

ADVANCED TREATMENT SYSTEMS OVERVIEW

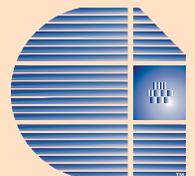
State of Washington

CONFERENCE ON ADVANCED TREATMENT FOR CONSTRUCTION SITES

CalEPA – October 21, 2004



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Clear Water Compliance Services, Inc.



Regulatory Permitting (NPDES Applications)



Stormwater Pollution Prevention Planning



Stormwater Treatment System Design



On-site Stormwater Management

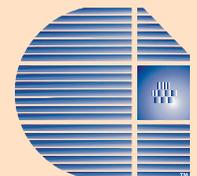


Regulatory Compliance Monitoring

**Full Service Stormwater and Process Water Management
for Construction and Industrial Sites**



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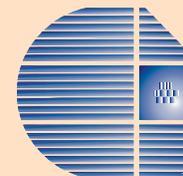


Clear Water Compliance Services, Inc.

- + **Established September 1998.**
- + **Certified in 1998 under the auspices of the City of Redmond and the Northwest Regional Office of the Department of Ecology to employ batch-operated chemical treatment systems on construction sites using the flocculant, *Calgon CatFloc 2953*.**
- + **The first independent company in Washington State authorized to perform water treatment at construction sites for others.**
- + **Developed its first proprietary auto-control filtration system in 2001; now manufacturing and employing third-generation systems with remote data logging and remote alarm capabilities.**



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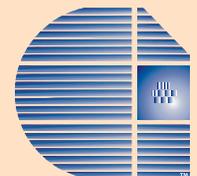
LISTING OF SELECT PROJECTS AND CLIENTS

- + Weyerhaeuser / Quadrant Homes
- + Cam West Development
- + Burnstead Construction
- + GLY Construction
- + Ferguson Construction
- + KLB Construction
- + North Forty Development
- + Murray Franklyn Homes
- + Costco
- + Microsoft
- + Home Depot
- + Specified by name in bid documents issued by Wal-Mart for its retail centers.

Please Note: Most of these are repeat clients.



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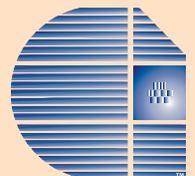


GOALS OF THIS PRESENTATION

- ✚ Discuss Why Advanced Treatment is Needed
- ✚ Present an Overview of Various Treatment Technologies
- ✚ Discuss the Process Used for Selecting a Treatment Approach
- ✚ Managing and Treating Non-visible Pollutants
- ✚ Offer a Summary of the Presentation
- ✚ Issue a Request for Consistency in Enforcement of the Regulations



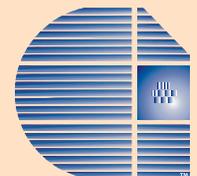
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Why Advanced Treatment is Needed – 1



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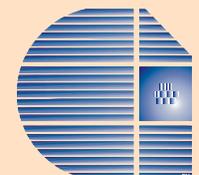


Why Advanced Treatment is Needed – 2

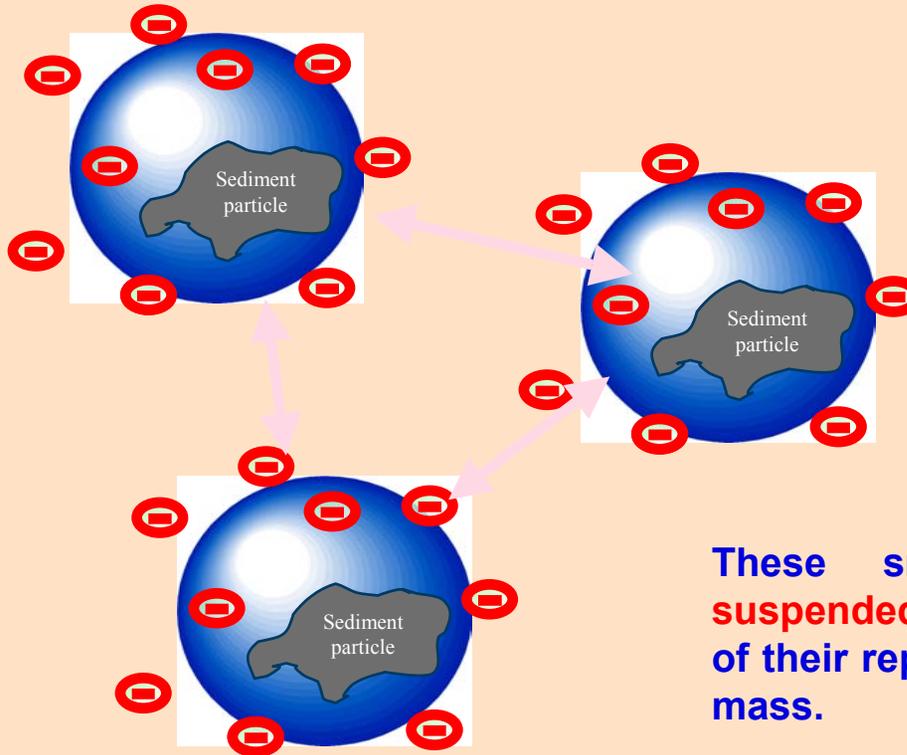
DESCRIPTION	SETTLING TIME
GRAVEL	1 SEC.
	9.8 SEC.
COARSE SAND	48 SEC.
	67 SEC.
FINE SAND	125 SEC.
	47.6 MIN.
SILT	107 MIN.
	7.2 HRS.
	20.1 HRS.
CLAY	180 HRS.
	754 DAYS
	207 YEARS
COLLOIDAL PARTICLES	



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Why Advanced Treatment is Needed – 3

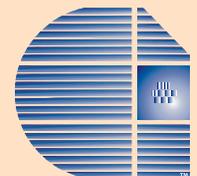


Note: The diagram shows negative electrostatic charge; many soil particles exhibit a positive electrostatic charge.

These small particles remain suspended in stormwater because of their repellent charges and small mass.



