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Municpal Stormwater NPDES Permit, TMDL/Benchmark Development

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Agenda

1. TMDL/Benchmark requirements
2. General Benchmark Development Process
3. Challenging Issues in Developing Benchmarks
4. Benchmark Modeling
5. Model Results
6. Interpretation of Model Results
7. Quantitative Benchmarks: What can you do to get ready?
8. Conclusions

TMDL Benchmark Requirements

- TMDL program:
  - Loads are allocated for non-point sources (TMDL implementation plan required).
  - Waste loads are allocated for point sources such as those from industries, wastewater treatment plants and MS4s (permit required).

Clarification on Point versus Non-Point Sources

The Purpose Section (Section 1.1) of the TMDL Implementation Plan Guidance (May, 2007) states that "TMDL Implementation Plans are required by Oregon Administrative Rule (OAR) 340-042-0080 for nonpoint sources of pollution that are not covered by permits.

OAR 340-042-08080(1) states that "Management strategies identified in a WQMP to achieve wasteload and load allocations in a TMDL will be implemented through water quality permits for those sources subject to permit requirements in ORS 468B.050 and through sector-specific or source-specific implementation plans for other sources."

TMDL Benchmark Requirements

- TMDL Pollutant Loads
  - Evaluated through use of pollutant load reduction benchmarks.
- Pollutant Load Reduction Benchmarks:
  - A benchmark is a total pollutant load reduction estimate for each parameter that has an established WLA at the time permit is issued.
  - A benchmark is not a numeric effluent limit; rather it is a goal that is subject to the MEP standard.
  - MS4 permittees must provide rationale for the proposed benchmark, which includes an explanation of the relationship between the benchmarks and the TMDL wasteload allocations.

Process for Developing Benchmarks

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- Quantitative–Loads modeling to numerically estimate pollutant loads generated, pollutant loads reduced, and future pollutant reduction anticipated.
  - Model existing and future loads (GIS-based or spreadsheet)
  - Technical memorandum outlining results
- Qualitative–Non-quantitative assessment of the effectiveness of current BMPs and future BMPs in reducing pollutant loads.
  - Review of existing and future BMPs (structural and non-structural).
  - Technical memorandum outlining results

Ideal Process – Quantitative Method

- Use a model to estimate pollutant loads.
- Model pollutant loads that account for current land use and BMPs.
- Compare modeled current loads with TMDL wasteload allocations to estimate how close the existing program is to meeting WLAs.
- Determine whether additional BMPs would be needed to meet WLAs.
- Evaluate, select and implement types of BMPs to address WLAs.
- Model future land use with anticipated additional BMPs (over the five year permit period) that will allow for additional pollutant load reduction.
- Establish benchmarks (load reduction anticipated in five year permit period as a result of current and anticipated additional BMPs).

Challenging Issues in Developing Benchmarks

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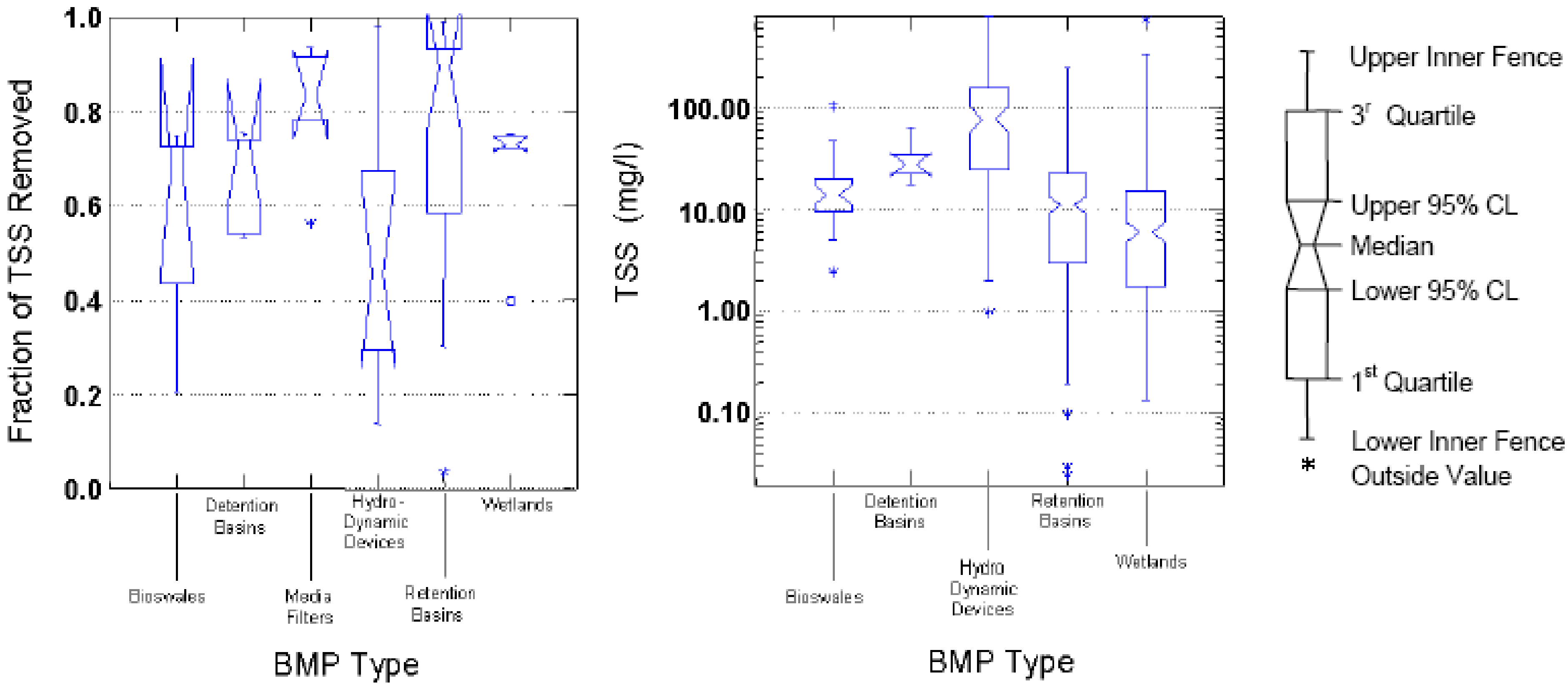
- Effluent concentrations should be considered as opposed to percent removals.
- Need to address flow reduction from BMPs in addition to the reduction of pollutant concentrations.
- Need to estimate the effectiveness of BMPs in series.
- BMP effectiveness data are not available for all pollutants of concern.
- BMP effectiveness data are not available for all BMP types.



