Lower Boise River Technical Advisory Committee on Water quality trading

Technical Advisory Committee Meeting:
Foundations for Revising the Lower Boise River Water Quality Trading Framework
March 1, 2016

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Water Quality Trading Note I: Components of a Water Quality Trading Framework

Background

In 1997, the Lower Boise River was selected as a demonstration project to examine how trading could help improve water quality and lower the overall cost of meeting pollutant reduction objectives established by Total Maximum Daily Load (TMDL) processes. A watershed-scale framework to support trading in the Lower Boise was developed by Ross and Associates in 2000 and formally adopted as the Lower Boise River Water Quality Trading Framework (Framework) in 2010.

This Framework has been in place ever since, and represents one of the most complete and thoughtful examples of a watershed-scale trading framework in the country. Now, DEQ and the Lower Boise River Watershed Advisory Group (WAG) have decided to take a fresh look at that original Framework and recommend updates that consider results from the recently approved Lower Boise River Total Phosphorus Addendum to the TMDL (DEQ 2015), associated technical work completed by Willamette Partnership (WP 2015) and The Freshwater Trust (TFT 2015), and concepts from the Regional Recommendations for the Pacific Northwest on Water Quality Trading (also referred to as the Joint Regional Recommendations (WP et al 2014).[1] The update process may also consider lessons learned from around the country, including a recently published reference by the National Network on Water Quality Trading.[2]

Over the next 6-9 months, a technical advisory committee (TAC) for the WAG will develop an updated draft Framework to recommend for approval by the full WAG and DEQ. This memo describes guiding principles for water quality trading programs and provides an overview of the components of a trading framework that will be discussed over the coming months.

Guiding Principles for a Trading Framework

Program developers often wrestle with tough ecological, economic, and social tradeoffs in designing a trading system to meet clean water goals in a cost effective way. The Joint Regional Recommendations and National Network on Water Quality Trading offer the following guiding principles to provide state agencies and other stakeholders with a cohesive approach to think through the tough design and implementation issues:

1) Effectively accomplish regulatory and environmental goals;
2) Be based on sound science;
3) Provide sufficient accountability, transparency, accessibility, and public participation to ensure that promised water quality improvements are delivered;
4) Produce no localized water quality problems;

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1 The Joint Regional Recommendations were developed by the state water quality agencies from Oregon, Washington, and Idaho, with facilitation by Willamette Partnership (WP) and The Freshwater Trust (TFT), and review by US EPA Region 10. The Joint Regional Recommendations represent dialogue between the states to identify the critical components of water quality trading and to recommend several approaches to achieve these components.

2 The National Network on Water Quality Trading diverse collaborative that seeks to establish a national dialogue on how water quality trading can best contribute to clean water goals. For more information on the National Network, see http://willamettepartnership.org/nn-wqt/

5) Be consistent with the CWA regulatory framework; and
6) Include appropriate compliance and enforcement provisions to ensure long-term success.

Components of a Trading Framework

The National Network on Water Quality Trading has identified 11 elements common to many trading programs that should be considered when designing and implementing water quality trading programs. Regarding each of these elements, there is no "one size fits all solution." Instead, there are considerations that make different options more or less viable under different conditions. Updates to the Lower Boise Framework should consider the following trading program components (see Appendix A for Draft Outline of the Lower Boise Framework):

1. **Establishing/identifying regulatory instruments to support trading:** incorporating trading into relevant federal and state regulatory instrument, including NPDES permits and other regulatory documents.
2. **Trading basics:** who is eligible to trade, where trading can occur, and what is being traded.
3. **Eligibility:** the basic requirements that credit buyers and credit sellers need to meet, including baseline thresholds.
4. **Quantifying water quality benefits:** the methods used to estimate or measure pollutant load reductions from trading projects.
5. **Trading ratios:** managing risk and uncertainty in the trading program through ratios and other mechanisms.
6. **Defining credit characteristics:** the essential characteristics of a credit in a water quality trading program, including how long a credit is good for (credit life); project renewal; and relationship with other crediting or mitigation programs.
7. **Establishing project implementation and assurance guidelines:** design, construction, and maintenance quality standards (BMP guidelines) help ensure that projects deliver the promised water quality benefits.
8. **Establishing procedures for project review, certification, and tracking:** confirming that credits are real and tracking credits from their generation through credit sales and usage.
9. **Ensuring compliance and enforcement:** ensuring compliance of Clean Water Act permits and associated enforcement in a water quality trading program.
10. **Adaptive management:** improving quantification methods, approving new BMPs, and evaluating overall program effectiveness.
11. **Defining roles & responsibilities:** planning for the program's administration and ongoing operations.

