Ground Water Quality Rule and Significant Degradation

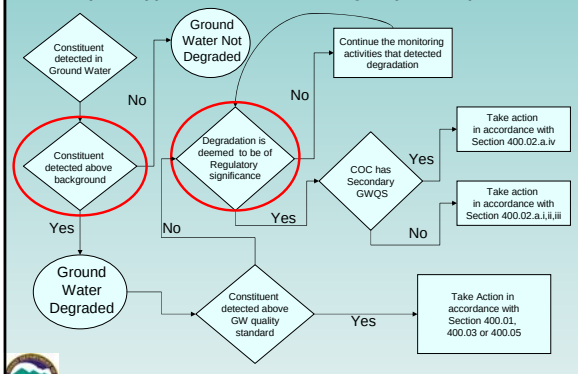
2010 Idaho Water Reuse Conference
May 19, 2010

Idaho Department of Environmental Quality
Ed Hagan

Ground Water Quality Rule Guidance

1) Conceptual approach to implementation of GWQR
2) Statistical Guidance - Background and degradation
3) Degradation of regulatory significance

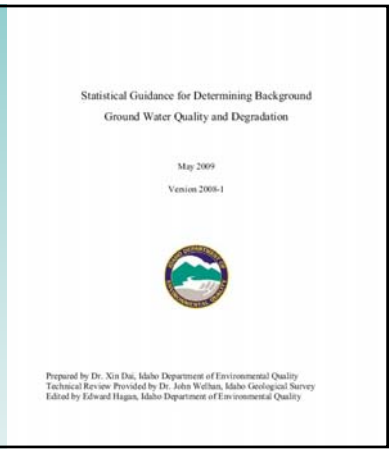
Conceptual Approach to Ground Water Quality Rule Implementation



Ground Water Quality Rule Degradation

1) Statistical Guidance Background and statistically significant degradation
2) Regulatory significant degradation

Ground Water Quality Rule Statistical Guidance


Statistical Guidance for Determining Background
Ground Water Quality and Degradation

May 2009

Version 2008-1

Prepared by Dr. Xin Dai, Idaho Department of Environmental Quality
Technical Review Provided by Dr. John Welhan, Idaho Geological Survey
Edited by Edward Hagan, Idaho Department of Environmental Quality

Statistics means never having to say you're certain

Statistical Guidance Document

Determine background and degradation

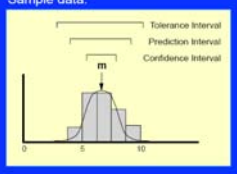
- Provide a standardized framework or process to evaluate ground water quality data
- Utilize a decision tree showing required elements
- Provide flexibility for site-specific conditions
- Suggest certain statistical tools but allow for negotiated alternatives

Determination of Background

- Two options
  - 1) Use Alternative Concentration Limit (ACL)
    - Use the largest value of the most recent data collected
    - Mean + 1.65 x Standard Deviation
    - Median + 1.65 x IQR,
      IQR = the interquartile range
    - The method that gives the lowest value is chosen
  - 2) Use statistical analyses to determine upper limit
    - consider data distributions (normal, log-normal, non-parametric), data trends, seasonality

Some Relevant Definitions

Sample data:



Confidence Interval - at 95% confidence, m falls in [5.4, 7.8] (population parameter)

Prediction Interval - at 95% confidence, the next 4 measurements will all fall in [4.2, 9.0]

Tolerance Interval - at 95% confidence, 99% of future measurements will fall within [3.0, 10.2]

