stormwateRx™

Reclaiming the world's water.

Advanced Stormwater: New Developments in Stormwater (Filtration)

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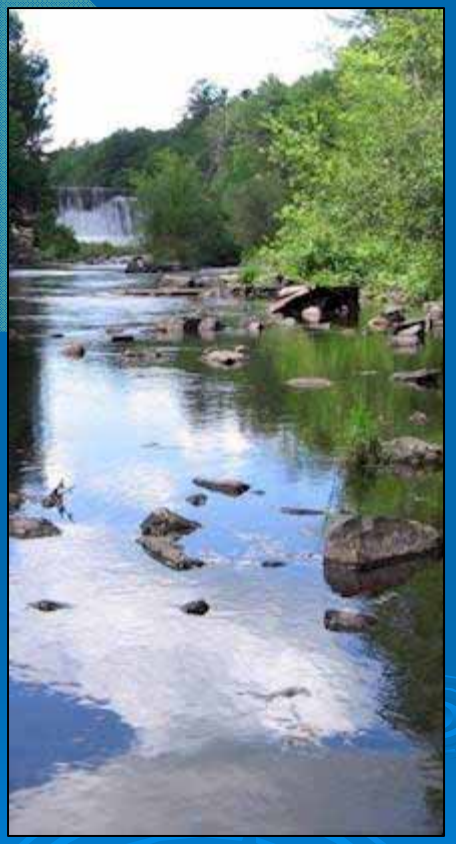
New Developments in Stormwater Filtration

- Northwest Industrial Permits
- Treatment BMPs: Role of Chemistry
- aquip™
- Case Studies



Industrial Stormwater in the NW

Parameter	Unit	Oregon		Washington	
		1200Z Benchmark	1200COLS Benchmark	Action Level	Benchmark
TSS	mg/L	130	50		
Turbidity	NTU			50	25
O&G	mg/L	10	10	30	15
pH	std. units	5.5 - 9	5.5 – 8.5	5 – 10	6 – 9
Zinc	mg/L	0.6	0.24	0.372	0.117
Copper	mg/L	0.1	0.036	0.149	0.0636
Lead	mg/L	0.4	0.06	0.159	0.0816
BOD5	mg/L		33	60	30
Ammonia	mg/L			38	19
N/N Nitrogen	mg/L			1.36	0.68
Phosphorus	mg/L		0.16	4.0	2.0
Ecoli	#/100 mL		406		

Treatment BMPs: Role of Chemistry

Treatment Train or Serial Processes

1. Oil and grease
2. Fine solids, turbidity
3. Dissolved metals

Metals in Water

- Seldom in pure form
- How's metal found in water?
  - Elemental – charge-neutral
    - Particulate (>0.45µm dia)
    - Dissolved size (<0.45µm dia)
  - Ionic – charged ion, bio-available fraction
  - Complexed – with anion, or organic compound, etc.
  - Depends on many factors: pH, chemical composition, concentration, temperature…

