

TECHNICAL DOCUMENT 3228
June 2008

Metals Load Reduction in Storm Water using High-Efficiency Sweepers

**Joint Services Environmental
Management Conference
5–9 May 2008, Denver, Colorado**

C. Katz
E. Arias

Approved for public release;
distribution is unlimited.

SSC San Diego

TECHNICAL DOCUMENT 3228
June 2008

Metals Load Reduction in Storm Water using High-Efficiency Sweepers

**Joint Services Environmental
Management Conference
5–9 May 2008, Denver, Colorado**

C. Katz
E. Arias

Approved for public release;
distribution is unlimited.



SSC San Diego
San Diego, CA 92152-5001

SSC SAN DIEGO
San Diego, California 92152-5001

M. T. Kohlheim, CAPT, USN
Commanding Officer

C. A. Keeney
Executive Director

ADMINISTRATIVE INFORMATION

This presentation was prepared by the Environmental Sciences Branch (Code 71750) of the Advanced Systems and Applied Sciences Division (Code 71700), Space and Naval Warfare Systems Center San Diego. The presentation was made at the Joint Services Environmental Management Conference held 5–9 May 2008 in Denver, Colorado.

Released by
D. B. Chadwick, Head
Environmental Sciences Branch

Under authority of
M. Machniak, Head
Advanced Systems and
Applied Sciences Division

This is a work of the United States Government and therefore is not copyrighted. This work may be copied and disseminated without restriction. Many SSC San Diego public release documents are available in electronic format at <http://www.spawar.navy.mil/sti/publications/pubs/index.html>.

Metals Load Reduction in Storm Water using High Efficiency Sweepers

Chuck Katz
Ernie Arias

Environmental Sciences Branch
SPAWAR Systems Center San Diego
chuck.katz@navy.mil