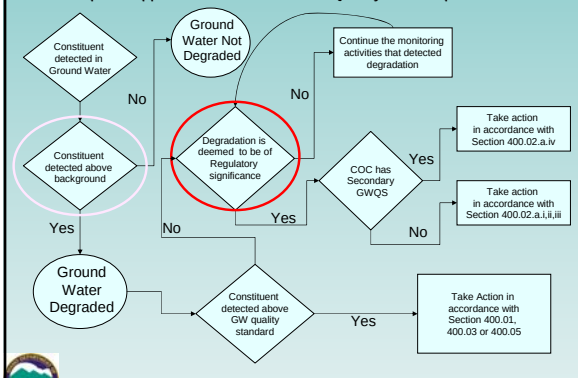
Intervals can be one-sided or two-sided

Prepared by Dr. John Welhan

Degradation Summary

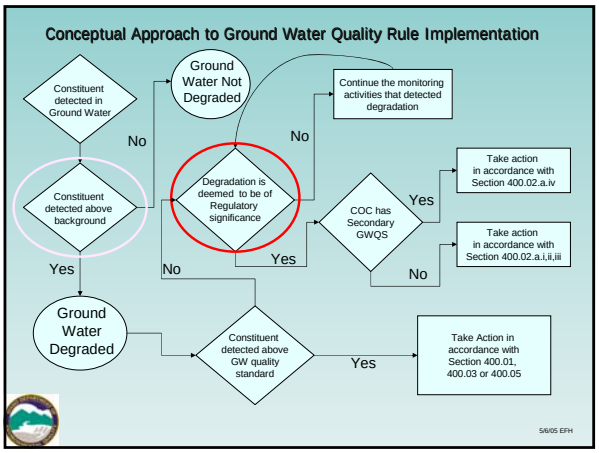
- Degradation is a detection above upper limit of background as determined using previous methods.
- Degradation will be site-specific and dependent on the background.
- At a specific site, degradation may be well specific.

Conceptual Approach to Ground Water Quality Rule Implementation



Why Determine Regulatory Significant Degradation

- Determination of regulatory significance is important because DEQ is required to take action when degradation is deemed to be significant.



Criteria

§ 400.02.b of the Rule provides criteria for DEQ to use in determining what is significant degradation.

1. Site-specific hydrogeologic conditions;
2. Water quality, including seasonal variations;
3. Existing and projected beneficial uses;
4. Related public health issues; and
5. Whether the degradation involves a primary or secondary constituent.

Consensus process

Regulatory Significance Process

Guidance addresses the 5 criteria with 9 questions.

The questions are weighted based on impact to human health.

A numerical score is generated to provide a relative indication of the potential for beneficial uses to be impacted by the detected degradation.

High scores indicate degradation is more likely to impact public health or a beneficial use than low scores

Scores separated into five categories

Examples illustrating application of guidance using nitrate as COC

Significant degradation determination

High Score

Degradation is significant if the COC is detected above the site background

Degradation is not significant until COC is detected above site background level plus **10% of the difference of Ground Water Quality Standard – background**)

Degradation is not significant until COC is detected above site background level plus **25% of the difference of Ground Water Quality Standard and background**
(up to ½ the numerical Ground Water Quality Standard)

Degradation is not significant until COC is detected above site background level **plus 50% of the difference of Ground Water Quality Standard – background**
(up to ½ the numerical Ground Water Quality Standard)

Degradation is not significant until COC is detected above ½ the numerical Ground Water Quality Standard

LOW Score

Example using nitrate as COC

- If the background concentration is over ½ the GWQS, the highest increase before the degradation is significant is 10% of difference between background and standard

standard = 10 mg/L background = 5.5 mg/L

Difference 10 – 5.5 = 4.5

10% of 4.5 = .45

5.5 (backgrnd) + 0.45 (increase) = 5.95 mg/L

A detection above 5.95 mg/L would be significant degradation

Exceptions

Any detections of a synthetic organic chemical (SOC) or a volatile organic chemical (VOC) are significant.

Summary

1) Statistical guidance is complete

   a) background ground water quality, and

   b) degradation (statistically significant and reproducible).

2) A draft guidance providing a process for DEQ to use to determine when degradation is of "regulatory significance" is being released for public review.

Top ten reasons to be a statistician

1) Estimating parameters is easier than dealing with real life.
2) Statisticians are significant
3) I always wanted to learn the entire Greek alphabet.
4) The probability a statistician major will get a job is > .9999.
5) If I flunk out I can always transfer to Engineering.
6) We do it with confidence, frequency, and variability.
7) You never have to be right - only close.
8) We're normal and everyone else is skewed.
9) The regression line looks better than the unemployment line.
10) **No one knows what we do so we are always right.**