TABLE 3.1
Major inorganic species in natural waters

CONDITION	ELEMENT	MAJOR SPECIES
Hydrolyzed, anionic	Boren (B)	H_3BO_3, $B(OH)_4^-$
	Chromium (Cr)	CrO_4^{2-}
	Arsenic (As)	$HAsO_4^{2-}$
	Selenium (Se)	SeO_4^{2-}
	Molyboenum (Mo)	MoO_4^{2-}
Predominantly free ions	Lithium (Li)	Li^+
	Sodium (Na)	Na^+
	Magnesium (Mg)	Mg^{2+} (Mg^{2+}, $MgCO_3$)
	Potassium (K)	K^+
	Calcium (Ca)	Ca^{2+} (Ca^{2+}, $CaSO_4$)
	Strontium (Sr)	Sr^{2+}
	Cesium (Cs)	Cs^+
	Barium (Ba)	Ba^{2+}
Complexation with OH^-, CO_3^{2-}, HCO_3^-, Cl	Aluminum (Al)	$Al(OH)_3(s)$, $Al(OH)_2^+$, $Al(OH)_4^-$
	Manganese (Mn)	$MnO_2(s)$
	Iron (Fe)	$Fe(OH)_3(s)$, $Fe(OH)_2^+$, $Fe(OH)_4^-$
	Cobalt (Co)	Co^{2+}, $CoCO_3$
	Nickel (Ni)	Ni^{2+}, $NiCO_3$ (Ni^{2+}, NiCl)
	Copper (Cu)	$CuCO_3$, $Cu(OH)_2$
	Zinc (Zn)	Zn^{2+}, $ZnCO_3$ (Zn^{2+}, ZnCl)
	Silver (Ag)	Ag^+, AgCl ($AgCl_2^-$, AgCl
	Cadmium (Cd)	Cd^{2+}, $CdCO_3$ ($CdCl_2$)
	Mercury (Hg)	$Hg(OH)_2$ ($HgCl_4^{2-}$)
	Lead (Pb)	$PbCO_3$ ($PbCl^+$, $PbCO_3$)

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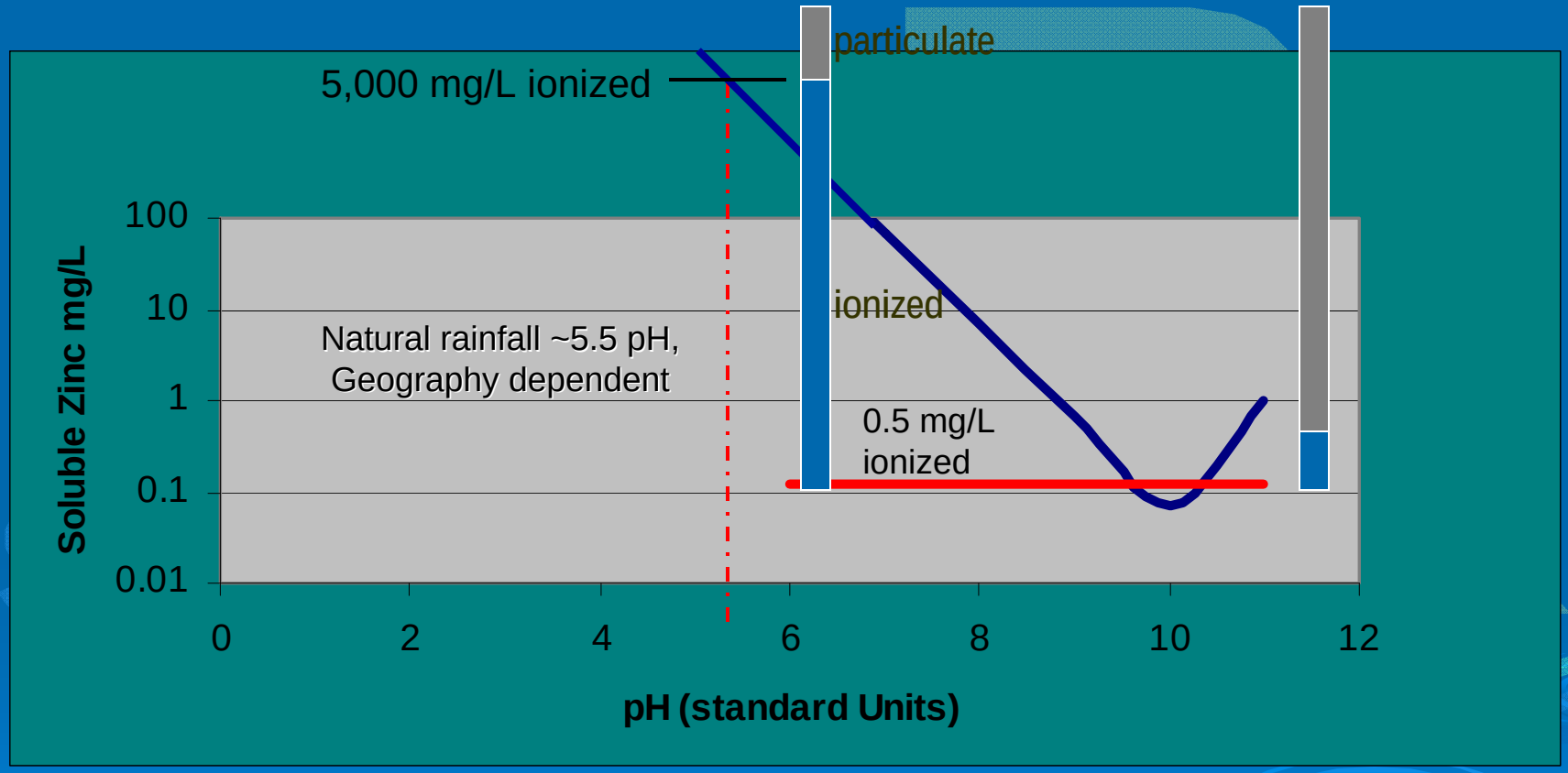
Zinc - Ubiquitous in the Urban Environment

