Stormwater Pollutant Monitoring

CELEBRATING 20 YEARS 1996-2016

Stormwater360 NEW ZEALAND

BETWEEN SKY AND SEA

Overview

- Why we monitor Stormwater
  - Environmental Protection
  - Regulations
- The Characteristics of Stormwater Pollution and how to Manage
- How to Monitor
  - Monitoring Guidance
  - Site Specific Monitoring
  - The Monitoring Plan
- Evaluation and Effectiveness
  - Effluent Limits vs Discharge Limits
  - Legal Implications
  - Why BMP's Fail
- Costs and Alternatives
- Conclusions

BETWEEN SKY AND SEA

Introduction

- Stormwater Pollution is an extremely big Problem
- The Stormwater Problem is New (<40 years)
- It's a Wild and Crazy thing Extremely variable
- Extremely difficult manage -No One Solution
- The key is better understanding and better communication

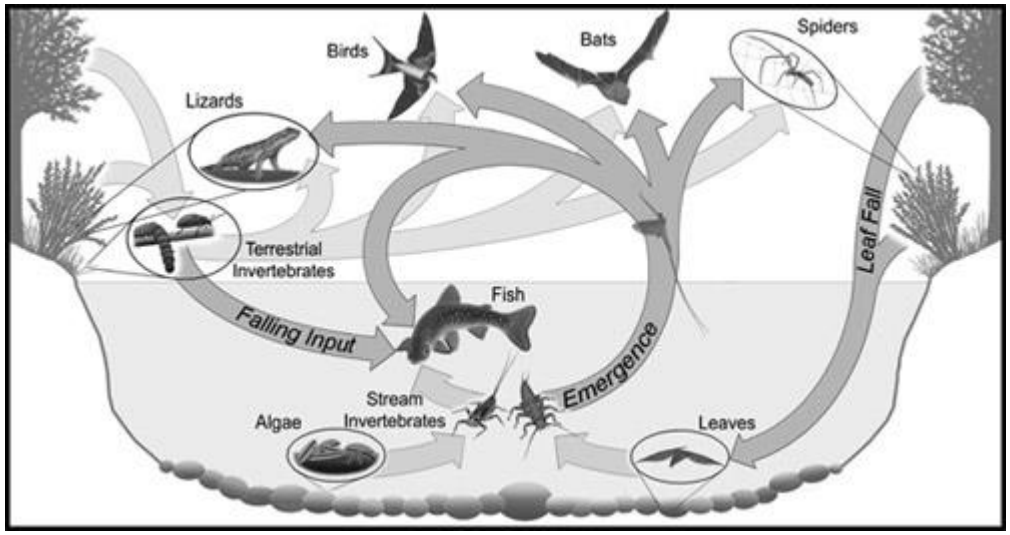
BETWEEN SKY AND SEA

WHY WE MONITOR

BETWEEN SKY AND SEA

Why We Monitor - Pollution

Why We Monitor - Ecology



BETWEEN SKY AND SEA

Why We Monitor - Resource Consent

When to sample and frequency	Sampling Location	Sampling method	Sampling Parameters and assessment criteria	Recording, reporting and review
Stormwater: Monitoring of stormwater prior to discharge from the site shall be undertaken on quarterly basis.	The final access point for site drainage before it is discharged to the public stormwater system: public stormwater manhole #1019653 located within the site at the end of Penihana Place.	Samples collected using extendable sampling pole, and transferred into dedicated sample jars supplied by the laboratory. Samples placed into an ice filled chilly bin and submitted under appropriate chain of custody (CoC) documentation to an IANZ accredited laboratory.	Laboratory analysis for pH, total suspended solids (TSS), dissolved and total metals (copper, zinc, lead) and Total Petroleum Hydrocarbons (TPH)	Sample analysis results will be recorded and reported against ANZECC Guideline values. Reporting will be accompanies by relevant meteorological data (rainfall intensity, dry days etc.) Drains, pits and interceptors will be inspected and maintained as per the maintenance and monitoring program (Refer to Section 3.2; Management of water treatment devices). Results of inspections will be recorded in the site audit records.
Trade Waste: Sampling undertaken biannually	One sample location (tradewaste discharge point into sewer from oil and grit interceptor treating bus washing bay). 1 QA/QC duplicate per round.	Samples collected using extendable sampling pole, and transferred into dedicated sample jars supplied by the laboratory. Samples placed into an ice filled chilly bin and submitted under appropriate chain of custody (CoC) documentation to an IANZ accredited laboratory.	***Sampling program to be refined based on conditions as specified by Watercare in the Trade Waste Agreement.*** Proposed sampling undertaken biannually with samples analysed for pH, oil and grease and total petroleum hydrocarbons (C7-C36 and C7-C14 fractions).	

BETWEEN SKY AND SEA

Resource Consent Conditions

Substance	Trigger levels	
	ANZECC Guidelines (2000)[1,2]	Trade Waste Bylaw (2013) Controlled Substance Standards
Total metals		
Copper	-	10
Lead	-	2
Zinc	-	15
Chromium	-	25 (Total) / 5 (vi)
Nickel	-	5
Dissolved metals		
Copper	0.007	
Lead	0.017	
Zinc	0.04	
Chromium	0.005	
Nickel	0.055	
TPH		
Total C_7-C_{36}	-	50
Total Suspended Solids	100[3]	1000
pH (pH units)	6 - 9	6 - 10.5

NOTES:

All results and criteria are expressed as mg/L.

- = no guideline criteria.

(1) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000.

(2) Values converted from µg/L.

(3) No ANZECC guideline is available and hence the value specified in Environmental Guidelines for Water Discharges from Petroleum Industry Sites (MfE, 1998) has been adopted.

