LID Systems are Less Prone to Seasonal Performance Variations than Conventional Stormwater Management Systems

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The UNH Stormwater Center

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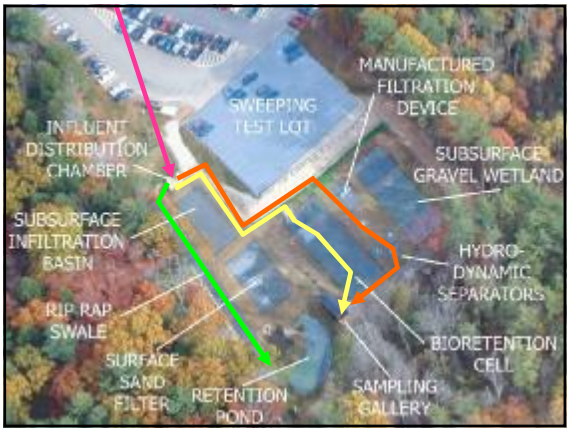
The UNH Stormwater Center
Durham, New Hampshire

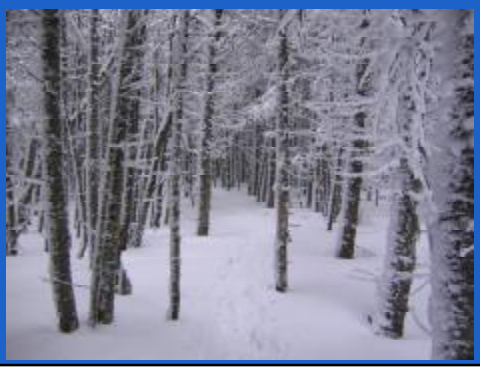
Research and development of stormwater treatment systems

To provide resources to stormwater communities currently involved in design and implementation of Phase II requirements

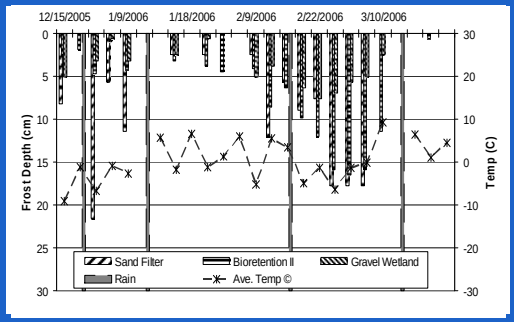
http://www.unh.edu/erg/cstev



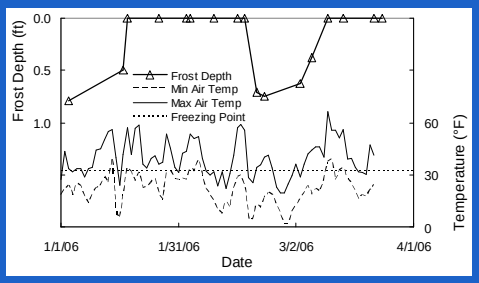
Seasonal Monitoring



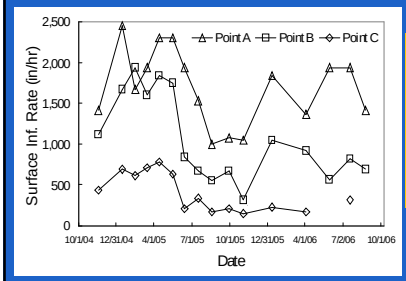
Filter Media Frost Penetration

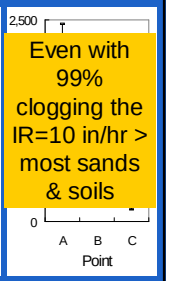


Porous Asphalt Frost depth, with min. and max. air temp. for winter, 2006



Surface infiltration rates for the porous asphalt 11/04-10/06



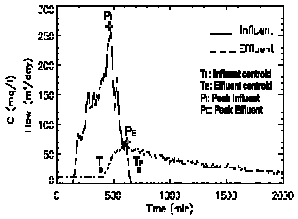


Even with 99% clogging the IR=10 in/hr > most sands & soils

Hydraulic Efficiency

Equation 1: Peak reduction coefficient $k_p = \frac{Q_{p,effluent}}{Q_{p,\text{inf luent}}} \leq 1$