Sample Box Plot results for TSS, comparing BMP effectiveness as percent reduction and effluent concentration (Eric Strecker/Geosyntec et al 2004)

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Challenging Issues in Developing Benchmarks

- Baseline land use data is not available for all pollutants of concern.
- Jurisdictions don’t always have detailed inventory of BMPs, BMP types, and BMP drainage areas.
- Baseline data already includes the implementation of BMPs but the extent of implementation will be difficult to determine.
- Costly sampling is needed to detect changes due to wide ranges of variability.

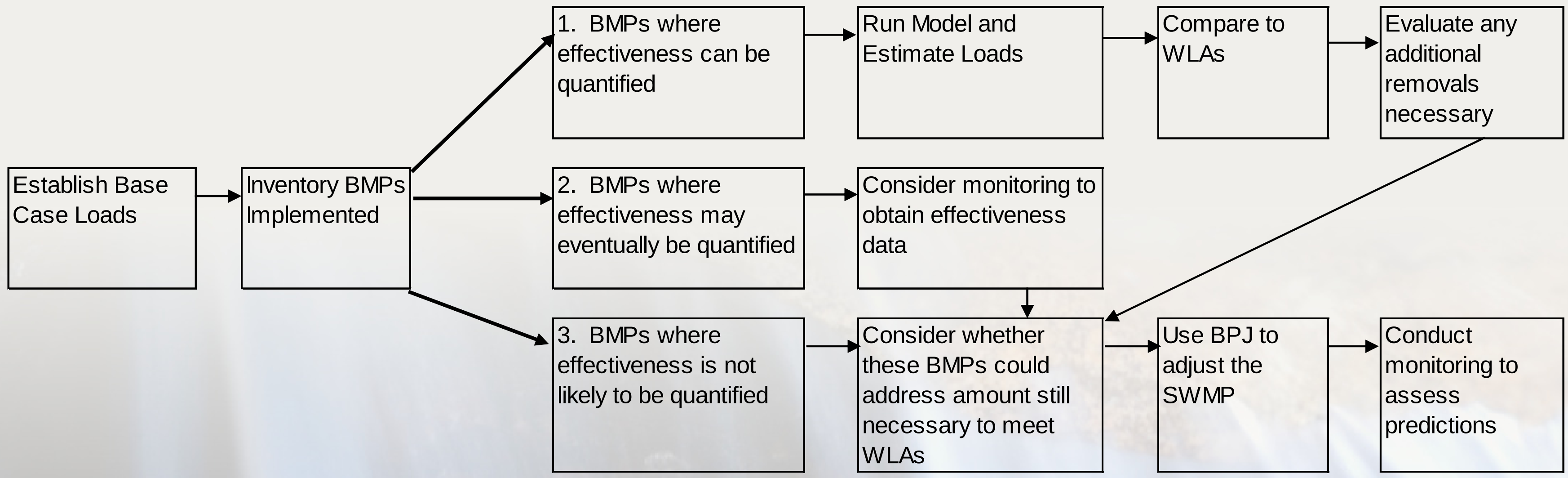
Analysis of Sample Sizes Needed to Statistically Detect Changes in Mean Pollutant Concentrations from Two Stations in Portland, Oregon

		Number of samples required to detect the indicated % reduction in site mean concentration*		
Monitoring site	Parameter	5%	20%	50%
R1 - Fanno Creek	TSS	202	14	4
	Copper	442	29	6
Residential	Phosphorus	244	16	4
M1 - NE 122nd and	TSS	61	5	2
Columbia Slough	Copper	226	15	4
Mixed Use	Phosphorus	105	8	3

* 80% certain of detecting the indicated % reduction in mean of the EMCs.

