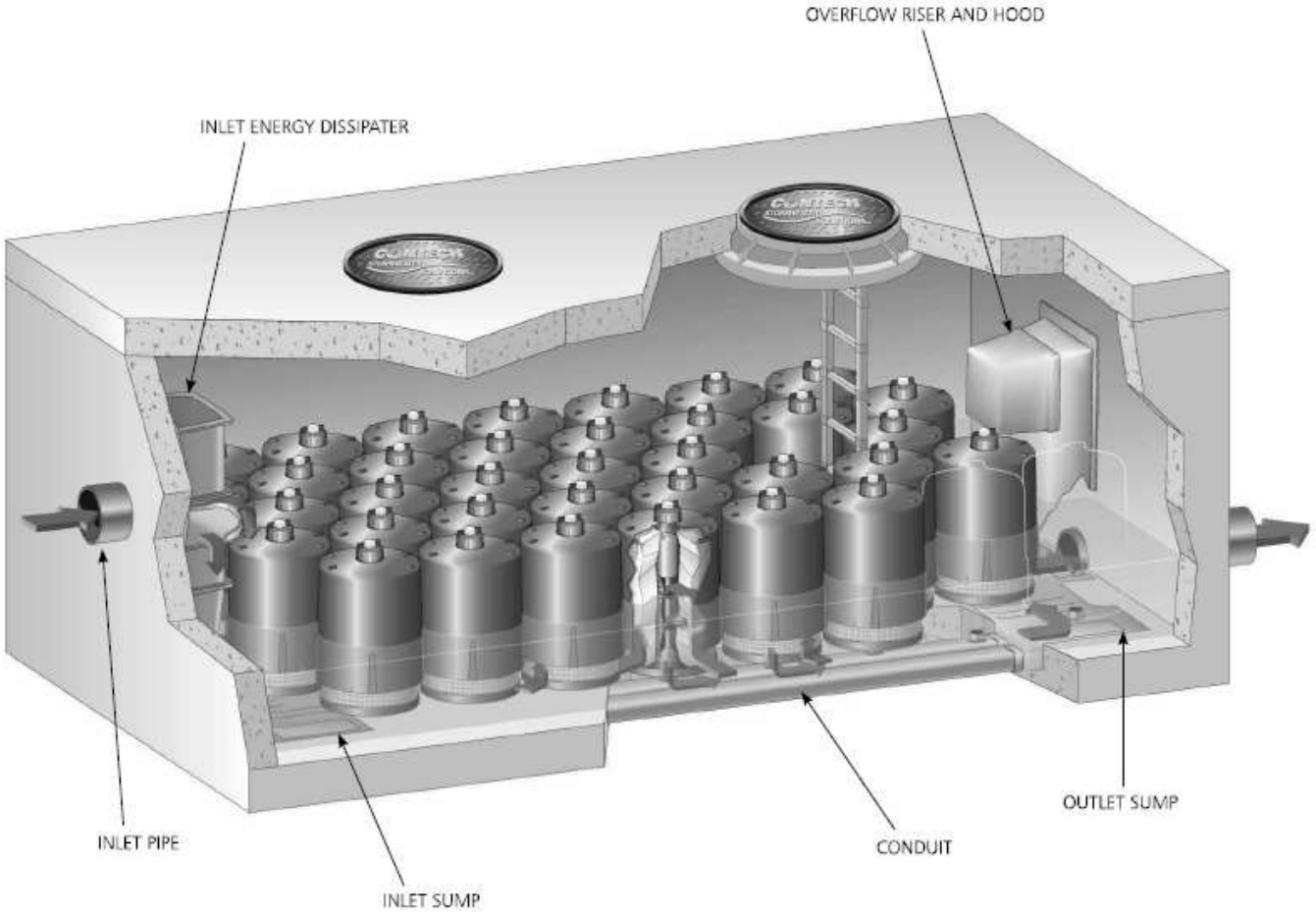
Modular Filters Treatment Option

- A combination of preventive and treatment measures is needed to achieve the stringent WQBELs which may require upwards of 90% removals
- Ultimate solution depends on the evaluation of many factors (e.g., real estate may be limited for certain BMPs)
- A key consideration is gaining an understanding of relative proportion in dissolved phase
- AECOM had prior success with modular media filtration with a pre-treatment step for suspended solids removal

Modular Filters Treatment Option



Source: ConTech Storm Filter®

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Modular Filters Treatment Option

– Typical Design Steps:

- Identify locations needing treatment
- Estimate quantity of water needing treatment
- Estimate quality of water needing treatment
- Conduct treatability studies to identify appropriate medium for filtration
- Conduct field pilot studies if needed
- Install and operate treatment system

Case Study – Site 1

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Filter Media Testing

- Collected first flush samples at five locations
- Analyzed the samples for metals and other chemistry parameters
- Selected three filtration media (GAC, zeolite, zeolite and peat mix) for testing based on literature review
- Added 20 g of media sample to one liter of water and mixed by tumbling
- Collected and analyzed aliquots at 5 min, 50 min and 24 hours for metals and pH