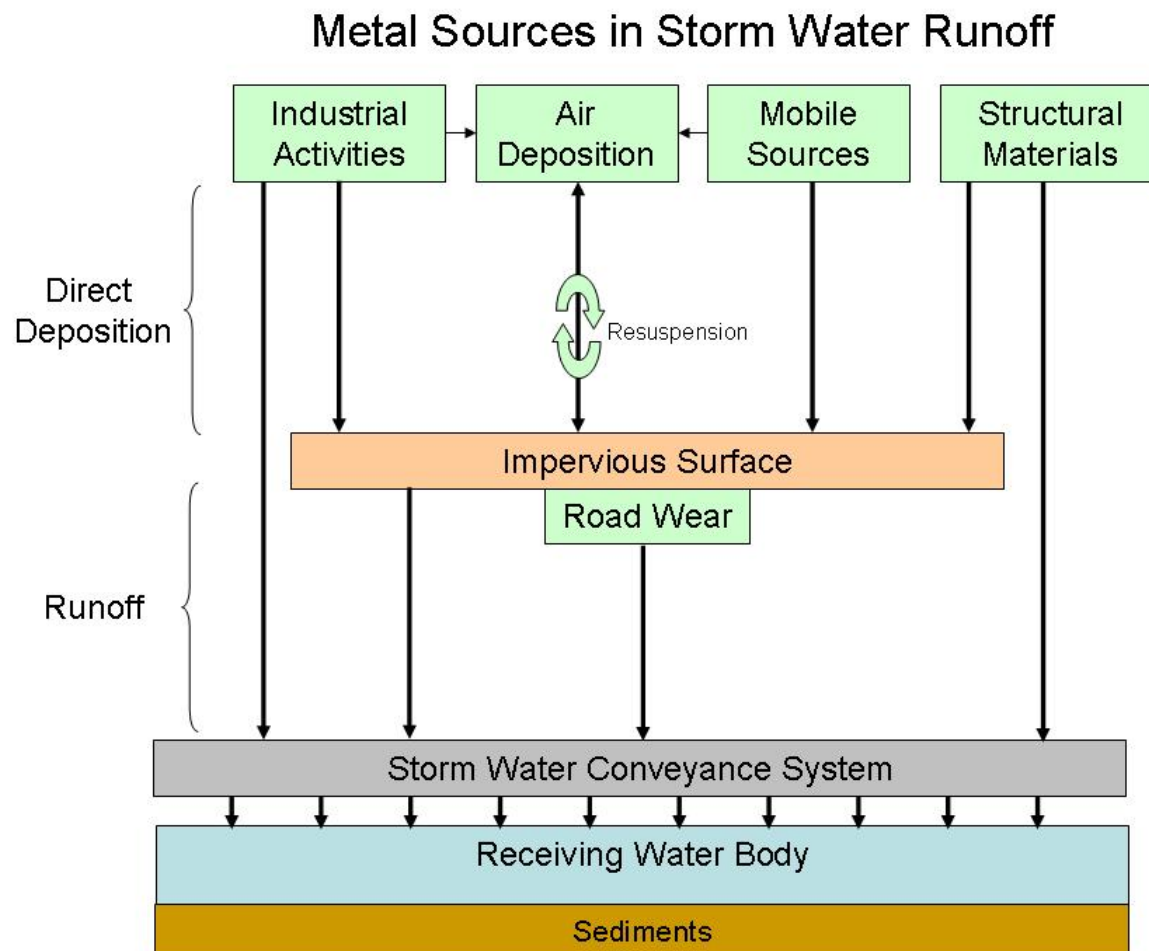
The Problem

- Storm water metal concentrations, particularly copper and zinc, commonly exceed storm or process water discharge compliance requirements resulting in:
 - Lawsuits: Storm water in Navy Region Southwest
 - NOVs: Dry docks in Navy Region Northwest and Hawaii
 - TMDLs: Water and sediment TMDLS in most Regions

Why?

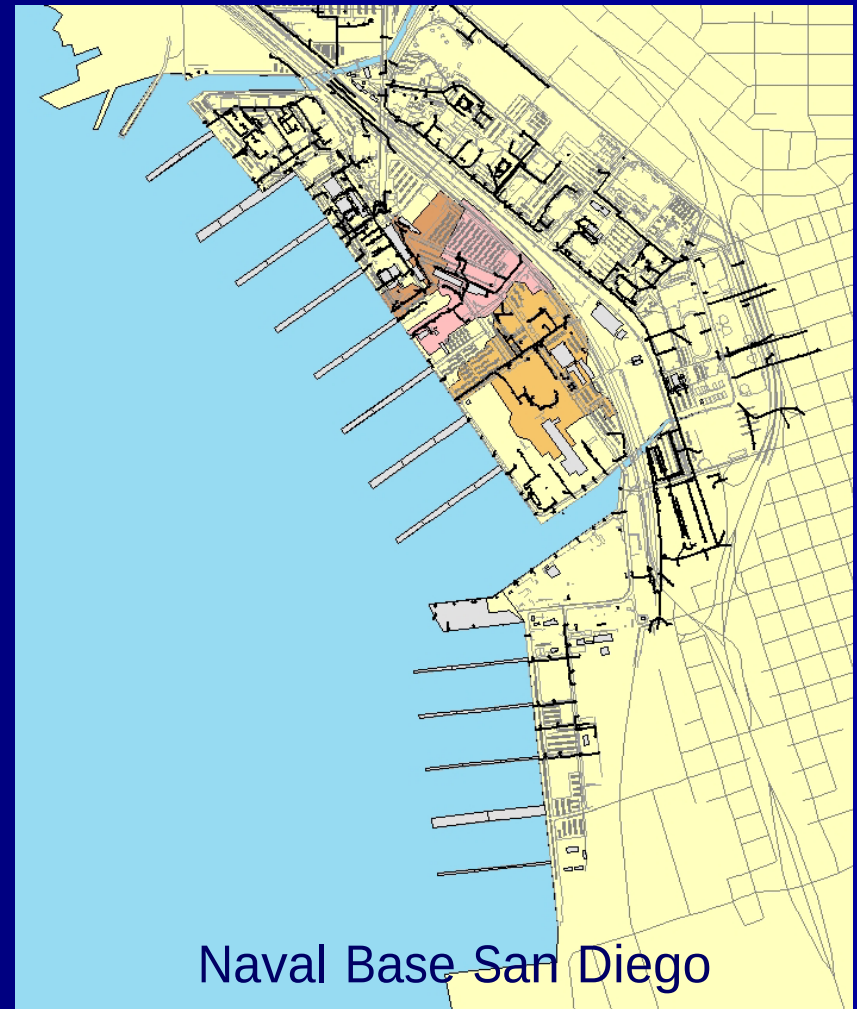
- Numerous widespread sources
- Some sources not easily controlled
- Large areas with many discharge points
- Receiving water impacts occur at low (ppb) concentrations
- Metals accumulate in sediments