Benchmark Modeling

Benchmark Modeling Approach



Summary of State-Related Efforts

- Jurisdictions have coordinated through Oregon ACWA.
- ACWA efforts included the following:
  - Organized a technical committee made up of approximately 15 jurisdictions.
  - Funded a contract to develop a comprehensive BMP effectiveness database.
  - Funded a contract to develop a pollutant loadings model for all jurisdictions to use in evaluating the effectiveness of their BMPs.
  - Organized a subcommittee to compile concentration data for use in the model.
  - Goal was to pool resources and provide consistency in reporting among jurisdictions.

Summary of State-Related Efforts

Parameter	Land Use	Count	Bootstrapped MEAN		
			95% L-CI	Mean	95% U-CI
TSS	C (1)	72	64	82	103
mg/L	I	48	117	184	284
	OP (2)	10	16	31	50
	R (3)	65	44	66	99
	T	23	124	169	227
Pb,T	C (1)	25	37.8	54.0	72.7
µg/L	I	22	32.7	48.3	67.0
	OP (2)	9	0.6	0.8	1.1
	R (3)	28	11.0	17.7	27.6
	T	22	37.1	63.1	98.8

Example from Table of ACWA's shared land use runoff concentrations.

Summary of State-Related Efforts

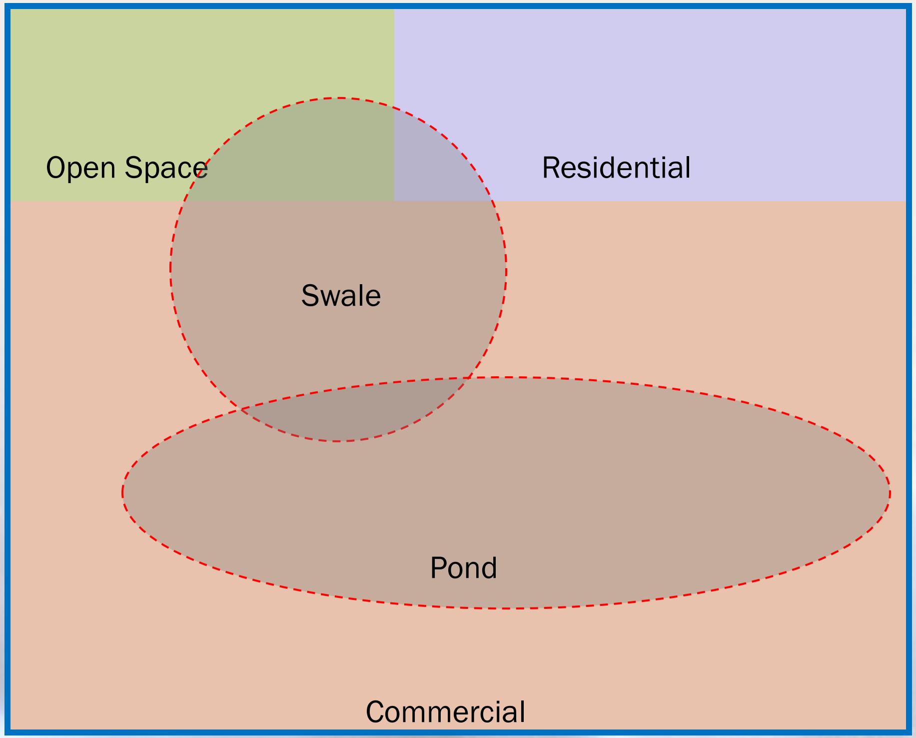
MEANS							
Parameter	Units	Centrifugal separator hydrodynamic devices	Filters (leaf/sand/other)	Ponds, dry vegetated detention pond	Ponds-wet retention basin	Swales-vegetated filter strips	Wetlands-constructed surface flow
TSS	mg/L	115.00	43.00	43.00	29.0	24.00	25.00
TP	mg/L	0.22	0.15	0.35	0.2	0.21	0.16
E. coli	CFU/100 mL	5587	79.00	1922	499	1922	499
Cu, d	mg/L	0.014	0.004	0.014	0.003	0.006	0.003
Cu, T	mg/L	0.015	0.006	0.023	0.008	0.013	0.008
Pb,d	mg/L	0.0021	0.0013	0.0024	0.0001	0.0005	0.0001
Pb,T	mg/L	0.014	0.008	0.032	0.003	0.008	0.003
Zn,d	mg/L	0.035	0.008	0.059	0.030	0.021	0.014
Zn,T	mg/L	0.103	0.015	0.123	0.074	0.055	0.032
Flow reduction	decimal %	0.00	0.00	0.23	0.1	0.29	0.00
BOD	mg/L	6.0	3.4	6.1	6.1	5.4	6.1

Example from Table of ACWA's shared BMP effluent concentrations.