Pre-treatment Concentrations

	Location 1		Location 2		Location 3		Location 4		Location 5	
	Tot	Dis	Tot	Dis	Tot	Dis	Tot	Dis	Tot	Dis
Copper	0.141	0.016	0.116	0.028	0.053	0.019	0.028	0.014	0.111	0.008
Zinc	1.090	0.111	0.711	0.092	0.189	0.032	0.548	0.166	0.420	0.000
TSS	511		385		289		166		655	

Note: All results presented in ppm or mg/L

Tot – Total Metals
Dis – Dissolved Metals
TSS – Total Suspended Solids

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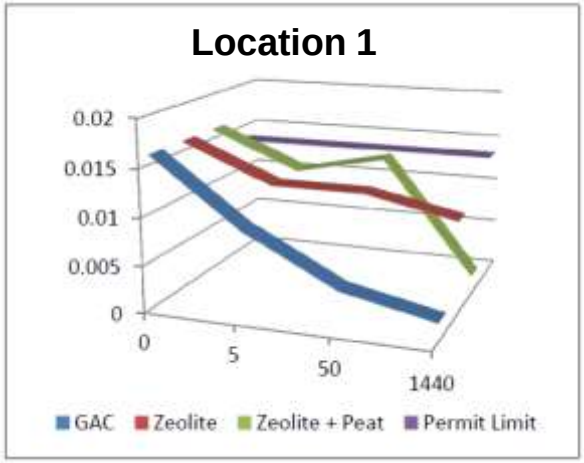
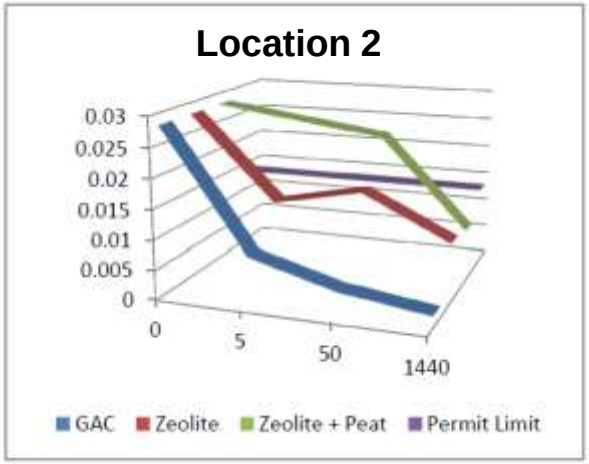
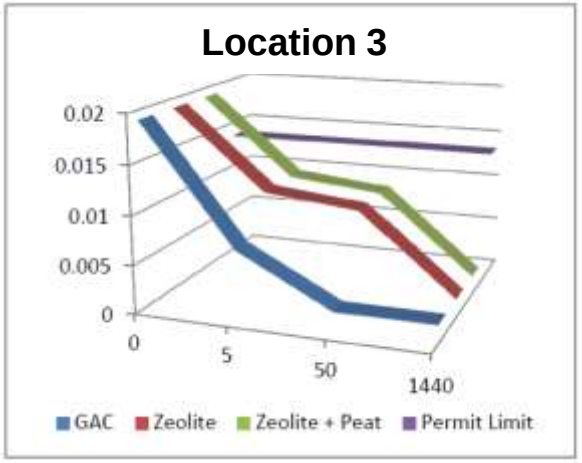
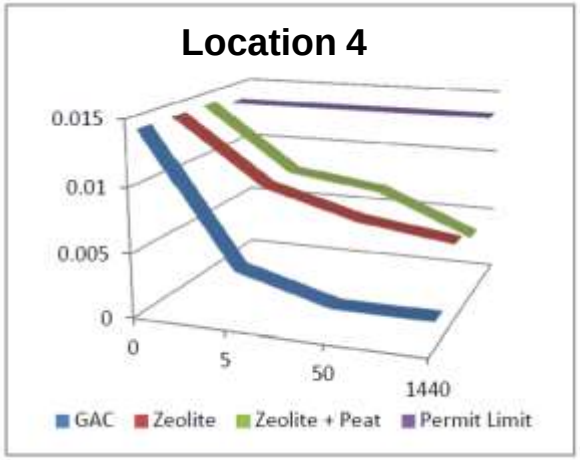
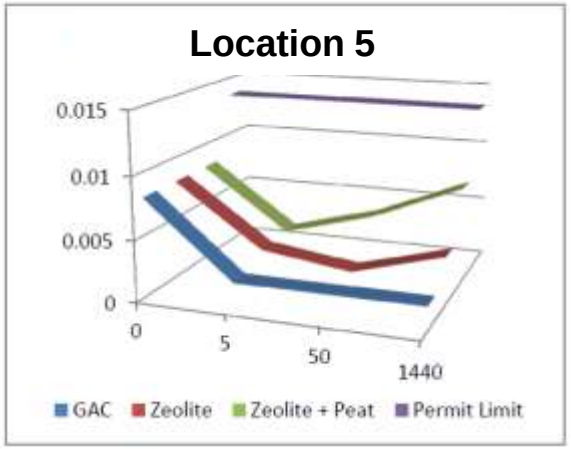
Test Results for Copper