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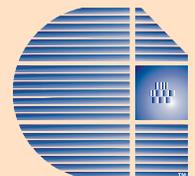


Overview of Various Treatment Technologies – 1

- # Gravity Settling
- # Natural Filtration (Infiltration and/or Bio-filtration)
- # Mechanical Filtration (no chemicals employed)
- # Active Stormwater Treatment - Chemical Coagulation & Flocculation
- # Coagulation Using Sacrificial Electrodes (EC)
- # Chemically Enhanced Filtration



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Natural Settling

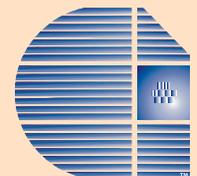
DESCRIPTION	SETTLING TIME
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	9.8 SEC.
COARSE SAND	48 SEC.
FINE SAND	67 SEC.
	125 SEC.
	47.6 MIN.
SILT	107 MIN.
	7.2 HRS.
	20.1 HRS.
CLAY	180 HRS.
	754 DAYS
COLLOIDAL PARTICLES	207 YEARS

Sometimes soil particles will settle out quickly enough to achieve satisfactory discharge quality.

Frequently, however, they won't.



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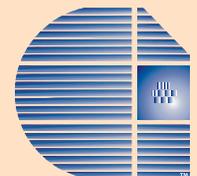
Gravity Settling



**Most often,
however,
they won't.**



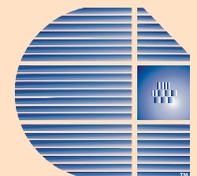
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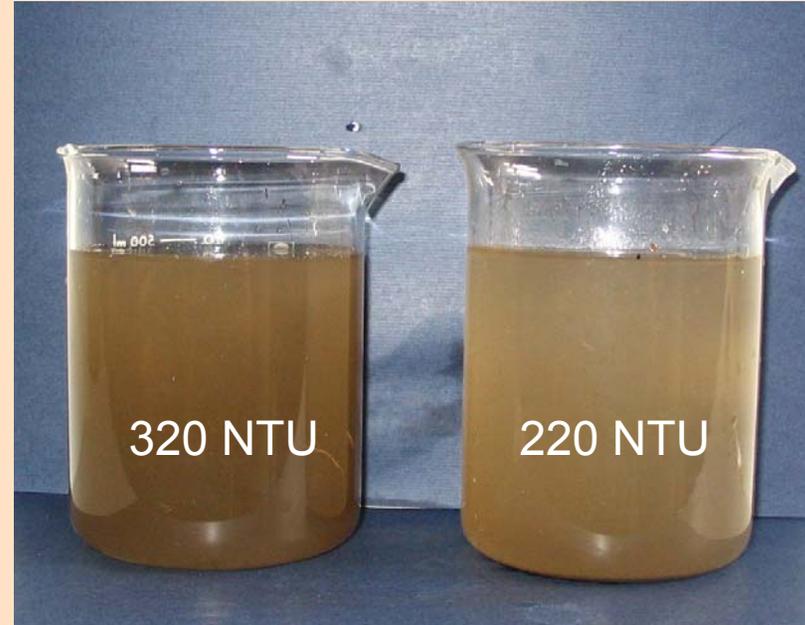
Natural Filtration (Infiltration and/or Bio-filtration)



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Mechanical Filtration (no filter-aid chemicals) - 1

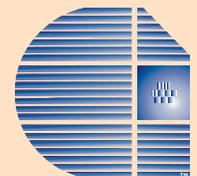


Problems:

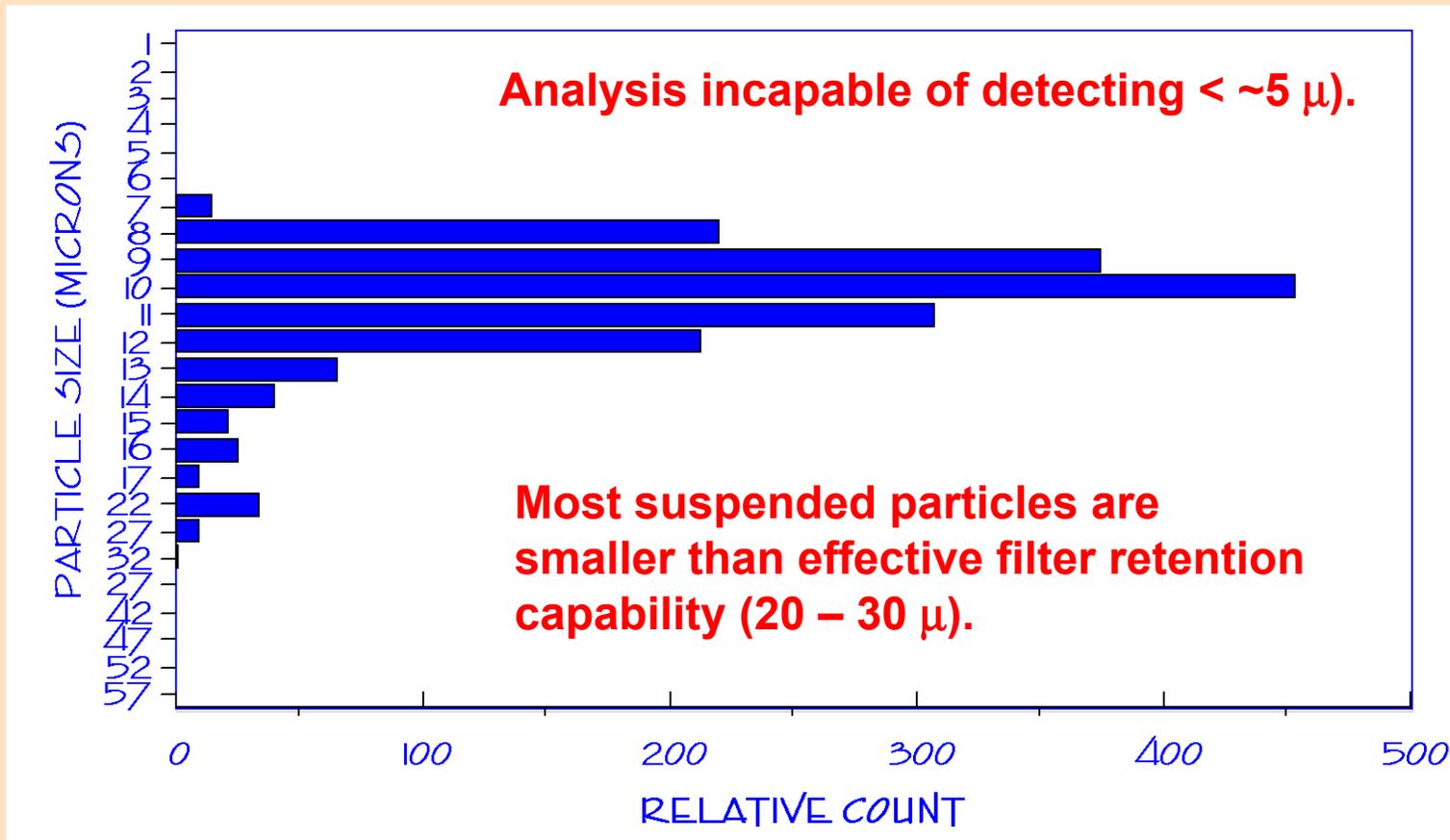
1. (Most) often it doesn't work.
2. Usually occludes filter in < 1 hour