Quantitative Process for Developing Benchmarks (Steps 1 - 3)

- Step 1: Review TMDL to estimate WLA
- Step 2: Compile model input parameters
  - rainfall data
  - land use data (acreage, impervious areas and runoff concentrations)
  - BMP data (location, acreage of drainage areas and effluent concentrations)
- Step 3: Compile GIS or use GIS to determine areas to include in the model

Input Information for Benchmark Model



Step 1 Watershed Information

	Total area (ac)	Total area (excluding UIC, waterbodies, and ODOT ROW) (ac)
Total Area of XXX watershed within the Jurisdiction service boundary (current condition):		
Total Area of XXX watershed within the Jurisdiction service boundary (future condition):		

Step 2 Land Use Information

	Current Condition (2009)	Future Condition (2025)
Agriculture (AGR):		
Commercial (COM):		
Residential (RES):		
Industrial (IND):		
Vacant (VAC):		
Parks and Open Space (POS):		
Total [1]:	0.00	0.00

Step 3 BMP Information

	Current Condition Land Use Breakdown [2]				
	AGR	COM	IND	VAC	POS
Filters (sand filters, StormFilters):					
Dry, detention ponds:					
Wet, retention ponds:					
Swales and vegetated filter strips:					
Wetlands:					
Sedimentation Manholes:					
Hydrodynamic Device (CDS, Stormceptor)					
Soakage/Infiltration Trench					
none					
Total					

	Future Condition Land Use Breakdown [2]				
	AGR	COM	IND	VAC	POS
Filters (sand filters, StormFilters):					
Dry, detention ponds:					
Wet, retention ponds:					
Swales and vegetated filter strips:					
Wetlands:					
Sedimentation Manholes:					
Hydrodynamic Device (CDS, Stormceptor)					
Soakage/Infiltration Trench					
none					

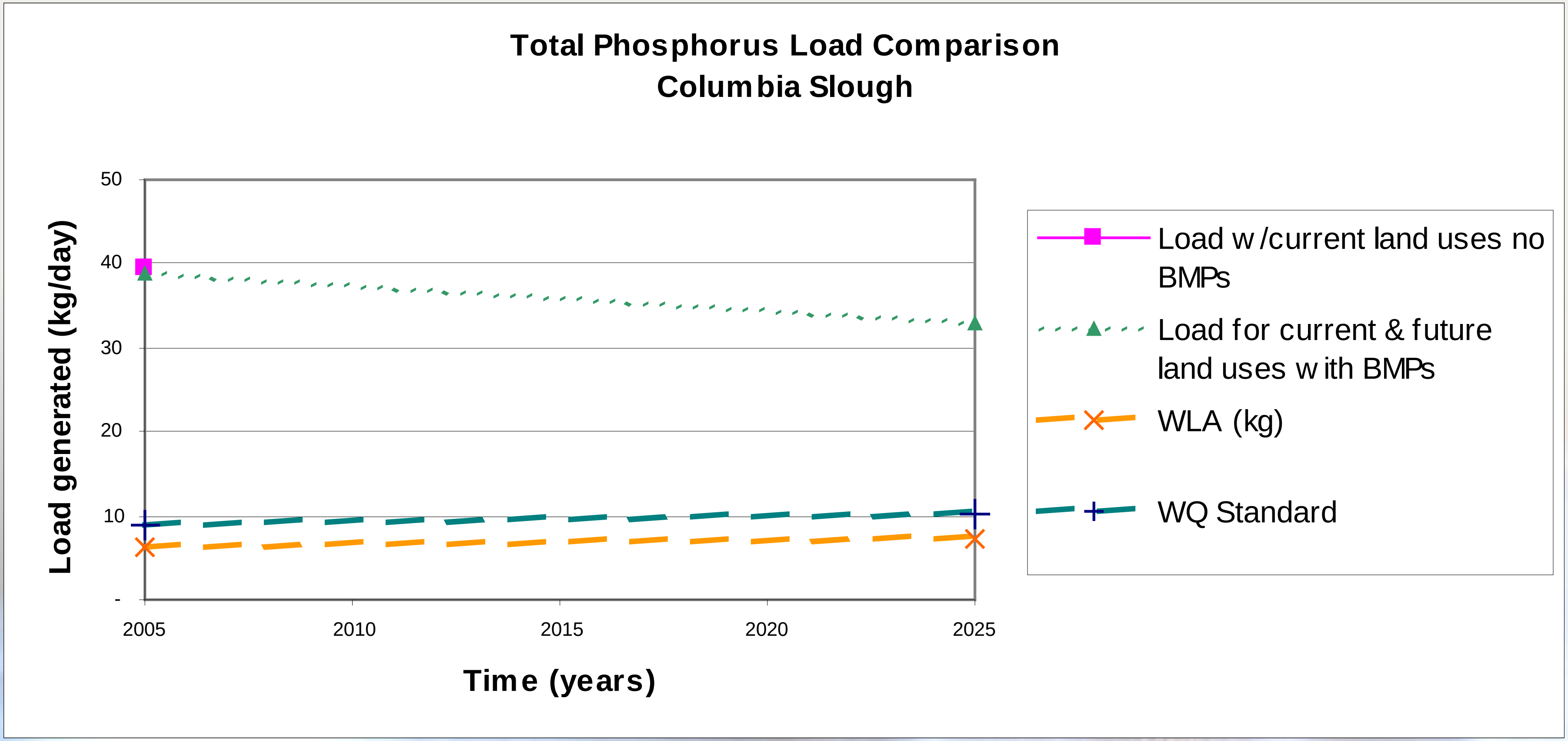
Quantitative Process for Developing Benchmarks (Steps 4 - 5)