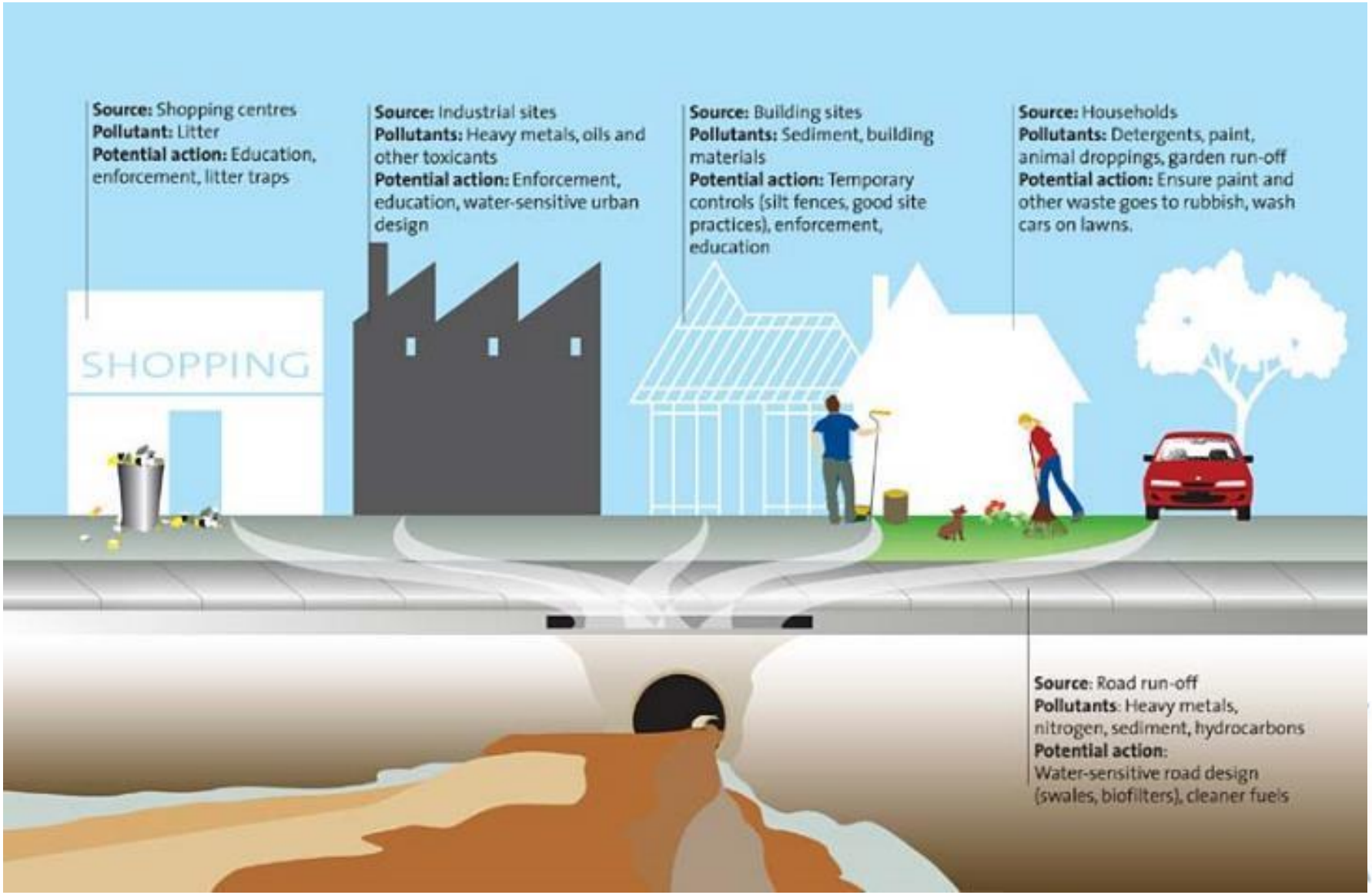
The

BETWEEN SKY AND SEA

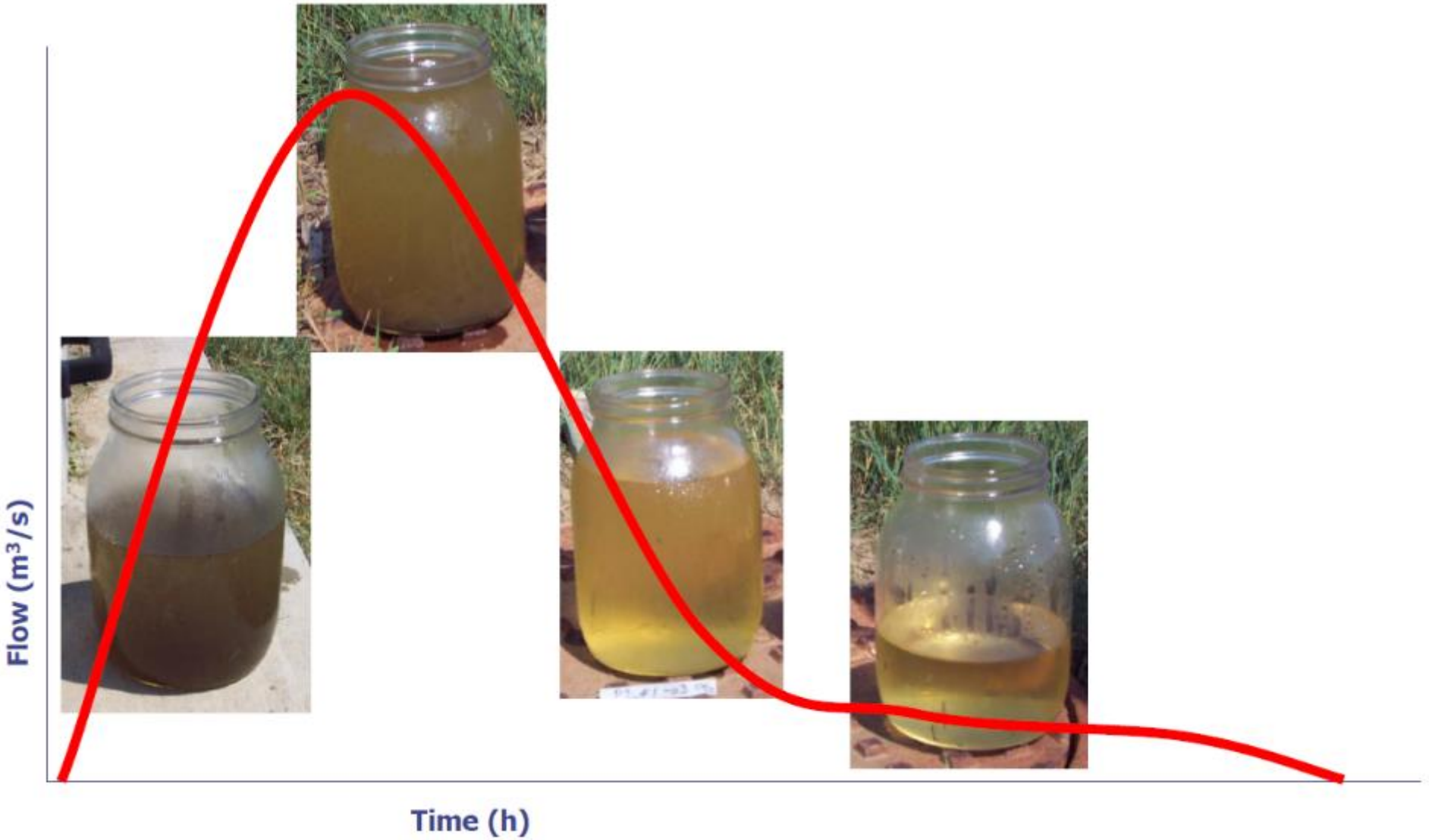
THE CHARACTERISTICS OF STORMWATER POLLUTION

