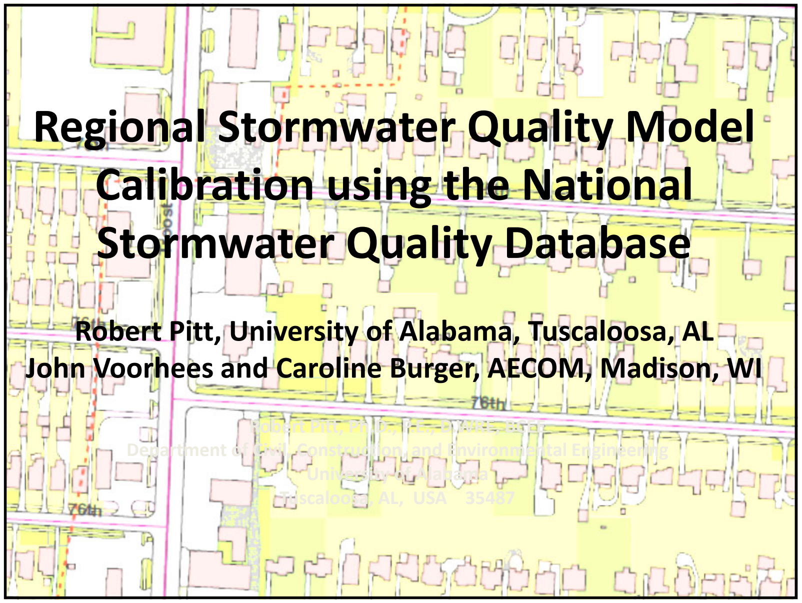


Regional Stormwater Quality Model Calibration using the National Stormwater Quality Database

Robert Pitt, University of Alabama, Tuscaloosa, AL
John Voorhees and Caroline Burger, AECOM, Madison, WI

1

Many stormwater managers are frustrated by the large amounts of data needed to calibrate and verify stormwater quality models. These data needs are usually divided into several broad categories:

- development characteristics for the land uses of interest
- rainfall and runoff data needed for describing the urban hydrology for the area
- stormwater quality data for the land uses and complete range of rain conditions
- performance data for the stormwater controls to be investigated

2

It is a daunting (time-consuming and expensive) task to collect this information. However, the investment is usually worthwhile for cost-effective and robust decisions concerning stormwater.

One approach that can be taken as a preliminary step is to use available data from the National Stormwater Quality Database (NSQD) and prior detailed calibrations.

This presentation briefly shows some of the early site-specific calibration efforts for WinSLAMM, followed by regional calibration efforts using the NSQD, and finally a recent example for Naval facilities building on the earlier calibration efforts.

3

Unique Features of WinSLAMM (and why it was developed!)

- WinSLAMM based on actual monitoring results at many scales and conditions.
- Early research results during the 1970s did not conform to typical stormwater assumptions (especially rainfall-runoff relationships and sources of pollutants; way before we had long lists of control practices too!).
- Initial versions of the model therefore focused on site hydrology and particulate sources and transport (and public works practices). Other control practices added as they are developed and data becomes available.

4

WinSLAMM Calibration Data

- Source area monitoring to calibrate para*.* files
  - Sheetflow and source area sampling from WI, CA, AL, Ontario, and elsewhere
- Research monitoring locations throughout the country
- Nationwide NPDES outfall monitoring to adjust para*.* files for regional variations
  - Using the National Stormwater Quality Database (NSQD)
- Specially collected monitoring data covering conditions not contained in the NSQD.