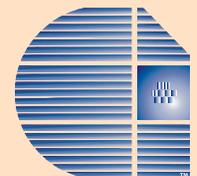
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Mechanical Filtration (no filter-aid chemicals) - 2



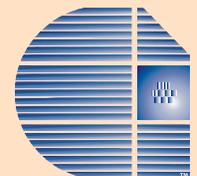
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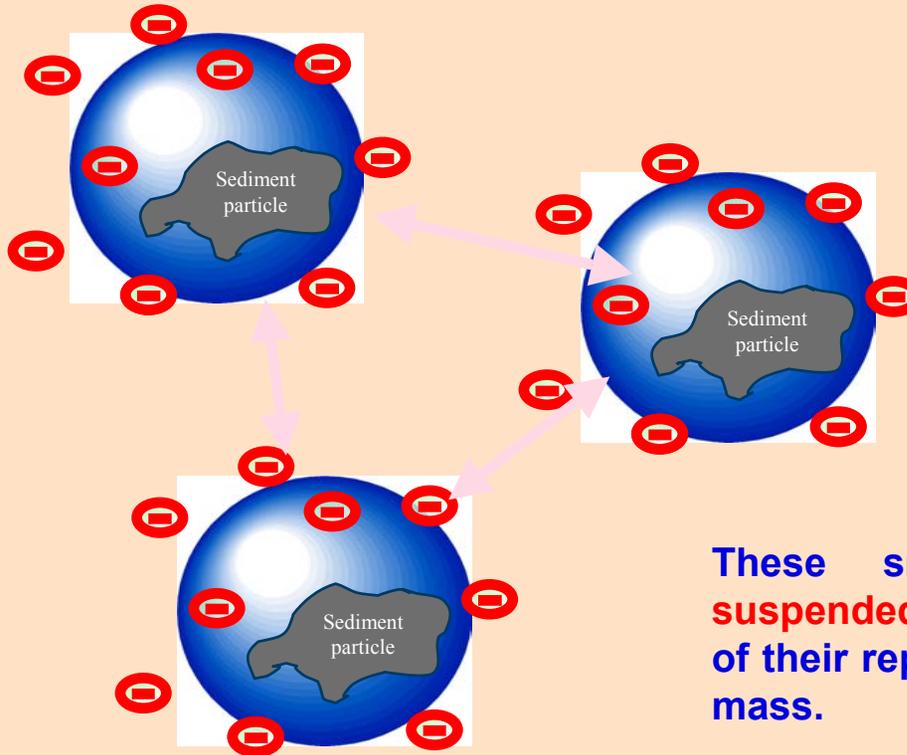
Advanced Treatment - Active Stormwater Treatment (Chemically-enhanced Treatment)



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Remember:

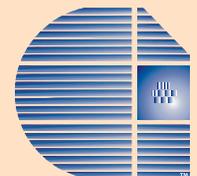


Note: The diagram shows negative electrostatic charge; many soil particles exhibit a positive electrostatic charge.

These small particles remain suspended in stormwater because of their repellent charges and small mass.



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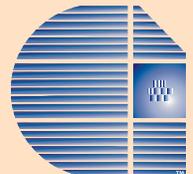


Coagulation and Flocculation

- ✚ Often used interchangeably, but are, in fact, two distinct processes.
- ✚ Coagulation is the destabilization of colloids by neutralizing the charges that keep them apart. As a result, the particles can collide to form larger particles (flocs).
- ✚ Flocculation is the action by which polymers facilitate the binding of floc particles into large clumps by providing adsorption sites onto which the particles can attach.



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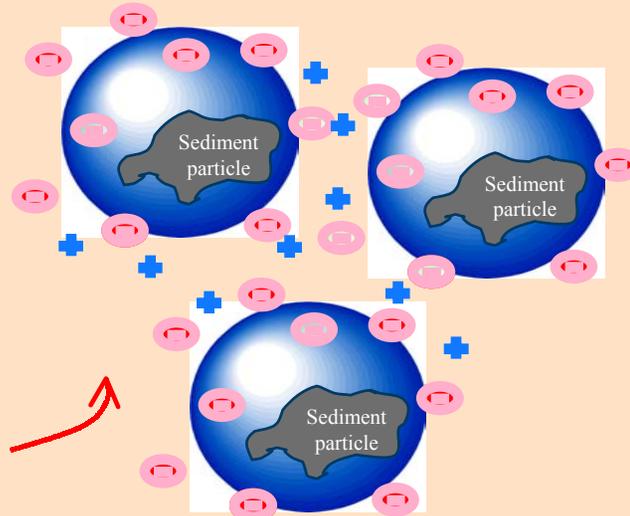


The Process of Coagulation and Flocculation – a Good Thing

Add
Coagulant



Neutralizes
electrostatic
charge

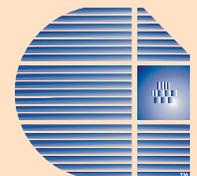


Flocculation

Once suspended particles are flocculated into larger particles, they can usually be removed from the liquid by settling, floating, filtering, or centrifuging.