BETWEEN SKY AND SEA

Where Does it Come From



The First Flush Phenomena



No Two Storms are the Same

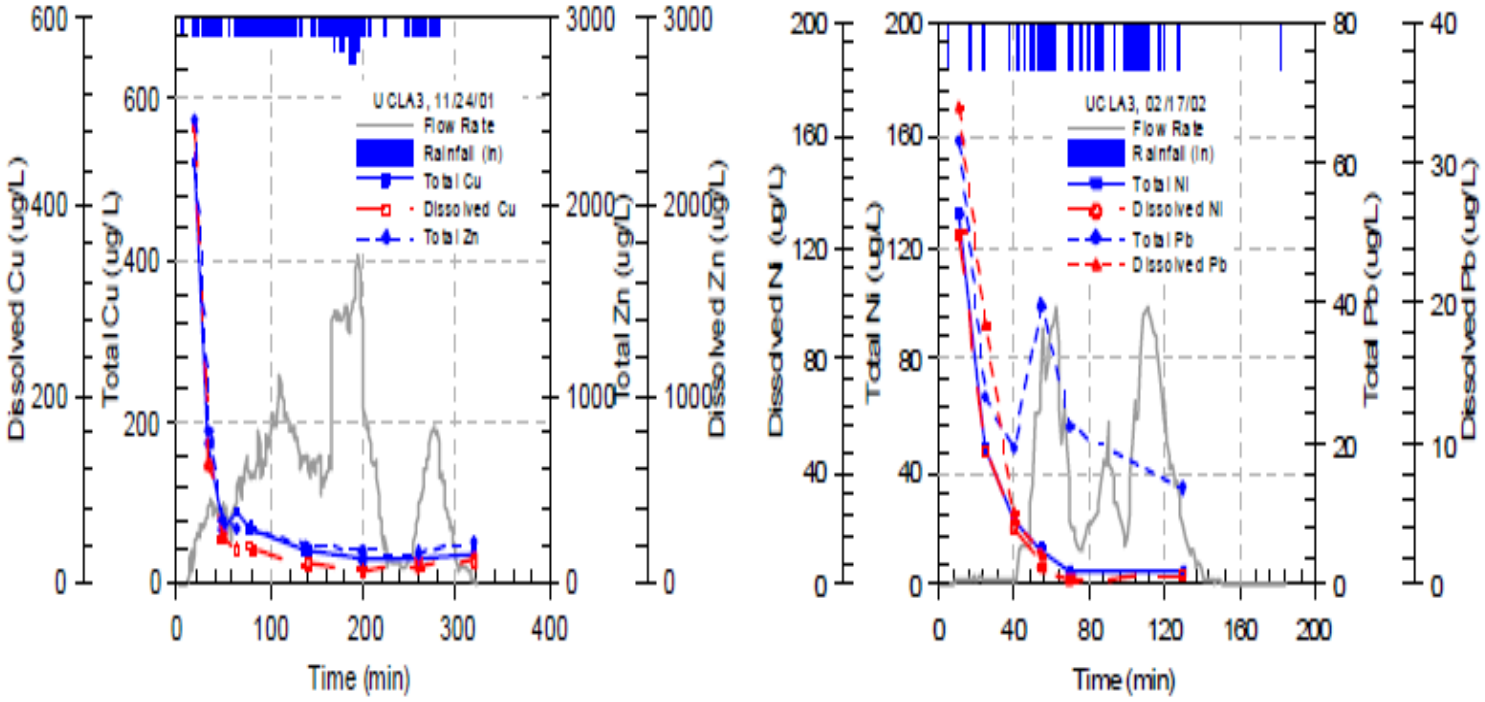
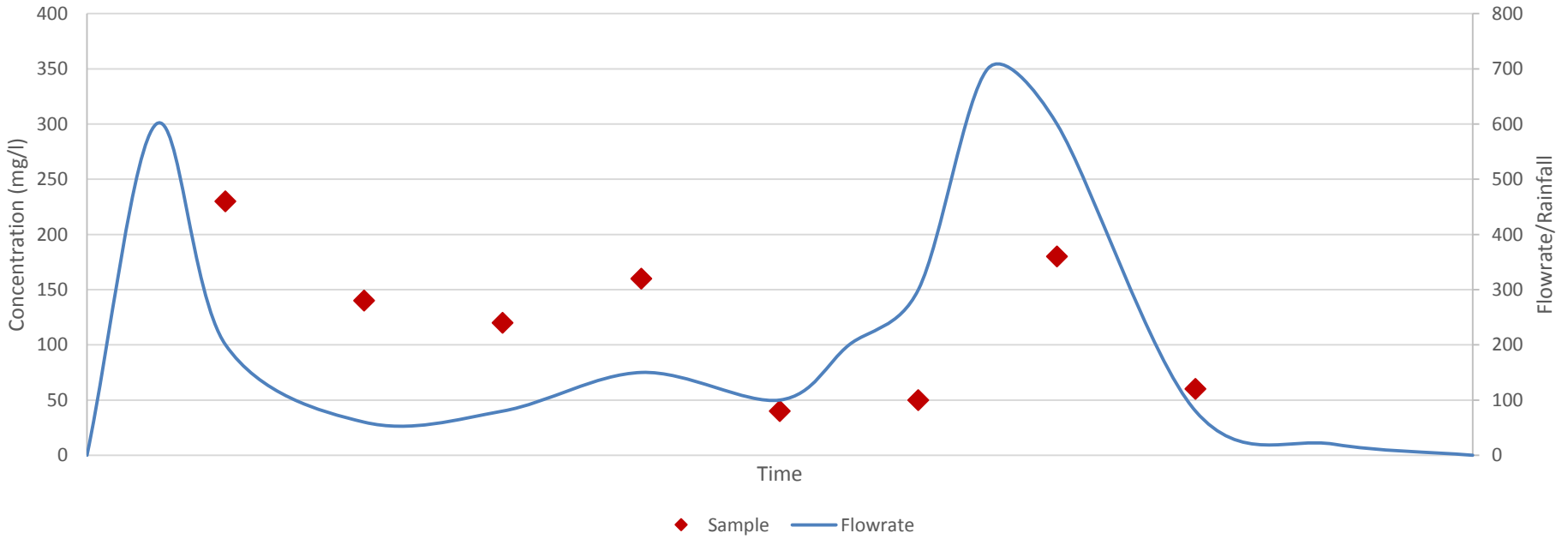
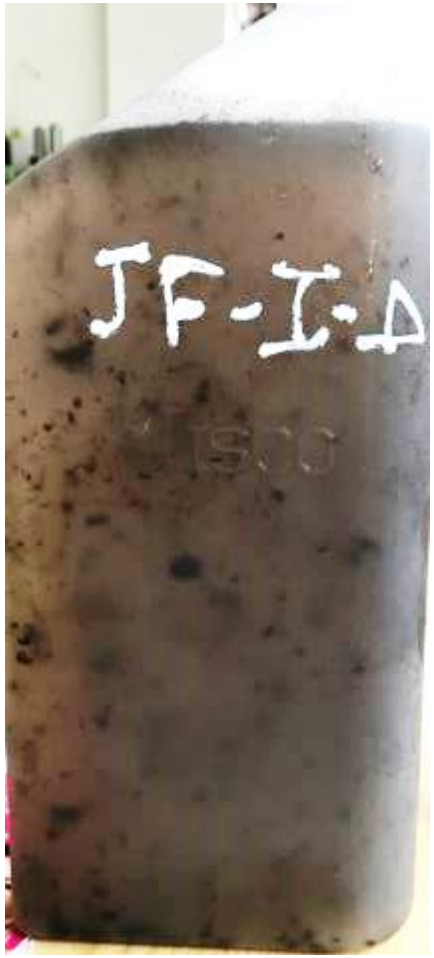