5

General WinSLAMM Calibration Process

1. Rainfall-runoff based on site rainfall and runoff data
2. Particulate solids data from source area and outfall data
3. Pollutant data based on source area and outfall total and filtered pollutant data

6

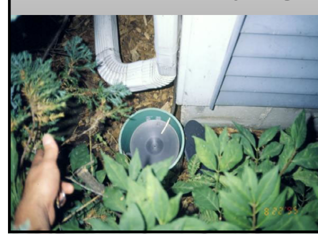
Model Strength – Based on Extensive Field Monitoring Data:

- **Source Areas – Roofs, Streets, etc.**
- **End of Pipe – Many Land uses**
- **Stormwater Control Practices**

Lawn Sheet Flow Sampler: Tipping Bucket for Flow and Cone Splitter for Water Sample

7

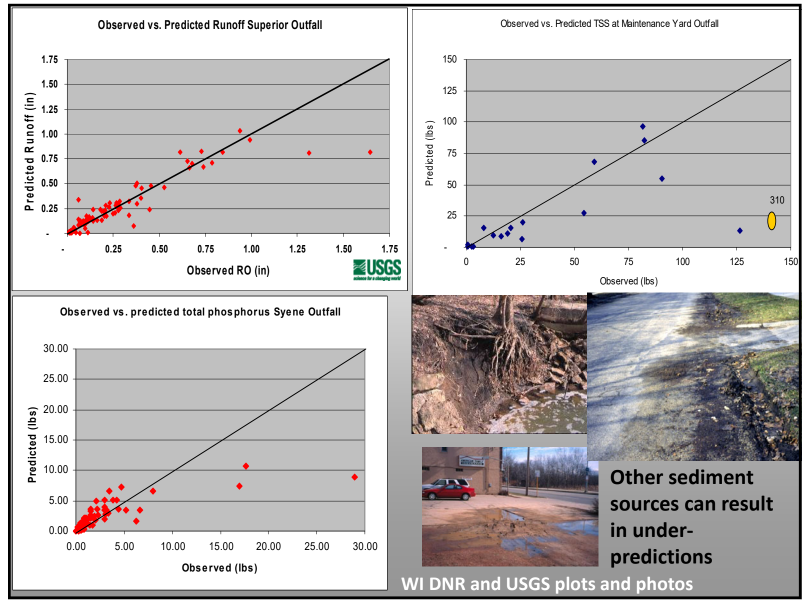
Source Area Sampling



End of Pipe Monitoring: Mass Balance

8

9



10

Standard Land Use Files for Regional Calibrations

	Commer.	Indus.	Instit.	Open Space	Resid.	Freeways/ Highways	Total by Region
Central	4	2	4	1	5	3	19
East Coast	3	1	1	1	2	3	11
Great Lakes (the USGS/DNR files)	6	4	4	2	11	4	31
Northwest	2	1	1	1	3	3	11
Southeast	7	2	3	5	8	4	29
Southwest	5	1	1	1	2	3	13
Total by Land Use	27	11	14	11	31	20	114

These locations had detailed land development information from site surveys and aerial photography evaluations, along with watershed rainfall and outfall runoff quantity and water quality data.

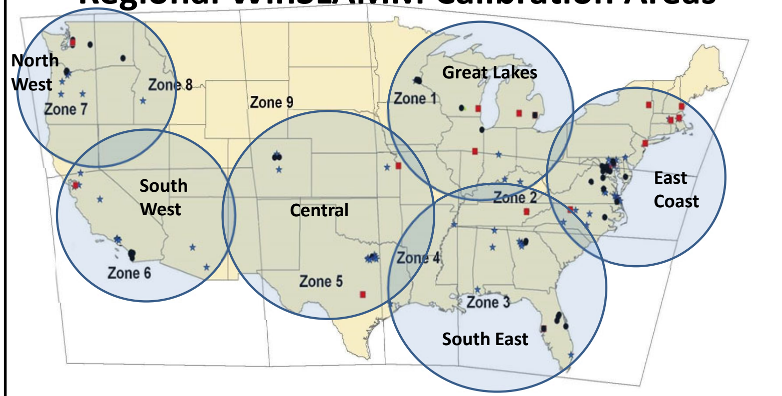
11

Characteristics of Several of the 114 Research Locations used for Regional Model Calibrations