- Typically >80% ionized, pH dependent
- Hydraulic oil @ 0.11% zinc
- Tires @ 1.5%
- Fertilizers @ 0.1%
  - Macronutrient
- Galvanized buildings and equipment
- Managed differently at municipal level

Zinc Solubility

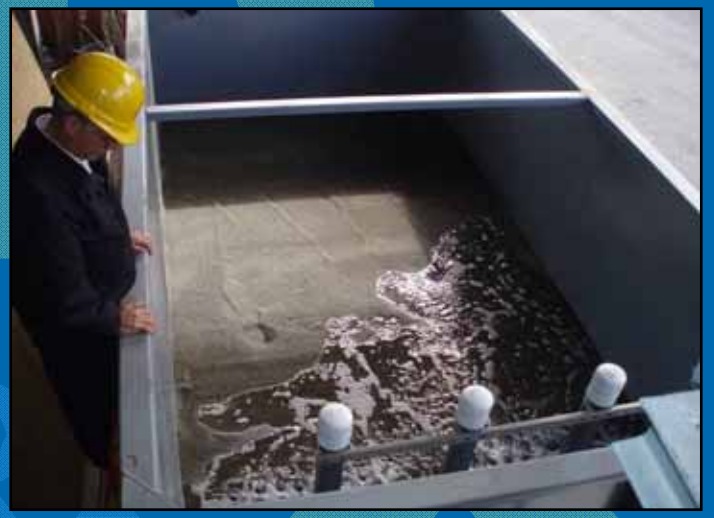


Based on $Zn(OH)_2$ Speciation ksp 1.2x10-17 and initially pure water

