Dealing With Uncertainty in Watershed Assessments

Last week…But do your data measure up?

- What are the data quality objectives?
- Do you have a comprehensive picture?
- How old are your sampling results?
- Can you move forward with what you have?

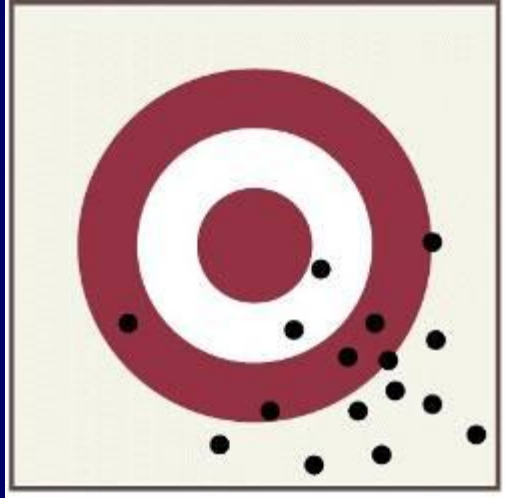
Data quality objectives

- Quantify or qualify how good data must be to achieve the goals of monitoring / assessment
- Described in terms of data quality indicators:
  - precision
  - accuracy
  - representativeness
  - comparability
  - completeness

Parameter	Accuracy	Range
Dissolved oxygen	+/- 1 mg/L	0 – 17 mg/L
pH	+/- 0.2 pH units	0 – 14 pH units
Total phosphorus	+/- 10%	0 – 5 mg/L
Nitrates	+/- 10%	0 – 50 mg/L
Turbidity	+/- 10 NTU	0 - > 100 NTU

Low bias and high precision

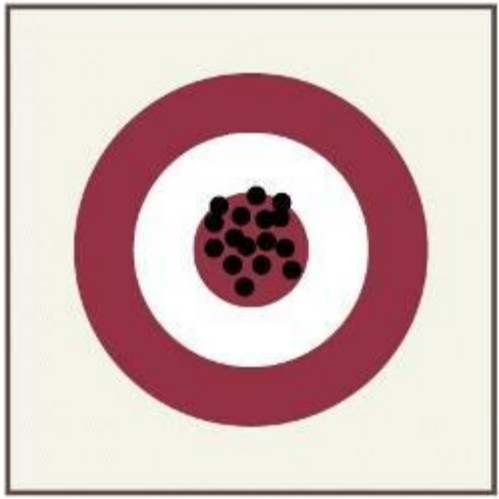
- Both needed to reflect true water body condition
- Can vary from "true" field values (biased), or vary in reliability
- Addressed by following protocols, using field blanks, spiked samples in lab



high bias
+ low precision
= low accuracy

low bias
+ low precision
= low accuracy

high bias
+ high precision
= low accuracy



low bias
+ high precision
= high accuracy

Completeness, representativeness, and comparability

- Collecting all samples planned
- Collecting samples that represent "true condition(s)" of the water body
  - During various seasons, flows?
  - Following sampling protocols?
- Confidence in comparing different data sets
  - Use similar data quality objectives
  - Avoid differences in methods, accuracy, precision

Comprehensiveness

- Do you have a clear picture of the problems?
  - Land use, cover, and watershed activities indicate likely pollutants
  - Biological assessments provide excellent screening info
- DO, pH, temp are primary parameters
- Nutrients*, conductivity, pesticides, herbicides, bacteria, and metals help to refine and focus the results