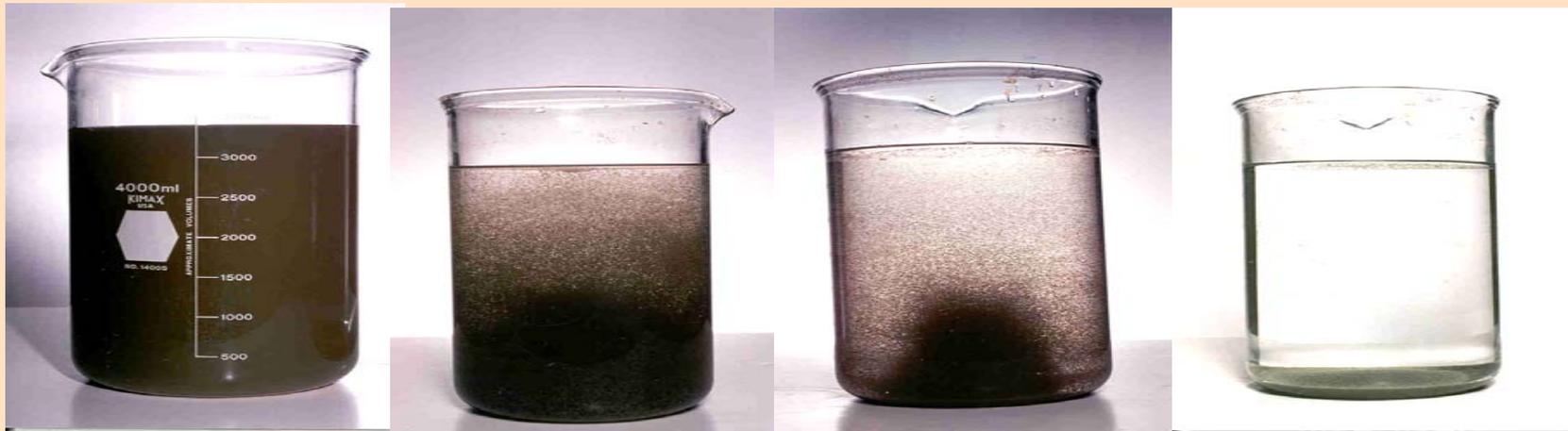


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Coagulation and Flocculation Demonstrated

(Chitosan Acetate added to form flocculate)



**No
Treatment**

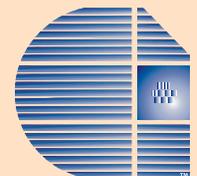
**At 30
Seconds**

**At 60
Seconds**

**At 30
Minutes**

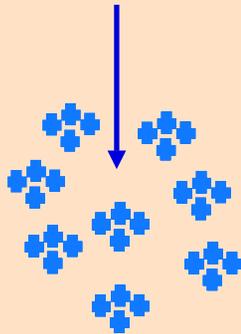


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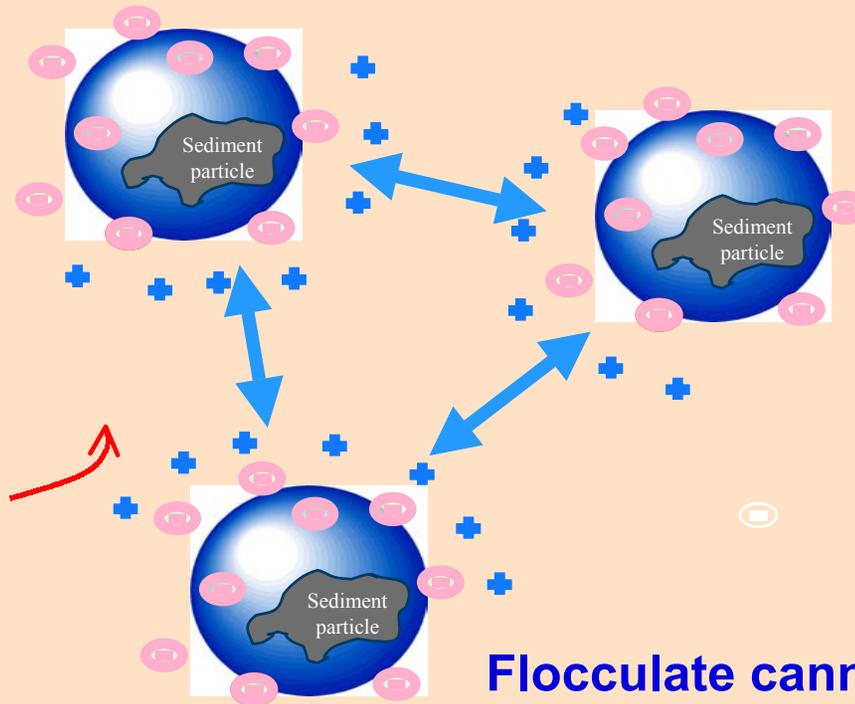


Over Dosing – Too Much of a Good Thing

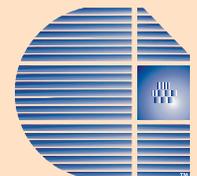
Add More
Coagulant



Reverses
electrostatic
charge



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Active (Chemically-enhanced) Stormwater Treatment

✦ Types of Coagulants and Flocculants (anionic, cationic, or non-ionic) –

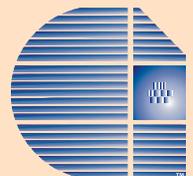
- Organic Polymers – e.g. chitosan, guar, modified starches
- Inorganic Polymers – e.g. Polyaluminumhydroxychloride, alum, ferric chloride
- Polyacrylamides (PAM)