New Development in Stormwater Filtration

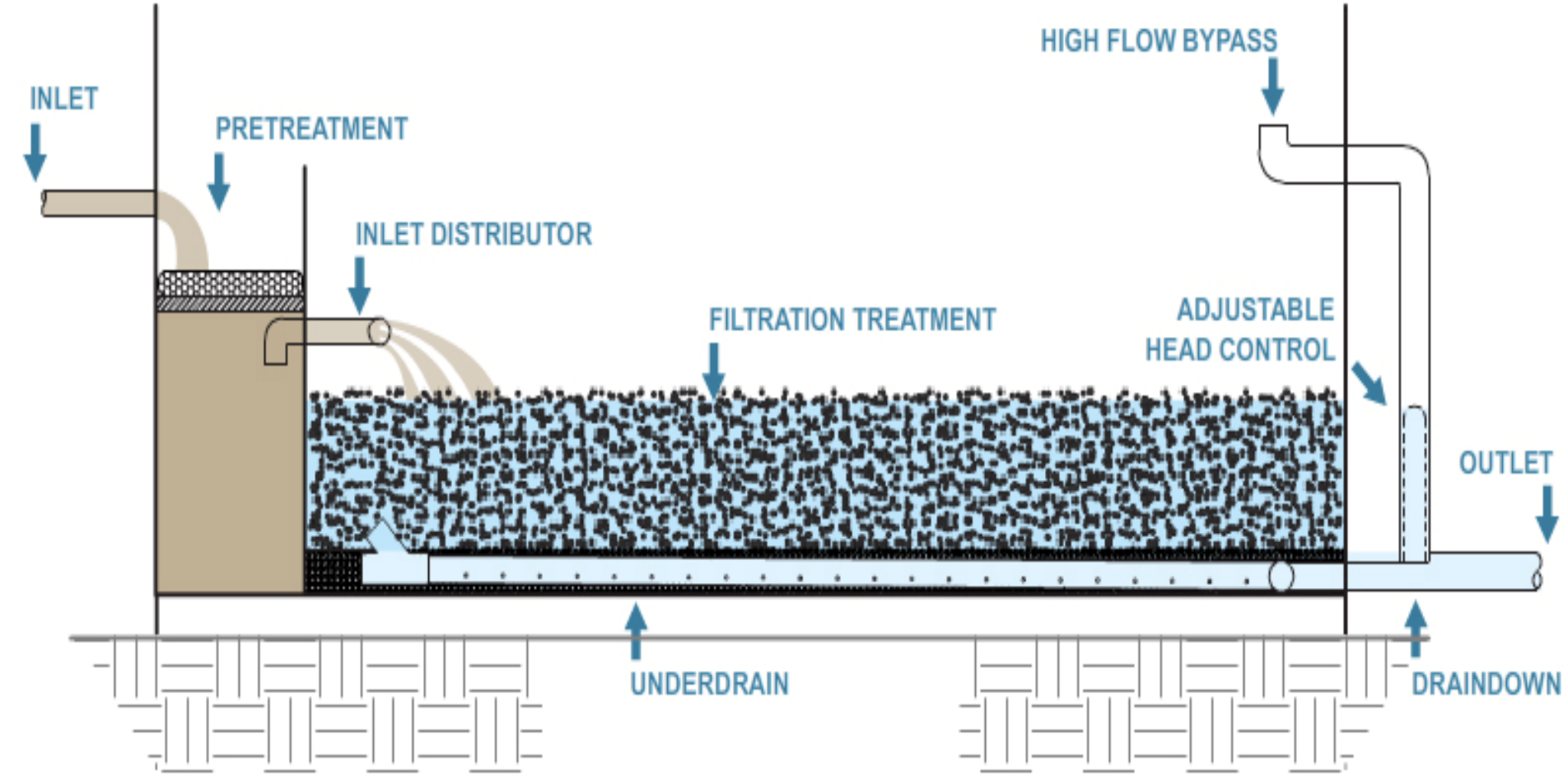
aquip™

Industrial Stormwater Filtration by StormwateRx



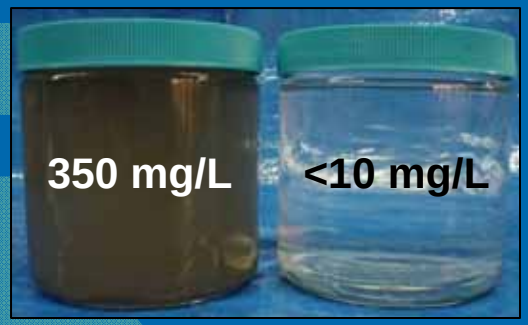
- Treatment train design
  - Pre-treatment - metals or oil
  - Polishing – particulates, dissolved metals
- High performing