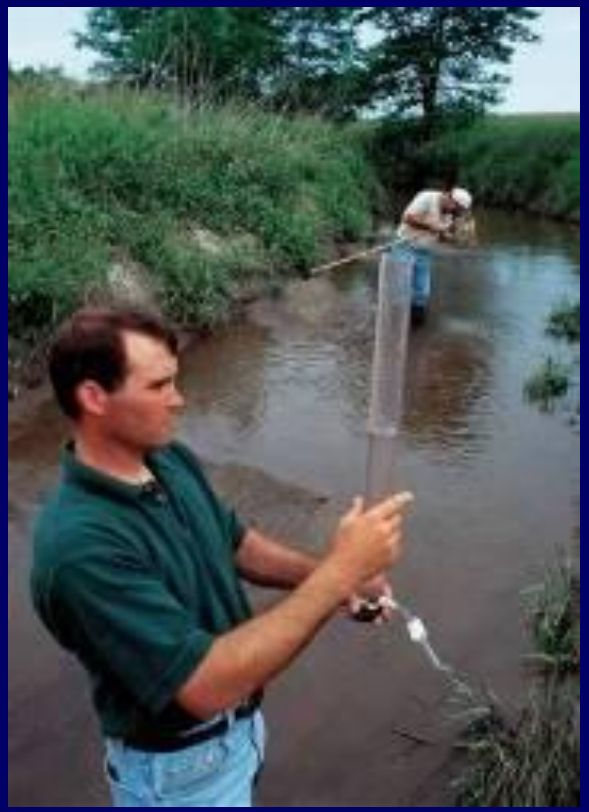
** Algae precursers????*

Age and applicability

- Data age considerations
  - Stable land use & cover make older data (5-7 yrs) more useful
  - Developing watersheds require newer data (2-4 years old)
  - Rapidly developing watersheds may be difficult to characterize
  - Note new or altered NPDES discharger info

Volunteer derived data

- Credibility is improved when:
  - Volunteers are trained by professionals
  - Sampling and analytical procedures match accepted protocols
  - Sampling is conducted under a Quality Assurance Project Plan



Volunteer (red) vs agency (black) data during 1989 - 2005

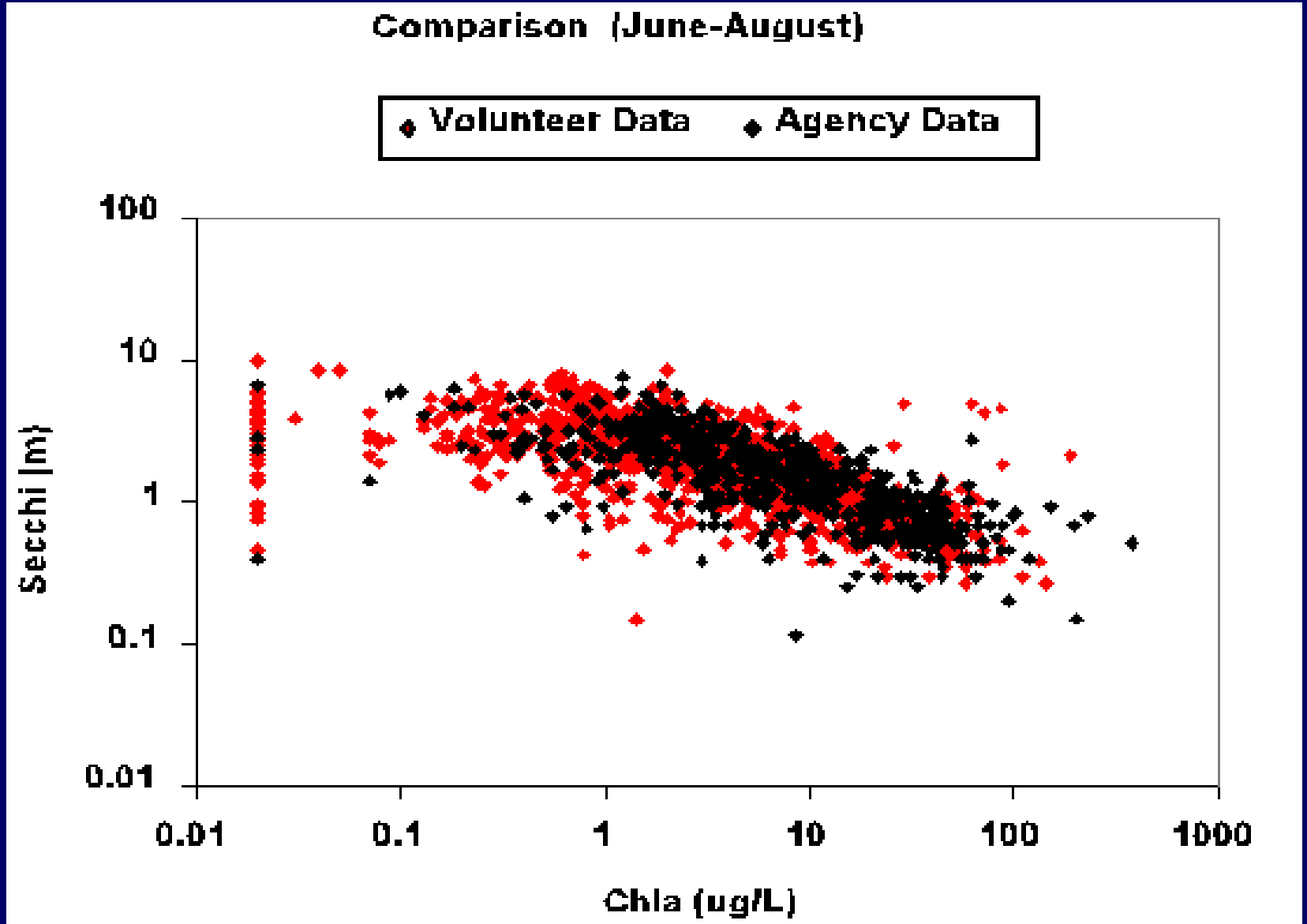


Table 8: Summarized Criteria for Use Support Assessment.