Equation 2: Lag coefficient $k_L = \frac{t_{c,effluent}}{t_{c,\text{inf luent}}} \geq 1$



Hydraulic Efficiency

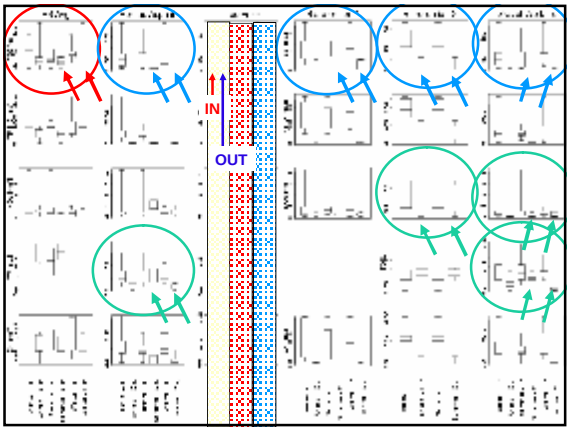
Annual and Seasonal lag (k_L) and delay (k_p) coefficients

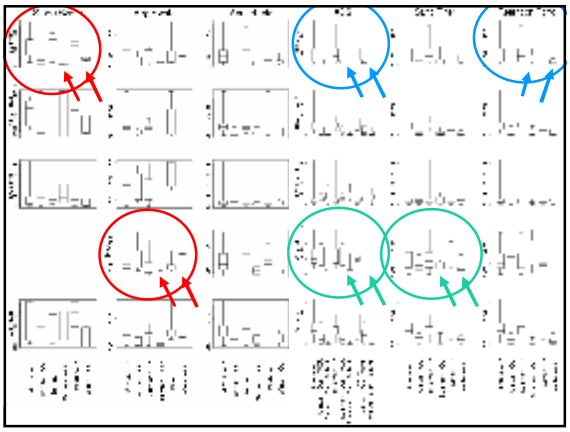
Device		Annual	winter(6)	summer(6)
Subsurface Infiltration	KI	1.60	1.68	1.46
	Kp	0.17	0.17	0.16
Surface Sand Filter	KI	1.47	1.56	1.27
	Kp	0.40	0.45	0.29
Retention Pond	KI	2.02	2.11	1.77
	Kp	0.15	0.16	0.11
Bioretention	KI	2.16	2.27	1.81
	Kp	0.15	0.18	0.06
Gravel Wetland	KI	1.58	1.56	1.61
	Kp	0.15	0.16	0.14
Stone-Lined Swale	KI	1.02	1.00	1.25
	Kp	1.03	1.13	0.79

MIN IMPACT

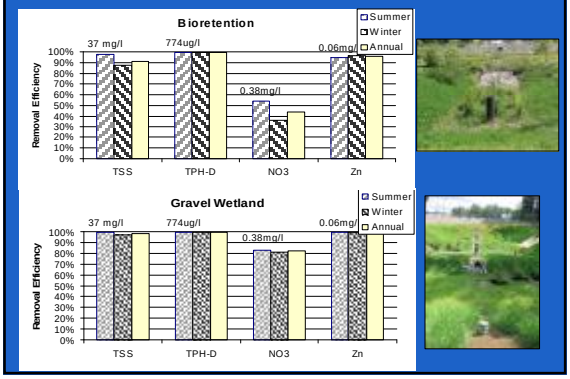
GREATEST IMPACT

Cold Climate Performance Results





Performance Efficiencies –Filtration/Infiltration



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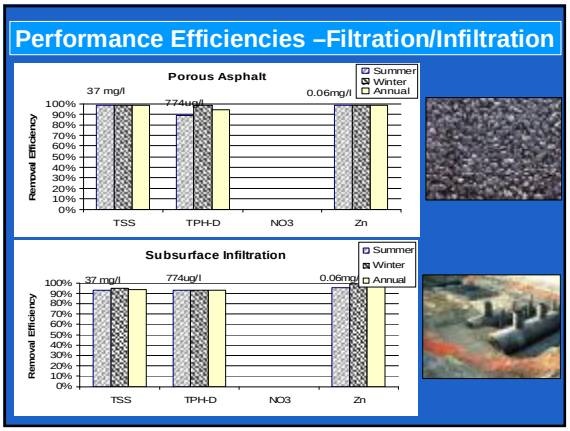