Figure 6. Typical pollutographs for total and dissolved Cu, Pb, Ni, and Zn during two representative storm events

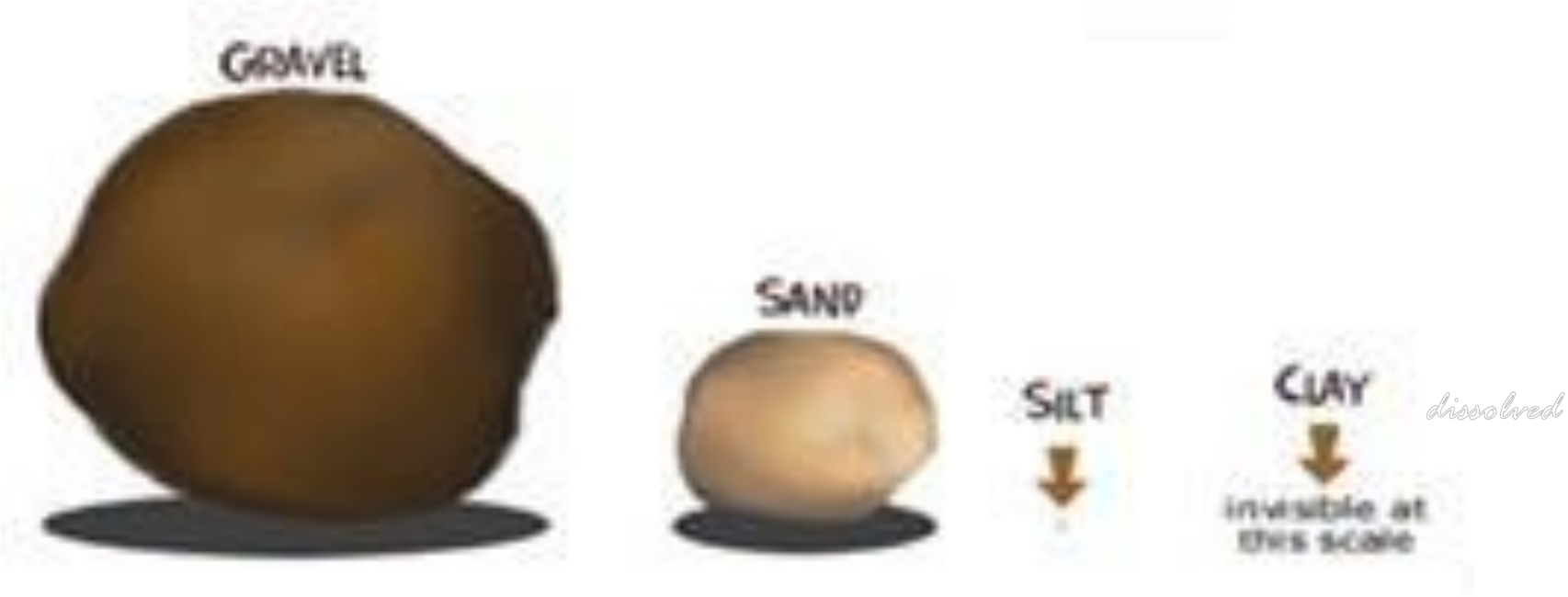
Rainfall and Concentration



Contaminates Transform



Size Matters?