Aquatic Life Use Support - Rivers and Streams		
Conventional inorganics	Dissolved oxygen, pH, sulfates, chlorides were evaluated for the exceedance(s) of Indiana's WQS. For any one pollutant, the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	For dissolved oxygen, one/more samples may be <4mg/L, but no more than 10% of all measurements are <5mg/L. For other conventional inorganics, criteria are exceeded in <10% of measurements.	For dissolved oxygen, one/more samples <4mg/L and more than 10% of all measurements are <5mg/L. For other conventional inorganics, criteria are exceeded in >10% of measurements.
Nutrients	Nutrient conditions were evaluated on a site by site basis using the benchmarks described below. In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events. • Total Phosphorus: One/more measurements >0.3 mg/l • Nitrogen (measured as $NO_3 + NO_2$) -- One/more measurements >10.0 mg/l • Dissolved Oxygen (DO) -- Measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/l or values >12.0 mg/l • pH measurements -- Measurements above the water quality standard of 9.0 or measurements that are consistently at/close to the standard, in the range of 8.7- 9.0 • Algal Conditions -- Algae are described as "excessive" based on field observations by trained staff.	
Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI) Scores (Range of possible scores is 0-8)	**Fully Supporting**	**Not Supporting**
	• mIBI ≥1.8 (for samples collected with an artificial substrate sampler) • mIBI ≥2.2 (for samples collected using kick methods)	• mIBI <1.8 (for samples collected with an artificial substrate sampler) • mIBI <2.2 (for samples collected using kick methods)
Qualitative habitat use evaluation (QHEI) (Range of possible scores is 0-100)	The Qualitative Habitat Evaluation Index (QHEI) is used in conjunction with mIBI and/or IBI data to evaluate the role that habitat plays in waterbodies where impaired biotic communities (IBC) have been identified. QHEI scores are calculated using six metrics: substrate, instream cover, channel morphology, riparian zone, pool/riffle quality, and gradient. QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities or if there may be other stressors/pollutants causing the IBC.	

Table 1: Summary of Use Support - Assessed and Reported 1998 through 2007.

Designated Use	Support	Threatened[1]	Non Support	Assessed	Not Assessed
Rivers (miles)					
Aquatic Life Use	13,913	--	3,622	17,535	14,606
Fishable Uses	1,044	--	3,402	4,435	27,705
Drinking Water Supply[2]	--	--	1	1	101
Recreational Use (Human Health)	3,700	--	8,374	12,073	20,100
Great Lakes Shoreline (miles)					
Aquatic Life Use	59	--		59	--
Fishable Uses	--	--	59	59	--
Drinking Water Supply[2]	33	--		33	--
Recreational Use (Human Health)	--	--	59	59	--
Lake Michigan (acres)					
Fishable Uses	--	--	154,176	154,176	--
Lakes and Reservoirs (acres)					
Aquatic Life Use	3,690	--	6,625	10,315	21,826
Fishable Uses	7,820	--	63,663	71,483	5,084
Drinking Water Supply[2]	230	--	16,385	22,905	12,926
Recreational Use (Human Health)	21,922	--	983	22,905	104,662
Recreational Use (Aesthetics)	29,035	--	8,006	37,041	90,526

Source: IDEM's Assessment Database

Let’s move on…Dealing with Uncertainty

Data Evaluation and Use

Types of Data Needed for Watershed Characterization & Assessment

- **Physical and Natural Features**
  - Watershed boundaries
  - Hydrology
  - Topography
  - Soils and Geology
  - Rainfall and Climate
  - Habitat
  - Wildlife
- **Land Use and Population Characteristics**
  - Land Use / Land Cover
  - Existing Management Practices
  - Demographics
  - Socioeconomic Conditions
- **Waterbody Conditions**
  - Water Quality Standards
  - 305(b) Report
  - 303(d) List
  - TMDL Reports
  - Source Water Protection Areas
- **Pollutant Sources**
  - Point Sources
  - Nonpoint Sources
- **Waterbody Monitoring Data**
  - Water Quality Data
  - Flow data
  - Riparian Conditions
  - Biological & Habitat data

If you have existing data:

- What type – water quality, biota, habitat, sediment?
- Who collected it, what methods were used?
- How old is it? Have conditions in the watershed changed since it was collected?
- How do the data compare with water quality criteria?
- Can you use it to develop a watershed assessment – are there gaps?

