San Francisco Bay Water Quality Trading Feasibility Assessment:

Initial Review & Recommendations

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Limitations

This initial analysis evaluates the viability of a water quality trading program for nutrients in San Francisco Bay and is intended to identify and inform subsequent investigations. The results and recommendations are preliminary—the findings are expected to evolve with further study. While the preliminary findings are expected to help guide regulatory compliance strategies generally, further investigation is needed before making final compliance decisions.

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The Freshwater Trust (TFT) does not represent any collaborators. Interpretation of information provided for this work was done by TFT and any resulting errors, if present, are TFT's alone.

About The Freshwater Trust

TFT is an independent nonprofit organization focused on using insight to solve problems at the intersection of water and the economy. By leveraging analytics, science, policy reform, and incentive-based solutions, TFT is working to build and apply data-driven conservation solutions that scale.

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EXECUTIVE SUMMARY

Water quality trading is a voluntary alternative Clean Water Act compliance strategy that enables a regulated discharger to meet its permit obligations by using pollutant reductions created by another source that has lower pollution control costs or achieves better environmental outcomes. Capitalizing on economies of scale and treatment cost differentials between sources, trading provides a flexible, cost-effective compliance approach. Additionally, by enabling dischargers to pursue the most economically and environmentally effective approaches, water quality trading can result in greater water quality and watershed benefits than more traditional regulatory approaches.

The Regional Water Board identified trading as a potential compliance option in the San Francisco Bay Nutrients Watershed Permit (Permit). The Permit regulates nitrogen discharges from wastewater dischargers in the San Francisco Bay thought to contribute to harmful algal blooms. However, satisfying the Permit's final effluent limits will require costly facility upgrades. To help mitigate this financial and operational burden, the dischargers have expressed interest in trading.

In response, the Bay Area Clean Water Agencies retained The Freshwater Trust to investigate the feasibility of a trading program and provide conceptual program design options. The investigation determined that WQT is likely a viable compliance strategy, with leading indicators of a successful program present in the San Francisco Bay, including:

- Interest in water quality trading from potential participants
- Scientific tools and experts available to support program design
- A gap in compliance pathways that water quality trading credits can fill
- Identifiable buyers and sellers (i.e., credit supply and demand)

To be successful, a trading program must be technically credible, legally durable, and economically viable. The Freshwater Trust's evaluation determined that trading has a durable legal and regulatory foundation. The technical analysis found that, based on the available technical and scientific information, trading would be a credible approach. Discussions with dischargers throughout the Bay likewise revealed widespread interest in trading, especially among potential credit buyers and sellers. Even dischargers that were unsure about their potential participation in trading were supportive of the concept to provide additional compliance flexibility and foster collaboration throughout the watershed.

Thus, the initial findings are broadly positive and supportive of a prospective trading program. Based on these findings, the analysis identifies potential program structures and characteristics that are anticipated to be appropriate for the watershed and responsive to dischargers' needs. It also details various options and considerations for program elements that are uncertain and that require further data, interviews, and scientific assessment.

Importantly, this analysis is predicated on preliminary information and should only be used to help inform further analysis. Additional investigation and outreach will be necessary to design a viable program that is legally durable, scientifically credible, socially acceptable, and economically feasible.

1. INTRODUCTION

The Bay Area Clean Water Agencies (BACWA) is a California joint powers agency comprised of the five largest wastewater treatment agencies in the San Francisco Bay (SF Bay). BACWA's members include local clean water agencies that provide sanitary sewer services to nine counties across the SF Bay area. In accordance with the Clean Water Act (CWA) and California law, the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) regulates the water quality of discharges from BACWA's members. In 2014, the Regional Board issued the first Nutrients Watershed Permit (Permit) to address the total inorganic nitrogen (TIN) load believed to contribute to harmful algal blooms (HABs). The Permit required all wastewater treatment plants in SF Bay to financially contribute to analysis and undertake monitoring to inform options for reducing nitrogen loading.

In 2016, the East Bay Municipal Utility District, a BACWA member agency, retained The Freshwater Trust (TFT) to investigate the potential for a nutrient water quality trading (WQT) program for the SF Bay. A WQT program would facilitate the buying and selling of excess TIN effluent reductions (i.e., credits) between the regulated clean water agencies in the SF Bay (point-to-point source trading) and potentially the creation of credits from projects that reduce nonpoint source nutrient loading (point-to-nonpoint source trading). The resulting report, *Point-to-Point Source Water Quality Trading for Nutrients in the San Francisco Bay: Assessing the Viability & Mechanics of a Nutrient Credit Trading Program* (*2017 TFT Trading Report*),[1] summarized the basics of WQT, identified challenges and opportunities for WQT in the SF Bay, proposed components of a conceptual program, and explored inclusion of nonpoint source reductions. Importantly, the Report identified that a typical precondition for a WQT program involving point sources, numeric discharge limits, did not exist in SF Bay and WQT was not needed for regulatory compliance.

Following a significant HAB in the summer of 2022, the Regional Water Board adopted the third iteration of the Permit in 2024, which included numeric TIN limits for all wastewater treatment plants.[2] The Permit extends through September 2029, at which time the Regional Water Board is expected to issue a revised permit for another five-year term (through 2034). Unlike the prior iterations, the 2024 Permit includes enforceable numeric TIN effluent limits and establishes a compliance schedule for achieving the interim and final effluent limits. The final effluent limits require an aggregate 40% reduction of TIN loading from 2022 dry season levels by 2034. All dischargers are assigned individual limits, compliance with the interim TIN limits is based on individual discharges while compliance with the final limits are determined in the aggregate. Achieving the reductions will be costly—HDR estimated the regionwide cost as $11 billion.[3]

The 2024 Permit references trading as a potential cost-effective regional compliance strategy. In response, BACWA retained TFT to conduct an initial feasibility assessment for a San Francisco Bay WQT Program. This Report summarizes the results of this assessment, analyzes options for program structure, and proposes a pathway for deploying a WQT program in the SF Bay.

The results of this analysis are preliminary—the findings are expected to evolve with further study.

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[1] The Freshwater Trust, *Point-to-Point Source Water Quality Trading for Nutrients in the San Francisco Bay: Assessing the Viability & Mechanics of a Nutrient Credit Trading Program* (January 2017), *available at* https://thefreshwatertrust.org/assets/storage/downloads/Final-SF-Bay-WQT-Report_2017.pdf (hereinafter "***2017 TFT Trading Report***").

[2] The Permit establishes interim and final limits for 30 dischargers, representing 36 facilities (28 individual facilities, one combined outfall for two facilities, and one combined outfall for 6 facilities. S.F. Bay Reg'l Water Quality Control Bd., Order R2-2024-0013, Permit No. CA0038873, San Francisco Bay Nutrients Watershed Permit (2024), www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2024/R2-2024-0013.pdf

[3] Michael Falk & Dave Clark, HDR, Memo, *Escalated Costs for the 3rd Nutrients Watershed Permit* (May 7, 2024), https://bacwa.org/wp-content/uploads/2024/05/BACWA_CostEscalation_Memo_20240507.pdf.

2. OVERVIEW OF WATER QUALITY TRADING

Despite decades of CWA regulation and investment, many waters continue to suffer from impairment, with nutrients representing one of the most common causes. The persistent nutrient issues are in part driven by point sources regulated by the CWA (e.g., wastewater dischargers), and in part by nonpoint source pollution that are commonly not subject to CWA regulation. Satisfying nutrient permit limits frequently requires regulated dischargers to make costly facility upgrades. However, the costs of achieving permit compliance can vary significantly between different dischargers.

Partially in response to this dynamic, water quality trading has become a more common compliance alternative, particularly when multiple point sources have very different costs to remove nutrients, nonpoint sources can reduce loads at lower costs, or both. Instead of individually meeting effluent limits exclusively through on-site treatment, WQT enables coordination between dischargers to collaboratively achieve the necessary reductions across the watershed. Dischargers can generate credits by going beyond their required level of control; other dischargers can then purchase credits to meet their own obligations. In some cases, credits can also be generated by nonpoint sources through installation of approved practices (wetlands, stormwater management, agricultural best management practices, etc.).

By allowing regulated dischargers to look beyond an individual facility to consider nutrient reduction opportunities throughout the watershed, WQT enables coordinated compliance efforts through a market-based program. As the Regional Water Board noted in the 2024 Permit, "Trading capitalizes on economies of scale and the control cost differentials between and among sources."[4] Thus, participants in a WQT program can pursue the most efficient and cost-effective compliance strategies while maintaining and improving overall load reductions.

For detailed information on water quality trading refer to Appendix A – *Legal Authorization*, Appendix B – *Types of Trading Programs*, and Appendix C – *Elements of Trading Programs*, as well as the *2017 TFT Trading Report*.

3. TECHNICAL ANALYSIS

At the highest level, there are three components necessary for a WQT to be successful: economic viability, legal permissibility, and scientific credibility. With the legal basis for WQT in SF Bay well established (Appendix A), this technical analysis focuses on scientific and economic elements. At this preliminary stage, the focus was identifying any "deal breakers" that would preclude further evaluation, prevent a successful program, or both. The questions included:

- **Unique Context**: What are unique considerations for the SF Bay that may influence WQT?
- **BACWA Member Perspectives**: Do dischargers want WQT? What do they need to participate?
- **Credit Supply & Demand**: Is there a need for WQT? Is there both supply and demand?
- **Credit Price**: What is the credit price? Is the cost-benefit considered reasonable for enough dischargers to engage in trading to make a program viable?
- **Scientific Resources & Tools**: What tools, models, and data are available to support analysis of the impact of a WQT program on water quality?