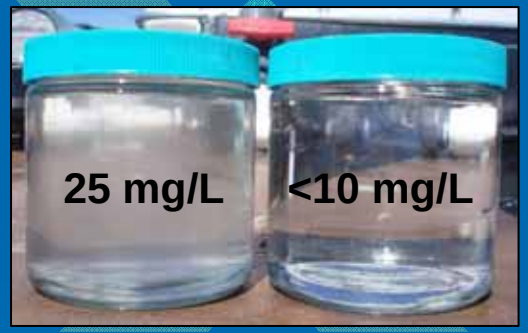
Stormwater Filtration



aquip™ Industrial Stormwater Filtration

- Passive
- Sustainable
- Known technology



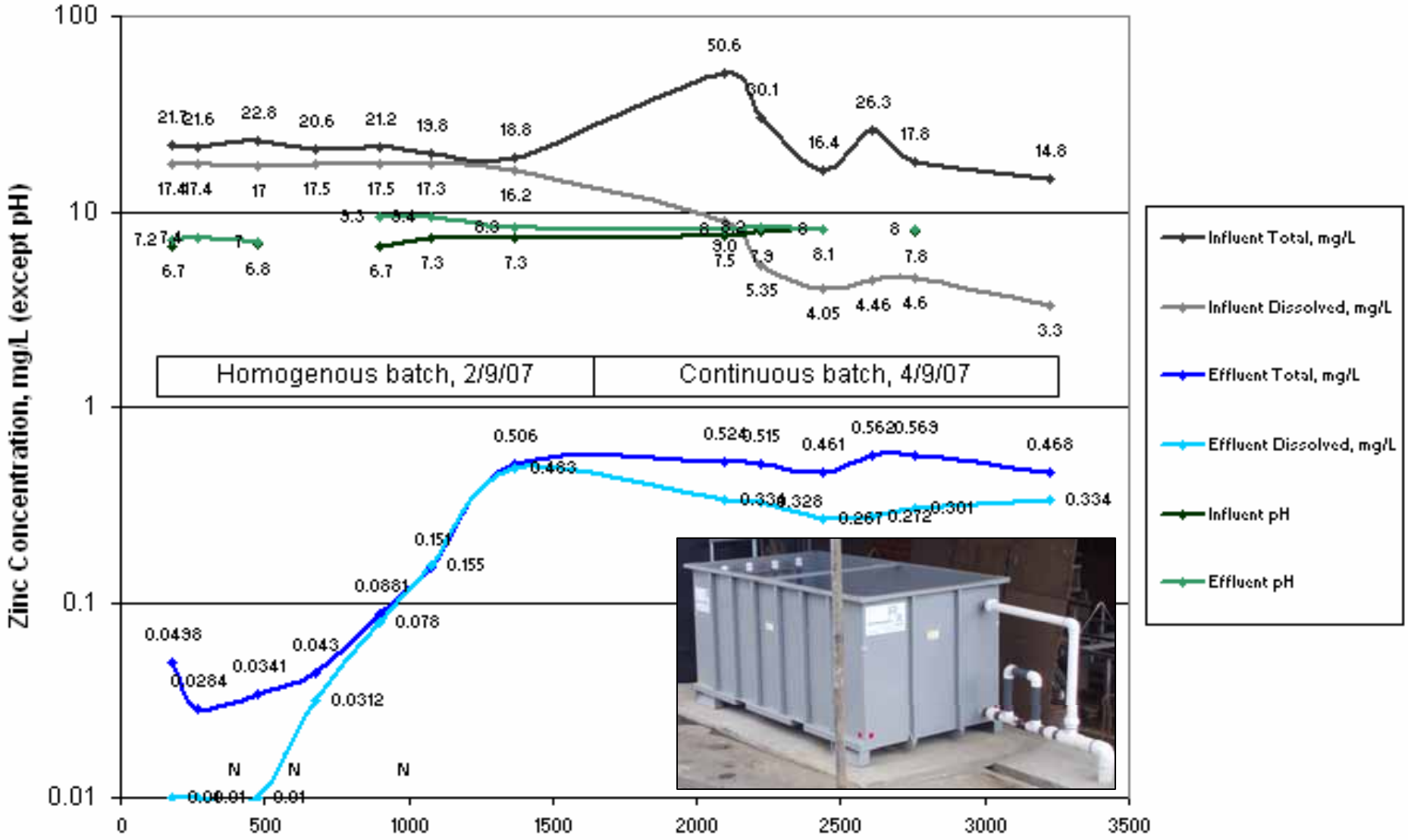


- Industrial Pollutants Ideal:
  - Particulates >0.1 micron*
  - Total metals – zinc, copper, lead, cadmium, etc.
  - Dissolved metals
  - Phosphorus
  - Organics – BOD, COD
  - pH
  - Free oil – with oil pretreatment module