Data gaps: when to collect more?

- Insufficient data to fully characterize water body
  - Bioassessment data without info on other parameters
  - No info on major tributaries
- Major questions regarding key pollutant source(s)
  - Sediment: stream banks, construction sites, or row crop lands?

Data gaps: when to collect more?

- Water quality data are inconsistent with what's known about the watershed
  - Bacterial source tracking shows high human bacteria, but few (or no) known sources
- Data are more than 3-4 years old, & watershed is changing rapidly
  - Agriculture to subdivision conversion areas

Looking for an invisible enemy

Volunteers testing state waterways for bacteria

Do you have enough information to begin implementation?

- As these things increase:
  - Number of pollutants
  - Complexity of loads/stressors
  - Uncertainty regarding existing information
  - Expense involved in addressing problems
- The need for more sophisticated assessment info also increases

Supplementing available data

- Windshield surveys
- Interviews with residents
- Volunteer monitoring results
- Bioassessment
- Targeted sampling
- Chemical/biological sampling

Helps lay the groundwork for implementation!

Visual assessment methods

- Assessment methods apply to:
  - Streams, rivers, lakes, other water bodies
  - Water body and bank / riparian areas
  - Land use and management practices
- Several protocols exist
  - NRCS Stream Visual Assessment Protocol
  - Center for Watershed Protection rapid assessments
  - Adaptations of US EPA Rapid Bioassessment Protocols and other stream and land use & management methods

Stream visual assessments

- Typical water body assessment parameters:
  - Clarity and appearance
  - Habitat structure (woody debris, substrate)
  - Sediment bars in channel
  - Colors, odors, foam, oil sheen
  - Bottom deposits, sludge, scum
  - Presence of live or dead organisms
- Bank and other parameters:
  - Vegetation type & buffer width
  - Evidence of bank erosion (roots, fallen trees)
  - Morphology (riffles, pools, alterations)
  - Fish barriers, other structures, trash

Upland visual assessments

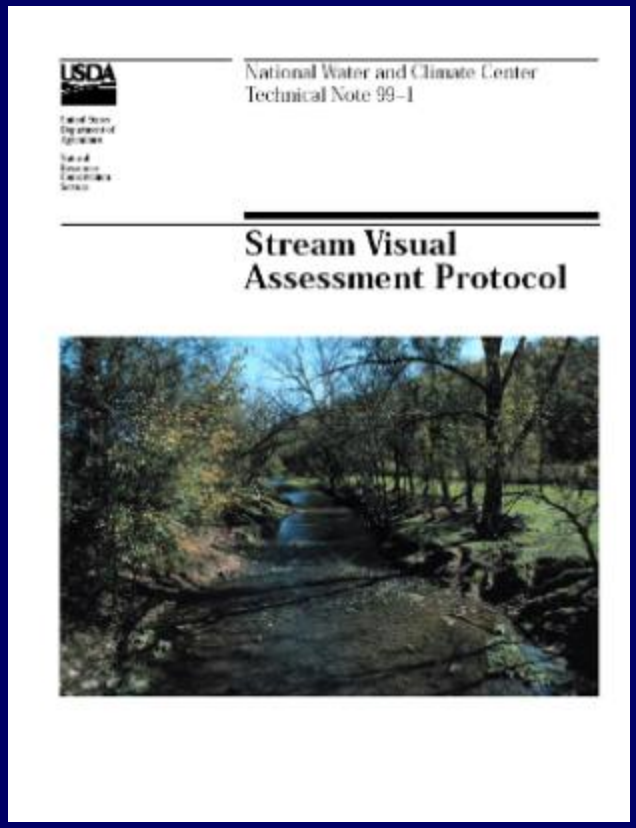
- Based on land use types
  - Row crop, pasture, livestock, forest
  - Urban, commercial, industrial, residential, institutional, active construction
- Drainage pattern parameters
  - Impervious areas, eroded ditches, retention & detention ponds, discharge into receiving waters
- Evidence of polluted runoff & discharges
  - Material storage, sediment, illicit discharges, land application practices, wastewater treatment

Stream Visual Assessment Protocol (NRCS)

One assessment tool provides basic stream health evaluation. Scores are assigned for the following:

Channel condition	Hydrologic alteration
Riparian zone width	Bank stability
Canopy cover	Water appearance
Nutrient enrichment	Manure presence
Salinity	Fish movement barriers
Instream fish cover	Pools and riffles
Invertebrate habitat	Macro invertebrates

http://www.wsi.nrcs.usda.gov/products/W2Q/water_qual/docs/svapfnl.pdf



Unified Subwatershed and Site Reconnaissance Survey

Neighborhood Source Assessment

Hot Spot Investigation

Pervious Area Assessment

Streets and Storm Drain Assessment

cwp.org

Excerpt from Wright et al., 2004

Neighborhood Source Assessment **NSA**

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:	
DATE: ___/___/_____	ASSESSED BY:	CAMERA ID:	PIC#:

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: _____ Neighborhood Area (acres) _____

If unknown, address (or streets) surveyed:

_____

Homeowners Association? ☐ Y ☐ N ☐ Unknown If yes, name and contact information: _____

Residential *(circle average single family lot size):* _____

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ½ acre ☐ Multifamily (Apts, Townhomes, Condos)

☐ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Mobile Home Park

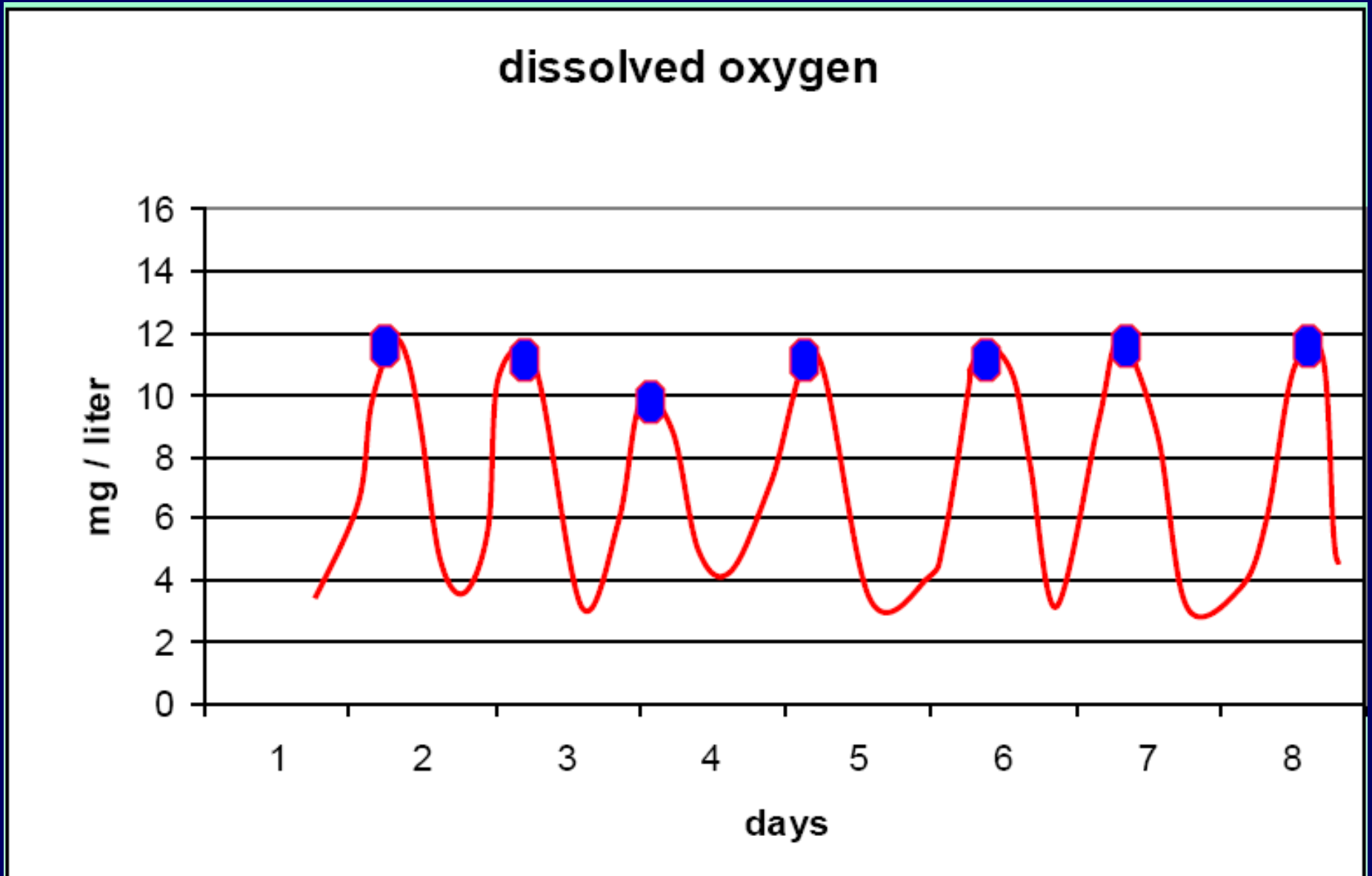
Estimated Age of Neighborhood: _____ years | Percent of Homes with Garages: _____% With Basements ____% | INDEX*