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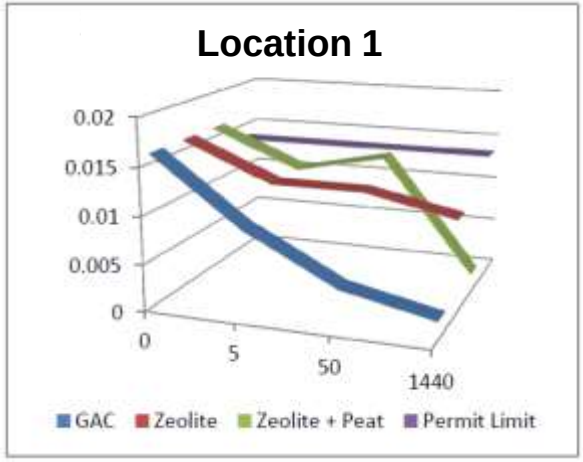
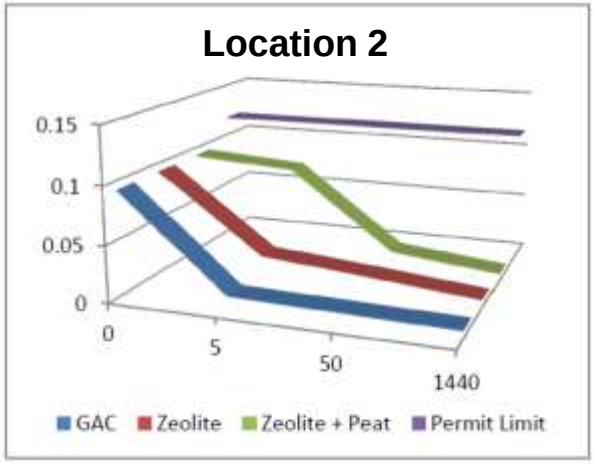
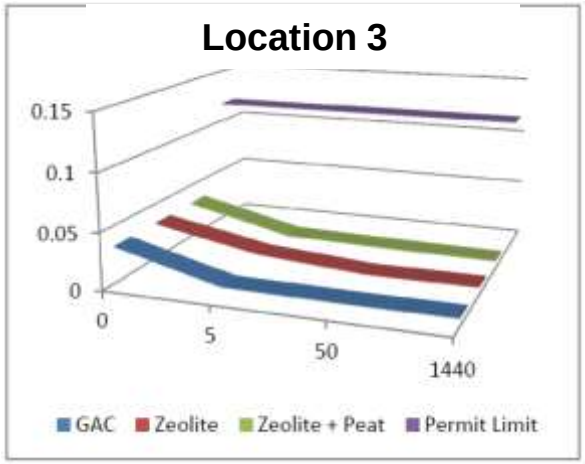
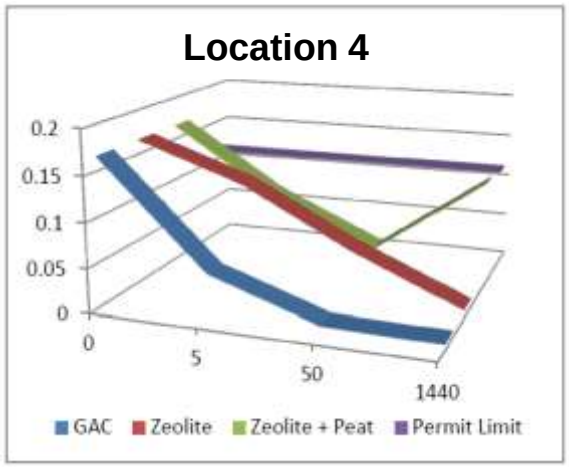
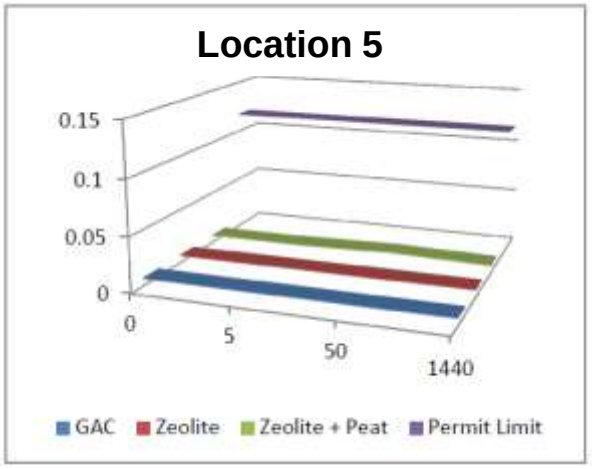
Test Results for Zinc











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Conclusion

- All three media tested appear to be capable of removing copper and zinc to the desired levels
- A majority of metal concentration in the case study is associated with suspended solids
- Preliminary test results indicate that a combination of solids removal and media filtration can potentially achieve the ultra low WQBELs

Thank You

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