Sources and Pathways



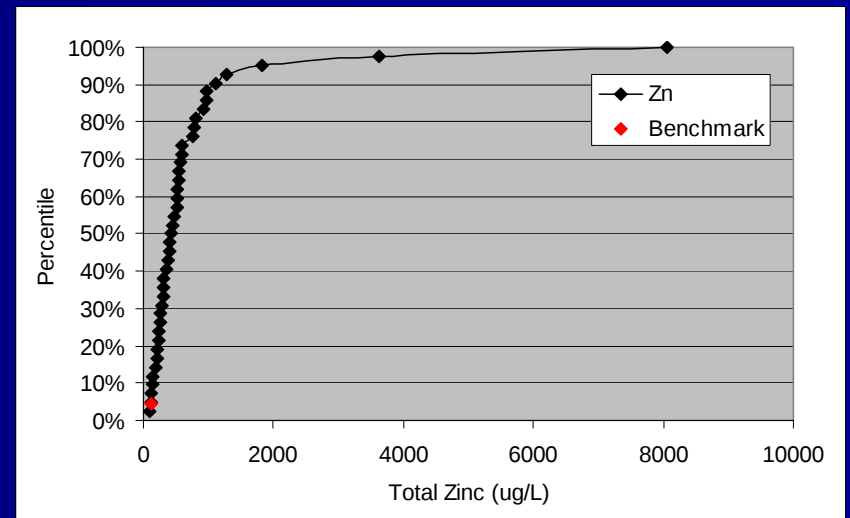
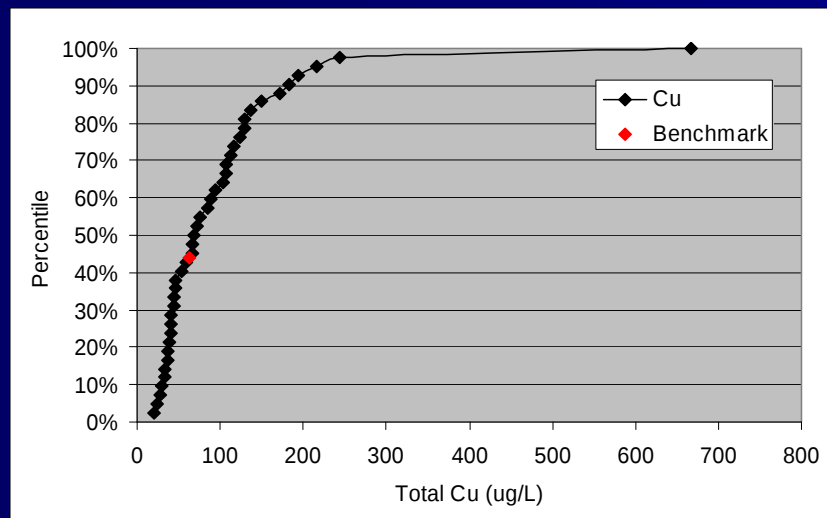
Spatial Extent