SKY AND SEA

Stormwater is a Soup

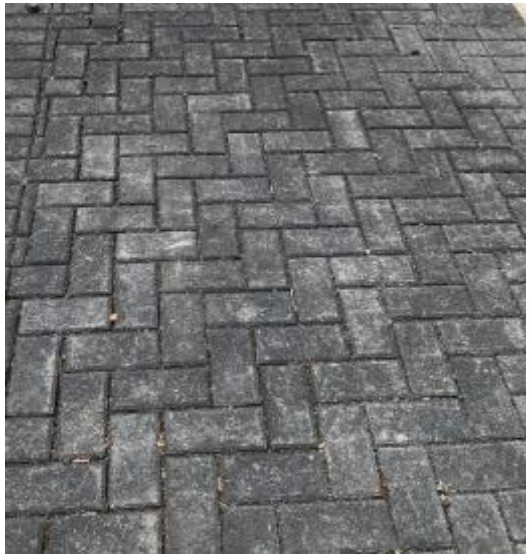
BETWEEN SKY AND SEA

HOW TO MANAGE IT

Best Management Practices

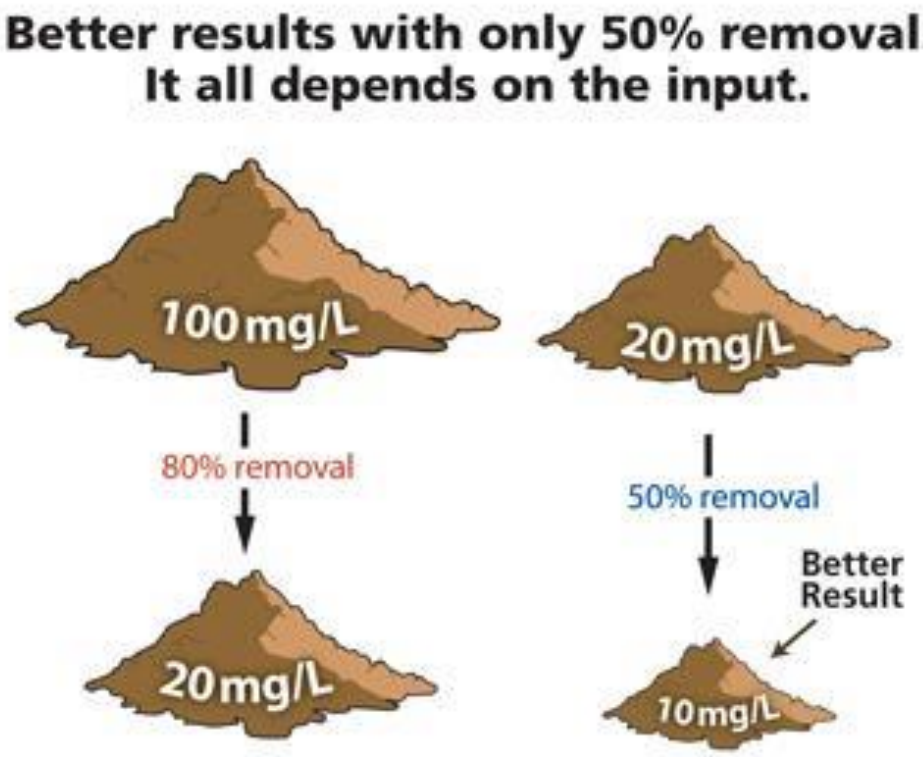
BETWEEN SKY AND SEA

Structural



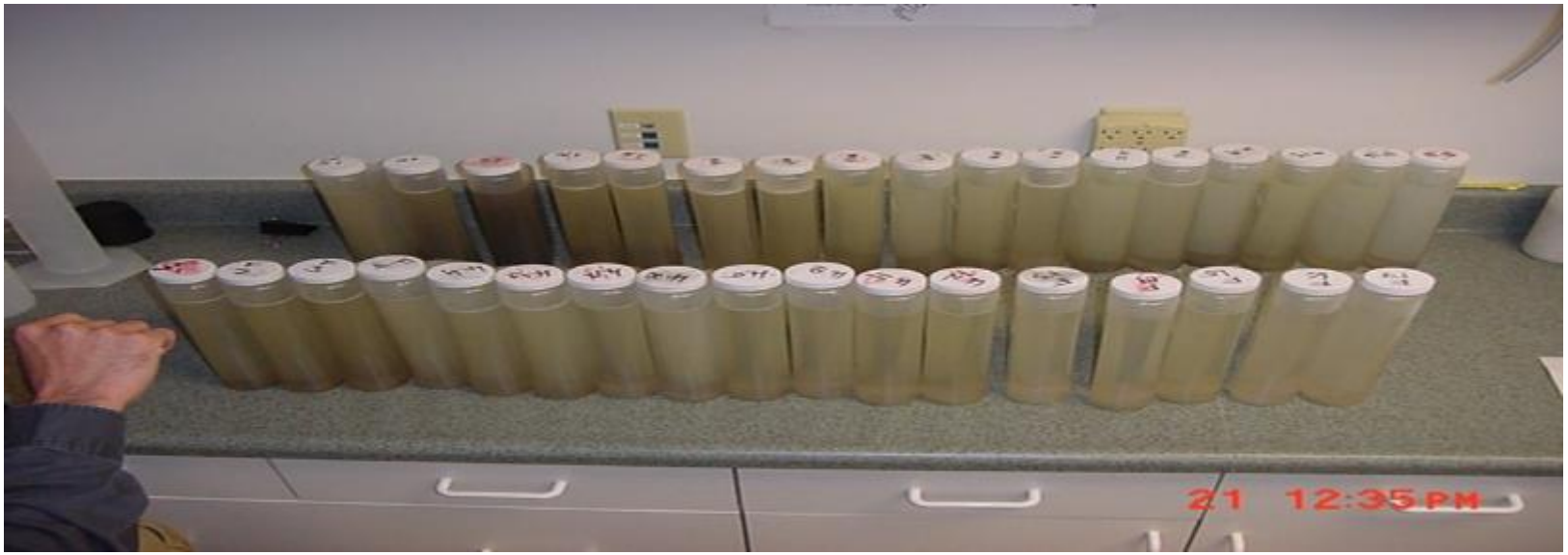
Non Structural BMP’s

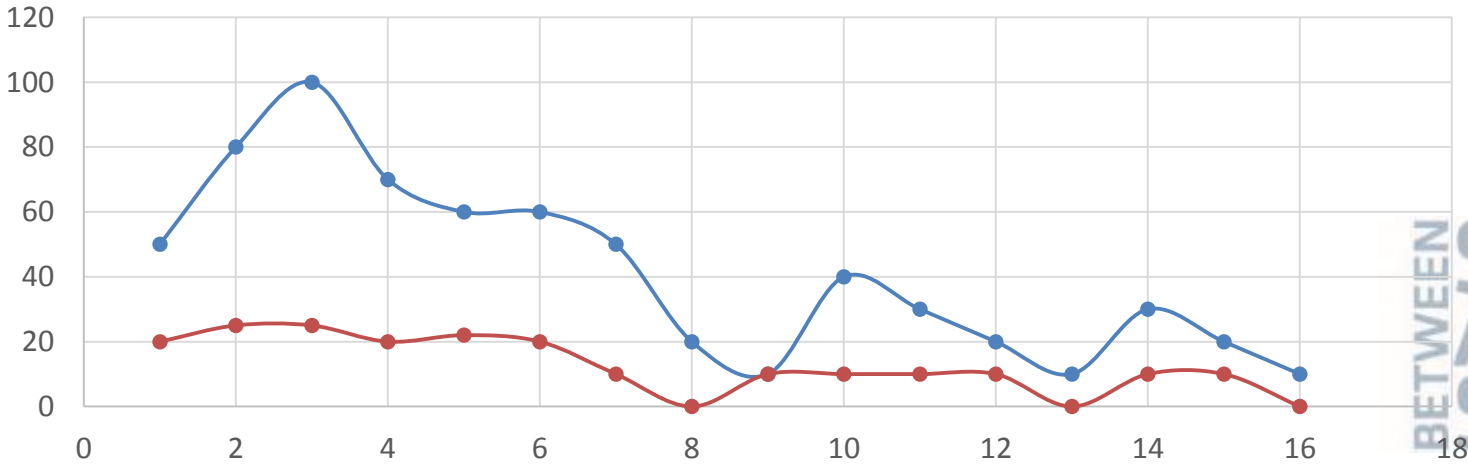
Three Keys to BMP Performance: Concentration, Volume, and Total Load



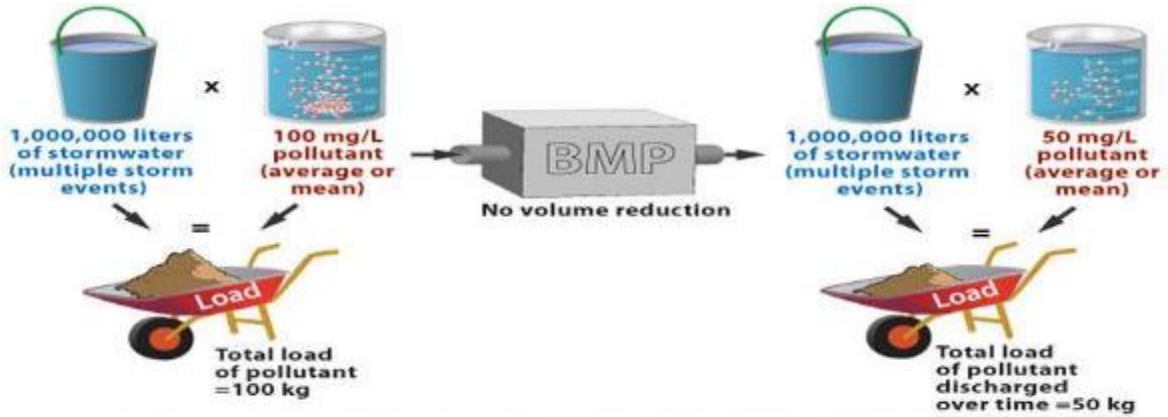
BETWEEN SKY AND SEA

Performance Varies With Concentration

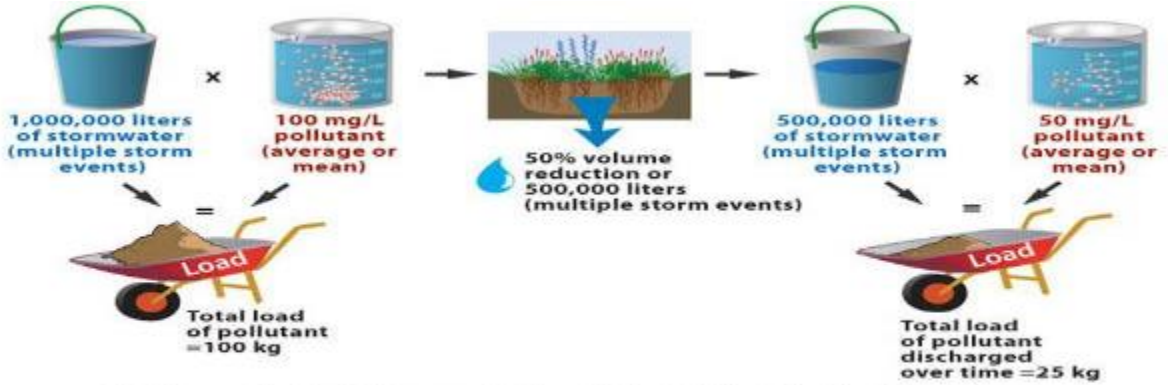




Load Reduction



In this example, the BMP removes 50 kg or 50% of the "total load" of this pollutant. It does not reduce the volume of stormwater discharged.



In this example, the BMP removes 75 kg or 75% of the "total load" of this pollutant. The "true" performance of this BMP is only apparent when we factor in the impact of volume reduction and calculate the total load of the pollutant.

BETWEEN SKY AND SEA

HOW TO MONITOR

BETWEEN SKY AND SEA

National and International Guidance

- USEPA
  - Industrial Stormwater Monitoring and Sampling Guide
  - NPDES Stormwater Sampling guide.
- New Zealand
  - Environment Southland, Design of Stormwater Monitoring Programmes