[4] Nutrients Watershed Permit, at § 6.3.3, fn. 3.

a. *Unique Context of San Francisco Bay*

The SF Bay presents several unique considerations that may influence a WQT program. Ecologically, the SF Bay is a complicated system with tidal influence, climate and weather variables, and fifteen different land cover types within the Regional Water Board's jurisdiction (Figure 1). The land management systems through which water flows into the SF Bay are diverse and include forests, wetlands, scrub/shrub lands, croplands, open space, and highly developed urban and suburban areas. Contributing to the complexity of the ecological system, there are significant flow changes between wet and dry seasons that can vary year-to-year based on precipitation, as well as variable water quality from the Sacramento-San Joaquin River Delta. While beyond the scope of this analysis, consideration of the land uses in the larger watershed flowing into the SF Bay, as shown by Figure 1, will be useful for informing opportunities to reduce stormwater and nonpoint source nutrient loading. Complex biogeochemical processes and flows have led to the definition of "subembayments" within the SF Bay for monitoring and management, discussed in more detail later in this report. Indeed, the SF Bay ecosystem so complex that there are full scientific publications dedicated to its understanding, including *San Francisco Estuary and Watershed Science*, a peer-reviewed, academic journal.[5]

Currently, an estimated 86% of dry season TIN loads come from regulated wastewater treatment facilities. The nutrients in the wastewater are largely outside the existing treatment capabilities of the facilities and increased TIN load is anticipated as a result of growth in residential population and regional employment, and, to a lesser extent, increased tourism. The 40% reductions required by the final effluent limits established in the 2024 Permit are considered "the minimum necessary" to protect against future HABs. It is possible that TIN limits will become stricter in the future, especially if future HABs occur. Given the competing dynamic—the prospect of increasing TIN loads on one hand, and the potential for lower TIN effluent limits on the other—it is prudent to consider non-traditional watershed-based approaches (e.g., WQT, nature-based solutions) to achieve the effluent limits and protect water quality in the SF Bay. Such alternative approaches encourage dischargers to collaborate and look beyond the impending permit requirements when completing alternative analyses, thereby creating opportunity for considering innovative compliance strategies that maximize conservation actions and improve the health of the SF Bay.

[5] This academic, peer-reviewed journal provides credible scientific information on California's complex water issues, specifically the SF Bay and the Sacramento–San Joaquin Delta. For more information, visit https://escholarship.org/uc/jmie_sfews.

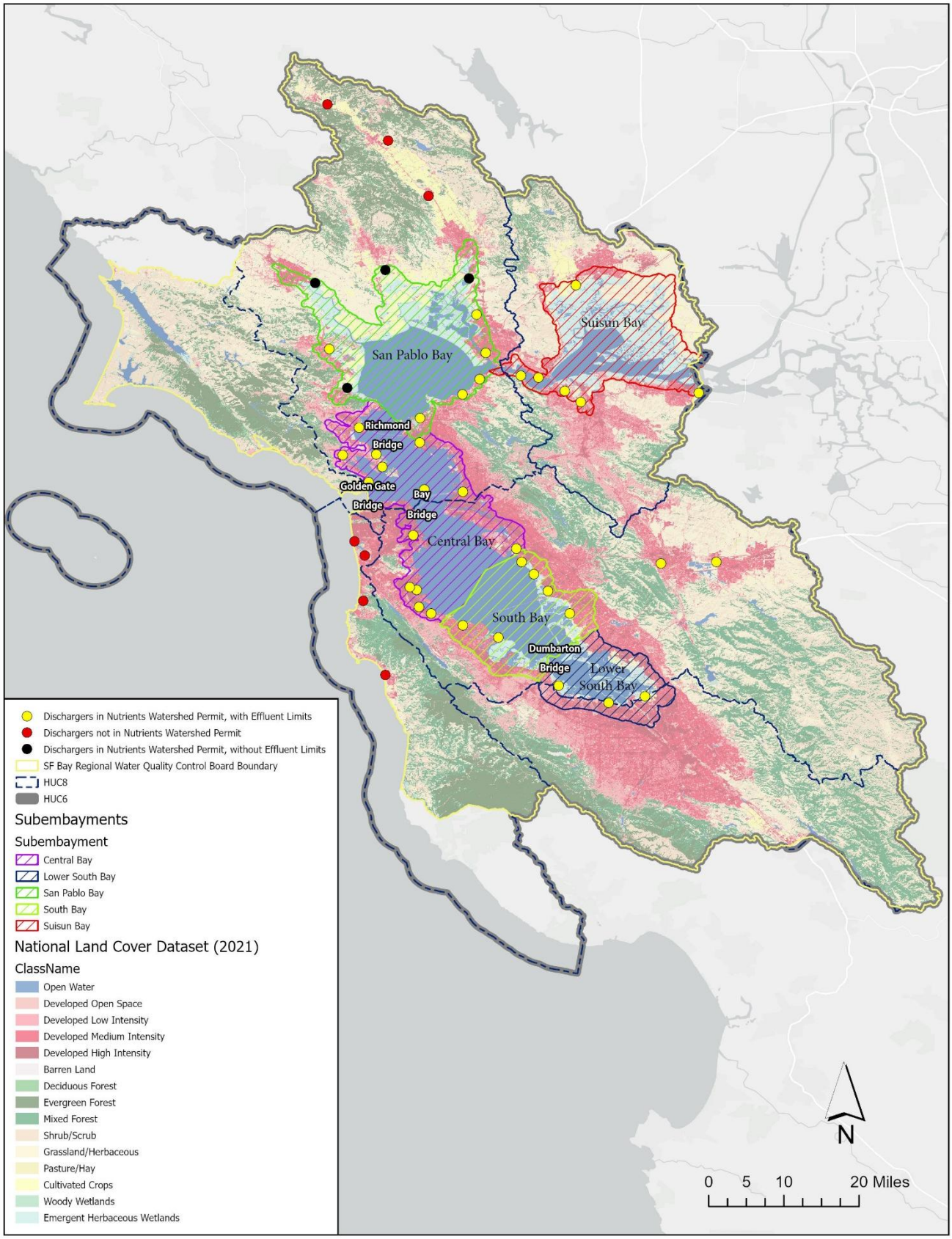

Figure 1. San Francisco Bay Landcovers, Subembayments, and Dischargers with a NPDES Permit. *Note*: The San Francisco Regional Water Board generally follows the Hydrologic Unit Code (HUC) 6 boundary, except for small portions of the northern and southern coastal areas.

From a regulatory perspective, the 2024 Permit includes various flexibilities and incentives for novel compliance pathways, such as:

- Allowing the full 10 years for compliance, the maximum time allowed in a NPDES permit.[6]
- Recognition that "multi-benefit solutions, such as nature-based treatment or water recycling, may take longer than 10 years to implement, and the Regional Water Board will use any available regulatory mechanisms to allow more time for these projects to be implemented."[7]
- "Early Actor" recognition and incentives.
- Embedded incentive to work together, including the final dry season TIN Aggregate Mass Load Limit of all dischargers (26,700 kg/day) satisfying the Permit, even if dischargers are in exceedance of their individual limits.[8]
- The Permit sets TIN reductions at the "*minimum necessary* to protect the Bay's aquatic life from an algal bloom that could form under ambient conditions similar to those in July and August 2022[.]"[9]

In addition to the ecological and regulatory landscape, awareness of the culture and socioeconomic aspects of SF Bay is prudent, given that the area is central to the regional economy and includes many important metropolitan areas such as the cities of San Jose, Oakland, and San Francisco. Moreover, it is an important area for tourism, recreation, and commercial and sport fishing.[10] The active SF Bay environmental community is reflected in the number of conservation organizations (e.g., San Francisco Baykeeper, Sierra Club, Save the Bay), groups that actively engage in environmental planning and public comment processes such as participating in public engagement opportunities for proposed CWA permits.

Take Away: The unique ecological and social context of San Francisco Bay is important to consider throughout the development of a WQT program; the Nutrients Watershed Permit creates opportunities for pursuing innovative, watershed-based compliance solutions such as WQT.

b. *BACWA Member Perspectives*

TFT conducted outreach meetings with BACWA members to gauge interest in WQT as a component of compliance strategies. Specifically, between August and December 2025, TFT conducted outreach to 26 Large, Medium, and Small dischargers, representing 87% (26 of 30) of those assigned effluent limits.

- August – September: 13 individual outreach meetings with 12 Large & Medium dischargers.[11] All large agencies contacted, 49 individual discharger staff attended outreach meetings, representing four of five large dischargers and eight of eleven medium dischargers.
- December: 2 group webinars, 16 Small & Medium dischargers invited, 35 discharger staff registered and 29 staffers attended the webinars

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[6] "The duration of the compliance schedule may not exceed ten years…." State Water Resources Control Board, Policy for Compliance Schedules in NPDES Permits, Res. 2008-0025, 5 (April 2008). Nutrients Watershed Permit, at § 6.3.3, Table 5.

[7] Nutrients Watershed Permit, at 7.

[8] "If the sum of all the individual Dischargers' total inorganic nitrogen mass loads is greater than the Aggregate Mass Load Limit set forth below, the Dischargers whose total inorganic nitrogen mass loads exceed their individual limitations shall be in violation of their individual limitations." Nutrients Watershed Permit, at § 4.2.

[9] Nutrients Watershed Permit, at 7 (emphasis added).

[10] Tourism generates nearly $9 billion annually and fishing (commercial and sport) is a $123 million per year industry. S.F. Bay Reg'l Water Quality Control Bd., Staff Summary Report: Item 6 – Nutrients from Municipal Wastewater Treatment Facilities' Discharges (July 10, 2024), www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2024/July/6_ssr.pdf.

[11] The facilities with combined outfalls were treated as one discharger (e.g., EBDA's six agencies were treated as one discharger, consistent with the Permit's effluent limits). TFT met with one discharger twice.

Four dischargers are subject to dry season discharge prohibitions and did not receive TIN effluents limits. These dischargers are not likely to participate in a WQT program and were therefore not contacted as part of TFT's outreach meeting efforts.[12]

To incentivize candid input, TFT provided the dischargers that participated in individual outreach meetings with assurances that their questions and comments would be kept confidential. Each meeting lasted approximately 1 hour, consisting of 20-30 minutes of TFT experts providing background on WQT and 30-40 minutes of discussion. TFT's presentations concluded with a list of questions for the attendees, which were structured to foster discussion and help guide the conversation (Appendix D). However, a free-flowing approach was encouraged to elicit insight into the attendees' main perspectives and concerns as well as to provide an opportunity for attendees to pose questions to TFT. Ultimately, several broad themes emerged as commonalities among most or all of the participating dischargers. Summary results are provided below, with no attribution to specific BACWA members.