✦ Separation of Suspended Sediment from Treated Water –

- Gravity Settling, or
- Filtering
- Centrifuging



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Active Stormwater Treatment Methods

Batch Treatment

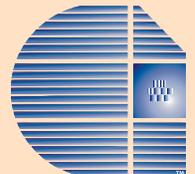
- Ponds
- Tanks

Flow-through Treatment

- Upstream Chemical Injection (Ponds or Tanks)
- Downstream Chemical Injection (Ponds or Tanks)



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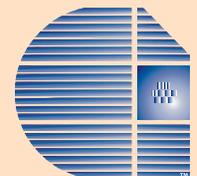


Stormwater Treatment in Washington

- ✚ City of Redmond – mid-1990s – pioneered the first methodical approach to temporary large-scale water treatment in the State.
- ✚ Resulted from the nexus of environmentally-conscious corporate developers (Microsoft), stringent environmental regulations, and two forward-looking (and independent thinking) regulators Guy Oliver (City of Redmond) and Ron Devitt (Ecology).
- ✚ *NPDES and State Waste Discharge General Permit for Stormwater Discharges Associated with Construction Activities* reissued in Nov. 1995.
- ✚ August 1999 – WA State Dept. of Ecology issues draft Best Management Practice for the implementation of construction chemical stormwater treatment.



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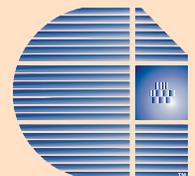


WA Turbidity Standards

- ± **Turbidity Standards for Discharges to Surface Waters Vary with the Turbidity of Receiving Waters.**
- ± **Turbidity Shall not Exceed:**
 - ± **5 NTU over background** turbidity when the background turbidity is 50 NTU or less.
- OR**
- ± **10 percent higher than background** when background turbidity is more than 50 NTU.
- ± **Other, more stringent standards may be required.**



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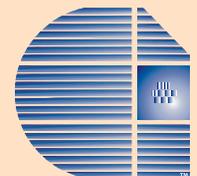
Active Batch Treatment



1. **Effective.**
2. **May require extended settling time.**
3. **Requires large footprint.**
4. **May require polishing filter at discharge.**



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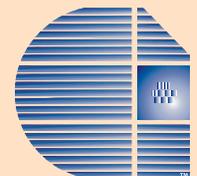
Active Flow-through Treatment – Dosing at Inlet



1. Effective and inexpensive.
2. Measure inlet flow and turbidity.
3. Liquid coagulant delivered in proportion to flow and turbidity.
4. Floc settles in pond.
5. Clean water decanted to discharge area.



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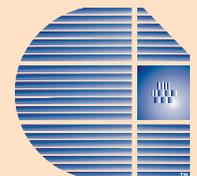
Active Flow-through Treatment – Dosing at Outlet



1. **Effective and inexpensive.**
2. **Passive chemical delivery (e.g. Gel-Floc).**
3. **Coagulant delivered in proportional to flow.**
4. **Floc removed by bio-filtration.**



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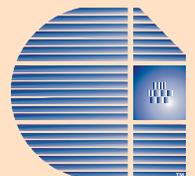


Coagulation using Sacrificial Electrodes (EC)

1. Technology described this morning by Jim Mothersbaugh of *Water Tectonics*.
2. Effective, safe, flow-through treatment process.
3. Currently under review by WA Dept. of Ecology.



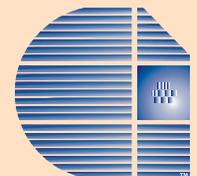
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CHEMICAL ENHANCED SAND FILTRATION



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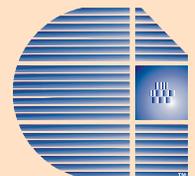
CHEMICAL ENHANCED SAND FILTRATION



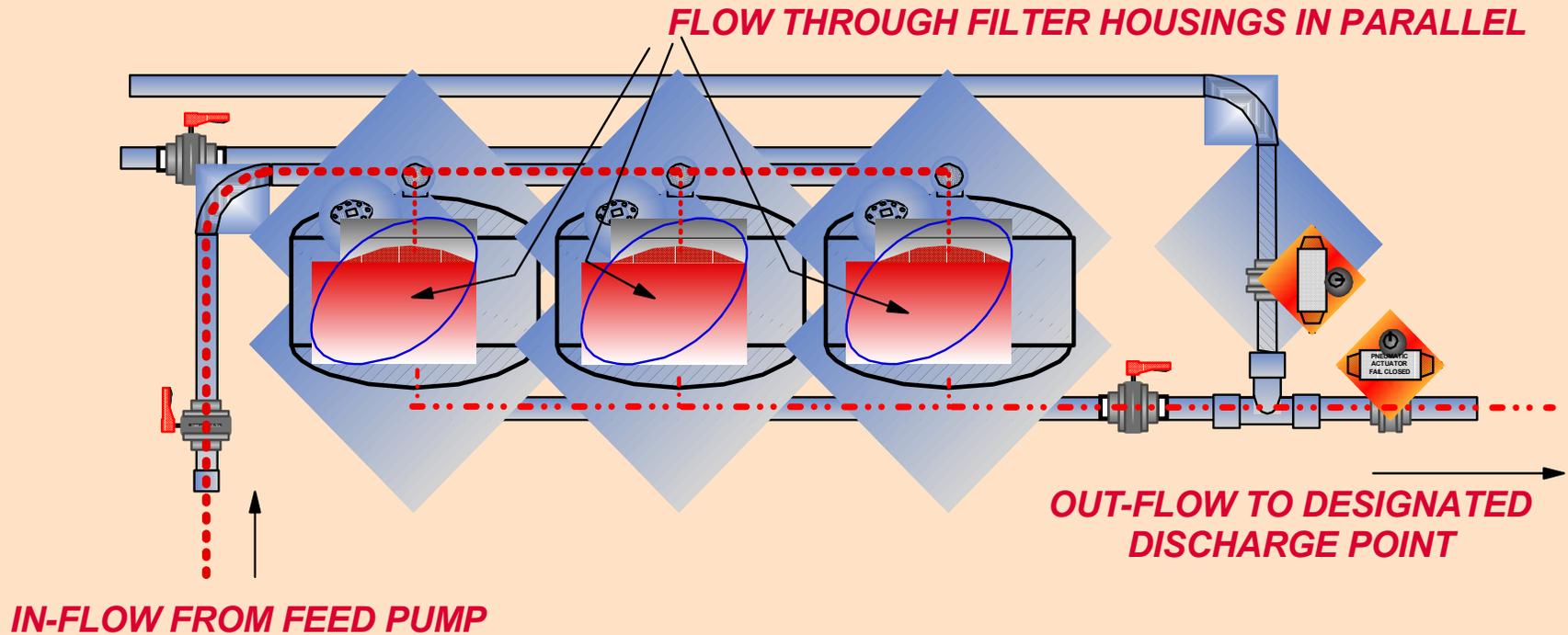
THE MOST COST EFFECTIVE PROCESS AVAILABLE FOR LARGE-VOLUME, FLOW-THROUGH STORMWATER TREATMENT