- Storm water:
 - Runs off of thousands of facility acres
 - Is carried through miles of pipes
 - Discharges through hundreds of monitored outfalls



Storm Water Metals

- Copper and zinc routinely exceed benchmarks

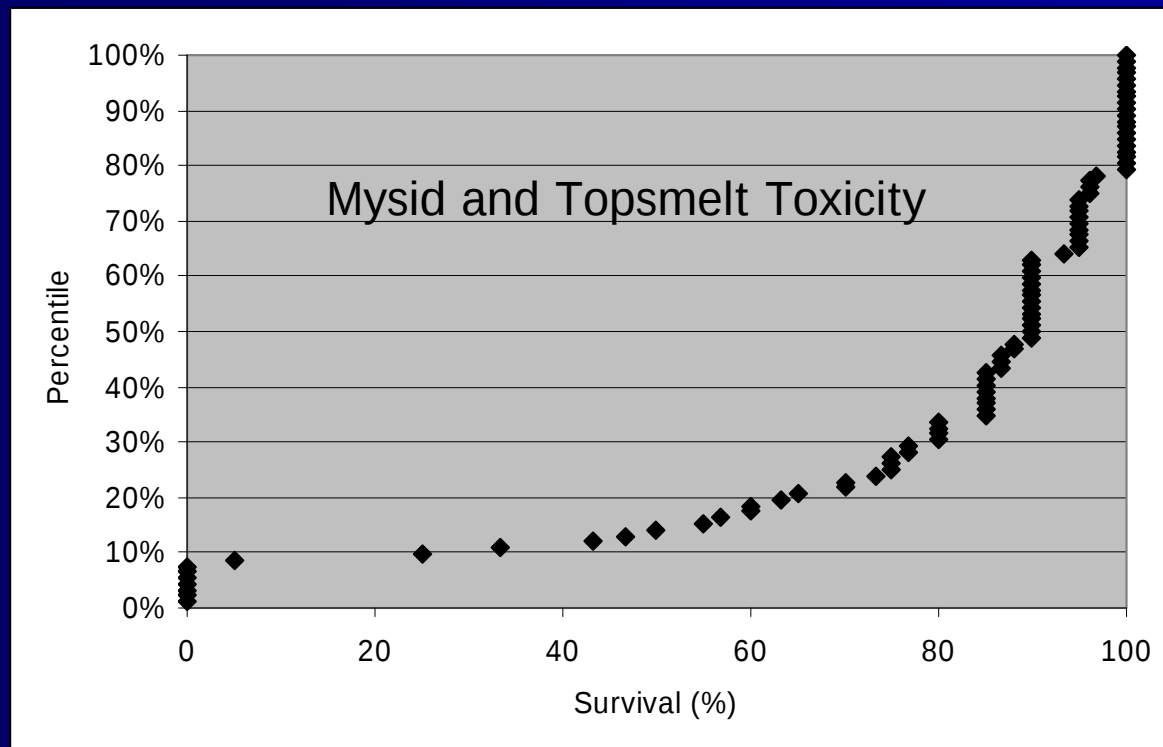


Region Southwest Facility Data*

* Source: Katz, Rosen and Arias (2006). Storm Water Toxicity Evaluation Conducted at Naval Station San Diego, Naval Submarine Base San Diego, Naval Amphibious Base Coronado, and Naval Air Station North Island. Technical Report 1938.