Sewer Service? ☐ Y ☐ N ○

Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10% ○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage	Comments/Notes	
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover			
B2. % of lot with grass cover			○
B3. % of lot with landscaping (e.g., mulched bed areas)			◇
B4. % of lot with bare soil			○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy			◇
B6. Evidence of permanent irrigation or "non-target" irrigation			○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: ____		○
	Med: ____		
	Low: ____		
B8. Outdoor swimming pools? ☐Y ☐N ☐ Can't Tell Estimated # ____			○
B9. Junk or trash in yards? ☐ Y ☐ N ☐ Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious ☐ N/A			

The importance of caution & ground-truthing



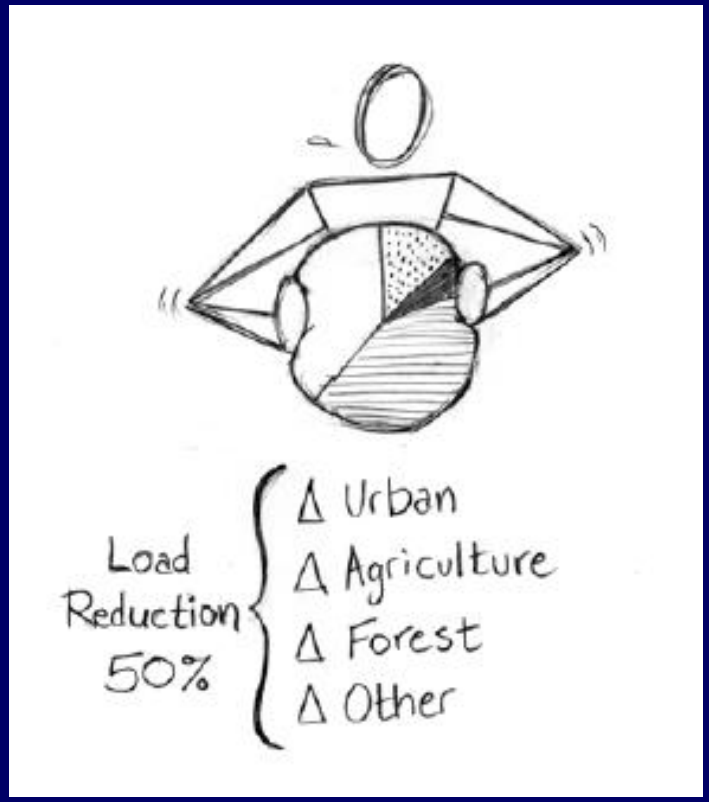
Reality checks

- Water quality data should be linked to land use, land cover, land management, and pollutant discharges
- Water body segments below the highest risk areas should register the most impacts
- Windshield surveys can confirm your final assessment results

Questions?

Proposed management measures

- Load reductions needed
  - Estimate quantitatively
  - Metrics selected should make sense!
- BMP types proposed
  - What will lessen your 'loads'?
  - Applicable to your situation?
- Load reductions from BMPs
  - How can you measure BMP impacts?
  - Use literature or actual values
- BMP installation sites
  - Which sites will hit the source(s)?
  - Are there critical areas to focus on?



Selecting/prioritizing/targeting BMPs

- Importance of waterbody
  - Drinking water source, recreational resource
- Magnitude of impairment(s)
  - Level of effort needed; public interest/attention
- Existing loads (causes & sources)
  - Magnitude, spatial variation, clustering
- Ability of BMPs to reduce loads
  - Sure thing, or a shot in the dark?
- Feasibility of implementation
  - Willing partners? Public support? Access?
- Additional benefits
  - Recreational enhancements, demonstration

Asking the right questions . . .