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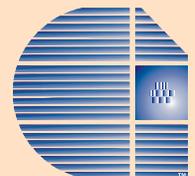
CHEMICAL ENHANCED SAND FILTRATION PROCESS FLOW DIAGRAM



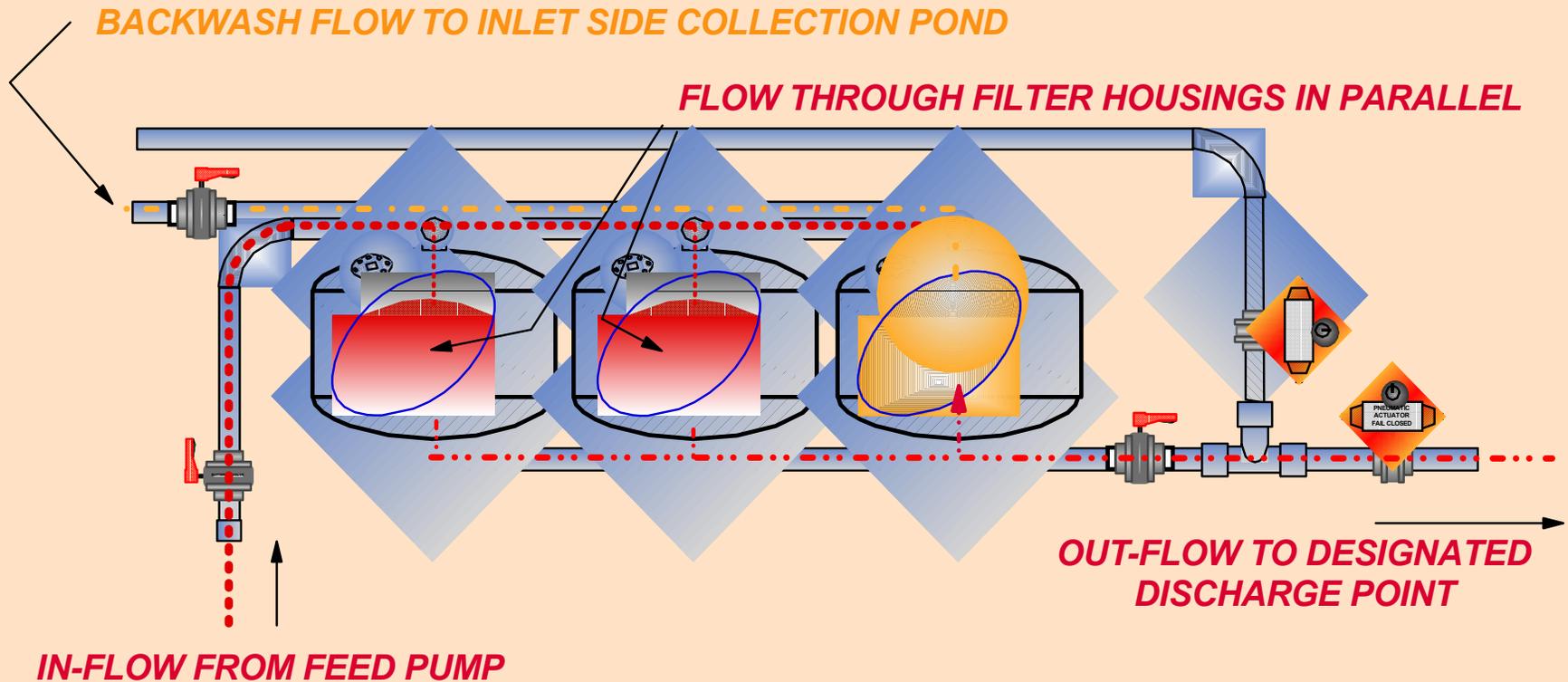
NORMAL FLOW



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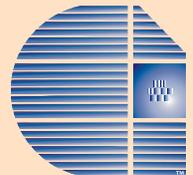
CHEMICAL ENHANCED SAND FILTRATION PROCESS FLOW DIAGRAM



BACKWASH FLOW – CYCLE 1

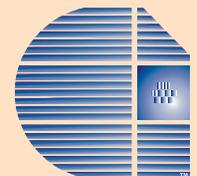


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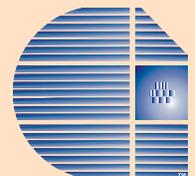
OPERATIONAL CAPABILITIES OF ENHANCED FILTRATION