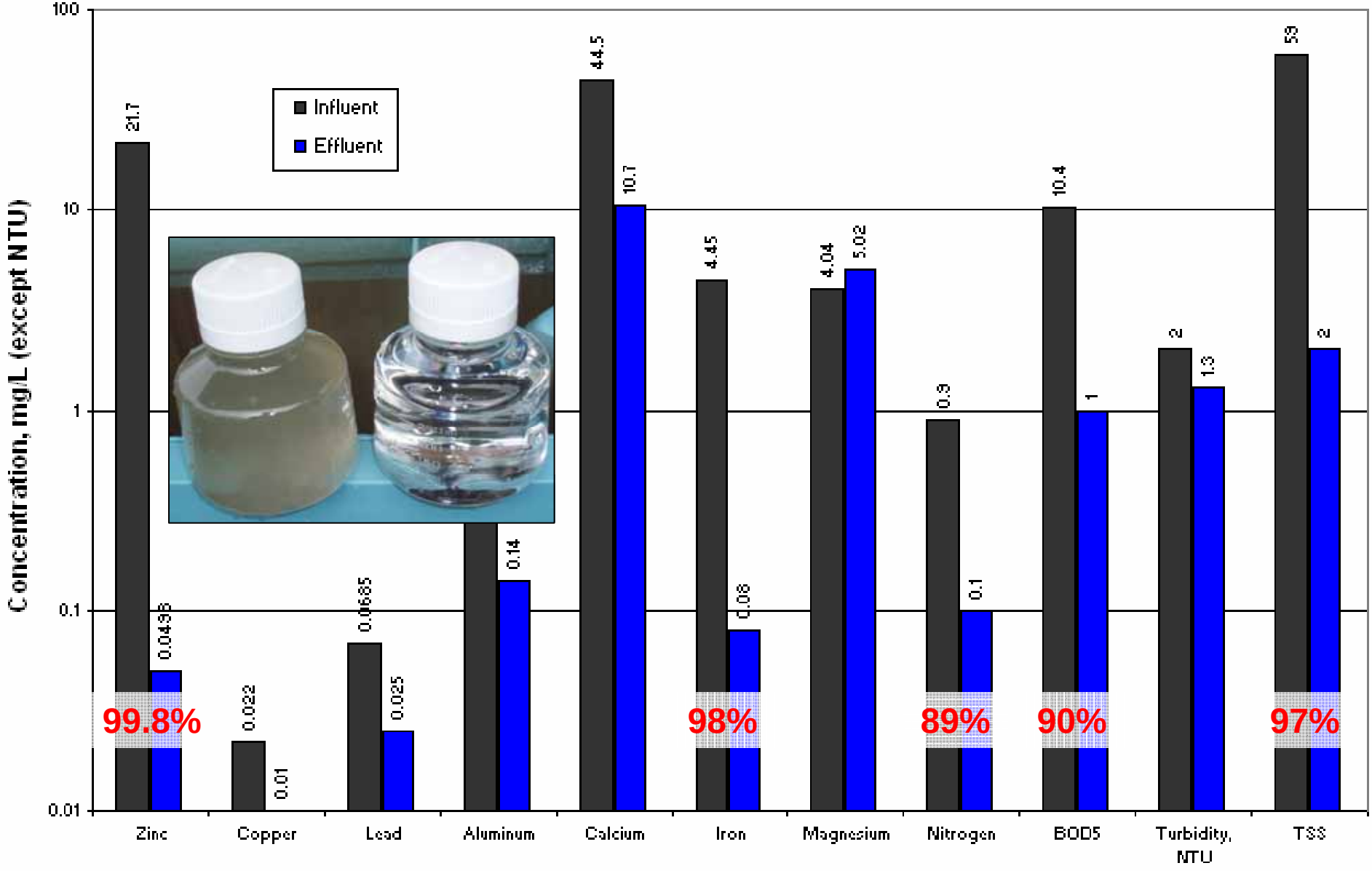
- Some Pollutants Not Ideal:
  - Ecoli/bacteria – performance not validated
  - Water soluble oils
  - Ethylene glycol