References

Idaho Dep't of Environmental Quality (2015). Lower Boise River TMDL: 2015 Total Phosphorus Addendum. Available at https://www.deq.idaho.gov/media/60177413/lower-boise-river-tmdl-total-phosphorus-addendum-0815.pdf.

The Freshwater Trust (2015). Lower Boise River Technical Analysis: Evaluation of agricultural best management practices, on-field conditions, and hydrologic connection to support water quality trading (available upon request from DEQ).

Willamette Partnership (2015). Lower Boise Framework Update: Findings & Recommendations (available upon request from DEQ).

Willamette Partnership, The Freshwater Trust, Idaho DEQ, Oregon DEQ, and Washington Ecology (2014). Draft Regional Recommendations for the Pacific Northwest on Water Quality Trading. Available at http://willamettepartnership.org/publications

Appendix: Draft Outline of Lower Boise Trading Framework

1. Introduction

1.1. Authority for Water Quality Trading in the Lower Boise

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Water Quality Trading Note II: What are Appropriate Credit-Generating Actions?

Adapted from Building a Water Quality Trading Program by the National Network on Water Quality Trading[3] and the Draft Joint Regional Recommendations for the Pacific Northwest[4]

There are many ways to improve water quality across the landscape, but not all projects can create credits. BMPs that generate credits need to be supported by enough information to understand their specific effect on water quality and to ensure that they deliver the promised benefits.

Potential Credit-Generating BMPs in the Lower Boise

A set of credit generating BMPs was initially approved as part of the 2010 Lower Boise Trading Framework (Framework). These BMPs were supported by good technical information and remain highly relevant in the Lower Boise. Information from the recently completed TMDL (DEQ 2015) and a technical evaluation by the Freshwater Trust should be used to update this list for the 2016 revision to the Lower Boise Framework. Based on the work completed by the Freshwater Trust, 12 of the 13 original BMPs are viable candidates, with the exception of conservation crop rotation (NRCS Practice Code 328) (TFT 2015). According to the report, conservation crop rotations have “a degree of ambiguity in the length of time, and the number and type of rotations required in order to generate trading credits.”

Table 1. Potential BMPs for the Lower Boise Framework

BMP Type	Design Criteria	Lifespan
Sediment basin (field scale)	NRCS 350	20 years
Sediment basins (watershed scale)	NRCS 350	20 years
Filter strips	NRCS 393	1 season
Underground outlet (years 1-2)	NRCS 620	2 years
Underground outlet (after year 2)	NRCS 620	18 years
Straw in furrows	NRCS 484	1 season
Sprinkler irrigation	NRCS 442	15 years
Microirrigation	NRCS 441	10 years
Tailwater recovery	NRCS 447	15 years
Surge irrigation	NRCS 449	1 season
Constructed wetland (farm scale)	NRCS 656	15 years
Cover Cropping	NRCS 340	1 year

As with the original LBTF, recommended updates do not include Nutrient Management (NRCS 590) because the efficiency of nutrient management is difficult to estimate. Nutrient Management is considered a complementary practice that enhances the outcomes of other BMPs when considered as part of a conservation plan.

Adding New BMPs, Quantification Methods, & Quality Standards

The Framework will need to adapt overtime to incorporate new information and practices. The 2010 Idaho State Guidance on trading outlines a four step process for adding new BMPs or improved design,

[3] The National Network on Water Quality Trading is a collaborative effort that brings together the perspectives of agriculture, point sources, environmental groups, regulatory agencies, and the practitioners delivering WQT programs across the country. The purpose of the Network is to establish a national dialogue on how water quality trading can best contribute to achieving clean water goals.