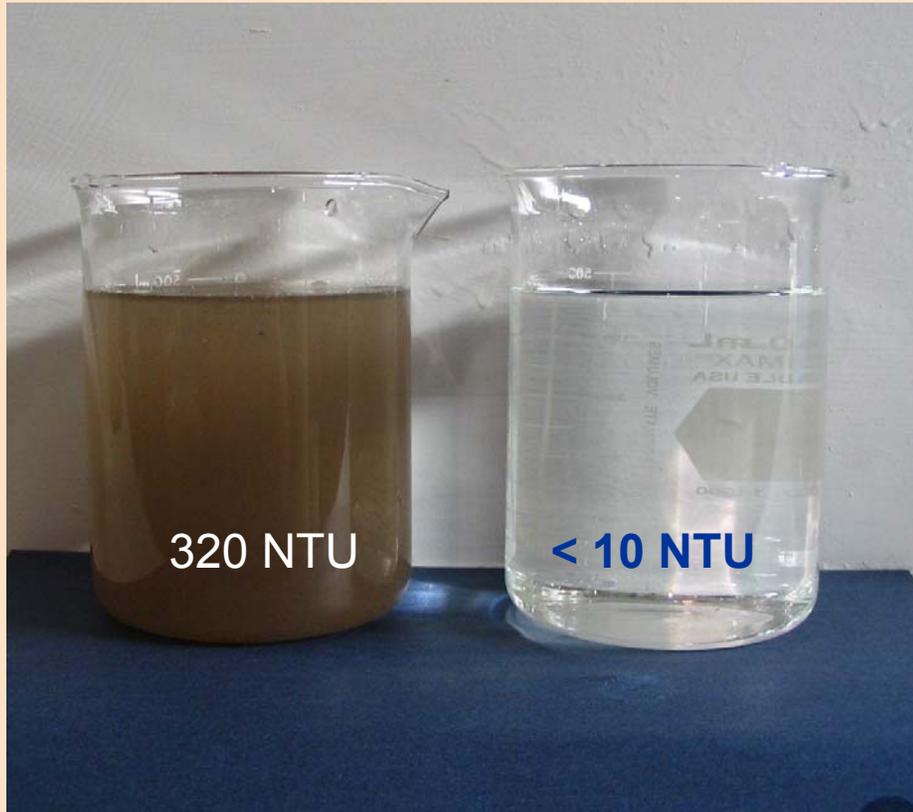
WHEN PROPERLY OPERATED AND MAINTAINED:

- OPERATES OVER THE pH RANGE OF 6.5 TO 8.5 (ENTIRE RANGE FOR ALLOWABLE DISCHARGES)
- < 10 NTU** 100% OF TIME WHEN INLET TURBIDITY < 400 – 500 NTU
- < 10 NTU** 100% OF TIME **WITH PRE-TREATMENT** OF INLET WATER WHEN INLET TURBIDITY > 400 – 500 NTU

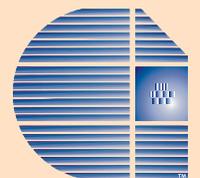


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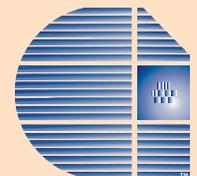
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A SIMILAR SYSTEM CAN BE ADAPTED FOR RECYCLING OF WHEEL-WASH WATER



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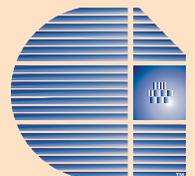


Selecting a Treatment Approach

- # Evaluate physical site conditions
- # Evaluate capacity of site to handle rainfall and runoff
- # Determine required system capacity
- # Conduct bench-scale testing



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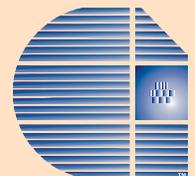


Evaluate Site Conditions

- ✚ Area
- ✚ Topography
- ✚ Soil Characteristics
- ✚ Water Characteristics
- ✚ Surface Conditions & Vegetation
- ✚ Downstream Conditions
- ✚ Other Off-Site Conditions
- ✚ Chemical Use on Site



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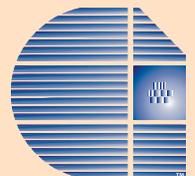


Evaluate Capacity of Site to Handle Rainfall and Runoff

- # **Historical rainfall volumes, durations, intensities**
- # **Anticipated runoff generated from rainfall**
- # **Maximum allowable rate(s) for discharging treated water**
- # **Actual / potential temporary storage volume for runoff**



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Determine Required System Capacity

$$\frac{(\text{Runoff Volume} - \text{Storage Volume})}{\text{Design Storm Duration}} = \text{Required System Capacity}$$

Required System Capacity < Allowable Discharge Rate

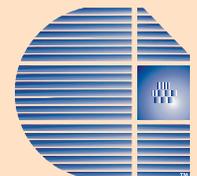
IF

Required System Capacity > Allowable Discharge Rate

MUST INCREASE STORAGE VOLUME



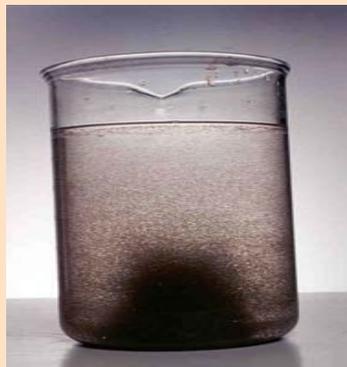
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Conduct Bench-scale Testing



✚ Evaluate filterability of water both before and after treatment.