- Estimate pollutant loads
  - Current condition (no BMPs and current BMPs)
  - Future condition (current BMPs and planned BMPs)
- Present results in graphical or tabular format.
  - Benchmark = Difference between future condition pollutant load with no BMPs and with BMPs

Model Results

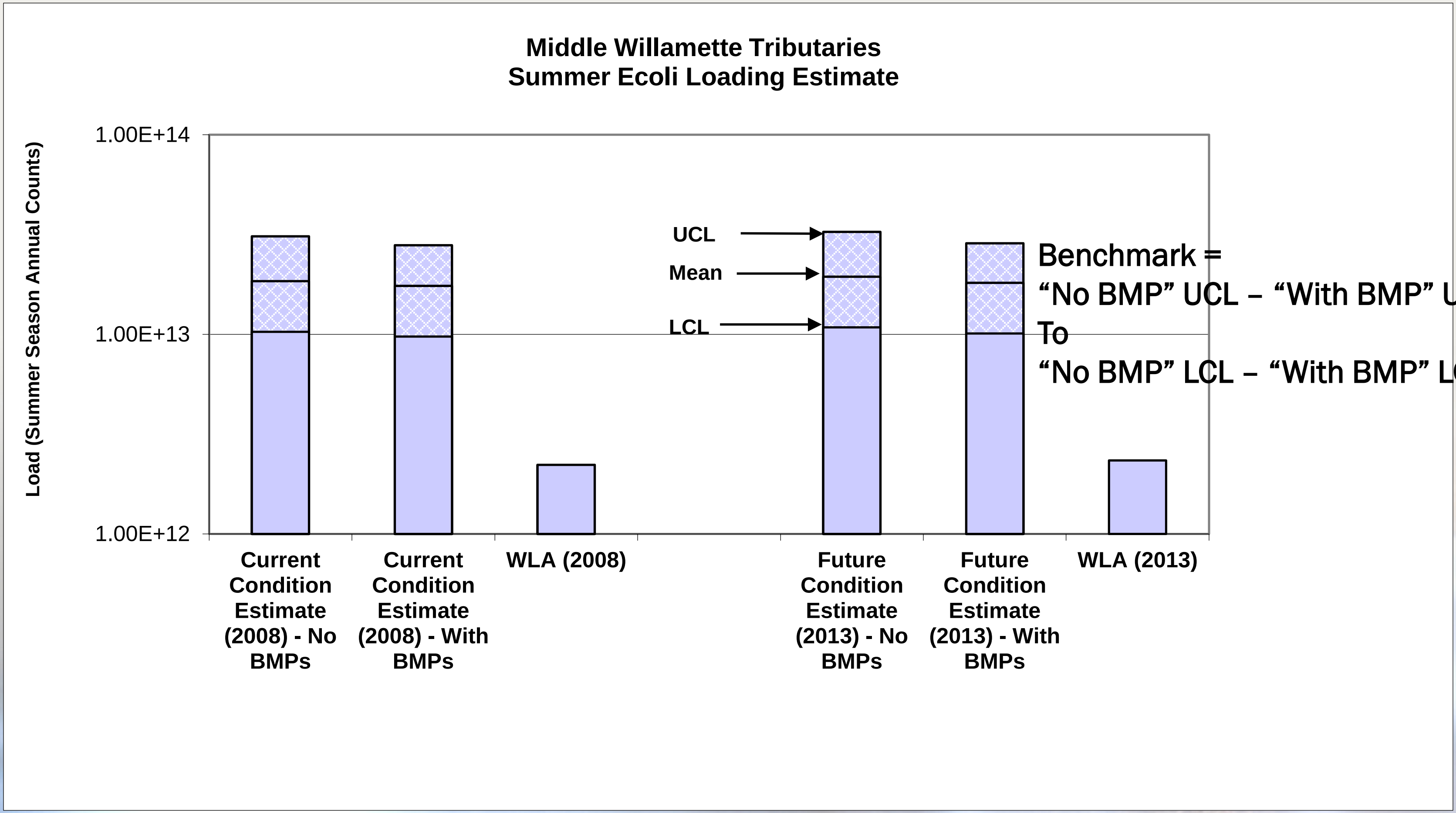
Model Results

Example of Initial Results



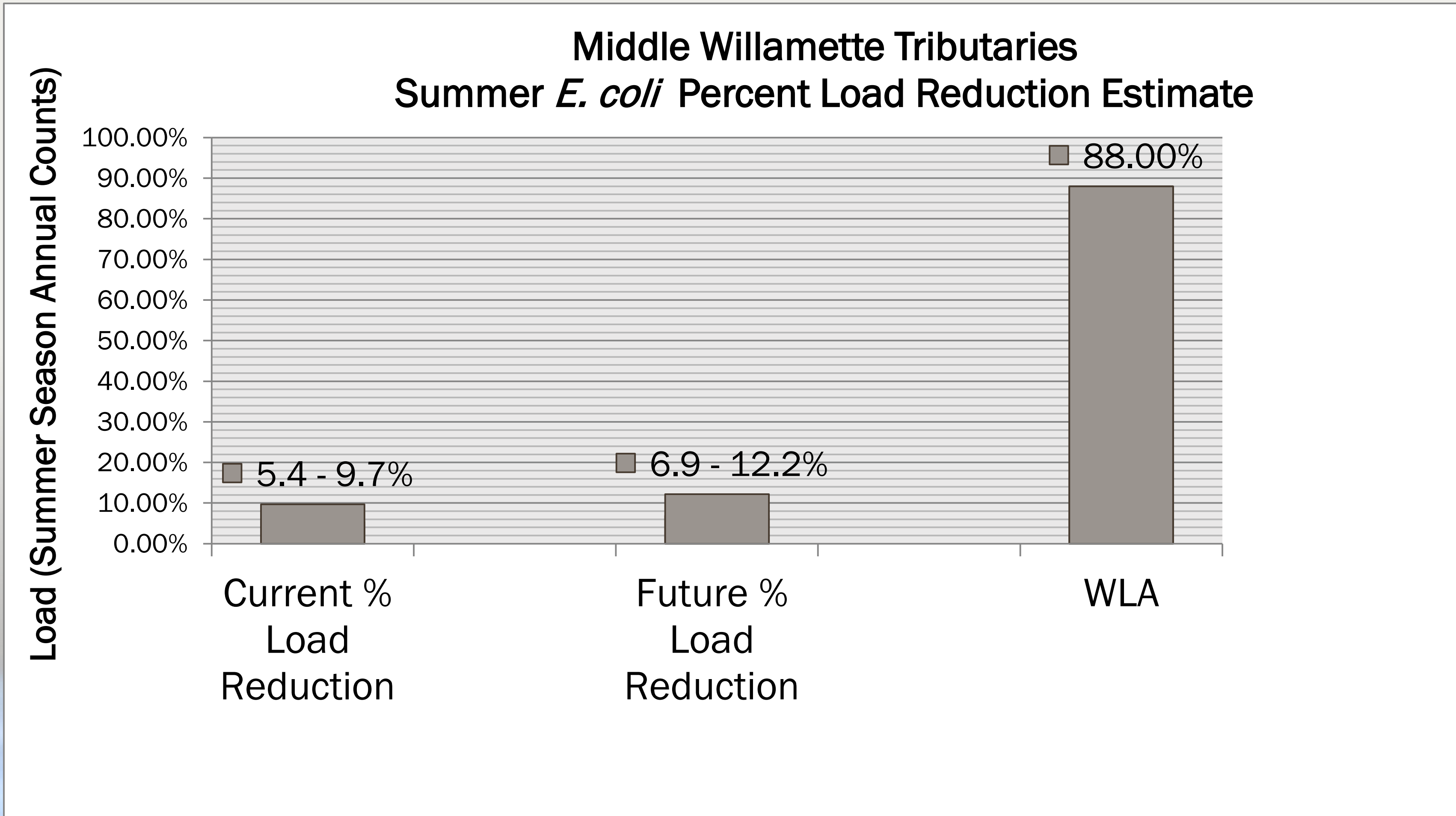
The increment between existing and future loads in this example represents an approximate $5 million expenditure and 50% coverage of the watershed with structural BMPs.

Example of Initial Results



Benchmark =
“No BMP” UCL – “With BMP” UCL
To
“No BMP” LCL – “With BMP” LCL

Example of Initial Results



Interpretation of Results

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- The difference between existing and future loads is only reflective of structural BMPs (public and private).
- Non-structural BMPs often make up a large component of our programs.
- We are always playing catch up with future development (low-impact development does not equal no-impact development). We are still increasing load reductions.
- Paying attention to the BMP types that are applied can make a difference.
- BMPs that reduce runoff volumes will have the most impact on reducing loads.
- Need to review results compared to instream trends.
- Need to evaluate sources and our ability to control those sources.

Non-structural BMP Efficiencies from the Watershed Treatment Model

Percent Removal Efficiency of Non-Structural BMPs (from WTM)				
Street sweeping	Efficiencies, residential		Efficiencies, other roads	
Sweeper type	Nutrients	TSS	Nutrients	TSS
Mechanical	24%	30%	4%	5%
Regenerative air	51%	64%	18%	22%
Vacuum assisted	62%	78%	63%	79%
		Efficiency		
Riparian buffers	TP	TSS	TN	
	10%	70%	30%	
	Efficiency			
Catch basin cleanouts	Nutrients	TSS		
Monthly cleaning	15%	25%		
Semi-annual cleaning	8%	13%		
Erosion and Sediment Control	Efficiency			
	70%			