[4] REFERENCE

measurement, and calculation of existing BMPs. The revised Framework should consider adopting a similar process to allow for continued innovation:

Step 1: Prepare and submit a proposed BMP package to DEQ for review

Step 2: Initial screening for completeness

Step 3: Review for BMP consideration by a BMP Technical Committee

Step 4: DEQ concurrence, public notice and comment

Step 5: Final decision

Ensuring Pollution Reductions Lead to Water Quality Improvements

Developing guidelines for each eligible BMP that set design, installation, maintenance, and performance standards creates confidence that BMPs are performing as anticipated and gives project developers a clear idea of how their project will be evaluated. Trades in Oregon, the Ohio River Basin, and Wisconsin all refer to such guidelines. Maryland and Pennsylvania maintain standing technical review committees to review BMPs.

The Joint Regional Recommendations and National Network on Water Quality Trading provide a list of suggested guidelines for credit generating BMPs. They are detailed in the table below along with a summary of the benefit provided.

BMP Guideline Component	Benefit
Basic information: Description of the BMP, how it works, its typical location on the landscape, and its suitability for the watershed.	Provides a clear, shared definition of the practice and supports eligibility requirements that target appropriate application of this BMP.
Quantification method • Technical analysis or literature review of predicted BMP effectiveness; • Technical summary of quantification method; • Procedures for applying and documenting application of the quantification method; and • Documenting information on who completed the quantification of water quality benefits.	DEQ, EPA, and permit writers have a sound technical basis for allowing credits to offset point source loads. Project developers can predict the likely credit value of a given project and expectations for how the quantification method is applied and what kind of documentation will be expected at project verification.
BMP *quality standards* • Description of where the BMP should be applied (appropriate site conditions); • Potential side effects, interactions, and additional benefits; • Specifications for BMP design, installation, operation, and maintenance; and • Monitoring requirements and performance standards.	Ensures that BMPs are high quality, functioning as expected, and functioning in a way that is consistent with the credit quantification. Quality standards are crucial to building confidence that trading projects are producing real water quality benefits.

Project documentation and review requirements • Procedures for project site screening and verification; • Documentation required for verification; and • Credit release schedule, if applicable.	Develops clear expectations between project developers and verifiers about what documentation is expected and when credits will be released. This makes the verification process smoother and more predictable.

Many of these pieces were considered in Dr. Carter's 2002 review of BMPs for the 2010 Lower Boise Framework, but should be reviewed for completeness relative to the list above and to revise any outdated information. A full list of recommended BMP guidelines is included as Appendix A.

References and Additional Information

Carter, David L. (2002) Proposed Best Management Practices (BMPs) to be Applied in the Lower Boise River Effluent Trading Demonstration Project. Available at: https://www.deq.idaho.gov/regional-offices-issues/boise/basin-watershed-advisory-groups/lower-boise-river-wag/

The Freshwater Trust (2015). Lower Boise River Technical Analysis: Evaluation of agricultural best management practices, on-field conditions, and hydrologic connection to support water quality trading (available upon request from DEQ).

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Idaho Dep't of Environmental Quality (2015). Lower Boise River TMDL: 2015 Total Phosphorus Addendum. Available at https://www.deq.idaho.gov/media/60177413/lower-boise-river-tmdl-total-phosphorus-addendum-0815.pdf.

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Attachment A: Supporting Information for Eligible BMPs

Category		Components
Basic Information		• Title and description of practice • Load sources addressed by BMP
Quantification Method		• Unit of measure • Credit quantification approach; modeling and/or tools o Technical documentation of modeling approach/tool, including assumptions and estimates of uncertainty o Procedures/user guidance for consistent application of the model/tool • Alternative modeling approach and/or tool (where appropriate) • Effectiveness estimate, including justifications/references
BMP Quality Standards	**Suitability/ Specific BMP Eligibility**	• Eligible land-uses and practices • Locations in watershed where BMPs are applicable • Potential interactions with other practices (e.g., riparian buffers with stream fencing increases combined effectiveness) • Identification of ancillary benefits or consequences (e.g., increased/reduced air emissions) • Description of conditions where or when the BMP will not work (e.g., large storms) • Any negative results (e.g., relocated pollutants, negative pollutant reduction data)
	Design criteria	• Installation instructions/guidance (e.g., installation according to manufacturer standards and/or NRCS standards) • Verifiable criteria for installation, including: o Quantitative criteria (e.g., 2600 stems/acre planting density, 100 ft. minimum buffer width, 30% residual residue, 2 hour inflow water capacity, 100 ft. from surface water) o Qualitative criteria for installation (e.g., watering hole outside riparian zone, fence/pipe material type)
	Management criteria	• Management instructions/guidance (e.g., seeding rate, tillage plan, crop list, water application rates and method, fertilizer application rates and methods)
	Monitoring	• Operation and maintenance requirements and how neglect alters performance • Description of how the practice will be tracked and reported (e.g., noting signs of erosion, measurement of vegetative cover, monitored irrigation systems)
Credit Issuance Procedures	**Performance standards**	• Verifiable criteria for performance (e.g., no rills or gullies, stem density of 1600 stems per acre or greater, no more than 20% cover invasive species, at least 10 inches crop stubble height)