Storm Water Toxicity

- Storm water fails acute toxicity requirements primarily as a result of high copper and zinc



Region Southwest facility data*

Total Maximum Daily Load

- The Navy's TMDL prioritization report identifies over 50 impairments to water, sediment, or tissue as a result of metals*

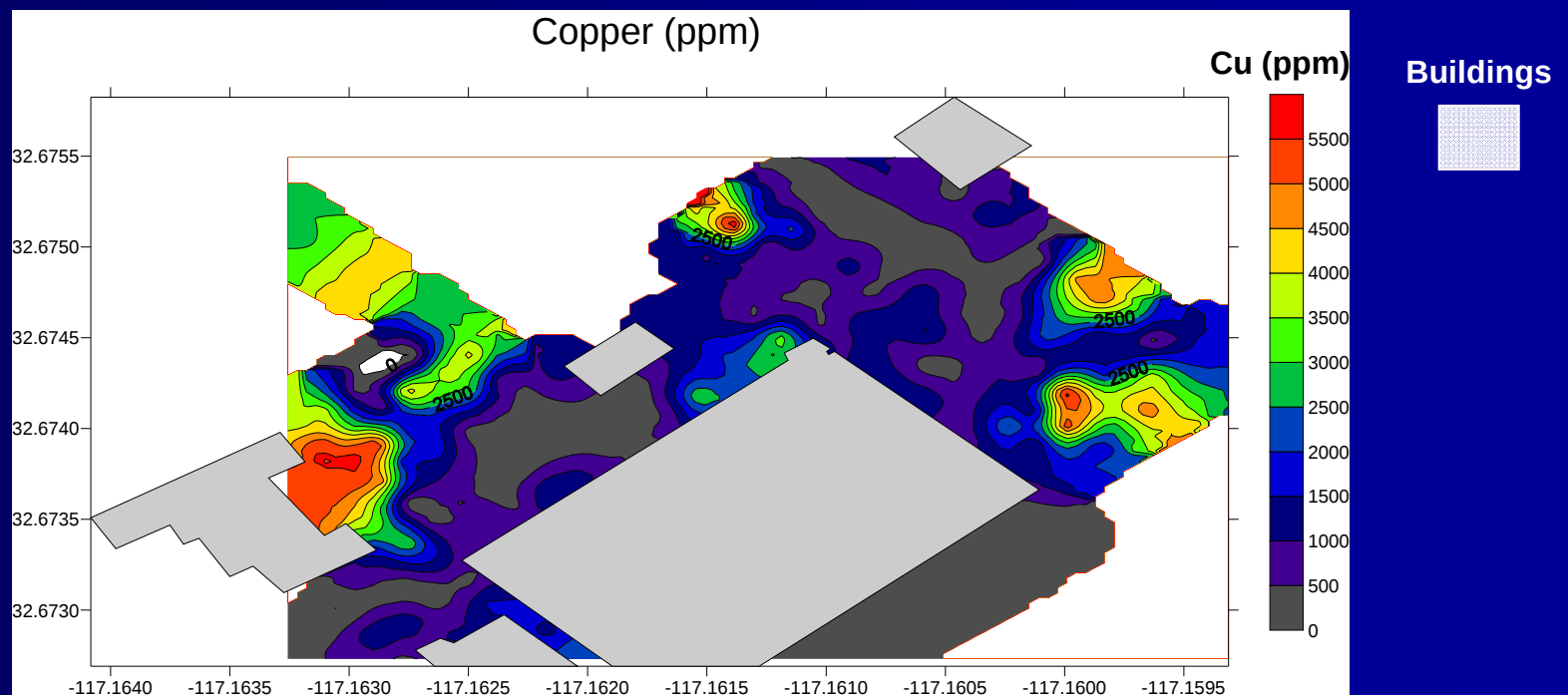
* Source: Navy Total Maximum Daily Load (TMDL) Prioritization Report, September 2006, Naval Facilities Engineering Command.

Why Sweeping BMP?