Case #1 – Galvanizing Industry

Case #1 - Galvanizing



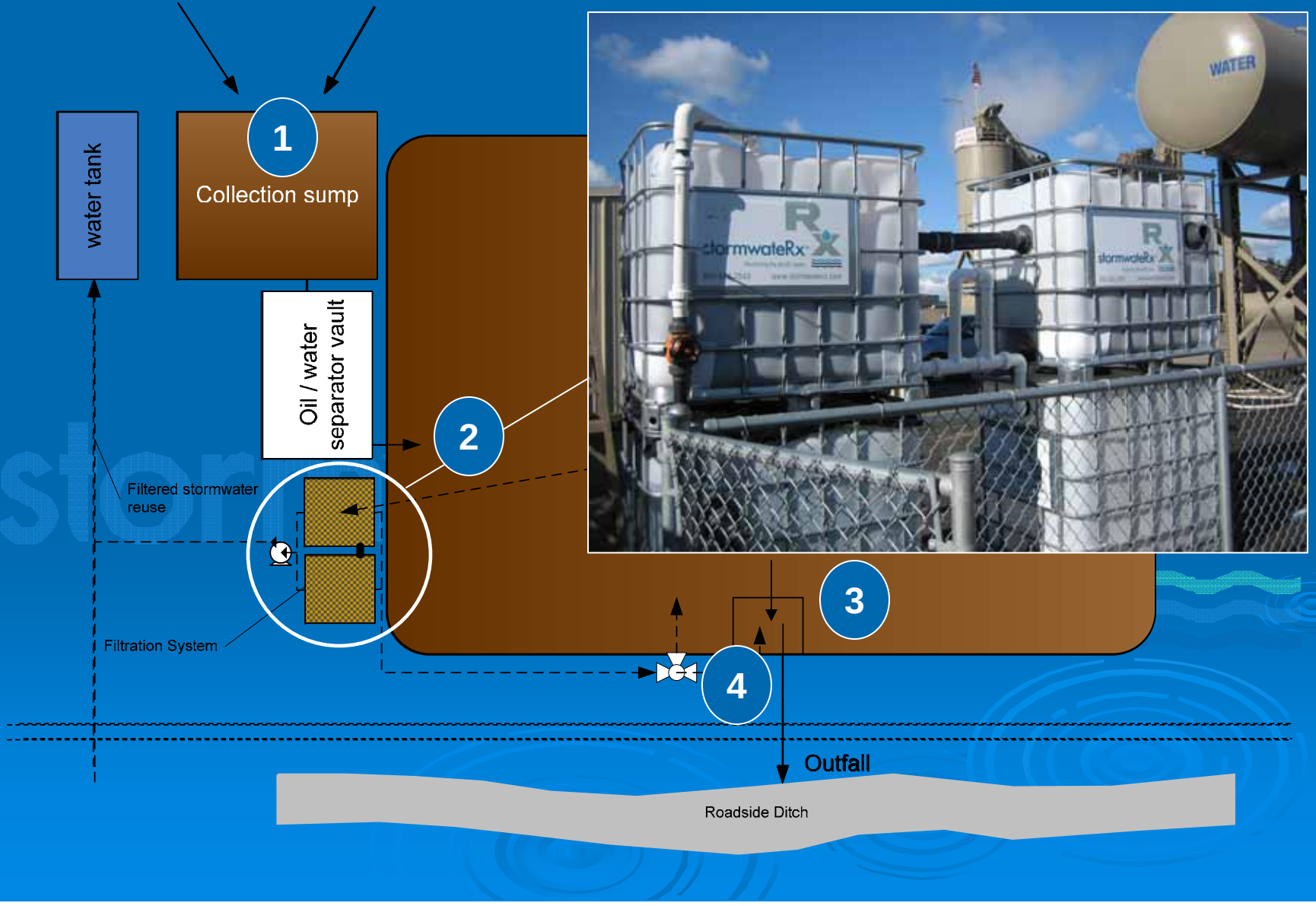
Case #1 - Galvanizing



Case #2 – Asphalt Paving Industry

- 15 acre site, aggregate blending
- Existing BMPs
  - Paved site, clean and well organized
  - Oil / water separator
  - Stormwater detention pond