The common themes that emerged generally related to practical considerations (e.g., logistics, costs, and uncertainty) and included:

- Credit Supply & Cost – Who generates credits, at what cost? Will there be sufficient credits available when needed?
- Trading Areas – Who can sell, who can buy? Will trades be limited to subembayments or other geographic boundaries?
- Certainty vs. Flexibility – Potential sellers were interested in ensuring sufficient flexibility to allow them to adapt to changing conditions; Buyers need certainty that credits purchased will be real and available when required for compliance.
- Risk – How does a WQT program or individual credit transaction account for risk of underperformance, credit shortfalls, or other unanticipated conditions?
- Uncertainty – Is Water Board aligned? Will WQT provide sufficient safeguards against uncertainty (e.g., credit supply, credit durability, future effluent limits)?
- Equity – Concerns about inequity and the apportionment of treatment costs between different dischargers.
- Timing Concerns – How can WQT be considered as a potential alternative when alternatives analyses and capital planning decisions are happening now, but WQT is still only a concept.

Technology investment decisions are generally responsive to the individual final effluent limits, not the Aggregate Mass Load Limit. As such, it is likely that opportunities for overtreatment with the purpose of generating sellable credits are not being fully considered. Meanwhile, compliance planning continues to move forward, driven by permit deadlines for dischargers to report efforts (April 1, 2026 for Alternatives Analysis; April 1, 2027 for Compliance Plan). Dischargers need support in the near-term to determine if WQT should be included in the April 1, 2026 report—inclusion of WQT in these responses will retain WQT as a potential compliance option while a program is developed.

[12] Bay Area Clean Water Agencies, Group Annual Report: Nutrient Watershed Permit Annual Report 2024 (April 1, 2025). These were the City of Petaluma, Las Gallinas Valley, Napa Sanitation District, and Sonoma Valley County Sanitation District.

Box 1: Common BACWA Member Perspectives

"We are making decisions now . . .when will WQT be available?"

"I'm holding my excess reductions as an insurance buffer. I don't want to sell them as credits."

"What if I only need credits for a short/long period of time?"

"What if I buy credits and the seller doesn't deliver?"

"We are VERY interested in WQT. Being a small facility, we don't have reasonable alternatives."

"We need details to include WQT as part of a compliance strategy."

"How much do credits cost? What is the total anticipated pool of credits available?"

The 2024 Group Annual Report, which included some basic questions about trading, provided some insight for this analysis, though the responses tended to be quite terse and did not provide much detail.[13] TFT anticipates that the next request for information for the annual report, which is planned for January 2026, will include additional questions about WQT. Still, further direct dialogue is needed to better understand the perspectives of BACWA members in order to design a trading program that is responsive to their needs.

Overall, TFT confirmed that significant interest in WQT exists among potential credit buyers and sellers. However, many dischargers lack sufficient confidence that WQT will materialize to justify seriously accounting for trading in their planning efforts. There is also uncertainty about specific aspects of a WQT program, including credit supply and demand, price, and timing (Box 1). Additionally, as demonstrated by other trading programs (see Appendix B for a discussion of select examples), every WQT program is unique as every program is designed in response to the distinct watershed and discharger circumstances.[14] Due to this reality, the dischargers will likely need varying amounts of individual support to fully evaluate their specific circumstances and for their ability/opportunity to participate in a WQT program, including their role as buyers/sellers, cost-benefit considerations, and confidence to engage in an innovative compliance program.

Take Away: BACWA members expressed strong interest in WQT as a compliance alternative. With impending reporting deadlines, BACWA members need rapid support in early 2026 to inform the alternatives analyses (due April 1, 2026) and include WQT as a potential alternative. This support will also help retain WQT as a component of the compliance plans (due April 1, 2027). It is necessary to foster confidence that WQT will be a viable compliance alternative, both generally and for specific dischargers, particularly during the WQT program development and approval process.

[13] Bay Area Clean Water Agencies, Group Annual Report: Nutrient Watershed Permit Annual Report 2024 (April 1, 2025), https://bacwa.org/document-category/nutrient-annual-reports/.

[14] See Appendix B & *2017 TFT Trading Report*.

c. *Scientific Resources & Tools*

It is important that a WQT program be built on a strong scientific foundation. Using best available science to test and design a program establishes credibility, provides regulators with defensible justification for approving the program, supports stakeholder engagement, and ultimately ensures protection of the watershed. However, data collection, tool development, and model calibration needed to test program design scenarios and to operationalize a program can be very costly. Conversely, the existence of these resources can significantly reduce the cost of developing and operating a program.

In the SF Bay, the San Francisco Estuary Institute (SFEI) has conducted water quality research for more than thirty years. In late 2025, TFT engaged in initial consultation with SFEI to determine the extent of existing tools, data and modeling, as well as to understand SFEI's interest in and capacity to collaborate on the design of a WQT program. Insights from this consultation, as interpreted by TFT, include:

- The hydrodynamics of SF Bay are complicated and require expert analysis to understand. Similarly, HABs can be difficult to predict, even when there is a clear understanding of TIN loading from wastewater facilities. Climate influences, annual precipitation, contributions of TIN from the Pacific Ocean and nonpoint sources (in the Sacramento-San Joaquin Delta and within the SF Bay), add to the complexity of modeling TIN loading and related biological responses.
- Early testing of pilot tools suggests that simulations of WQT scenarios are important, particularly given the complexity of the SF Bay. As a hypothetical example, if the primary goal was maximizing TIN reductions in the Central Bay, it could be appropriate to focus TIN reductions in the South Bay or Lower South Bay.
- Research and modeling at universities and the U.S. Geological Survey is available that can inform development of SF Bay WQT program. For example, SFEI has data and tools helpful in considering the scientific foundations of a durable WQT program, such as the Biogeochemical Model and Source Apportionment Model.[15] Likewise, the *San Francisco Estuary and Watershed Science* journal provides an excellent source of peer-reviewed information.[16]

Biogeochemical Model

The three-dimensional biogeochemical model is used to simulate nutrients (loads, transport, cycling), phytoplankton production, and oxygen cycling.[17] The model was designed by SFEI to explore nutrient cycling, source contributions, how nutrients leave the Bay, and the impacts of nutrient reductions on water quality. The spatial resolution of the horizontal grid ranges from 20 meters to 350 meters. Due to the intricate inter-dependency of biogeochemical processes, the numerous spatiotemporally-varying environmental factors and the multi-purpose management challenges for the system, a process-based,

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[15] SFEI has also developed the POTW dashboard, a publicly available, web-based tool that provides comprehensive nutrient monitoring in effluent from all publicly-owned treatment works (POTWs) that discharge to SF Bay. SFEI, San Francisco Estuary POTW Data, https://nutrient-data.sfei.org/SFPOTW/#section-overview. The data has a +/- 95% confidence interval. The underlying data is available at: https://bacwa.org/document-category/nutrient-annual-reports/.

[16] This academic, peer-reviewed journal provides credible scientific information on California's complex water issues, specifically the SF Bay and the Sacramento–San Joaquin Delta. For more information, visit https://escholarship.org/uc/jmie_sfews.

[17] SFEI, Water Quality Models, www.sfei.org/programs/cw/nutrients/wq-simulations (last visited Dec. 2025); Z. Zhang, D. Senn & A. King, SFEI, Delta-Suisun Biogeochemical Model Development: Year 2 Progress, SFEI Contribution #961 (2019), www.sfei.org/sites/default/files/2019_delta-suisun_biogeochem.pdf.

quantitative, and holistic approach was required to assess the nutrient impact and trend for the watershed and to evaluate the impact of management actions to support science-based decision making. This model has continued to be refined since its inception in 2014. Model development is underway to better understand how the various dynamics influence HABs.

TIN Source Apportionment Model

This model was designed by SFEI to enable an estimation of the zone of influence and relative TIN contributions by individual dischargers and subembayment (Figure 2). This model is useful for assessing potential WQT scenarios as it can evaluate the implications of potential specific buyer-seller interactions, trading areas, and pollutant attenuation, which is relevant for trading ratios. The model is currently a early version, with further development anticipated in early 2026.

Figure 2. Example of SFEI's TIN Source Apportionment Model, showing concentrations of tracer (representing Dissolved Inorganic Nitrogen) in micromolar.[18]

Take Away: Scientific credibility is a foundational component of any trading program. A San Francisco Bay WQT program will benefit from existing scientific resources to reduce the cost of developing a program and ensure that the best available science is applied to program design.

[18] Figure 2 is included for illustrative purposes only. For more discussion of this model, *see* P. Mugunthan, et al., San Francisco Estuary Institute, *Nutrient Source Apportionment in San Francisco Bay: Pilot Study*, SFEI Contribution #1022 (2021).

d. *Credit Supply & Demand*

A preliminary analysis was undertaken to determine if there is likely to be sufficient credit supply and demand to support a functional WQT program. At this early stage, the focus was simply determining if there are potential buyers and sellers at levels that could justify developing a WQT program for the SF Bay. Detailed projections of the credit market were not completed (e.g., total credit supply through the 2034 compliance deadline or annual credit supply/demand) because this analysis was constrained by available data. However, such projections should be the subject of future evaluation.

As potential credit transactions will be driven by credit supply and demand among the dischargers, this preliminary analysis looked to the following primary factors:

(1) Facility compliance pathways,
(2) Likelihood of meeting final effluent limit, and
(3) TIN reductions needed to meet final effluent limit.[19]

Facility Compliance Pathways

As of early 2025, dischargers were at various stages of facility compliance alternatives assessments, ranging from technologies already installed to initially considering options. The 2024 Group Annual Report included information on the status of individual discharger's planning activities, which is summarized in Table 1.[20] 'Early Actors' are generally proceeding with treatment plans and installations, which accounts for 26% of dischargers. Another 10% of dischargers have identified their pathway but have not proceeded with installation, and 10% have preliminarily considered their plans. Additionally, 53% of dischargers identified compliance alternatives, as required by the 2024 Permit, but had not yet selected a compliance pathway as of the 2024 Group Annual Report, leaving a large data gap for this initial analysis. Updated information is anticipated to be included in the upcoming Group Annual Report.