- Sweeping can be applied to large areas
- Particles on the ground are a source of storm water copper and zinc
- New sweeper technologies may be capable of removing significant amounts of particles and therefore metals

Particles as Metal Source

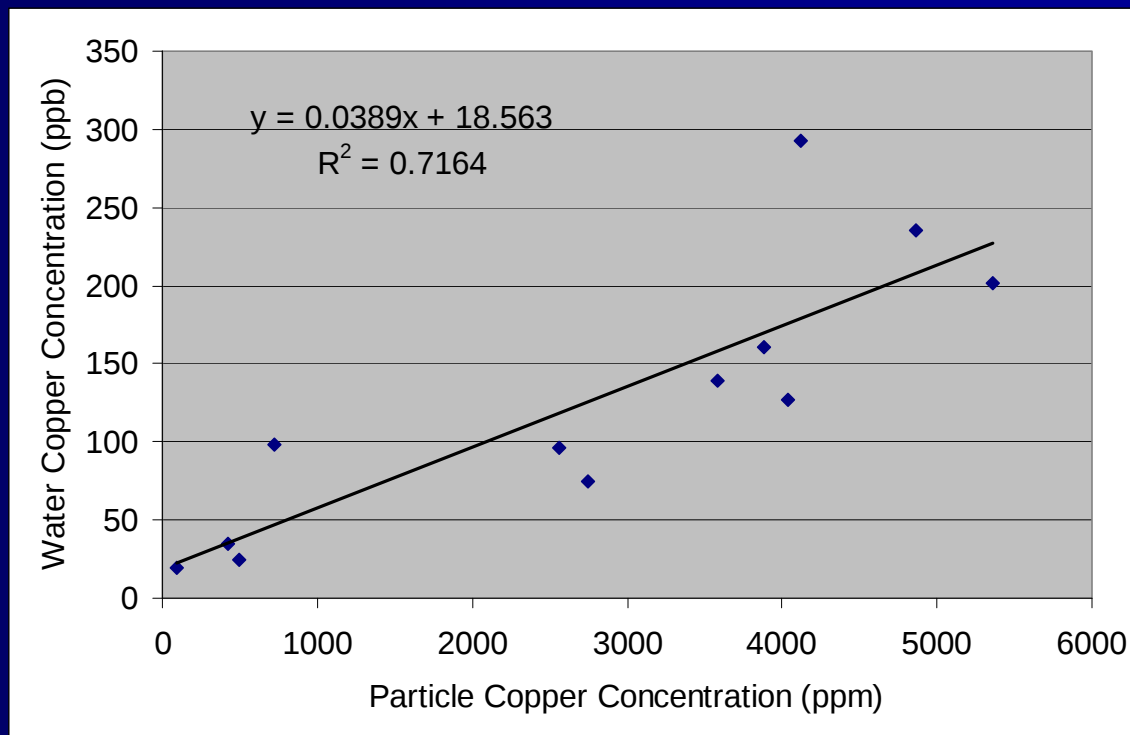
- Early tests showed that particles swept off the ground can be relatively high in copper and zinc



Naval Amphibious Base Coronado

Particles as Source of Dissolved Metals

- Early tests showed particles are a source of dissolved metals



Water concentrations after 30-min contact with water

Sweeper Technology

- Old technology focused on mechanical brushes for large-particle cleaning
- New technology utilizes vacuums, high pressure air or water, tandem systems, and particle filtration to collect fine particles (10 μm).

Mechanical



Regenerative Air



Sweeper Technology

Mobile Cleaning, Recovery and Recycling System (MCCRS)



High pressure spray, vacuum, filtration, and water recycling

Proof of Concept

- Develop Sampling Protocols
- Test Quick Screening Techniques
- Evaluate Load Reduction
- Evaluate Sweeper Efficiency

Pier Sweeping - SSC-SD



- Random sites tested for particle metal concentrations
- High efficiency vacuum system evaluated
- Pre/post sweeping evaluated for reductions