	Contract Duration and Credit Disbursement	• Cumulative, annual, or seasonal practice • Useful life; effectiveness of practice over time • Factors affecting temporal performance of the practice, including lag time between establishment and full function
	Validation of Credit Calculation Procedures	• Documentation that must be submitted to determine eligibility during a project screening/site validation • Procedures for reviewing project consistency with eligibility criteria • Applicable baseline requirements • Guidelines for applying methodology to pre-project site conditions • Guidelines for defining/predicting the future condition (for BMPs that take time to mature) • Guidelines for documenting assumptions and data included in the credit calculation
	Confirming Project Implementation	• Procedures for documenting pre- and post-implementation circumstances (e.g., farm records for 3 years prior, photo points documenting baseline condition, site visit after installation) • Procedures for reviewing consistency of pre- and post-implementation conditions with quality standards (e.g., no more than 15% discrepancy between reported and verified values)

Water Quality Trading Note III: Baseline

Adapted from Sections 3.1 and 3.2 of Building a Water Quality Trading Program by the National Network on Water Quality Trading (National Network 2015)[5] and Section 2 of the Draft Joint Regional Recommendations on Water Quality Trading for the Pacific Northwest (WP et al. 2014).

Trading baseline is an important component of any trading program, as it helps to ensure potential projects achieve water quality goals. Baseline is the threshold that must be met before selling credits, typically specifying the condition of the project site, or a performance threshold. Baseline thresholds are intended to ensure that tradable credits are awarded only after existing expectations have been met. Baseline often comes from requirements that exist outside the trading program, like state rules, regulations, or active permits. Baseline may also include trading-specific components, drawn from state-level guidance, a watershed trading framework, or a TMDL.

Trading Baseline is the threshold that must be met before selling credits. Credits are established by sources delivering additional pollutant reductions beyond a baseline level of reduction.

Point sources (e.g., waste water treatment facilities) often have permits under the NPDES program, which clearly define the expectations for a given facility. These NPDES permit are used as the foundation for point source baseline requirements, which makes them fairly straightforward. The expectations for a nonpoint source (e.g., farm or ranch) are not always as clear. There are multiple sources of information that can inform baseline thresholds for nonpoint sources.

Economic considerations

Trading baseline can have an effect on the trading program's viability (AFT 2013). If baseline is set too high in a trading program, it will be difficult for projects to achieve creditable load reductions at a reasonable cost and may limit the potential supply of credits. Alternately, if a trading program sets baseline levels too low, it may raise concerns that the program is not helping to achieve overall water quality goals. Setting a trading baseline too low may also penalize agricultural producers that have "done the right thing" by implementing BMPs early and voluntarily. A low trading baseline may also create perverse incentives to delay or remove existing BMPs in order to maximize the credits that could later be generated in a trading program. Ultimately, improving water quality is the goal and must inform baseline decisions.

Point Source Sellers

For point sources, credits can be generated after existing NPDES permit requirements are met, including technology-based effluent limits (TBELs) and their most stringent water quality based effluent limit (WQBEL). Typically, this means that a point source can sell credits for pollutant reductions below its WQBEL.

[5] The National Network on Water Quality Trading is a collaborative effort that brings together the perspectives of agriculture, point sources, environmental groups, regulatory agencies, and the practitioners delivering WQT programs across the country. The purpose of the Network is to establish a national dialogue on how water quality trading can best contribute to achieving clean water goals.

Nonpoint Source Sellers

Where do you find baseline requirements?

For nonpoint sources, there are a number of potential sources for baseline.