Table 1. Compliance Pathway Planning.

Compliance Pathway Planning	# of Dischargers
Early Actor – Path proceeding	8
Pathway Identified	3
Preliminary Pathway Identified	3
Alternatives Identified	16
Grand Total	**30**

Likelihood of Meeting Final Effluent Limit

In addition to compliance pathway planning, consideration of the likelihood of meeting the final TIN effluent limit can help predict credit supply and demand. This analysis captured narrative information from an interview with HDR regarding dischargers' facility plans, then assigned a 'likelihood' rating of meeting the final effluent limit. A four-level rating scale was used to categorize dischargers based on compliance pathway certainty, with the levels ranging from 'certain' to 'uncertain' and a fifth 'unknown' category for when information was unknown or unavailable. Additionally, the facility plans were cross-

[19] Nutrients Watershed Permit, at 8-11.
[20] Two West County Agency dischargers and six East Bay Dischargers Authority dischargers combined. BACWA, Group Annual Report: Watershed Permit Annual Report 2024 (April 2025), https://bacwa.org/document-category/nutrient-annual-reports/.

referenced with the needed reductions for each individual facility to inform the likelihood rating. For this analysis, the needed Permit reductions[21] were calculated as follows using:

2022 Dry Season Load – Final Effluent Limitations = TIN Reduction Needed

Overall, 40% of needed reductions were categorized as 'Uncertain' (7,100 kg/day of 17,850 kg/day) and an additional 37% were 'Unknown' (6,640 kg/day), as shown in Table 2. Dischargers that have already met the required reduction and/or are allowed to increase TIN loads were automatically assigned a 'Certain' rating as their pathway for Permit compliance is not in question. The reductions that are 'Certain' are mostly because those facilities are allowed to increase their discharge and are already in compliance, including 2,500 kg/day increase for City of San Jose/Santa Clara.

As this preliminary analysis demonstrates, the majority of compliance pathways are still under consideration. As a result, a gap in compliance strategies exists that could be satisfied with WQT credits. As dischargers' planning efforts proceed and more detailed information is provided by the dischargers, this analysis can be refined to provide greater certainty with more reliability.

Table 2. Estimated Likelihood of Dischargers to Achieve Final Effluent Limit.

Likelihood of Meeting Final Effluent Limit	**TIN Reduction Needed** (kg/day)
Certain	-2,653*
Mostly Certain	2,664
Somewhat Certain	4,100
Uncertain	7,101
Unknown	6,640
Total	17,852

**Negative numbers mean that a discharger can increase their loading.*

TIN Reductions Needed to Meet Final Limit

TFT also considered discharger-specific interest in trading, either as credit buyers or sellers. This analysis was based on current input from HDR via interviews, insights captured from TFT's outreach (see Section 3(b) – *BACWA Member Perspectives*), and information provided in the 2024 Group Annual Report, which included questions about interest in WQT. Lacking details regarding quantity of reductions needed and available, this preliminary analysis cross-referenced the status of compliance pathway commitments, likelihood of compliance, and total reductions needed (Table 2).

As a very initial indication, it appears that there may be buyers for 3,300 kg/day and sellers for 3,550 kg/day. This accounts for approximately 20% of the Aggregate Mass Load reductions needed for Permit compliance (3,500kg/day of 17,800 kg/day). Of note, some larger dischargers are overtreating to create a buffer to help ensure compliance, and out of concern that greater reductions may be required in the future to prevent a HAB. This overtreatment provides the discharger with confidence and operational stability, protecting against uncertainties such as lower effluent limits in future permits, load growth (i.e., increased population), and other variables.

[21] The Nutrients Watershed Permit provides the 2022 Dry Season Load (Table F-4) and the Final Effluent Limits (Table 4).

In contrast to the large dischargers, smaller dischargers face more difficulty meeting the Permit limits due to lower budgets, smaller ratepayer bases (some include disadvantaged communities), less available space for on-site treatment, or other operational constraints. Despite these hurdles, some small dischargers are nevertheless projected to be very close to satisfying the final effluent limit. In such cases, WQT credits can provide the nominal reductions needed to achieve the final effluent limits without costly treatment upgrades. Thus, a cost-effective WQT program could provide relief from significant compliance costs and provide greater options for achieving the final effluent limits.

Take Away: There is a gap in compliance pathways, estimated at 20-30% of the reductions needed to attain the final effluent limits. This analysis identified potential credit buyers and sellers, indicating that WQT can help bridge this divide to achieve Permit compliance.

e. *Credit Price*

The question of cost is top of mind for all utility decisionmakers as they navigate CWA compliance strategies while upholding their duty to the ratepayers. Potential credit buyers and sellers need to know the price of credits to evaluate their participation in a WQT program. During the outreach meetings, BACWA members repeatedly raised questions about credit costs, from the perspectives of both potential buyers and sellers. Through this investigation some preliminary cost information for specific dischargers was gleaned, but this information was insufficient to meaningfully inform projections of the potential range of credit costs. Because this WQT program is driven by point source credit generation, the cost of credits will be strongly linked to the cost of treatment. However, there are other factors related to the program structure that will influence credit price (Figure 3).

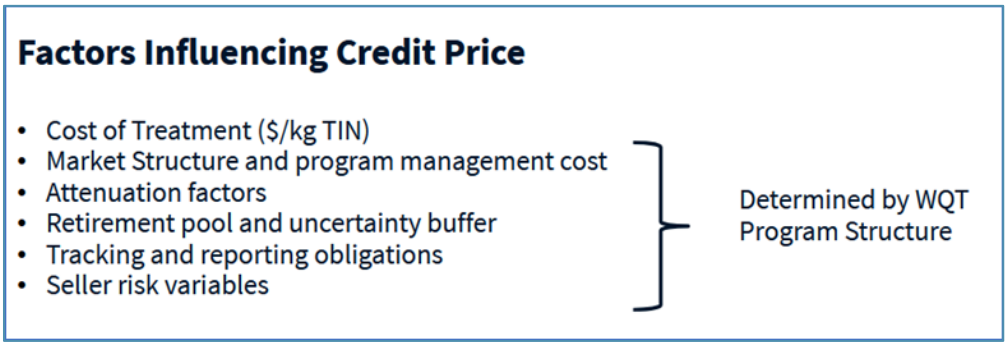

Figure 3. Factors Influencing Credit Price.

Reliable treatment cost information was not available to inform this analysis. Many dischargers are in the middle of alternative planning and do not have their compliance pathways determined (Table 2). If the $11B cost of compliance proves accurate, the cost per credit could *theoretically* be estimated at 17,800 kg/day reductions / $11B, assuming a credit equals 1 kg/day. However, there is simply too much uncertainty in the $11B estimate to justify this estimation approach as it risks creating inaccurate, misleading information. The following is needed to estimate credit price:

- Progress on facilities plans and technology alternatives, including cost estimates and projected TIN reductions.
- The timing of treatment technology installation, operation, and projected results.
- Separate capital costs vs. operation & maintenance costs to understand what a seller needs to recover via credit sales over time.
- A WQT Framework to inform the non-technology credit price variables.

To ensure the success of a WQT program and inform the dischargers' compliance strategies, costs will need to be meaningfully evaluated. As costs are a function of the treatment alternatives at each individual facility, determining costs will require intentional and ongoing outreach with dischargers.

Take Away: Many dischargers are still unsure about their individual compliance alternatives and the associated costs. Additionally, several elements of a WQT program can have cost implications. To estimate potential credit costs, information is needed regarding treatment costs and San Francisco Bay WQT program design.

4. SAN FRANCISCO BAY WQT PROGRAM DESIGN

To develop credit price projections and provide interested dischargers with sufficient certainty to account for trading in compliance planning efforts, it is necessary to begin designing a conceptual program. As noted, a WQT program must be designed to be scientifically credible, economically viable, and legally permissible. Fortunately, this effort should benefit from the strong scientific foundations present in the SF Bay as well as the demonstrable interest in a trading program uncovered during TFT's outreach efforts.

To varying degrees, every WQT program is unique, albeit within the overarching boundaries of being legally, scientifically, and economically appropriate. This initial analysis is intended to support further discussion and evaluation of the WQT program structure. Every design element of a trading program requires thorough vetting, with consideration of the needs of the dischargers, agencies, public, and watershed.

Elements of a potential WQT program for the San Francisco Bay Nutrients Watershed Permit that need definition include:

- Participation Eligibility
- Credit Characteristics
- Credit Quantification & Baseline
- Trading Area
- Transactional Mechanics
- Trading Ratios & Reserve Pool
- Tracking & Reporting
- Incentives for Early Participants
- Adaptive Management

For further discussion of these elements, see Appendix B – *Types of Trading Programs,* and Appendix C – *Elements of Trading Programs*. The *2017 TFT Trading Report* also includes detailed discussion on WQT and the elements of a trading program. Possible approaches for designing a San Francisco Bay WQT program are discussed below.

a. *Enabling Trading via Nutrients Watershed Permit*

For WQT to constitute an acceptable compliance strategy, the Permit needs to approve trading as a compliance alternative and establish sufficient procedures and requirements to provide regulatory durability.[22] Trading provisions can be established within a permit itself or developed in a separate document that is then incorporated into a permit by reference. As EPA has explained, the most common

[22] U.S. EPA, Water Quality Trading Policy, 6–10 (Jan. 13, 2003), www.epa.gov/sites/default/files/2016-04/documents/2008_09_12_watershed_trading_finalpolicy2003.pdf (hereinafter "**EPA Trading Policy**").

approach is to create a separate WQT Framework or trading plan "developed outside the NPDES permit process" then "incorporated or reflected in the permit" by reference.[23] This is ordinary in both point-to-point trading programs and those involving nonpoint sources, such as the Laguna de Santa Rosa Trading Program.[24] This approach ensures the WQT provisions are enforceable components of the permit, but also improves clarity by consolidating most or all of the relevant terms into a single, standalone document. Additionally, by providing programmatic approval, the regulators do not need to approve individual transactions so long as those transactions conform to the WQT Framework.