● Samples

Pier 160 SPAWAR Systems Center San Diego ~ 0.8 acres

Method Development



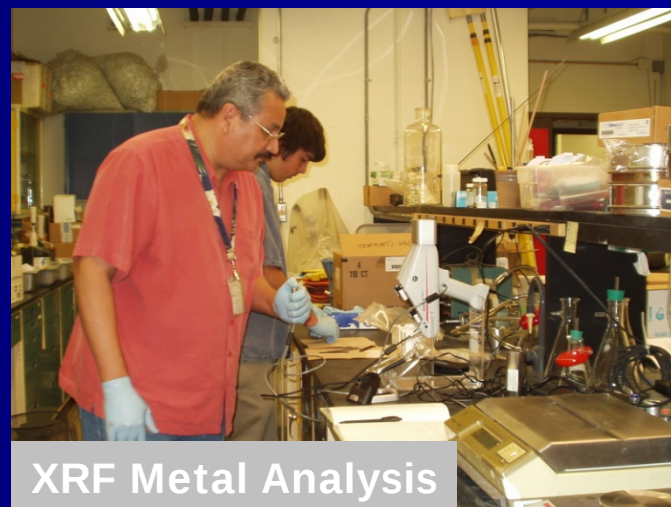
Collection



Fractionation



Mass Determination



XRF Metal Analysis

Sweeping Operations



Results

- Copper and zinc particle concentrations averaged 700 and 2200 ppm, respectively
- Most particles, copper, and zinc were found in the 0.1 and 1 mm size range
- 52 kg of particles collected ($\sim 15 \text{ g/m}^2$)
- Sweeper efficiency ranged between 56 and 71%