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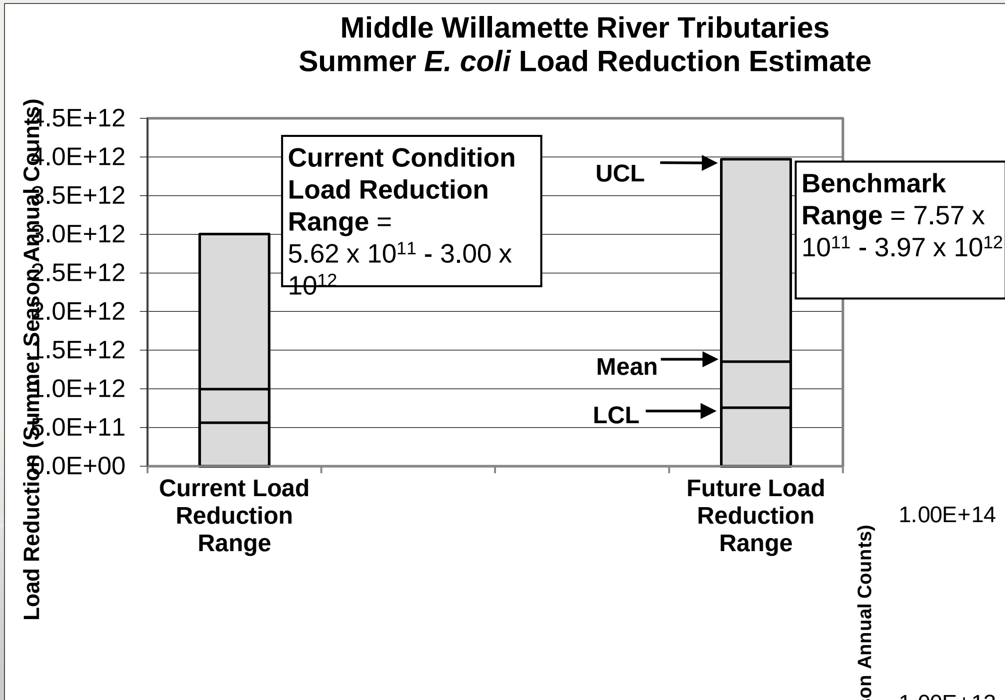
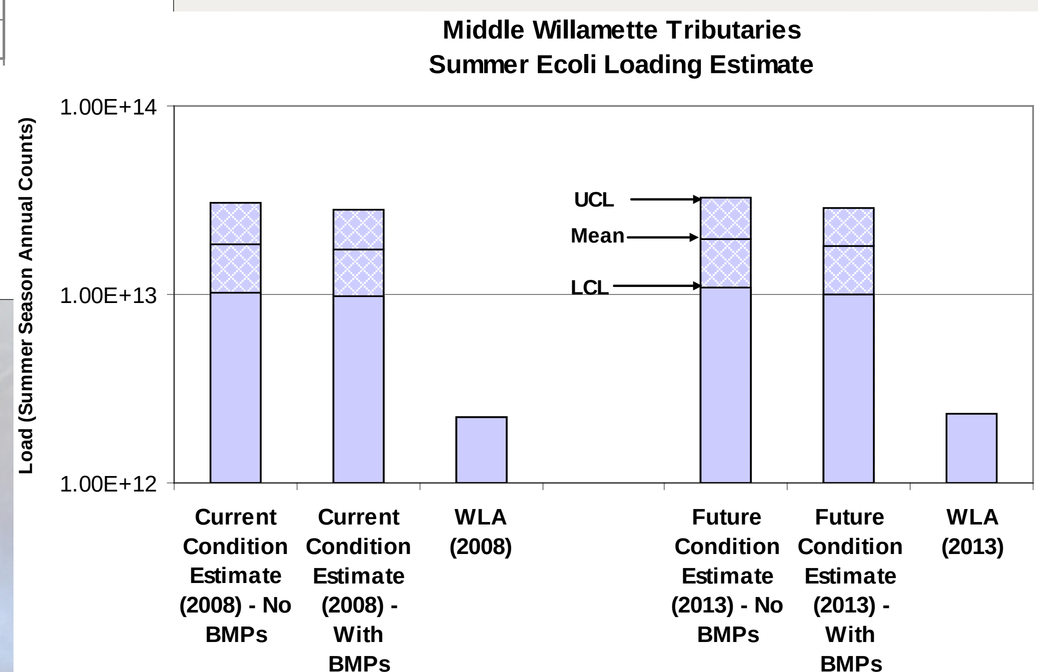
Presentation of Results





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Comparison to Instream Trends Analysis

Trend Analysis Results for the City of Lake Oswego				
Monitoring location	TMDL Watershed	TSS	*E. coli*	Total phosphorous
Tryon	Lower Willamette	N/A[1]	Downward	N/A
Temple	Tualatin	No trend	Downward	No trend
Bangy	Tualatin	Downward	No trend	Downward
Springbrook	Springbrook	N/A	Downward	N/A
Lost Dog	Oswego Lake	N/A	N/A	Downward
Bryant	Oswego Lake	N/A	N/A	No trend
Rosewood	Oswego Lake	N/A	N/A	Downward

[1]N/A means that there is no TMDL for the listed parameter in the listed watershed.