In the context of the Permit, the most logical approach is to develop a WQT Framework that would then be incorporated into the permit by reference. The WQT Framework approach would enable the collaborative development of the program structures, soliciting and incorporating input from dischargers and other stakeholders during the development process. A substantially complete WQT Framework, comprised of provisions largely agreeable to the potential participants, could then be presented to the Regional Water Board for consideration. The 2024 Permit Fact Sheet seems to contemplate this approach, explaining that if dischargers desires to use WQT "the Regional Planning report may propose *a framework for nutrient trading* to facilitate compliance" with the effluent limits.[25] Following a preliminary review by the regulators and the incorporation of any input provided, a proposed WQT Framework could then be incorporated into the Permit by reference through a permit modification or future renewal.

Although the Regional Water Board explained in the 2024 Permit that it "intends to consider a formal trading program with the next permit reissuance" in 2029, this timeframe may not be sufficiently aggressive based on deadlines for finalizing compliance pathway for dischargers (April 2026 for Alternatives Analysis; April 2027 for Compliance Plan).[26] Given the justification for an accelerated timeline, the permit modification process appears to be the most viable initial approach, with any future WQT program revisions completed as part of subsequent permit renewal processes.

b. *Market Structure*

There are three primary models for point-to-point source trading: (1) peer-to-peer trading; (2) multiple facility trading without a central exchange; and (3) trading through a central exchange (Figure 4). Each approach has benefits and drawbacks in terms of flexibility, rigor, effort, and cost.

The first option (peer-to-peer trading) is more common for small WQT programs with few participants. Peer-to-peer trading does not appear appropriate for SF Bay, as each credit transaction would require its own rules and individual approval by the Regional Water Board. Thus, in the context of the Nutrients

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[23] U.S. EPA, WATER QUALITY TRADING TOOLKIT FOR PERMIT WRITERS, EPA 833-R-07-004 (Aug. 2007, updated June 2009), *available at* www.epa.gov/npdes/pubs/wqtradingtoolkit.pdf (hereinafter "**EPA TRADING TOOLKIT**").

[24] Following adoption by the Regional Board, the WQT Framework for the Laguna de Santa Rosa was incorporated into the participants' individual permits by reference. North Coast Reg'l Water Quality Control Bd., Order R1-2021-0041, Amendment of Order R1-2020-0012 for the City of Santa Rosa (2021); Order R1-2021-0042, Amendment of Order R1-2020-0010 for the Windsor Water District (2021) , www.waterboards.ca.gov/northcoast/water_issues/programs/nutrient_offset_program/.

Even some single point source WQT programs utilize a separate trading plan or framework instead of defining the trading provisions in the permit itself, such as the Oregon temperature trading programs for the City of Medford, the City of Ashland, the Metropolitan Wastewater Management Commission (Cities of Eugene-Springfield) and Clean Water Services. *See e.g.,* Or. Dep't of Envtl. Quality, Permit Nos. 101141, 101142, 1011431 101144 & 101309: Clean Water Services NPDES Waste Discharge Permit (2022); Or. Dep't of Envtl. Quality, Permit No. 101609: City of Ashland NPDES Waste Discharge Permit (2022).

[25] Nutrients Watershed Permit, at F-37 (emphasis added).

[26] Nutrients Watershed Permit, at F-29.

Watershed Permit, the second and third options are the most suitable. These options offer WQT program structures that can facilitate multiple transactions among many participants using programmatic rules (i.e., a WQT Framework) that avoid the need to secure regulatory approvals for individual transactions.

Figure 4. Programmatic Options for Trading Program.[27]

A Central Exchange (Option 3), while offering some advantages, tends to have higher operating costs and the least flexibility. This approach requires a single central entity to run the program and serve as a credit exchange. All transactions flow through the exchange, which holds all credits, sets credit pricing, and shoulders full program risk. A central exchange increases certainty for participants but limits flexibility and entails comparatively high operational costs to maintain the exchange. The credit exchange would likely have to be either operated by or approved and overseen by the state regulators, which may require a potentially robust commitment from the state. This approach has been used in contexts such as the Long Island Nutrient Credit Exchange and the Ohio River Basin Water Quality Trading Program, but with significant funding and support to establish the exchange, finance the purchase of credits, or both.[28] Building and funding a central exchange to run a SF Bay WQT program would likely protract the program deployment timeline, increase program development and operation costs, and may not be justified by the transaction volume.

In contrast, Option 2: Multiple Facility Trading Without an Exchange, provides greater flexibility and lower upfront costs. A programmatic WQT Framework would be developed to define program elements, then individual trades could be negotiated between participants and formalized via private contracts between the parties. The WQT Framework would reduce transactional costs by establishing key considerations (quantification, accounting, reporting, etc.), while still leaving flexibility for the parties to individually negotiate the core contract terms (e.g., price, credit quantity, duration) and other agreement provisions (e.g., allocation of risk, performance incentivizes, inflation, etc.). This approach does not entail the high operational costs associated with an exchange. To further minimize the costs and streamline the transactional process, a credit contract template can be included in the WQT Framework. A contract template would ensure that regulators are satisfied with the transactional mechanism and provide many

[27] EPA TRADING TOOLKIT – FUNDAMENTALS, at 16.

[28] This program was supported by state funding for many years and has only become financially self-sustaining in recent years. See Appendix B for a discussion of the Connecticut's Long Island Nutrient Credit Exchange.

of the boilerplate provisions of an agreement, thereby reducing potential transactional costs while leaving parties free to negotiate specific core contract terms.

This option, a multiple facility trading program without a central exchange, appears to strike the appropriate balance for the SF Bay. This approach could be developed and operationalized on a shorter timeline and at a lower cost but would still provide sufficient structure to support a multi-party trading program. This model would enable WQT to move forward more rapidly by avoiding the significant time and costs necessary to establish a central exchange, while a third-party facilitator could be retained to provide some of the benefits of a central exchange (e.g., transaction support, reporting assistance, etc.). As the WQT program becomes established and the extent of potential future transactions becomes better understood, eventually a central exchange could be developed if deemed useful based on credit transaction volumes, price, and participant needs. In the near-term though, a central exchange would likely delay deployment of a trading program and could constrain the ability for a WQT program to adapt to changing circumstances.

c. *Eligibility to Engage in Trading*

Participant Eligibility

A WQT program designed to offer an alternative compliance pathway for the Permit should enable all dischargers regulated by the Permit to participate. EPA and California regulators have taken the position that trading can only be used to achieve water quality-based effluent limits, not technology-based effluent limits.[29] There are no nutrient technology-based effluent limits for dischargers as of the issuance of the 2024 Permit; instead, the nutrient limits are strictly water quality-based.[30] Therefore, all dischargers should be allowed to use trading to satisfy the discharge limits in accordance with the provisions of the Permit and the WQT Framework.

Trading Areas

A trading area establishes the geographic boundaries for a WQT program, all buyers and sellers must be located within a defined trading area to participate in a trading program. EPA recommends a large trading area, considering the water quality goals, watershed connectivity, hydrology and data availability, to realize the most economically effective and ecologically beneficial outcomes.[31] In some cases, a WQT program may have multiple trading areas based on the watershed dynamics to ensure sufficient connectivity between where a credit is generated and where it is used for compliance. Although further investigation is necessary to confirm the appropriateness, initial findings indicate the entire SF Bay could be the trading area for the Permit. This would encompass all the dischargers regulated by the Nutrients Watershed Permit, enabling all dischargers covered by the Permit to engage in trading.

The 2024 Permit explains that a "proposed trading program should evaluate baywide and subembayment trading allowances that are supported by the best available science."[32] While no subembayments or discrete portions of the SF Bay have been designated as more sensitive than other areas, it will likely be necessary to demonstrate that trading will not result in significant changes in

[29] EPA Trading Policy, at 6. See Appendix A for a discussion of restrictions on trading for different types of effluent limits.
[30] Nutrients Watershed Permit, Attachment F, § 4.
[31] Memorandum from David Ross, Asst. Administrator, EPA Office of Water, to EPA Regional Administrators, on *Water Quality Trading on a Watershed Scale* (Nov. 2020), www.epa.gov/npdes/water-quality-trading-watershed-scale.
[32] Nutrients Watershed Permit, at 16.

localized TIN concentrations. Preliminary analysis indicates that trading need not be limited to individual subembayments; nevertheless, the factors leading to subembayment designation are important to consider, including the role of jurisdictional boundaries, watershed dynamics, and politics.

Five subembayments have been defined for San Francisco Bay (Suisun, San Pablo, Central, South, Lower South), as shown by Figure 1. The subembayment boundaries were a product of a five-year effort to redesign the Regional Monitoring Program to "evaluate the existing Status and Trends monitoring design, apply what had been learned about contaminant trends in the Estuary to date, and develop a design that would fit the new, revised [Program] objectives."[33] The extensive stakeholder engagement and scientific analysis resulted in a proposal for defining discrete subembayments for the purposes of watershed monitoring and management.