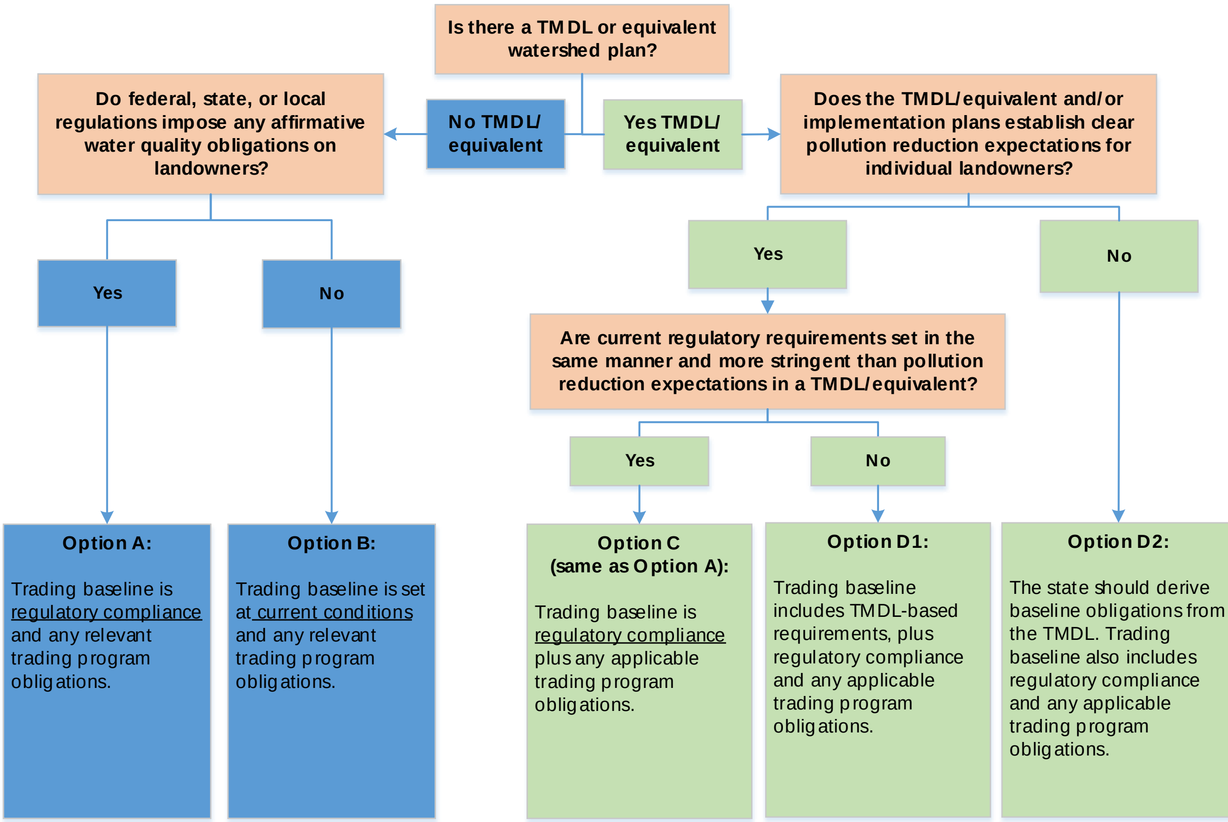
- **Regulatory requirements:** This includes relevant requirements under federal, state, tribal, and local regulation in place at the time. For example, if state law requires riparian pastures to exclude animals from surface waters, then having streamside fencing in place would be required to meet regulatory requirements and would not be a BMP eligible to generate credits.
- **TMDL or other water quality obligations**: Where there is a TMDL in place, the 2003 U.S. EPA Trading Policy states that nonpoint source "pollutant reductions [should be] greater than those required by a regulatory requirement or established under a TMDL." The 2007 Permit Writers Toolkit further interprets this to mean that "each nonpoint source participating in trading under a TMDL make reductions consistent with the Load Allocation before they can generate credits (additional reductions) for sale," and that a nonpoint source's baseline should be "derived from the nonpoint source's Load Allocation," to ensure that progress is made toward water quality standards with each trade. But EPA guidance does not specify how to derive baseline for particular sites from the Load Allocation and translating Load Allocations into thresholds for individual nonpoint sources or projects can be quite challenging.
- **Trading program obligations**. Particularly where TMDL Load Allocations prove difficult to translate into site-specific thresholds, a trading program may set forth its own trading baseline. In this case, baseline might reflect trading program stakeholder views as to the role of nonpoint source sectors in reducing pollutant loading, or seek to avoid penalizing early adopters of conservation practices.