Case #2 – Asphalt Paving Industry



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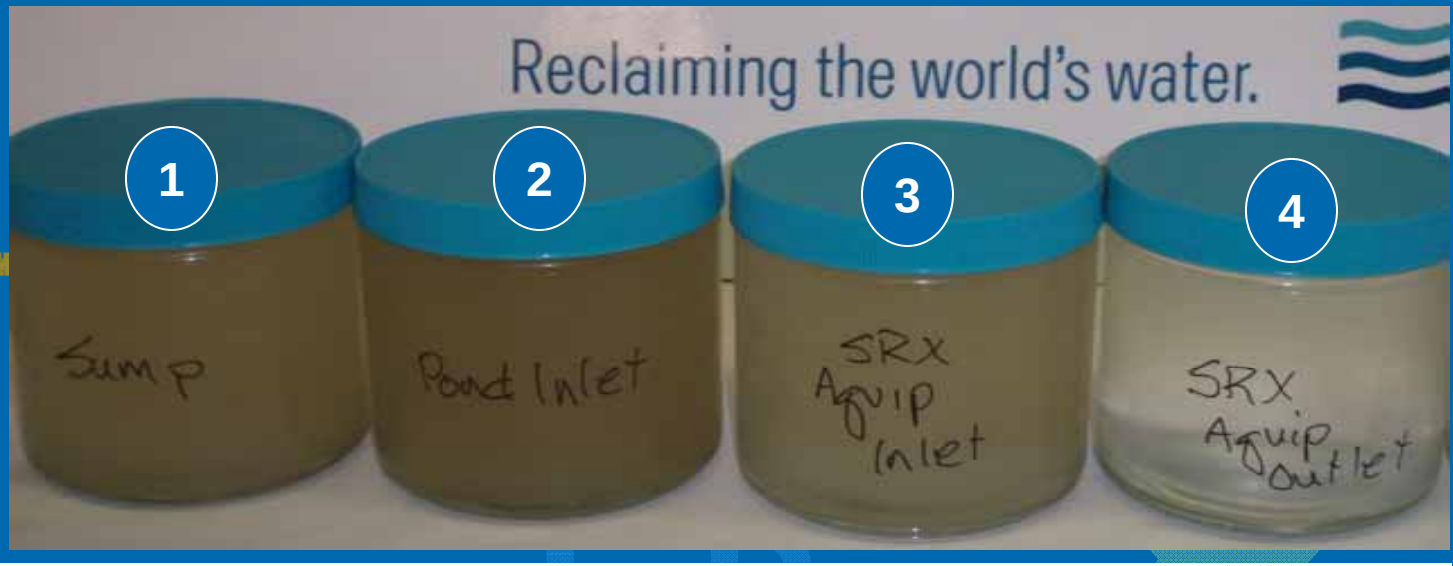

Pollutant	Action Level	1 SW Sump	2 SW Pond Inlet	3 Aquip Filter Inlet	4 Aquip Filter Outlet
Turbidity (NTU)	50	153	218	139	**40 MEETS**
TSS (mg/L)	NA	60	130	80	10

New Developments in Stormwater Filtration

- Northwest Industrial Permits
  - Progress toward benchmarks
- Treatment BMPs: Role of Chemistry
  1. Oil and grease
  2. TSS and turbidity
  3. Dissolved metals

- Industrial stormwater filtration
  - High performing, flexible
  - Go to www.stormwaterx.com

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