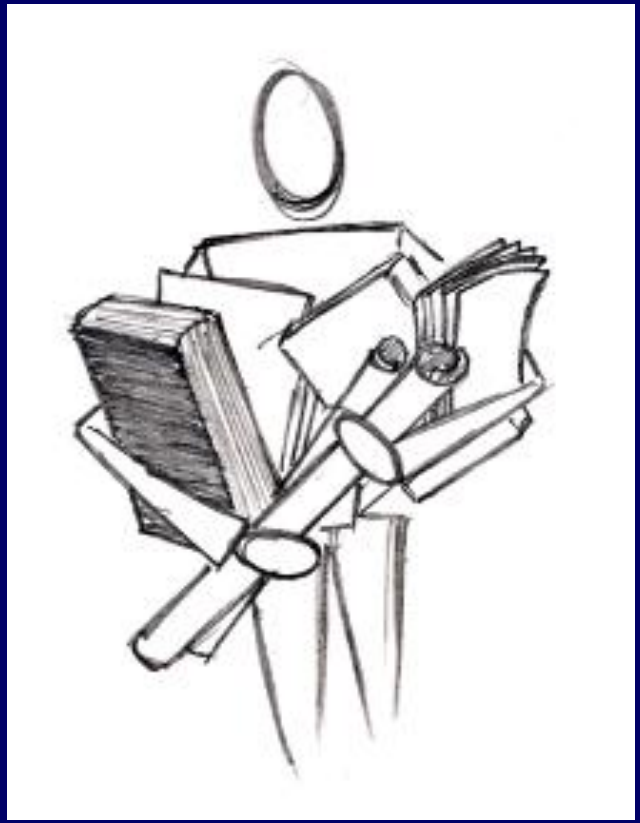
- Who can help implement the BMPs or controls?
  - Agencies, businesses, non-profits, citizens, producers
- How can they be implemented?
  - What has been done in the past?
  - How well did it work?
  - Can we do it (or adapt it) here?

Asking the right questions . . .

- When can we get started?
  - Reasonable short-term actions
  - Long-term or major actions
- How do we know if it's working?
  - And what do we do if it's not?

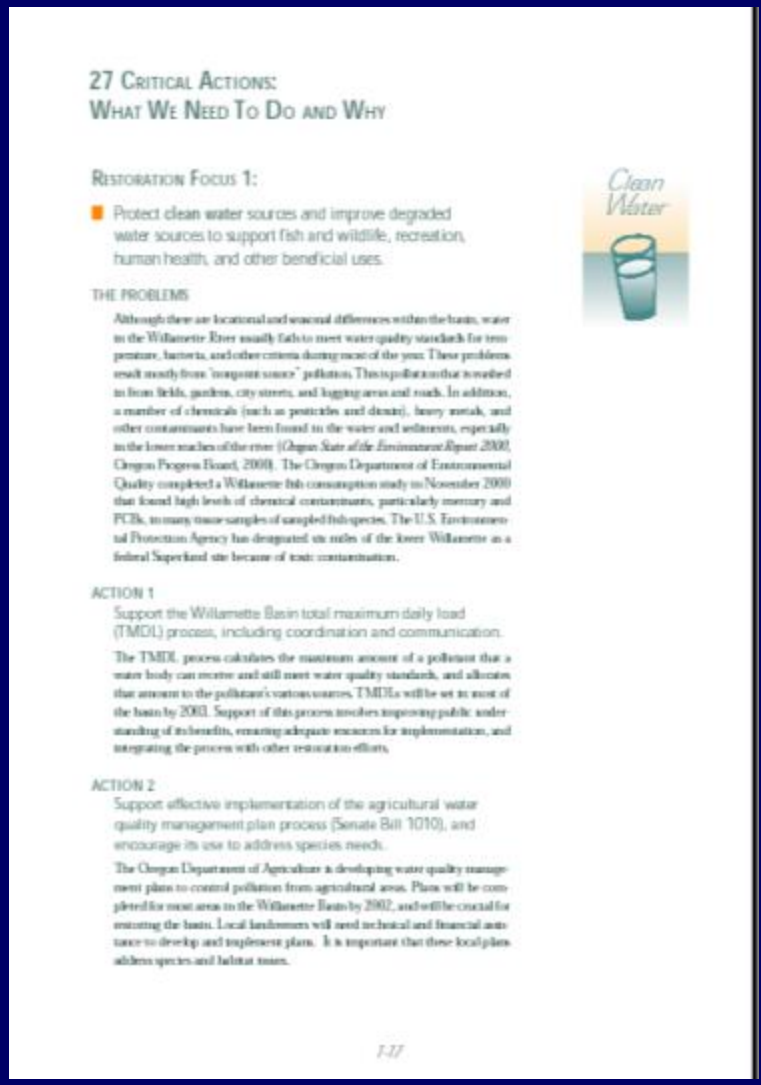
Estimate technical and financial assistance needed

- Funding sources
- Sources of technical assistance
- Regulatory or other authority
- Matching support sources



Setting times and targets

- Develop implementation schedule
  - Think about short term (< 2 yrs) and long-term (> 5 yrs) goals
- Determine how you will measure success
  - What indicators are linked to the problems you're dealing with?
- Set interim milestones
  - What helps to show progress?
  - Can be both water quality & programmatic indicators



27 Critical Actions:
What We Need To Do and Why

Restoration Focus 1:

- Protect clean water sources and improve degraded water sources to support fish and wildlife, recreation, human health, and other beneficial uses.