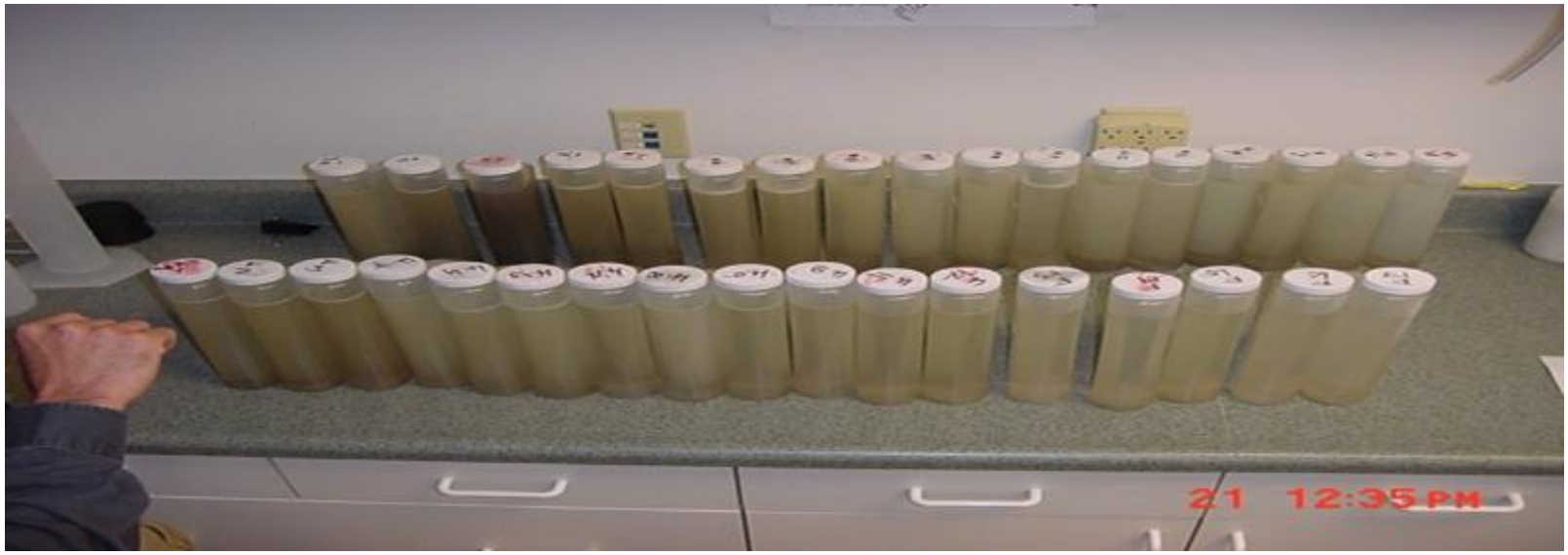
BETWEEN SKY AND SEA

Monitoring Programme

- **Site selection considerations**, to ensure samples accurately represent the area of interest and to ensure safety of equipment and personnel.
- **Storm event considerations** such as the depth of rainfall required and the time between storms.
- **Flow measurement methods** including water level control structures, water level measurements and direct flow measurements; and the advantages and disadvantages of each.
- **Water sampling methods,** using grab sampling and auto samplers; time proportional, flow-proportional and volume-proportional sampling; and discrete versus composite samples.
- **Analytes and methods** that will provide relevant and useable data for different monitoring programmes.
- **Data collection, management and manipulation:** to obtain the maximum value from monitoring programmes through collection of additional metadata, error checking and calculation of stormwater measures such as EMC and loads.

Grab Sampling

BETWEEN SKY AND SEA



- For Grad sample to be meaning full the following information should acquired.
  - Numerous samples with time noted at each sample
  - Time calibrated rain gauge
  - Samples should be collected through the duration of the storm.

BETWEEN SKY AND SEA

Flow Proportional Sampling

Methods

Table 7-2 (contd): Recommended bottles, preservation, holding times, methods and suitable detection limits for stormwater analytes.

Analyte	Bottle type	Preservation method	Recommended maximum holding time when preserved	Recommended Analytical Method	Method Reference	Suitable detection limit
Total metals (except mercury)	Acid-washed PE	Add HNO_3 to pH<2	6 months	Total recoverable digestion (HNO_3 / HCl) extraction, ICP-MS	USEPA 200.2	Cu 0.0006 mg/L, Zn 0.001 mg/L, As 0.001 mg/L, Cd 0.0001 mg/L, Cr 0.0006 mg/L, Ni 0.004 mg/L, Pb 0.0001 mg/L
Dissolved metals (except mercury)	Acid-washed PE	Filter immediately then add HNO_3 to pH<2 If cannot be filtered, store at < 4°C	6 months	Filtration, ICP-MS	USEPA 200.2	Cu 0.0006 mg/L, Zn 0.001 mg/L, As 0.001 mg/L, Cd 0.0001 mg/L, Cr 0.0006 mg/L, Ni 0.004 mg/L, Pb 0.0001 mg/L
Total mercury	Acid-washed glass	Either HNO_3 to pH<2 or 0.5% H_2SO_4, 0.05% $K_2Cr_2O_7$	28 days	Hydridation vapour AAS, or cold vapour AFS, or ICP-MS	APHA 3112B, USEPA 245.7, APHA 3125	0.0001 mg/L
Dissolved mercury	Acid-washed glass	Filter immediately then add HNO_3 to pH<2 If cannot be filtered, store at < 4°C	28 days	Filtration then hydridation vapour AAS, or cold vapour AFS, or ICP-MS	APHA 3112B, USEPA 245.7, APHA 3125	0.0001 mg/L
TPH	Solvent-washed glass	< 4°C, H_2SO_4 to pH <2	7 days	Solvent extraction, GC-FID	OEMG or USEPA 8015C	0.2 mg/L
VOCs	Solvent-washed amber glass	< 4°C	7 days	Purge and trap or headspace extraction, GC-MS	USEPA 8021	0.005 mg/L
SVOCs	Solvent-washed glass	< 4°C	14 days	Solid phase or liquid/liquid extraction (LLE), GC-MS selected ion monitoring (SIM) quantification	USEPA 8270	0.01 mg/L
PAHs	Solvent-washed glass	< 4°C	14 days	Solid phase or LLE, GC-MS SIM quantification	USEPA 8270	0.0001 mg/L
Phenols	Solvent-washed glass	< 4°C, H_2SO_4 to pH <2	28 days	Solid phase or LLE, GC-MS SIM quantification	USEPA 8270	0.01 mg/L

BETWEEN SKY AND SEA

Quality Assurance & Consistency

- Minimum of 3 dry days before a monitoring event
- Minimum of 6 samples
- Photos of samples and visual observations noted.
- Duplicates taken
- Quality Assurance Plan

BETWEEN SKY AND SEA

Costs

- Grab Sampling
  - At least 6 samples
  - 13 x 6 x 30=$2340^{++} per storm
  - No very meaningful
- Flow Proportional
  - $3-5000 Set Up
  - $180 per storm
  - Representative and comparable Da

Substance
Total metals
Copper
Lead
Zinc
Chromium
Nickel
Dissolved metals
Copper
Lead
Zinc
Chromium
Nickel
TPH
Total C_7-C_{36}
Total Suspended Solids
pH (pH units)

BETWEEN SKY AND SEA

EVALUATION

BETWEEN SKY AND SEA

Water Quality and Effluent Limits

- ANZECC is an example of water quality guideline for ambient water.
- Currently no discharge quality guidelines in NZ

BETWEEN SKY AND SEA

Development of Effluent Guidelines

- To develop Effluent Guidelines, EPA first gathers information on:
- industry practices
- characteristics of discharges (e.g., pollutants, flow variability, stormwater)
- technologies or practices used to prevent or treat the discharge
- economic characteristics
- EPA identifies the best available technology that is economically achievable for that industry and sets regulatory requirements based on the performance of that technology. The Effluent Guidelines do not require facilities to install the particular technology identified by EPA; however, the regulations do require facilities to achieve the regulatory standards which were developed based on a particular model technology.

