National Water Quality Indicator for Canada:

Communicating Results

Rob Kent, Chris Lochner, Janine Murray, Connie Gaudet
Water Quality Monitoring and Surveillance
Water Science and Technology
Environment Canada

National Water Quality Monitoring Conference
San Jose, California
May 8 – 12, 2006

Outline

- Background, context
- Data generation – monitoring
- Canadian Water Quality Index and Reporting out
- How is it calculated?
- Benefits and challenges
- Conclusions

Background

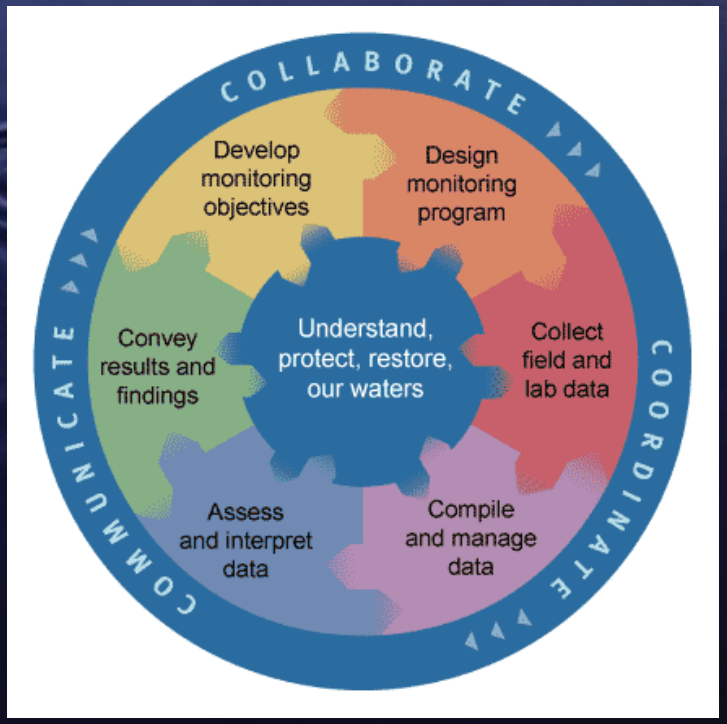
- Consistently a top priority for Canadians
- Increased public concern and decreased confidence in water safety
- External criticism of current status
- Commitment to better inform Canadians on national water quality
- Respond to Canadian values on water: *drinkable, swimmable, fishable, available*

A modern integrated approach

...moving beyond "taking the sample"

Functional Elements:

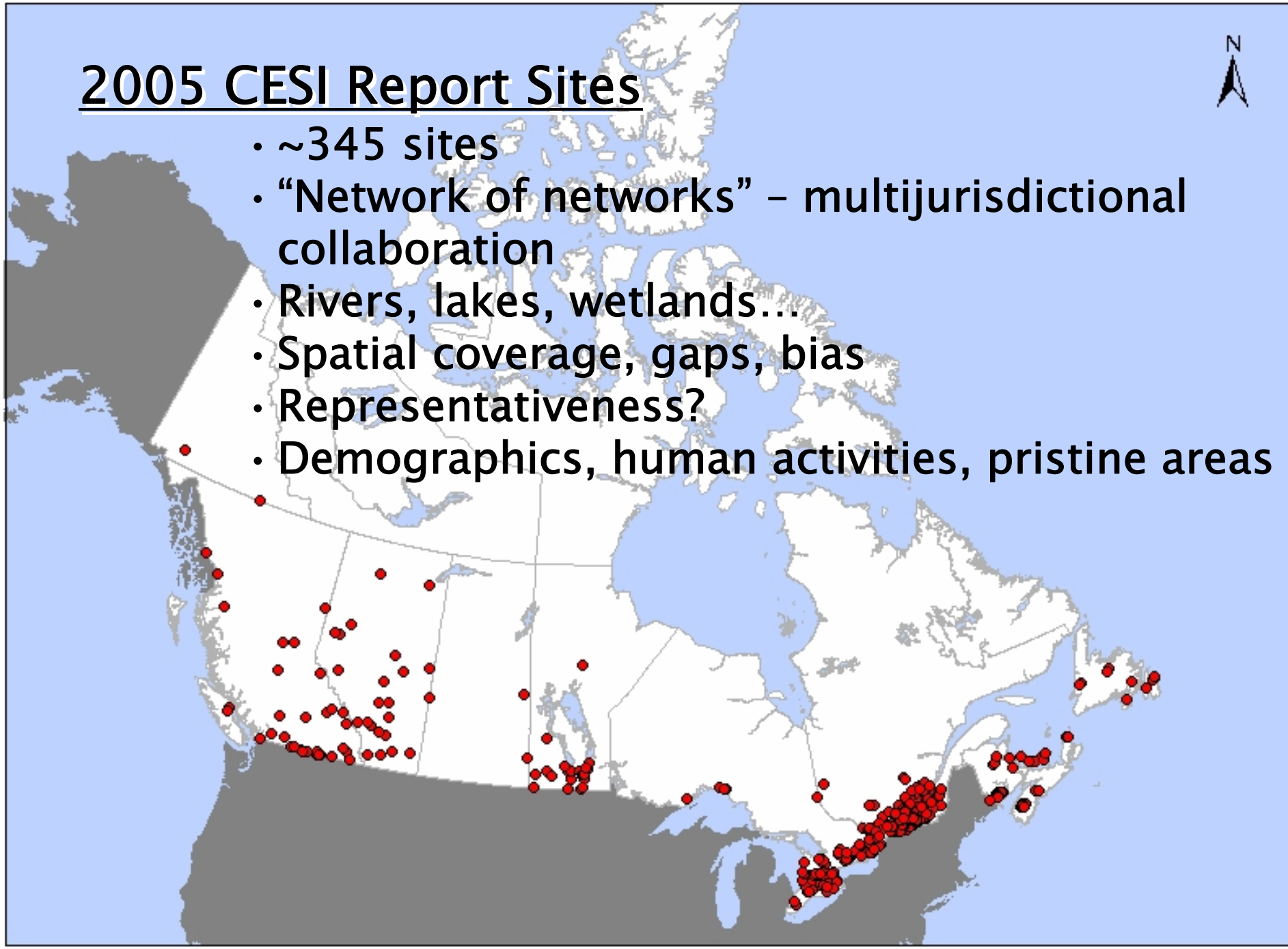
1. Program Design – objectives
2. Methods development, Lab support
3. Research support
4. Data management
5. Interpretive tools/guidance
6. Reporting, indicators and information systems
7. Partnerships / Outreach
8. National co-ordination



(Source: U.S. National Water Quality Monitoring Council Framework, 2002)

2005 CESI Report Sites

- ~345 sites
- "Network of networks" – multijurisdictional collaboration
- Rivers, lakes, wetlands…
- Spatial coverage, gaps, bias
- Representativeness?
- Demographics, human activities, pristine areas



The CWQI
and
Reporting Out

National Water Quality Indicator Initiative

Vision: *Canadians will recognize and use the WQ Indicator as a trusted source of information on national water quality that will be reported yearly starting in 2005*

Sustainability of major water uses:

1. Water for aquatic life
2. Source water for drinking
3. Water for recreation
4. Water for agriculture (livestock, irrigation)
5. Water for industrial uses

CCME Water Quality Index

- The CCME WQI developed/used by experts to translate large amounts of complex water quality data into a simple overall rating for a site.
- Results converted into a qualitative scale that is used to rate sites as follows:

Excellent (95.0–100.0)

Good (80.0–94.9)

Fair (65.0–79.9)

Marginal (45.0–64.9)

Poor (0–44.9)

Water quality never/rarely exceed guidelines

Water quality exceeds guidelines frequently and/or by a considerable margin.

Canadian WQI

$$WQI = 100 - \frac{\sqrt{F_1^2 + F_2^2 + F_3^2}}{1.732}$$

- *Scope (F1)* – number of variables not meeting water quality objectives
- *Frequency (F2)* – the number of times the objectives are not met
- *Amplitude (F3)* – the extent to which objectives are exceeded

F_1 *Scope*

- Scope assesses the extent of c
with water quality guideline
time period of interest
- F_1 indicates the pe
parameters, wh es are not
met.

Statistics…

$$F_1 \quad \frac{\text{Failed Variables}}{\text{Number of Variables}} \times 100$$

F_2 *Frequency*

- Assesses the frequency wit
  guidelines are not met
- F_2 indicates the n individual
  tests which d uidelines (i.e.
  "failed tes

$$F_2 = \frac{\text{Failed Tests}}{\text{Number of Tests}} \times 100$$

More Statistics…

F3 *Amplitude*

- Amplitude assesses the amount by which gui
  not met.
- F_3 indicates the amount by which fai not
  meet their guidelines, and is cal
- The number of times an in tion exceeds a
  guideline is termed an

When th xceed the guideline:

$$ex \left\{ \frac{\text{t Value}i}{\text{Guideline}j} \right\} - 1$$

he test value must not fall below the guideline:

$$excursion_i = \left\{ \frac{Guidelinej}{Failed\ Test\ Valuei} \right\} - 1$$

More Statistics...