The subembayment boundaries are not necessarily permanent, the 2024 Permit acknowledges the potential to redefine the subembayments as science evolves, particularly over the next five years:

> *Advances in modeling and data collected over the next five years will inform the Regional Water Board on the need to reassess and refine the final [effluent limits] and whether subembayments should be treated differently. For the permit reissuance scheduled for 2029, the Regional Water Board will consider advances in the science related to nutrients loading and beneficial use protection and available new information (e.g., observational data and improved load response modeling) to reassess and refine the final [effluent limits] developed for this Order to ensure that they are appropriate to protect San Francisco Bay beneficial uses.*[34]

As it relates to WQT, the subembayments could inform or define the trading area. As discussed in Appendix C, larger trading areas can lead to more efficient credit transactions. From a transaction and economic perspective, it is beneficial to maximize the trading area. The 2024 Permit expresses flexibility for baywide and subembayment trading, but points to the need for scientific basis:

> *While this Order establishes a baywide aggregate mass limit, the Dischargers may propose a baywide and subembayment trading program. As described in Fact Sheet section 6.3.2, there will be advances in our scientific understanding of how San Francisco Bay assimilates nutrient loads over this permit term.*[35]

Moreover, the 2024 Permit is neutral on where the load reductions occur as long as the SF Bay receives less than the Aggregate Mass Load Limit. Per the 2024 Permit, it is only when the final Aggregate Mass Load Limit is exceeded that the individual effluents become relevant, as the individual limits provide a basis for enforcement actions.[36] Allowing trading to occur throughout the SF Bay would be consistent with the current approach of considering Aggregate Mass Load. Further, given that the subembayments may be redefined in the future, avoiding structuring the WQT program around subembayments not only maximizes the pool of credits, but creates stability for the dischargers who may be concerned with rules

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[33] Sarah Lower, et al., SF Estuary Institute, *Re-design Process of the San Francisco Estuary Regional Monitoring Program for Trace Substances (RMP) Status & Trends Monitoring Component for Water and Sediment* (2005), www.sfei.org/sites/default/files/biblio_files/RMP_2002_No109_RedesignProcess_0.pdf.

[34] Nutrients Watershed Permit, at F-27.

[35] Nutrients Watershed Permit, at Fact Sheet § 6.3.4.

[36] "If the sum of all the individual Dischargers' total inorganic nitrogen mass loads is greater than the Aggregate Mass Load Limit set forth below, the Dischargers whose total inorganic nitrogen mass loads exceed their individual limitations shall be in violation of their individual limitations." Nutrients Watershed Permit, at Fact Sheet § 4.

changing. Table 3 shows the Final Effluent Limit and reductions needed by subembayment (using 2022 Dry Season loads). Further scientific analysis is needed to inform trading area for SF Bay.

Table 3. TIN Reductions and Final Effluent Limits by Subembayment.

Subembayment	2022 TIN Loads (TIN kg/day)	Reduction from 2022 Loads to Final Limit (TIN kg/day)	Final Effluent Limit (TIN kg/day)
Central Bay	12,227	7,737	4,490
Lower South Bay	5,200	-1,740*	6,940
San Pablo Bay	5,234	1,800	3,434
South Bay	19,881	9,940	9,941
Suisun Bay	1,992	114	1,878
Grand Total	**44,534**	**17,851**	**26,683**

**Negative numbers mean that a discharger can increase their loading.*

d. *Credit Characteristics*

Credit Unit & Quantification

The credits should match the units used to define the effluent limit in the Permit, both in terms of quantity and time. The 2024 Permit defines the effluent limits as average daily TIN load (in kilograms) for May 1 through September 30.[37] As part of a SF Bay WQT program, a credit should therefore represent a kilogram of total inorganic nitrogen for the May 1 through September 30 period. Moreover, the credits should be quantified using the same seasonal averaging approach as the Permit, subject to applicable considerations such as baseline.

Duration of Credit

Just as with the credit unit, the credit duration is linked to the NPDES permit effluent limit. In the case of the 2024 Permit, the limits apply during the May 1 through September 30 season. The credit duration should therefore mirror the same season to adhere to EPA's guidance and facilitate accounting of credits against the Permit's effluent limits. Although the credits will only have a duration of one season, the treatment technologies that give rise to credits will continue to function year over year and may continue to generate credits for as long as the technology remains operational. Therefore, credit purchase agreements could transact credits over multiple years if consistent with the credit generating activity.

Credit Baseline

Baseline represents the minimum reductions that must be achieved by one discharger to generate credits that can be used by another discharger to satisfy their effluent limits. From a policy perspective, the baseline should be compliance with the Permit limits in effect in a given year. The interim limit would be the appropriate baseline for calculating credits—if any trading occurred to satisfy the interim limits—and the final limits would provide the baseline once those effluent limits go into effect late 2034.

While the relevant effluent limits will likely provide the applicable baseline, further evaluation of this consideration will be necessary as part of the development of a WQT program. As discussed in Appendix A and Appendix C, both EPA and the State Water Board have policies that prohibit degradation of the

[37] Nutrients Watershed Permit, at 8.

existing water quality.[38] In the trading context, the antidegradation policies are usually satisfied where the result is both no net increase of nutrient loading and no change in localized impact of discharge, thereby maintaining the beneficial uses.

Table 4. TIN Loads and Effluent Limits (EL) by Discharger.

Discharger	2022 TIN Loads (kg/day)	Interim TIN EL (kg/day)	Final TIN EL (kg/day)	TIN Reduction: 2022 to Final EL (kg/day)
American Canyon, City of	11	79	62	-51*
Benicia, City of	200	290	120	80
Burlingame, City of	250	610	160	90
Central Contra Costa SD	3,700	4,300	2,300	1,400
Central Marin Sanitation	1,100	1,300	480	620
Crockett Community Services (Port Costa)	-	5.3	3.7	-
Delta Diablo	950	2,000	920	30
East Bay Dischargers Authority (EBDA)	6,900	9,000	4,200	2,700
East Bay Municipal Utility District (EBMUD)	10,000	11,000	3,300	6,700
Fairfield-Suisun Sewer District	1,000	1,600	880	120
Marin County (Paradise Cove), SD No. 5 of	0.9	3.7	3.5	-2.6*
Marin County (Tiburon), SD No. 5 of	47	69	47	-
Millbrae, City of	240	340	100	140
Mt. View Sanitary District	42	190	78	-36*
Novato Sanitary District	-	210	140	-
Palo Alto, City of	2,200	2,900	1,200	1,000
Pinole, City of	370	460	190	180
Rodeo Sanitary District	39	50	38	1
San Francisco (SFO Airport), City & County of	91	560	71	20
San Francisco (SFPUC) (SE Plant)	7,400	11,000	3,300	4,100
San Jose and Santa Clara, Cities of	2,500	6,400	5,000	-2,500*
San Mateo, City of	1,300	1,700	670	630
Sausalito-Marin City Sanitary District	110	180	69	41
Sewerage Agency of Southern Marin (SASM)	250	280	140	110
Silicon Valley Clean Water	2,500	3,000	880	1,620
South San Francisco and San Bruno, Cities of	1,200	1,500	560	640
Sunnyvale, City of	500	830	740	-240*
Treasure Island Development Authority	20	29	21	-1*
Vallejo Flood and Wastewater District	770	1,000	580	190
West County Agency (WCA)	700	1,100	430	270

**Negative numbers mean that a discharger can increase their loading.*

[38] 40 C.F.R. § 131.12(a)(1); Cal. State Water Resources Control Bd., Res. No. 68-16: Statement of Policy with Respect to Maintaining High Quality of Waters in California (Oct. 28, 1968). Additionally, the CWA's anti-backsliding provisions should not pose an issue.

If WQT to achieve the interim limits is of interest, the further analysis is necessary to justify using the interim limits as baseline for credit calculation due to potential for degradation of existing water quality, both localized and baywide. Although using the final effluent limits as baseline would align with some of the discussion in the 2024 Permit Fact Sheet,[39] such an approach would hinder the dischargers' ability to engage in WQT in the near-term for interim effluent limit compliance. Alternatively, if interim limits do not provide a feasible baseline, it may be appropriate to use the 2022 loads as the baseline because the 40% reduction target was based off the 2022 loading. While trading of interim limits could be beneficial for long-term WQT program success by providing an opportunity for the dischargers to build familiarity and comfort with WQT, there may not be sufficient near-term demand. In any event, further evaluation is necessary to define the most appropriate baseline (interim, 2022 load, or final) and establish a robust scientific justification for the baseline.

Trading Ratios & Credit Reserve Pool

Trading ratios represent a discount factor that requires a discharger to secure more credits than would otherwise be required for satisfying the effluent limits using traditional on-site technologies. Trading ratios are used to account for two overarching considerations:

1. Biogeochemical processes in the water that could affect the water quality benefits represented by a credit between sellers and buyers (i.e., attenuation)
2. Uncertainty (e.g., benefit quantification, scientific) to guarantee environmental benefits result from trading.

Therefore, when determining the appropriate trading ratios, it is important to evaluate the applicable purpose(s) in the specific context. Based on the circumstances, trading ratios may be necessary to account for attenuation, modeling/scientific/measurement or other sources of uncertainty, to provide certainty to participants and assurances that water quality benefits will result (e.g., creation of buffer/insurance), or some combination of these factors.

Box 2: Two Reasons for Trading Ratios

Biogeochemical Processes – Nutrient Attenuation

- Benefits may change when moving through the watershed
- Influenced by specific biological conditions
- Determined by modeling or negotiation

Uncertainty & Insurance

- Uncertainty in direct measurements and/or models
- Ensure water quality benefits accrue
- Create "reserve/insurance" credit pool

For point-to-point source trading, where the credits are directly measured from the actual discharge, there is little need for a trading ratio to account for measurement uncertainty. However, there may be rationale for a trading ratio to account for attenuation, create an insurance buffer in the program, or establish a safeguard against water quality degradation. Although some point-to-point trading programs allow for a ratio near 1-to-1 when shown to be scientifically justified,[40] the determination of the appropriate trading ratio must evaluate all potential considerations and may even be used as a mechanism to provide additional assurances to trading participants, such as by supporting a credit reserve pool.

[39] "As part of their regional coordination strategy, Dischargers may propose a formal nutrient trading or offset program to **achieve final effluent limits** for total inorganic nitrogen." Nutrients Watershed Permit, at F-37 (emphasis added).

[40] Some point-to-point WQT programs allow a 1-to-1 trading ratio. For more discussion on this, see Appendices B & C.

A credit reserve pool represents a related consideration and, in practice, is often a component of the applicable trading ratio. A reserve pool is comprised of credits that are set aside to ensure water quality improvements and address any unexpected compliance gaps. A reserve pool can be established through an increase in the trading ratio (e.g., 10%), with that portion of the credits being held unless and until necessary to respond to an unanticipated event. Establishing a credit reserve pool is a means of providing additional assurances to WQT participants and the regulators.