MCCRS Test Results

NAB Little Creek



Bridge Caisson Maintenance Area

Copper @ 650 ppm

Zinc @ 80,700 ppm

94-95% Particle Reduction

50-77% Copper Reduction

89-90% Zinc Reduction



Metal Recycling Yard

Copper @ 680 ppm

Zinc @ 4300 ppm

82-84% Particle Reduction

75-90% Copper Reduction

67-71% Zinc Reduction

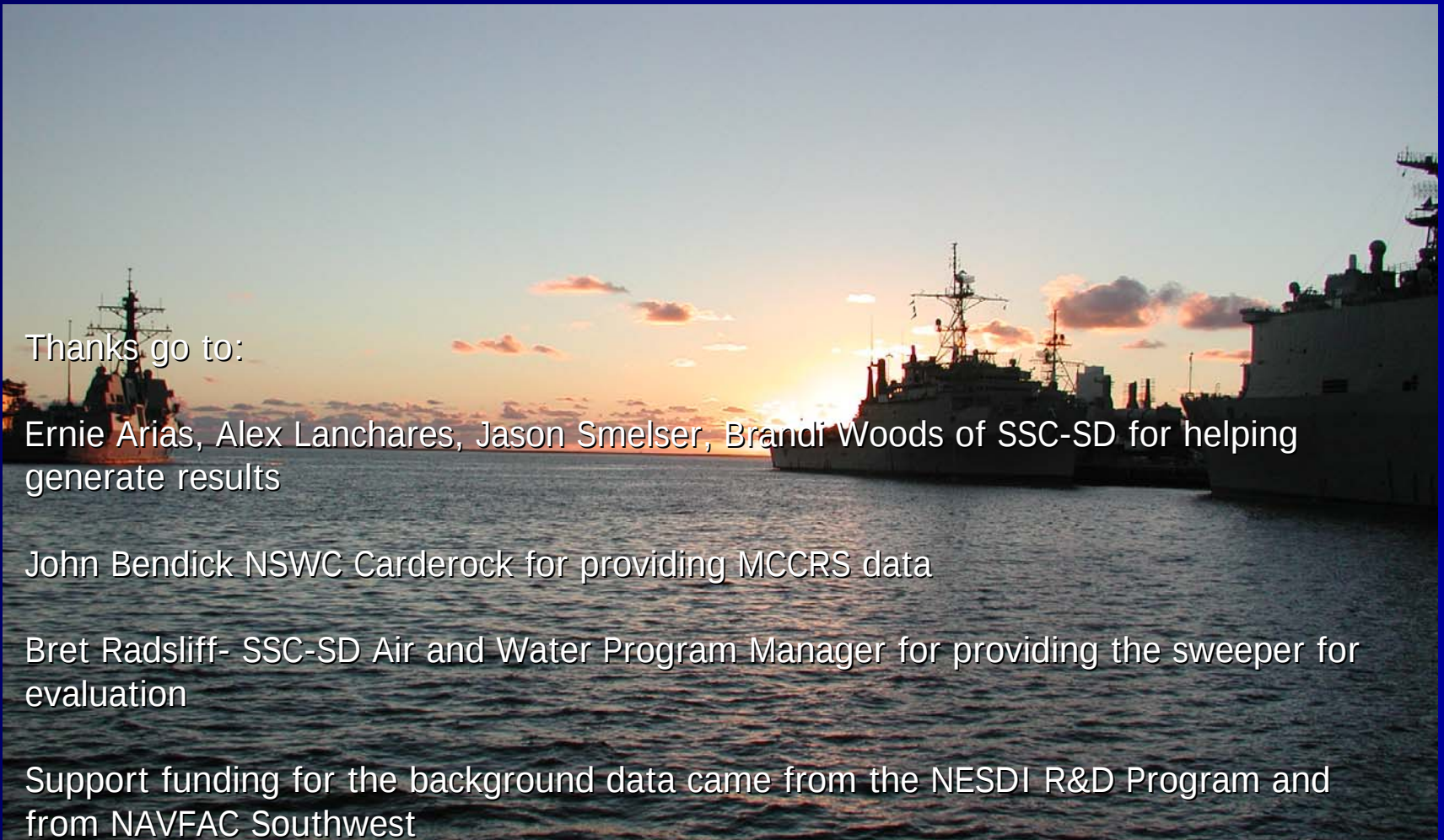
Conclusions

- Particles are a significant source of storm water copper and zinc
- High efficiency sweepers can remove a significant amount of metals before they become entrained in storm water
- Sweeping provides a potentially useful wide-area BMP

Way Forward

- Load reduction quantitation
- Storm water impact validation
- Implementation optimization

Acknowledgments



Thanks go to:

Ernie Arias, Alex Lanchares, Jason Smelser, Brandi Woods of SSC-SD for helping generate results

John Bendick NSWC Carderock for providing MCCRS data

Bret Radsloff- SSC-SD Air and Water Program Manager for providing the sweeper for evaluation

Support funding for the background data came from the NESDI R&D Program and from NAVFAC Southwest

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-01-0188	
The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden to Department of Defense, Washington Headquarters Services Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY)		2. REPORT TYPE		3. DATES COVERED (From - To)	
06-2008		Final			
4. TITLE AND SUBTITLE METALS LOAD REDUCTION IN STORM WATER USING HIGH-EFFICIENCY SWEEPERS Joint Services Management Conference, 5-9 May 2008, Denver, Colorado				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHORS C. Katz E. Arias				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) SSC San Diego San Diego, CA 92152-5001				8. PERFORMING ORGANIZATION REPORT NUMBER TD 3228	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES This is the work of the United States Government and therefore is not copyrighted. This work may be copied and disseminated without restriction. Many SSC San Diego public release documents are available in electronic format at http://www.spawar.navy.mil/sti/publications/pubs/index.html					
14. ABSTRACT This presentation discusses the problem of storm water metal concentrations, particularly copper and zinc, and based on test results, concludes that new sweeping technology provides potentially useful wide-area best management practices.					
15. SUBJECT TERMS Mission Area: Environmental Science storm water toxicity sweeper technology metal concentrations pier sweeping					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			C. Katz
U	U	U	UU	29	19b. TELEPHONE NUMBER (Include area code)
					(619) 553-5332

Approved for public release; distribution is unlimited.



SSC San Diego
San Diego, CA 92152-5001