The diagram below (next page) shows how the presence of a TMDL and the clarity of expectations within the TMDL program affects where states and trading stakeholders should look to set baseline.

Nonpoint Source Baseline in the Lower Boise

The Lower Boise has a TMDL in place, but does not establish Load Allocations in a way that can be applied to individual landowners, so Option D2 is most relevant. In developing a revision to the Lower Boise Framework, the nonpoint source Load Allocation (0.07 mg/L) should be used as an important source for baseline thresholds (DEQ 2015, p24-29).

Figure 1. Sources for baseline. Diagram from the National Network on Water Quality Trading.



Applying baseline in stages

Some trading programs phase in an increasingly strict baseline over time, affording early participants a lower threshold for entry, with the intention of increasing entry requirements in future years. This approach may be used in a watershed where a TMDL is under development or where TMDL implementation timelines are not specified. The timelines for a phased-in approach will likely need justification, similar to compliance schedules for point sources. Such an approach would be consistent with U.S. EPA's phased TMDL implementation memo (US EPA 2006).

What are the units of baseline?

Baseline can be expressed as a BMP requirement, pollutant load reduction, or percentage of reductions to be met at the time of trading project initiation. There are pros and cons to each of this methods for *expressing* baseline:

- **Technology or practice-based baseline (e.g., implement one or more required BMPs):** This approach is straightforward because the presence or absence of the required BMP can be easily confirmed. It is also seen as fair to early adopters. If conservation practices are already in place, no further action is needed. However, pollution reductions not guaranteed because the effectiveness of BMPs differs by type of operation and location.

- **Performance-based baseline (e.g., 200 lbs TP/year):** This approach is the most flexible because it allows landowners to use the BMPs that make the most sense on their operation, but it may be more complex to confirm, potentially involving significant data gathering and/or monitoring.

- **Standard water quality contribution (e.g., 30% of estimated pollution reductions):** Requiring a standard contribution is straightforward approach, but it can be seen as unfair to early adopters. Those who have already taken steps to reduce runoff (e.g., irrigation water management) will have fewer credits to sell compared with those who have not implemented any conservation practices.

What is the scale of baseline?

Should nonpoint source baseline apply on the entire farm or only on individual fields? What if the landowner owns more than one operation? Would all operations under common ownership and control need to meet baseline before they were eligible to trade? These questions get at the issue of *leakage*, where environmental improvements in one location occur at the expense of increasing degradation somewhere else. The following options are commonly considered:

- **Require baseline to be met on individual fields:** With this option, a program runs the risk that producers may increase inputs on other fields that are not enrolled in the trading program.

- **Require baseline to be met on the entire agricultural operation:** This approach ensures that impacts are not just shifting within an operation. However, this approach requires more data than applying baseline to individual fields. The program should further define what happens when a landowner rents out portions of its operation or where a landowner operates multiple distinct operations.

- **Require baseline to be met by entire sub-watershed:** In this option, all landowners in a watershed need to meet baseline thresholds prior to any one landowner being able to generate credits. This provides certainty that Load Allocations are achieved prior to trading, but may be difficult for any one credit seller to implement, and therefore significantly limit supply of credits.

References:

American Farmland Trust (AFT) Center for Agriculture in the Environment, *Setting Agricultural Baselines in Water Quality Trading Programs*, at pp. 7-9, (2013), *available at* http://www.farmland.org/documents/SettingAgriculturalBaselines_FINAL_10.13update.pdf.

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U.S. Environmental Protection Agency, *Water Quality Trading Policy*, 68 Fed. Reg. 1608, (Jan. 13, 2003) (final policy), *available at* http://www.gpo.gov/fdsys/pkg/FR-2003-01-13/pdf/03-620.pdf.

U.S. Environmental Protection Agency, *Benita Best-Wong memorandum to Water* Division Directors re: Clarification regarding "Phased" Total Maximum Daily Loads, (Aug 2, 2006), *available at* http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.html.

U.S. Environmental Protection Agency, Office of Wastewater Management, *Water Quality Trading Toolkit for Permit Writers*, (2007; updated 2009, *available at* http://water.epa.gov/type/watersheds/trading/WQTToolkit.cfm.