For SF Bay, a low trading ratio (e.g., near 1-to-1) would be legally defensible *if* shown to be scientifically justifiable. However, there is also the question of whether a reserve pool of credits is necessary to mitigate programmatic risk and provide additional assurances to participants. In any event, any proposed trading ratio will require further analysis to establish a credible scientific justification for the ratio, as well as to determine if creating a reserve pool is needed.

Banking Credits

Despite interest from some utilities in potentially "banking" credits—holding credits from one year for use in future years—this is unlikely to be allowed by the regulators and is generally cautioned against. Because the Permit's effluent limits are defined seasonally each year, carrying credits into future years creates the potential to degrade water quality by allowing increased nitrogen discharges in years when banked credits are used. However, the potential for some limited credit banking should be further investigated. If a scientific basis is found, credit banking may represent a valuable strategy for incentivizing early trading and provide a backstop for credit shortfalls.

e. *Tracking & Reporting Credit Transactions*

To demonstrate permit compliance, credit sales and credit use can be reported as part of the Permit's existing monitoring and reporting program.[41] Credits traded, used, and the buyer/seller could be added to the required self-monitoring and discharge monitoring reports.[42] Regulators could then use those documents to confirm that the baywide effluent limits have been satisfied after accounting for credit transactions and, if the exceedances occur, identify the discharger(s) responsible.

The 2024 Permit requires an Annual Nutrients Report, a requirement largely satisfied through BACWA's group report. The Annual Report could account for all credit transactions in the reporting period, identifying the buyers/seller, credit quantities, and credit usage. For a strictly point-to-point WQT program, adding a WQT credit reporting component into the existing reporting should provide sufficient certainty and accountability.[43] However, this is subject to regulatory agreement on a proposed approach and any expansion to allow for nonpoint credits will require further accounting and reporting structures.

f. *Adaptive Management*

To provide a mechanism to adapt to lessons learned, watershed developments, scientific advancements, and other potential developments, the WQT Framework should include an adaptive management strategy. Further consideration is necessary to define the most appropriate adaptive management

[41] Nutrients Watershed Permit, Attachment E.
[42] NAT'L NETWORK ON WATER QUALITY TRADING, BUILDING A WATER QUALITY TRADING PROGRAM: OPTIONS & CONSIDERATIONS, Table 1.3.1 (2015).
[43] EPA TRADING TOOLKIT – WQT SCENARIO: MULTIPLE FACILITY POINT SOURCE TRADING, at 13–16.

approach, but generally it will likely involve two components: (1) a recurring programmatic evaluation, and (2) a responsive strategy to react to unanticipated developments or circumstances.

The recurring programmatic evaluation should be designed to identify and propose improvements to the WQT program. For practical reasons, this may be designed to align with the five-year Permit renewal cycles, which present an opportunity for revising and updating the WQT Framework. The adaptive management process should evaluate progress toward watershed goals, potential improvements to the WQT standards, protocols and process, updated water quality modeling, etc. This would also provide an opportunity to expand the WQT program to incorporate other sources of credits (i.e., nonpoint sources). The second component of an adaptive management strategy should be a process for identifying and responding to unanticipated events. Given the inherent impossibility of defining a specific response to unforeseen developments, this adaptive management approach should be flexible and could be comprised of notifying the regulators and proposing an appropriate response. The specific structure of an adaptive management approach will require further consideration to fully develop.

g. *Nonpoint Source Trading – Credits from Watershed Restoration Practices*

As discussed in the *2017 TFT Trading Report*, nonpoint sources offer a potential source of water quality improvements. To reduce risk, expand credit supply, and improve cost effectiveness, a point-to-point WQT program could integrate a nonpoint source component that enables the generation of credits from watershed restoration practices. Incorporating nonpoint sources also support adaptive management, by providing a means to directly improve the watershed and water quality by addressing additional sources of loading. However, given the added complexity inherent in nonpoint source trading, adding a nonpoint component to a point-to-point WQT program requires notable scientific investigation and program development to provide the requisite economic, scientific, and legal durability and certainty.

The 2024 Permit states that regulated dischargers account for about 86% of the TIN loading to San Francisco Bay, with 100% of the loading in Lower South Bay, South Bay, and Central Bay. This figure does not account for the dry season TIN loads from nonpoint sources (upstream land use, urban stormwater, aerial deposition) "because load estimates were not available and assumed to be relatively small."[44] Yet stormwater and nonpoint source loading from the diverse land uses in the watershed can influence SF Bay water quality (i.e., MS4, agriculture, landscaping). Moreover, environmental restoration projects may influence water quality by preventing TIN loading or removing TIN from the water column, thereby offering another potential source of nonpoint source credits. For example, the Maryland WQT program allows credits to be generated from certain in-water practices that reduce nutrient concentrations (i.e., oyster aquaculture).[45] While potentially a promising component of a trading program, nonpoint source trading needs additional evaluation to understand its potential role in a WQT program for the SF Bay.

Therefore, the recommended approach is to develop and implement a point-to-point WQT program in the near-term and simultaneously commence the research necessary to develop a nonpoint source credit component for the WQT program. Nonpoint trading could then be added to the existing WQT Framework as part of a future Permit renewal. This strategy would see WQT become established and operational while providing time to identify the appropriate nonpoint practices and define the program structures.

[44] Nutrients Watershed Permit, at F-18.
[45] For more discussion on the Maryland WQT program and other trading programs, see Appendix B.

h. *Incentives for Early WQT Participants*

The initial trading participants will be important for WQT deployment and success. As such, mechanisms for incentivizing and recognizing early participants should be evaluated for potential inclusion in the WQT Framework. Just as the 2024 Permit provides recognition of early actors, there could be incentives for 'Early Traders' in a WQT program.[46] This could take a number of forms—early participants could receive more beneficial baseline, more favorable trading ratios (like some Oregon WQT Programs[47]), credit purchase assurances (like Connecticut or Maryland[48]), some allowance for credit banking, more flexible compliance schedules, or any number of other advantages. Whatever the chosen approach, the goal will be to encourage early participation by convincing potential participants that would otherwise remain undecided. Potential approaches will need careful consideration from legal, economic and ecological perspectives, and will likely be identified and vetted when developing a WQT Framework.

i. *Potential Restrictions*

Any potential restrictions on the ability of dischargers to participate in a WQT program warrant further analysis and evaluation to ensure such considerations either do not present obstacles to participation or, if they do, to identify pathways to navigate such restrictions. One such potential restriction relates to the ability of dischargers to use ratepayer funds to purchase credits from other dischargers, which could be viewed as financially supporting facility upgrades at another utility. This may not present an issue since credit buyers are using ratepayer funds to secure their own permit compliance but given the complexities of local government revenue measures under California law[49] this matter will need to be carefully considered (with the support of legal professionals). Similarly, any other regulatory or operational restrictions must be identified, which may entail some utility-specific evaluation due to the variety of organizational structures among the dischargers. Although important considerations, these specific matters were beyond the scope of this initial analysis and will require future investigation.

5. STEPS TO DEPLOYMENT

The following steps to deployment are proposed for BACWA consideration. The overarching schedule is driven by the compliance planning deadlines for dischargers: the impending April 1, 2026 deadline to perform alternatives analysis and the April 1, 2027 deadline for submit compliance plans, as well as the 2029 permit renewal schedule to a lesser extent. With consideration for BACWA Member input, compliance pathway deadlines, and the 2024 Permit compliance schedule, Table 5 proposes a schedule for program deployment. The schedule is divided into three phases: Build, Implementation, Refine. This schedule is informed by TFT's extensive experience building and operating WQT programs across the United States, taking into account the unique considerations for SF Bay.

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[46] Nutrients Watershed Permit, at § 6.3.

[47] For instance, the City of Ashland, Oregon received more favorable trading ratios for nonpoint source projects implemented prior to permit issuance. City of Ashland, Water Quality Trading Plan (approved Feb. 18, 2022).

[48] The Long Island Sound Nutrient Credit Exchange purchases all credits generated, regardless of demand, thereby providing certainty to credit sellers. The Maryland WQT program encourages nonpoint sources to generate credits by spending millions of dollars annually to buy credits, though this is still only a portion of the credits generated.

[49] For a discussion of these restrictions, see League of California Cities, *Propositions 26 and 218: Implementation Guide* (May 2017), https://meyersnave.com/wp-content/uploads/LOCC-Implementation-Guide-Prop-26-and-218.pdf.

Overall, the recommendation is to proceed with Building in 2026, then Implementation (and testing) from 2027-2030, followed by Refinements from 2031-2034 and thereafter as necessary. This schedule aligns with the 2024 Permit compliance deadline of 2034, prioritizes creation of the point-to-point source trading program, allows years to prove and refine the program, and includes a path for incorporating nonpoint source credits.

To establish a WQT program, it is necessary to develop a WQT Framework that would define the rules, restrictions, and processes for the entire SF Bay. The WQT Framework would need to be approved by the Regional Water Board and incorporated into the Nutrients Watershed Permit. This approval could occur as part of a permit modification or renewal, and would involve a public notice and comment process.[50]

Table 5. Proposed Timeline for WQT Program Development.

WQT Program Development Milestones	
BUILD PROGRAM (2026)	
Discharger Engagement	January - March 2026
Permit: Alternatives Analysis Due	April 1, 2026
Technical Analysis & Vetting	March - June 2026
WQT Framework to Water Board	July 2026
Finalize WQT Framework	September 2026
Enable Supporting Systems	October 2026 - February 2027
Launch WQT Program	February 2027
Permit: Compliance Plan Due	April 1, 2027
IMPLEMENT PROGRAM (2027-2030) - Consider Nonpoint Source Credits	
REFINE PROGRAM (2031-2034)	

The 2024 Permit states that, if sufficient interest exists, the "Regional Water Board intends to consider a formal trading program with the next permit reissuance."[51] However, it would be advantageous for the WQT Framework to be developed and adopted sooner because the utility planning processes are currently underway and, given the long timelines for selecting, constructing and operationalizing treatment solutions, it is necessary to enable dischargers to consider WQT as another alternative soon. Therefore, to provide the dischargers with sufficient certainty and clarity to account for WQT in their compliance strategies, the development and adoption of a WQT Framework should be pursued as quickly as possible. Delay could threaten the viability of trading WQT as the construction and permit timelines for technological upgrades will force potential participants (both buyers and sellers) to pursue other alternatives before a WQT program is formalized.