Location	Land use	area (acres)	directly connected impervious (%)	pervious (%)	# of events
Bellevue, WA					
Surrey Downs	residential medium density	95.1	17	64	196
Lake Hills	residential medium density	101.7	17	64	201
San Jose, CA					
Keyes	residential, medium density	92	30	48	6 (drought)
Tropicana	residential, medium density	195	25	56	8 (drought)
Toronto, Ontario					
Thistledowns	residential, medium density	96.4	21	55	35
Emery	industrial	380.5	42	25	60
Tuscaloosa, AL					
City Hall	Institutional/ commercial	0.9	100	0	31
BamaBelle	commercial	0.89	68	32	17 (on-going)

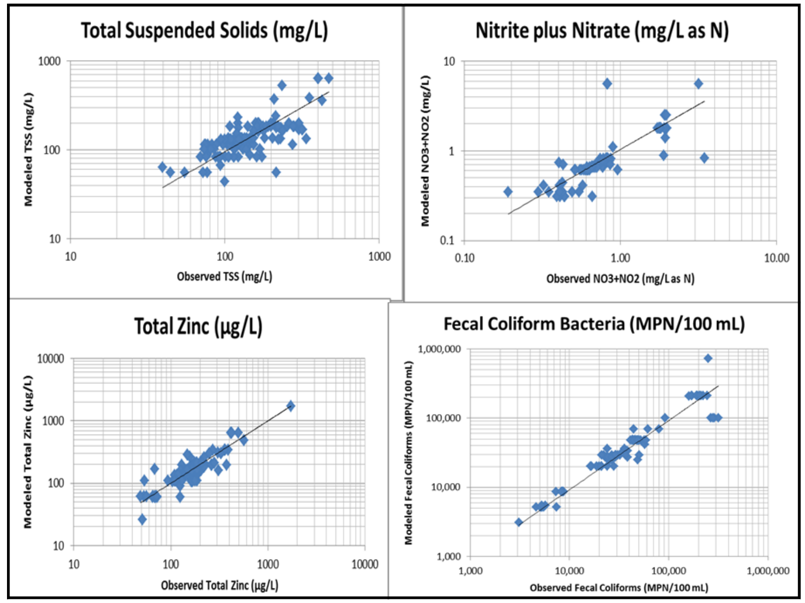
12

National Stormwater Quality Database and Regional WinSLAMM Calibration Areas



Much of the NSQD data only has basic land use and land area information. However, the regional standard land use files that describe the development characteristics can be used with these water quality data for regional calibrations.

13



14

Standard Source Areas for Each Land Use for City Calibrations

- Roofs
- Paved Parking/Storage
- Driveways
- Sidewalks
- Playgrounds
- Streets
- Small Landscape
- Large Landscape
- Unpaved parking
- Undeveloped Areas
- Isolated Areas
- Other Pervious Areas
- Paved Lane & shoulder

Directly connected and disconnected roofs and paved areas are subcategories, along with different soil types in the area.

15

Additional Special Source Areas Developed for Naval Facilities

- Area 1: Airfield apron/runway paved areas
- Area 2: Other airfield paved areas
- Area 3: Light industrial storage/laydown area, concrete (light industrial/laydown activity, concrete)
- Area 4: Moderate industrial storage/laydown area, concrete (moderate industrial/laydown activities, concrete)
- Area 5: Heavy industrial storage/laydown area, concrete (heavy industrial/laydown activities, concrete)
- Area 6: Light industrial storage/laydown area, asphalt (light industrial/laydown activity, asphalt)
- Area 7: Moderate industrial storage/laydown area, asphalt (light industrial/laydown activity, asphalt)
- Area 8: Heavy industrial storage/laydown area, asphalt (heavy industrial/laydown activities, asphalt)
  Area 9: Galvanized metal roofs, flat, directly connected to drainage system
- Area 10: Other areas having substantial galvanized metal materials (fences, etc.)