Clean Water

THE PROBLEMS

Although there are locational and seasonal differences within the basin, water in the Willamette River usually fails to meet water quality standards for temperature, bacteria, and other criteria during most of the year. These problems result mostly from "nonpoint source" pollution. This is pollution that is washed in from fields, gardens, city streets, and logging areas and roads. In addition, a number of chemicals (such as pesticides and dioxin), heavy metals, and other contaminants have been found in the water and sediments, especially in the lower reaches of the river (*Oregon State of the Environment Report 2000*, Oregon Progress Board, 2000). The Oregon Department of Environmental Quality completed a Willamette fish consumption study in November 2000 that found high levels of chemical contaminants, particularly mercury and PCBs, in many tissue samples of sampled fish species. The U.S. Environmental Protection Agency has designated six miles of the lower Willamette as a federal Superfund site because of toxic contamination.

ACTION 1

Support the Willamette Basin total maximum daily load (TMDL) process, including coordination and communication.

The TMDL process calculates the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and allocates that amount to the pollutant's various sources. TMDLs will be set in most of the basin by 2003. Support of this process involves improving public understanding of its benefits, ensuring adequate resources for implementation, and integrating the process with other restoration efforts.

ACTION 2

Support effective implementation of the agricultural water quality management plan process (Senate Bill 1010), and encourage its use to address species needs.

The Oregon Department of Agriculture is developing water quality management plans to control pollution from agricultural areas. Plans will be completed for most areas in the Willamette Basin by 2002, and will be crucial for restoring the basin. Local landowners will need technical and financial assistance to develop and implement plans. It is important that these local plans address species and habitat issues.

1-17

Plan implementation details

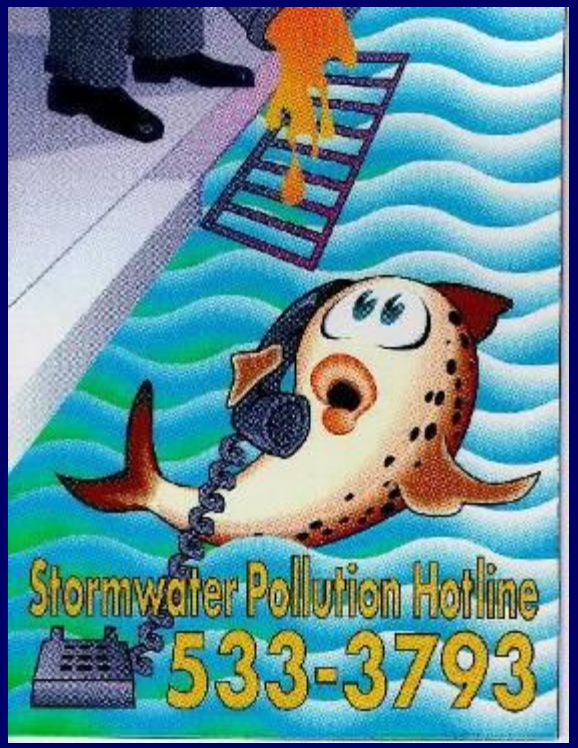
Sample Implementation Plan Matrix

Watershed Goals
Goal 1: Restore water quality to meet designated uses for fishing
Objective 1: Reduce sedimentation by 20 percent

Tasks for G1/O1	Respon. Party	Total Costs	Funding Mechanism	Indicators	Milestones			
					Short < 1 yr	**Med < 3 yr**	**Long < 7 yr**	**Remaining**
Task 1 Seek donation of conservation easements from property owners along Baron Creek	Local land trust	$0		# acres donated	2	7	10	10
I/E Activities Task 1 Hold informational workshop with property owners Develop brochures on how to donate easements	Local land trust	$3,000	Sect. 319 funding	# workshops held # participants # requests for assistance	3 40 2	3 45 4		0
Task 2 Purchase greenway alongside Baron Creek	County park district	$2,000/ mile	County general funds	# miles purchased	2	4	7	5
I/E Activities Task 2 None								

Coordinate with other water resource and land use programs

- Section 303, Water Quality Standards, TMDLs
- Section 319, NPS Program
- Section 402, NPDES Permits, CAFOs, Stormwater I & II
- Source Water Protection Plans – local water utilities
- Wetlands Protection Programs
- EQIP, CRP, BLM, USFS, USFWS
- More…



During implementation, remember:

- Plans are guides, not straitjackets
- Be aware of unforeseen opportunities
- Picking the low-hanging fruit is easy . . . BUT it helps to build a sense of progress & momentum
- If possible, work quietly for as long as you can on the most contentious issues