Water Quality Trading Note IV: Trading Ratios

Adapted from Section 5 of *Building a Water Quality Trading Program* by the National Network on Water Quality Trading (National Network 2015)[6] and Section 4.2 of the *Draft Joint Regional Recommendations on Water Quality Trading for the Pacific Northwest* (WP et al. 2014).

Much of trading program design focuses on reducing risk and uncertainty. Nonpoint credit projects operate in a dynamic environment, where natural events such as floods and drought can alter credit-generating BMPs and affect pollutant loads. That dynamism can create variability in BMP performance and make it difficult to estimate the water quality benefits delivered from individual BMPs (*scientific uncertainty)*. Other sources of risk come from changing rules (*regulatory risk*), risk that purchased credits will not be delivered as promised (*buyer risk*), and uncertainties regarding credit supply and demand (*market uncertainty*). Combinations of eligibility policies, approved credit-generating actions, credit quantification methods, and trading ratios can be integrated to successfully address these uncertainties.

When constructing a water quality trading program, managers can tailor each component to consider specific policy objectives, watershed goals, economic feasibility, and acceptable levels of risk or uncertainty.

Trading Ratios: A trading ratio is a numeric value that is multiplied by the number of credits that would otherwise be required (i.e., the amount of water quality benefits reduced by baseline obligations), used to ensure that the environmental benefit of a credit-generating project is equivalent to or greater than the reduction that would occur if the buyer installed treatment technology on site (U.S. EPA 2007). Trading ratios are often expressed as a number of credits needed per unit of discharge (e.g., a 2:1 ratio means that two credits need to be bought per one unit of impact), or as a discount factor (e.g., a 10% reduction factor applied to the estimated credits).

Different trading ratios can be used to adjust estimated water quality benefits (U.S. EPA 2007):

- **Uncertainty ratio**: A ratio that reduces the estimated pollution reduction or estimated credit amount in order to compensate for potential inaccuracies in estimation methods and/or variability in project performance. In some cases, the uncertainty ratio is used to compensate for lack of scientifically derived attenuation or equivalency factors.
- **Reserve ratio**: A ratio that sets aside a portion of the estimated credits into a reserve pool to insure buyers against unforeseen credit losses due to project failure. Such credits will need to be tracked and accounted for; and

[6] The National Network on Water Quality Trading is a collaborative effort that brings together the perspectives of agriculture, point sources, environmental groups, regulatory agencies, and the practitioners delivering WQT programs across the country. The purpose of the Network is to establish a national dialogue on how water quality trading can best contribute to achieving clean water goals.

- **Retirement ratio**: A ratio applied to the estimated credits which sets aside a portion of credits for net environmental benefit. This kind of ratio is often used to accelerate water quality improvements and demonstrate environmental gains. In other cases, it is used as a hedge against potential environmental degradation.

In addition to the above ratios, the 2007 U.S. EPA Permit Writer's Toolkit further defined trading ratios as mechanisms to adjust estimated loads to appropriately convey the impact of the estimated loads on the point of concern (delivery ratios) or to create equivalency between different forms of the same pollutant or different types of pollutants that contribute to the environmental stress in multi-parameter trading programs (equivalency ratios). Because these factors are often derived from and incorporated within the measurement or modeling of water quality benefits, the National Network on Water Quality considers them largely as part of the credit quantification, and not as trading ratios. Figure A depicts how the National Network publication differs from the 2007 Permit Writer's Toolkit in its consideration of delivery, location (attenuation), and equivalency ratios.

Figure A. Comparison of treatment of trading ratio topics in the Permit Writer's Toolkit and National Network

	Trading Ratios	Quantification of Water Quality Benefits
2007 U.S.EPA Permit Writer's Toolkit	• Delivery • Location • Equivalency • Uncertainty • Retirement	• Edge-of-field
National Network	• Uncertainty • Retirement • Reserve	• Edge-of-field • Delivery • Location • Equivalency

- **Delivery, location, and/or attenuation ratio**: A ratio to adjust estimated loads to appropriately convey the impact of the estimated loads on the point of concern; and
- **Equivalency ratio**: A ratio to create equivalency between different forms of the same pollutant or different types of pollutants that contribute to the environmental stress in multi-parameter trading programs.

Given variability in terminology around ratios, it is helpful when trading programs document the assumptions underlying the chosen ratio in a transparent manner in the approved regulatory documents (e.g., trading guidance or individual permit).