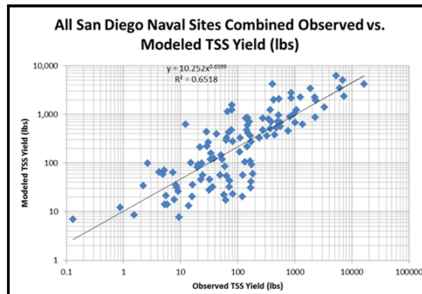
16

17

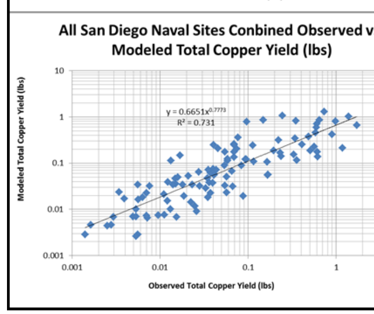
18

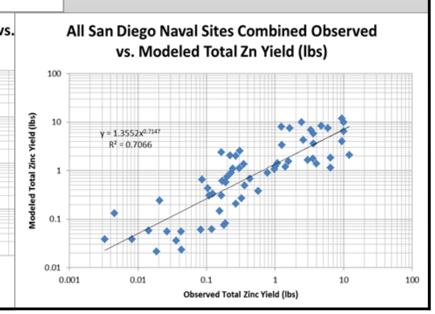
Outfall 9	
AT 1: Roofs	0.17 ac flat roofs to silty soil 0.35 ac flat roofs directly connected
AT2: Paved parking	0.39 ac directly connected
Streets	0.34 ac rough asphalt (40 ft wide)
AT 7: Large landscaped areas	2.07 ac silty soil (baseball field)
AT 8: Small landscaped areas	0.01 ac silty soil (near buildings)
Other area 4: Moderate use concrete pier/laydown/storage/loading dock areas	1.49 ac
Other area 5: Heavy use concrete pier/laydown area/storage/loading dock/and scrapyard areas	0.27 ac
Other area 7: Moderate use asphalt pier/laydown/storage/loading dock areas	0.15 ac
Other area 10: Other impervious areas with galvanized materials	0.09 ac
Total Area	5.33 ac

19

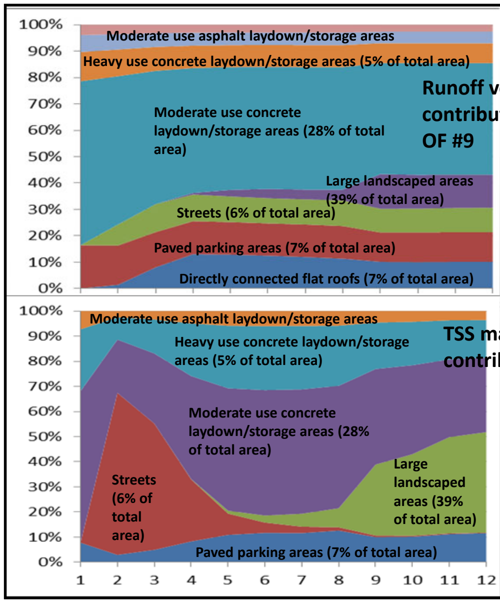


Plots of all monitored event discharge yields at several naval outfalls in San Diego compared to WinSLAMM calculated event yields.





20



The calibrated model can then be used to identify significant flow and pollutant sources for different rain conditions.

Event number	Rain Total (inches)
1	0.01
2	0.05
3	0.1
4	0.25
5	0.5
6	0.75
7	1
8	1.5
9	2
10	2.5
11	3
12	4

21

Conclusions

- Historical data can be effectively used to calibrate stormwater quality models.
- The better documented the data and areas, the more successful the calibration.
- The National Stormwater Quality Database contains stormwater quality data for many areas and land uses.
- Local data is still highly desirable for verification and to reduce the uncertainties of the final calibrated model.

22

23