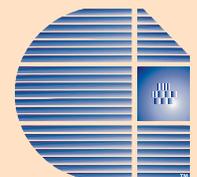
✚ Try different coagulants and flocculants

✚ Try different dose rates

✚ Determine optimum product and dose



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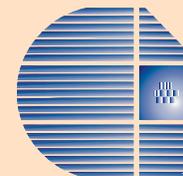


Managing and Treating Non-visible Pollutants

- # Phosphorus
- # Dissolved Metals
- # Solvents
- # Emulsified Hydrocarbons
- # Any Material Stored on Site
- # Other non-visible pollutants



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**Perform concrete work
in advance of storms**



**Designate areas
for tool and truck
wash out**

Collect slurry and runoff



Provide inlet protection

**Cover sacks
of concrete
and
admixtures**



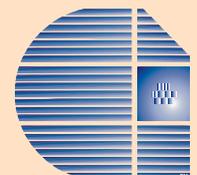
pH

▲	pH 14	Concentrated caustic soda
■	pH 13	Drain cleaner
■	pH 12	<u>Concrete wash-out water</u>
■	pH 11	Runoff from fresh concrete
■	pH 10	Runoff from fresh concrete
■	pH 9	Baking soda in water
■	pH 8.5	Highest pH for discharge
■	pH 8.0	Nearly neutral
■	pH 7.5	Nearly neutral
■	pH 7	NEUTRAL
■	pH 6.5	Lowest pH for discharge
■	pH 6	Nearly neutral
■	pH 5	(Some) Rainwater
■	pH 4	Cola
■	pH 3	Lemon juice
■	pH 2	Strong acid
■	pH 1	Strong acid
▼	pH 0	Concentrated sulfuric acid

**This pH range
will not harm
fish.**



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Manage pH

± CO₂ (solid, liquid, or gas)

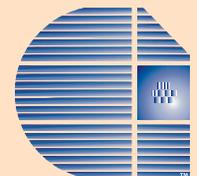
± H₂SO₄

± NaHCO₃

± NaOH



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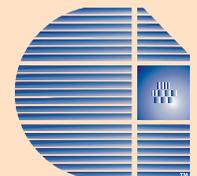


Temporary Treatment Ponds

- ✚ Heavy metals and semi-volatile organics were mobilized during pile driving operations.
- ✚ Detained, treated, and released to sanitary sewer.

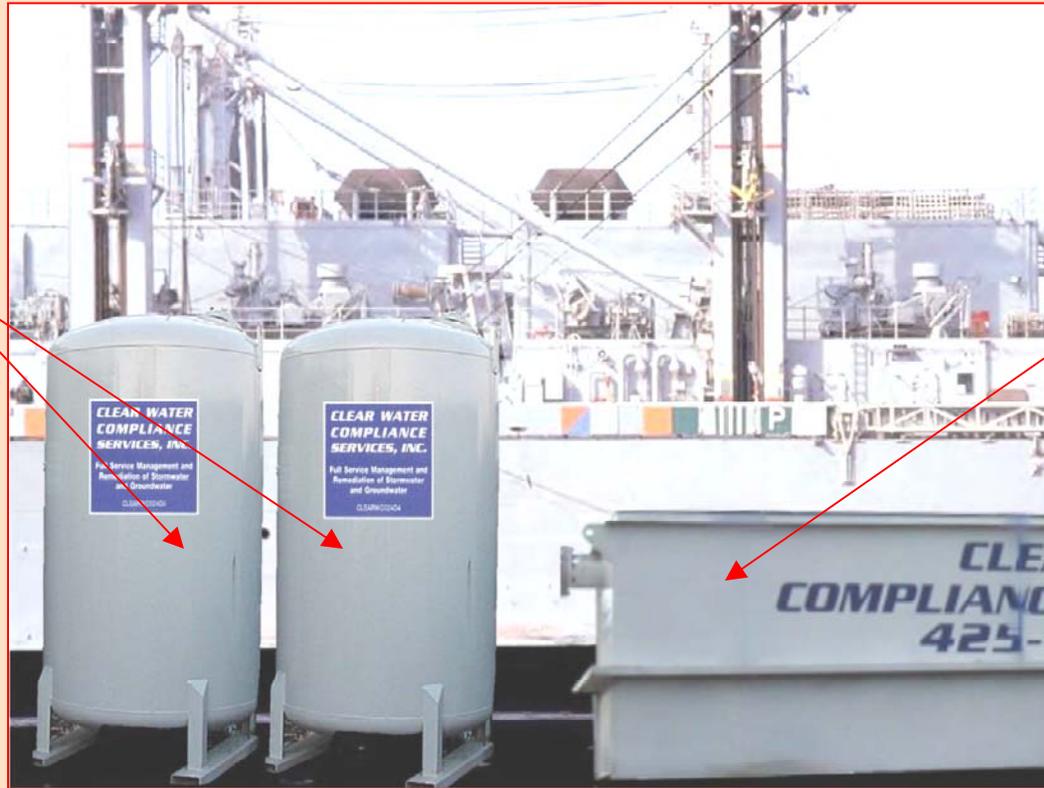


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Hydrocarbon Filtration

Carbon-Clay Polishing Media

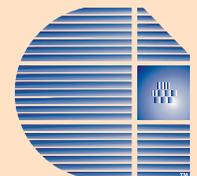


Oil/Water Separator

**TPH out 5 to 50 ppm (typical);
Discharge to sanitary sewer.**



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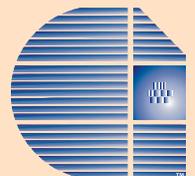


Summary

- ✚ **Why Advanced Treatment?**
- ✚ **Overview of Various Treatment Technologies**
- ✚ **Process Used for Selecting a Treatment Approach**
- ✚ **Managing and Treating Non-visible Pollutants**



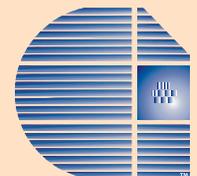
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- + AT needed because suspended sediment particles will not settle naturally in a timely manner.**
- + AT use coagulants to cause suspended sediment to agglomerate and settle or be filtered out.**
- + No one treatment methodology is appropriate for all conditions.**
- + Selection should account for site characteristics, soil and water characteristics, physical constraints, and applicable discharge water-quality criteria.**



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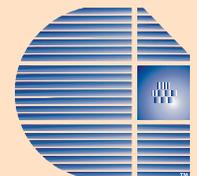


Stormwater Treatment Technician's Dream

- ✚ Clearly defined requirements
- ✚ Uniformly enforced from jurisdiction to jurisdiction



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Regulatory Permitting (NPDES Applications)



Stormwater Pollution Prevention Planning



Stormwater Treatment System Design



On-site Stormwater Management



Regulatory Compliance Monitoring

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