Other Mechanisms to Manage Scientific and Biophysical Risk

In the discussion of trading ratios, it is easy to lose sight of the multiple other mechanisms that are available to deal with scientific uncertainty around BMP effectiveness, variability in natural systems, and the accuracy and precision of the tools we use to estimate load reductions.

Ultimately, risk and uncertainty are inherent in water quality trading programs, especially when it comes to nonpoint sources. The goal of the water quality trading program is to ensure that adequate steps are being taken to minimize the various forms of risk while managing transaction costs.

See Table B (final page) for a summary of the mechanisms available to mitigate scientific and biophysical risk in water quality trading programs.

Basis for Trading Ratios in the Lower Boise Framework

The original Lower Boise Framework, adopted by DEQ and appended to the state guidance in 2010 (DEQ 2010), proposed a set of ratio or ratio-like factors that would apply to trades. The table below describes the proposed ratios from that document and more recent information that can be considered during the 2016 revision.

Table A. Ratio considerations for the 2016 Lower Boise Framework revision. See Section 5 of the National Network on Water Quality Trading publication for specific references.

Ratio	Original Framework	Considerations for Revision
Delivery	Site location and deliver ratios ranging from 0.20 to 0.95 were proposed to account for the attenuation of phosphorus between specific points of generate, points of sale, and the mouth of the Lower Boise near Parma (DEQ 2010, Appendix B).	The TMDL Addendum on Total Phosphorus (DEQ 2015) and a related technical report from Willamette Partnership (WP 2015, p.5-6) recommend that these location ratios are no longer relevant. Our current understanding of the Boise system indicates that there is no evidence of significant attenuation from one point of discharge to another location.
Uncertainty	Dr. Carter's report recommends accounting for variability in BMP efficiency rates with uncertainty rates for each BMP type, ranging from 5-20% (Carter 2002). This does not account for variability in performance or weather, which may affect water quality benefits provided.	Nationally, some form of uncertainty ratio is almost always employed. In some cases, it's applied to the entire trade (VA), in other cases, it's associated with variability for specific BMP types (WI), uncertainty in model estimates (Ohio River Basin) or efficiency rates incorporate uncertainty directly (MD, PA) (National Network 2015, p.87).
Retirement (Net Envt Benefit)	The original Lower Boise Framework references a ratio attached to each trade to help meet nonpoint source water quality goals. The proposed approach ranges from 10%-20% ratio in initial years, with later phases tying these ratios to TMDL and TMDL implementation plan needs (DEQ, 2010, Sec 2.2.7).	The use of retirement ratios for net environmental benefit is being applied in the Ohio River Basin, Maryland, and Pennsylvania (National Network 2015, p.90).
Minimum trade ratio	The original framework references a possible minimum ratio of 1:1 for simple trades, where buyers and sellers are located near	A technical memorandum from EPA Region 3 suggest that ratios should never be less than 2:1 (EPA 2014).

	each other. However, given the variety of factors considered with other ratios (described above), the 1:1 scenario would have been rare.	

Table B. Types of scientific and biophysical uncertainty and mechanisms by which to address them

Type of Uncertainty	Mitigating Mechanism	Pros	Cons	Cost
Scientific and Biophysical	Direct measurement	• If conducted properly, may be most accurate credit estimation method	• Is labor intensive • Is technically challenging • Has attribution challenges	high
	Conservative BMP effectiveness estimates	• Can rely on available data • Achieves consistency among trades	• Rely on averages that are not site-specific	low
	Scientifically-vetted estimation tools and models	• Can be site-specific	• Have their own degrees of uncertainty	varies
	Uncertainty ratio	• Communicates easy-to-understand margin of safety • Can be adapted to specific BMPs or circumstances	• May be duplicative if other mechanisms are in place (e.g., conservative assumptions within quantification method, reserve pool in place)	varies
	Retirement ratio	• Assures water quality is not compromised	• May be duplicative if other mechanisms are in place (see above)	varies
Extreme Events	Clear liability in the event of failure, mechanism for remedy	• Consistent with existing NPDES policies regarding liability (rests with permittee).	• Potential for time lag before new or remedied projects are functioning • May be duplicative if other mechanisms are in place	varies

	Centralized Credit Reserve (via reserve ratio)	• Pools risk	• May be duplicative if other mechanisms are in place • Less appropriate service areas with one or few permittees.	varies

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