F_3 *Amplitude* *(cont.)*

- The collective amount by which individual tests
  compliance with guidelines is calculated by
  excursions of individual tests, and dividi
  number of tests which failed guideli
- This variable is referred to as the
  excursions, or *nse.*

n

ns

More Statistics…

…lculated to yield a value between 0 and 100

$$F_3 = \left\{ \frac{\text{nse}}{0.01\ nse + 0.01} \right\}$$

Typical Applications

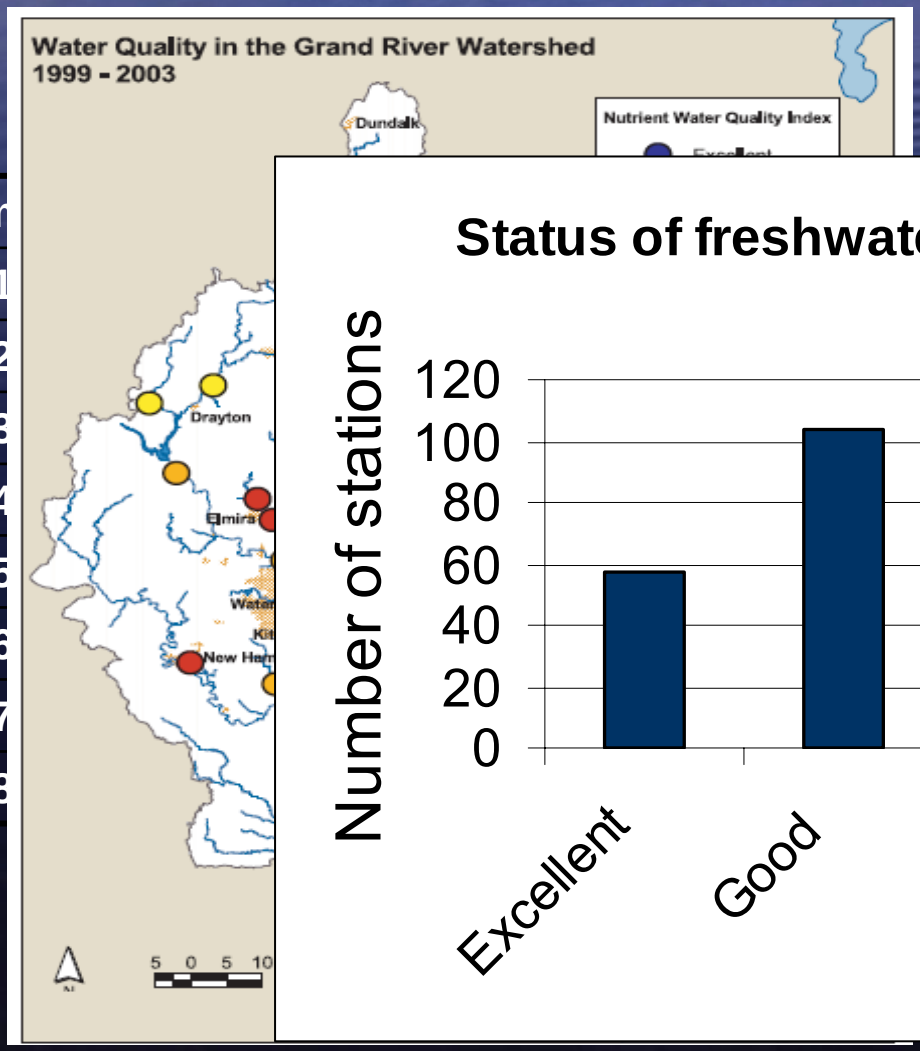
- Selected parameters (~10) related to water use at a monitoring site
- Most appropriate ambient WQ guidelines or objectives (site-specific)
- Rivers: 3yr average values of at least 4 samples/yr
- Lakes: at least two (2) samples a year, if taken during fall and spring mixing, or at least four (4) times a year, if taken during other time periods
- Great Lakes: each lake once every 3 years; not included in national roll-up due to differences in monitoring and application of WQI