Action Levels

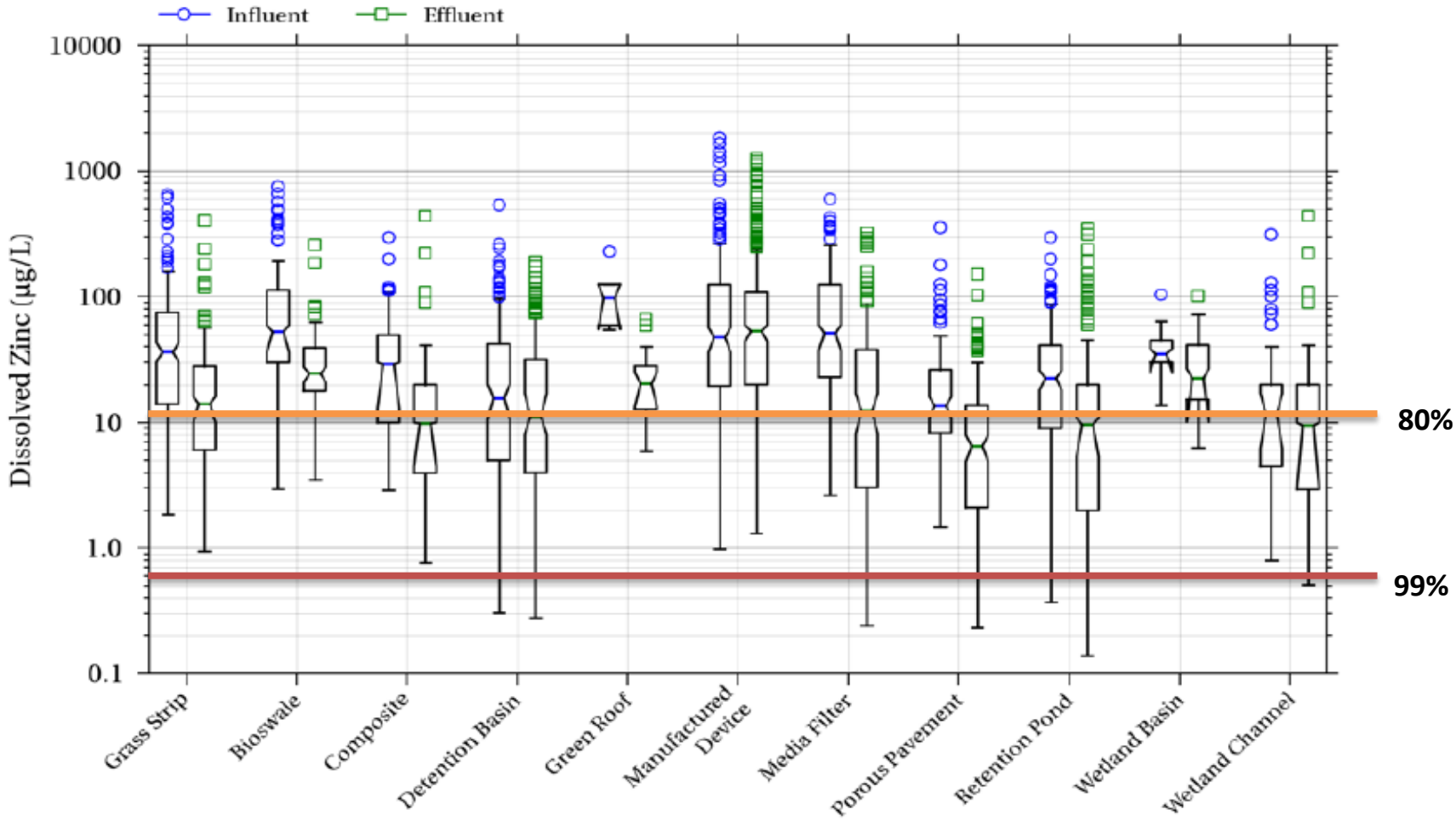
Parameter	Test Method	Reporting Units	Annual NAL	Instantaneous Maximum NAL
pH*	See Section XI.C.2	pH units	N/A	< 6.0 or > 9.0
Suspended Solids (TSS)*, Total	SM 2540-D	mg/L	100	400
Oil & Grease (O&G)*, Total	EPA 1664A	mg/L	15	25
Zinc, Total (H)	EPA 200.8	mg/L	0.26**	
Copper, Total (H)	EPA 200.8	mg/L	0.0332**	

Source: California Water Board Numeric Action Levels

Alternately develop dilution factors(multiplier) based on ANZECC to allow for mixing zones for discharge location

BETWEEN SKY AND SEA

Structural BMP Performance



http://www.bmpdatabase.org/

Urban Runoff Quality Information System (URQIS)

Legal Issues

- Not possible to set a effluent limit on a municipal network as it is not possible to control the sources of pollutants.
- It is possible to set a limit for an industrial site as they should be able to control what goes on a site.

Why BMP's Fail

- Designed incorrectly
- Constructed incorrectly
- Not being maintained correctly

Process monitoring/ Physical progress monitoring

- An alternative to discharge monitoring
- Is process monitoring/ physical progress monitoring and review.
- The leading cause of BMP failure is poor design, construction and operation.
- i.e. make sure the BMP is design correctly, Constructed correctly and Operated correctly.
- This can be applied to both structural and Non structural
- More meaningful than discrete grab sampling.

Conclusion

- The variable nature of stormwater pollutants makes monitoring stormwater difficult.
- Water quality guidelines are not discharge quality guidelines
- Conditions should either require a approved monitoring/ sampling plan or prescribe how sampling should undertaken
- Automatic storm based sampling is more meaningful the grab samples
- Structural BMP's performance is limited other method's may be needed top meet limits.
- Catchment or network wide discharge limits are currently not legally enforceable
- Action levels should be set considering land use, performance ability of best available technology's or dilution factors
- BMP fail because of incorrect design, construction and maintenance. Process monitoring can address this

Thank You

&

Questions?

michaelh@stormwater360.co.nz