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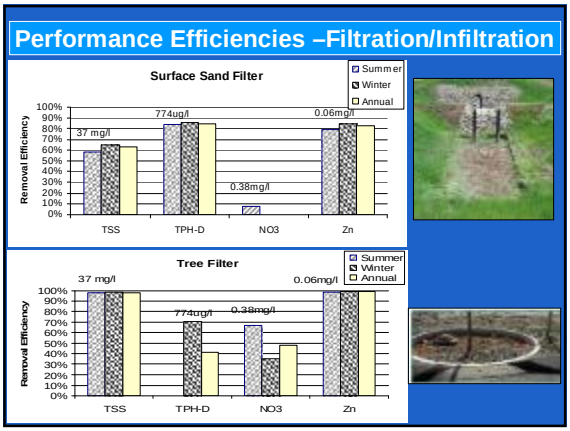
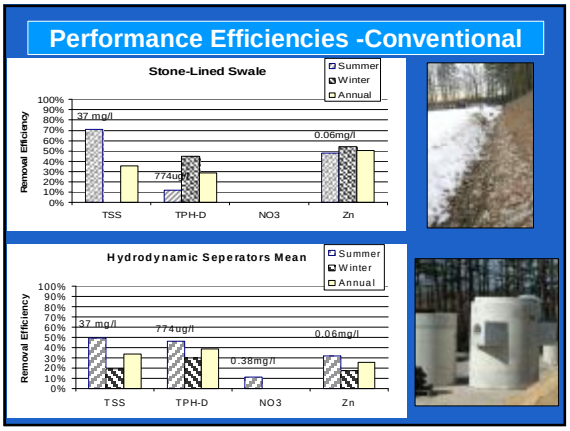
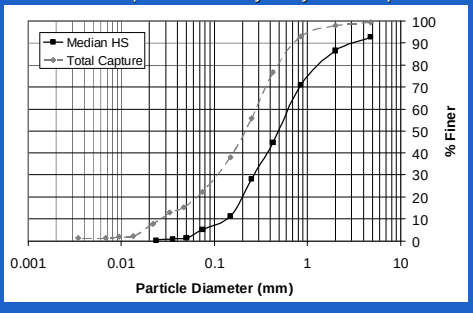


Performance Efficiencies -Conventional



Particle size distribution summary for influent sediments vs. sediments captured within hydrodynamic separators



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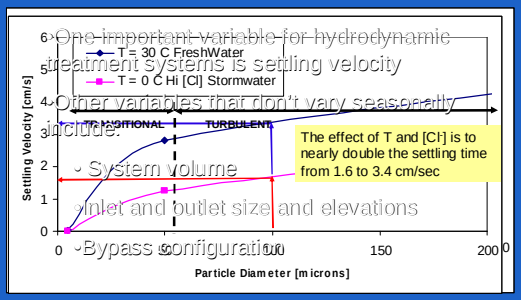
Temperature and Salinity Effects on Settling Velocity



The effect of T and [Cl-] is to nearly double the settling time from 1.6 to 3.4 cm/sec

One important variable for hydrodynamic treatment systems is settling velocity

Other variables that don't vary seasonally include:

- System volume
- Inlet and outlet size and elevations
- Bypass configuration

*Oberts (2003), Jokela (1990)

Summary Conclusions

- While concerns exist for LID in cold climates, seasonal variations are observed for conventional BMPs and Manufactured systems
- LID designs have a high level of functionality during winter months and frozen filter media does not reduce performance
- Infiltration and filtration systems have the highest removal efficiency
- The standard of practice is moderate at best, and low especially for stone lined swales
- Systems dependent on particle settling show the greatest affect by season.
- It is interesting to note that many of the systems used routinely, without concern for reduced winter performance, are showing otherwise.

Acknowledgements

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Questions?