Benefits
and
Challenges

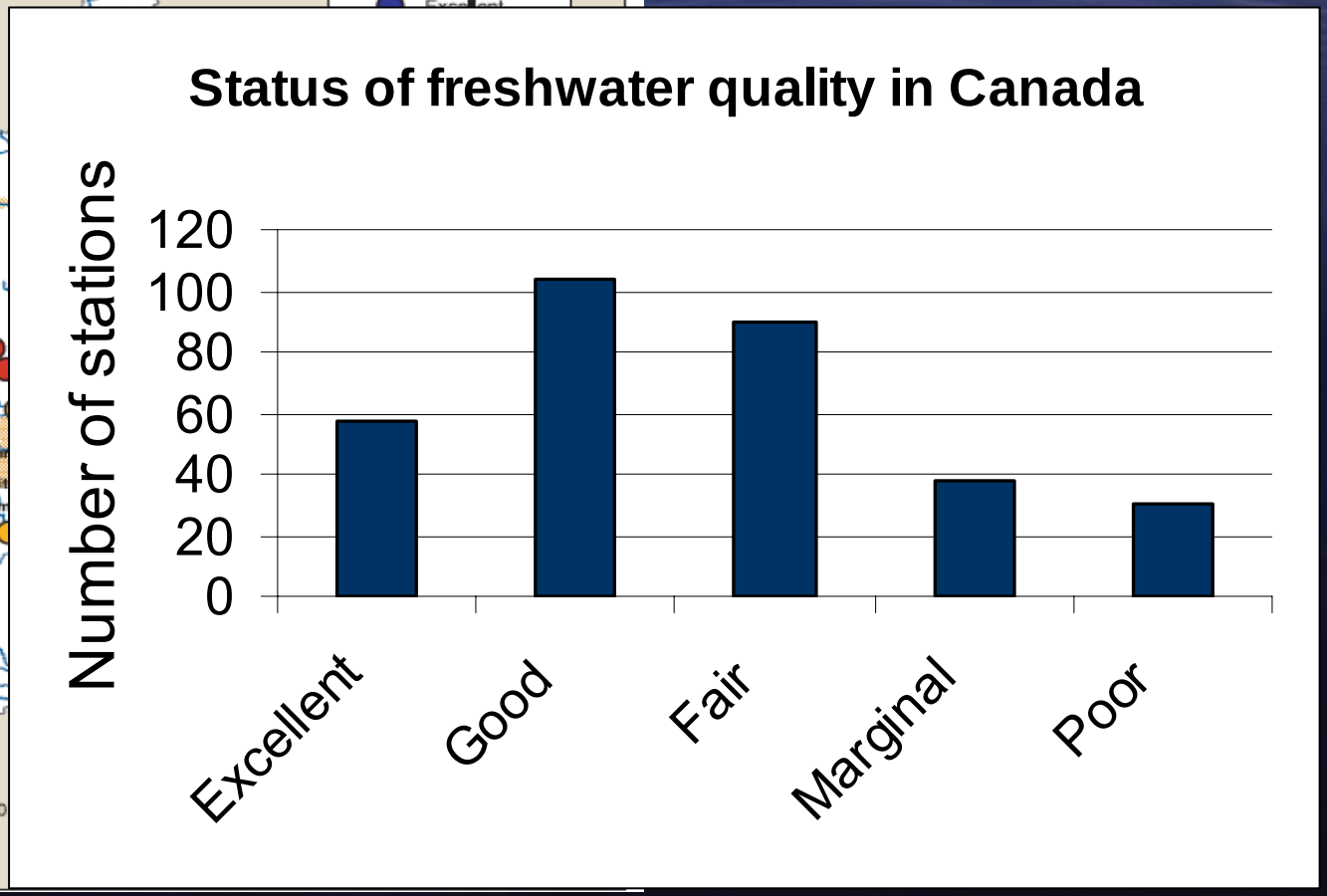
CWQI – What does it do?

- Communication tool – transforms complex water quality data into universally understandable descriptions (*e.g.*, good, fair, poor)
- Scientific rigor – maximum use of monitoring data
- Consistent use and interpretation across distributed jurisdictions
- Applies to all beneficial water uses *i.e.*, socio-economically relevant
- Amenable to multiple reporting scales – local, regional and national

CWQI – *From data to knowledge*



Sam
1
2
3
4
5
6
7
8



Challenges

- Integrating physical, chemical <u>and</u> biological measurements and processes
- Spatial scale; aggregating results
- Weighting of $F_{1,2,3}$
- Natural phenomena *vs* human impacts
- <u>Best scientific judgement</u>

Conclusion

- Water quality indicator integrating all data into socially relevant "report card" – within distributed multi-jurisdictional model
- Continuous improvement
- Credibility through expert judgement
- Start at integrating water quality and quantity measures into natural capital accounting
- Key to behavioural change, strengthened measurement capacity and enhanced resource management performance