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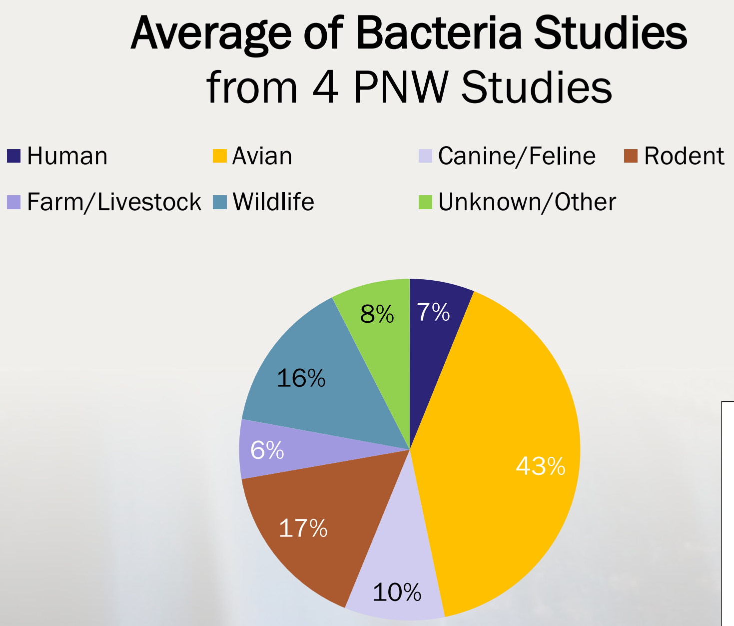
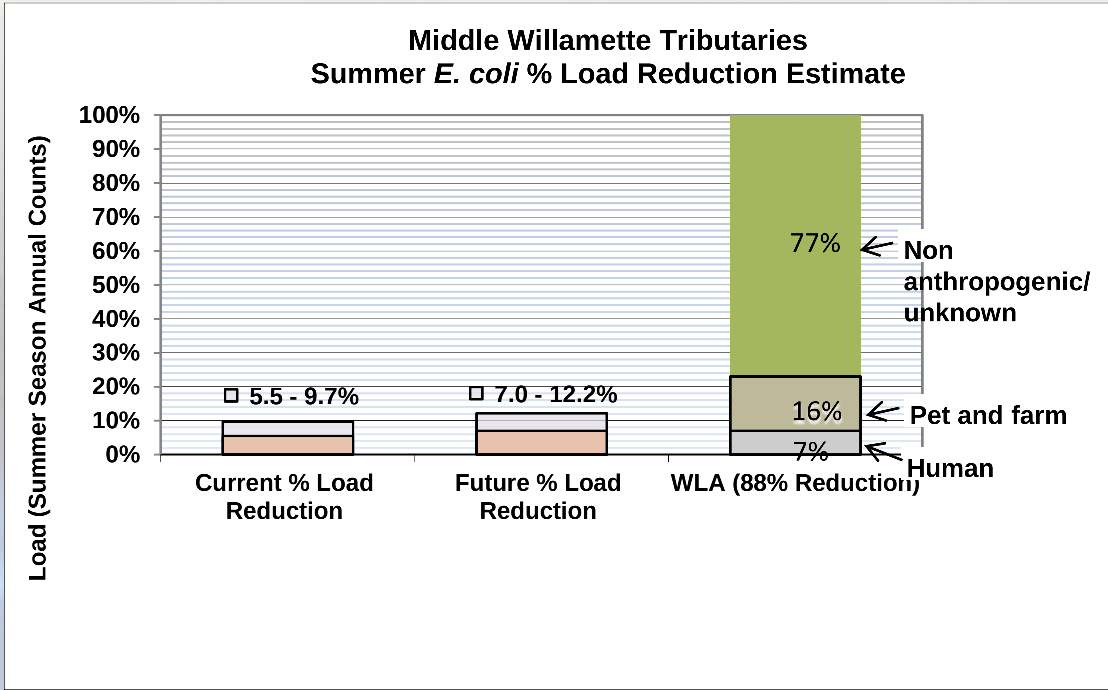
Identification of Sources – Attainment Assessment





Quantitative Benchmarks: What Can You Do to Get Ready?

Steps You Can Take To Get Ready?

- Develop a good inventory of the structural BMPs that are in place (both public and private).
- Map the locations of the structural BMPs and identify the BMP type.
- Delineate the drainage areas served by the BMPs.
- Develop a land use map. If zoning is used, identify currently vacant lands.
- If necessary, identify the coverage of selected non-structural BMP activities such as street-sweeping and catch-basin cleaning.
- Consider coordination with other jurisdictions.

Cost Share Example

- Benchmark Narrative – August 2010
  - Required to describe that (per modeling), progress was being made towards meeting WLAs.
  - Required review of monitoring data, literature, benchmark modeling assumptions, non-structural BMP implementation, and graphical depiction of loads.
  - Prepared narratives for 12 Phase 1 jurisdictions.
  - Initial cost estimates varied between $7,000 and $11,000 per jurisdiction.
  - Final costs ranged from $2,500 to $5,000.
  - Average savings of 60 percent per jurisdiction.

Conclusions

Conclusions

- For some parameters and some receiving waters:
  - existing and new BMPs will allow achievement of WLAs, or
  - significant investment would be required (potentially beyond our current means) to achieve WLAs, or
  - state-of-the-art BMPs will not be adequate to achieve WLAs.
- There are still so many unknowns to understanding surface water quality for individual water bodies.
- WLAs may either be under- or over-protective or they may not even be focused on all the appropriate issues of concern (e.g., water quantity).

Conclusions (continued)

- Challenges presented here provide some of the rationale regarding the original MEP (or non-numeric) standard.
- Benchmark requirements have forced us to make some initial estimates regarding the effectiveness of our SWMPs. (Is it possible to get there?)
- Results may eventually lead to “use attainability analyses” and a revision of beneficial uses in some urban areas.

Questions?