Developing a WQT Framework for the Permit will require completing additional investigations to resolve outstanding legal, regulatory, and scientific questions. Additionally, discharger engagement will be

[50] Incorporating a WQT Framework into the Permit is a major modification requiring public notice. 40 C.F.R. § 122.62.
[51] Nutrients Watershed Permit, at F-29.

needed to confirm the WQT Framework satisfies their needs. A functional WQT Framework can only be created once the circumstances are well understood, limitations identified and supporting analyses completed, thereby ensuring the WQT Framework is properly tailored to the context. The following investigations are necessary and should be pursued simultaneously and expeditiously:

1. Legal and regulatory considerations must be researched and strategies to navigate potential hurdles developed as necessary. This will likely require the assistance of California licensed attorneys on some matters (e.g., financial constraints and administrative restrictions).
2. Continuing ongoing watershed modeling and analyses to strengthen the scientific underpinnings for a trading program and inform aspects of the WQT Framework (e.g., trading ratios, baseline).
3. Credit supply/demand, timing, and cost estimates must be identified and iteratively refined to determine transactional opportunities and inform decisions on compliance strategies by individual dischargers.
4. Outreach to and engagement with the dischargers must occur in order to develop the Framework, inform cost and credit estimates, elicit support for the program, and ensure participation.

Though these four efforts concern separate matters, they will often be interrelated and iterative. For example, the watershed modeling may define trading areas based on ecology, but agency-specific administrative restrictions may alter trading areas based on reality of program operation.

The priority is creating the point-to-point source credit trading program, since the majority of TIN during the dry season is from the regulated dischargers. Regarding nonpoint source involvement, an initial feasibility assessment is needed. Therefore, we recommend proceeding with development of the point-to-point source WQT program and conducting a parallel feasibility analysis of nonpoint credit generation.

Take Away: It is important to proceed at pace, given the reality of the discharger compliance decision deadlines (April 2026 and April 2027).

6. SUMMARY

The investigation determined that WQT is a viable compliance strategy for the San Francisco Bay dischargers. Leading indicators of a successful program in the SF Bay included: (1) interest in WQT from potential participants, (2) scientific tools and experts are available to support program design, (3) a gap in compliance pathways that WQT credits can fill, and (4) identifiable buyers and sellers.

Specifically, the SF Bay offers several unique attributes that lend support to a potential WQT program, such as the:

- **Existence of BACWA** – BACWA is dedicated to working their members, state and federal regulatory agencies, and non-governmental organizations to improve and enhance the SF Bay environment. Coordination provided via BACWA for development of a WQT program ensures that the program will be well-informed, thoughtful and effective.
- **Existing Science & Data** – SFEI has conducted water quality research for more than thirty years. SFEI is believed to have the data, credibility, independence, and technical capabilities needed to inform the scientific foundations of a durable WQT program, supplemented with additional existing experts and studies as needed.

- **Enabling Permit** – The Nutrients Watershed Permit specifically contemplates WQT as a potential compliance strategy and provides support for specific components of a trading program, such as a basis for a baywide trading area and incentives for early actors. The 2024 Permit's use of Aggregate Mass Load effluent limit also fosters collaboration among the dischargers, a core aspect of watershed-based compliance alternatives, particularly point-to-point trading programs.
- **Need for Solutions** – With an estimated $11B to achieve the Permit limits, compliance alternative limitations for many dischargers, and persistent HAB concerns, there is a demonstrable need for approaches that reduce cost, maximize ecological outcomes, and provide compliance options.

A WQT program would enable the dischargers subject to the Permit to collaboratively pursue the most cost-effective treatment solutions to achieve permit compliance. Dischargers close to meeting their permit limit can purchase a smaller number of credits, rather than working alone to install technologies or other on-site compliance solutions. WQT can potentially alleviate equity issues for dischargers that do not have the physical space or budgets to implement alternative treatment options. Maximizing on-site treatment by dischargers that are making capital investments can help realize TIN reductions in the most efficient manner, potentially covering long-term operation and maintenance expenses via credit sales. Looking ahead, creating a WQT program now sets the stage for inclusion of nonpoint source credit generation options later; adding nonpoint source credits increases the diversity and resiliency of the system, improves likelihood that the SF Bay will be in compliance with the regional permit, and can reduce chances of a future HAB by accelerating the reduction of overall TIN loading.

There is concern that delaying progress on a WQT program could create uncertainty for dischargers facing specific deadlines for planning, effectively missing the opportunity to include WQT credits in their strategies. The recommendation is to proceed with program design and approval in 2026, followed by implementation through 2030, and refinement through 2034. This schedule will maximize probability that WQT can be integrated in facility compliance planning, then be implemented and refined ahead of the anticipated 2034 compliance deadline.

Immediately, BACWA can enable a successful WQT program by:

1. Clearly communicating the timeline and milestones for considering WQT, thereby providing confidence to the dischargers to include WQT in their April 1, 2026 compliance alternatives.
2. Encouraging utilities to evaluate options to exceed current compliance obligations as a credit generation opportunity.
3. Developing a methodology for identifying credit supply, demand, costs and timelines that can be iteratively refined as additional information and data becomes available.
4. Proceeding with development of a trading framework for a point-to-point source WQT program in early 2026.

APPENDIX A: LEGAL AUTHORIZATION FOR WQT

Water quality trading as a CWA discharge permit compliance strategy has strong support from the EPA as well as from the California State Water Quality Control Board. The regulatory support and the agencies' positions on WQT are important for evaluating the viability of trading as well as designing a functional trading program that will secure the necessary regulatory approvals.

a. *Federal Authorization for Trading*

In 2003, the U.S. Environmental Protection Agency (EPA) issued its *Water Quality Trading Policy* (EPA Trading Policy), which explains how point and nonpoint sources can participate in market-based approaches to meet water quality standards more cost-effectively consistent with the CWA.[1] The EPA Trading Policy frames WQT as a voluntary, flexible compliance approach that can improve water quality and generate ancillary environmental benefits, so long as trading is implemented consistent with the CWA's provisions (e.g., anti-backsliding, antidegradation, enforcement, public participation, etc.). Notably, the Trading Policy explicitly endorses trading for nutrients. EPA followed with the *Water Quality Trading Toolkit for Permit Writers*, a practical "how-to" manual that describes how NPDES permitting authorities can incorporate trading provisions into permits consistent with the EPA Trading Policy.[2]

EPA has repeatedly reaffirmed this support for WQT. In 2019, EPA issued *Updating the Environmental Protection Agency's Water Quality Trading Policy to Promote Market-Based Mechanisms for Improving Water Quality* (2019 Memorandum).[3] That memo reiterates strong support for water quality trading and other market-based programs; promotes their use to incentivize nonpoint source controls; and identifies several overarching principles. In a subsequent pronouncement (2020 EPA Memo) EPA elaborated the principles in the 2019 Memorandum and issued recommendations on how program managers should define trading areas based on water quality goals, watershed connectivity, hydrology, and data availability.[4] Together, these publications evidence strong, ongoing support for trading across multiple EPA administrations.

Trading programs have also withstood judicial scrutiny on several occasions.[5] WQT has even benefited from other judicial opinions that may not immediately seem relevant to trading, such as the recent Supreme Court decision in *San Francisco v. EPA*, which provides greater certainty to dischargers.[6] As these

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[1] U.S. EPA, Water Quality Trading Policy, 68 Fed. Reg. 1608, 1610 (Jan. 13, 2003), www.epa.gov/sites/default/files/2016-04/documents/2008_09_12_watershed_trading_finalpolicy2003.pdf.

[2] U.S. EPA, WATER QUALITY TRADING TOOLKIT FOR PERMIT WRITERS, EPA 833-R-07-004 (Aug. 2007, updated June 2009), *available at* www.epa.gov/npdes/pubs/wqtradingtoolkit.pdf (EPA TRADING TOOLKIT).

[3] Memorandum from David Ross, Asst. Administrator, EPA Office of Water, to EPA Regional Administrators, on *Updating the Environmental Protection Agency's (EPA) Water Quality Trading Policy to Promote Market Based Mechanisms for Improving Water Quality* (Feb. 2019), www.epa.gov/sites/default/files/2020-10/documents/trading-policy-memo-2019.pdf.

[4] Memorandum from David Ross, Asst. Administrator, EPA Office of Water, to EPA Regional Administrators, on *Water Quality Trading on a Watershed Scale* (Nov. 2020), www.epa.gov/npdes/water-quality-trading-watershed-scale (2020 EPA Memo).

[5] *See, e.g., Food & Water Watch v. U.S. EPA*, 5 F. Supp. 3d 62 (D.D.C. 2013) (rejecting challenge to Chesapeake Bay TMDL's trading provisions due to lack of standing); *Am. Farm Bureau Fed'n v. U.S. EPA*, 792 F.3d 281 (3d Cir. 2015) (upholding Chesapeake Bay TMDL and the trading provisions); *Food & Water Watch v. Dep't of Envtl. Prot*., 253 A.3d 838 (Pa. Commw. Ct. 2021) (upholding trading program); *Friends of Pinto Creek v. U.S. EPA*, 504 F.3d 1007 (9th Cir. 2007) (striking down specific offset program without opining on legality of WQT broadly, EPA considers this case limited to its facts).

[6] *City & Cty. of S.F. v. EPA,* 604 U.S. 334, 145 S. Ct. 704 (2025). This decision eliminated NPDES permit "end-result provisions", which made a permit holder responsible for receiving water quality, not just the quality of their effluent. This decision resulted in less uncertainty for NPDES permit holders and strengthened the CWA's permit shield (33 U.S.C.S. § 1342(k)), providing

pronouncements and EPA's defense of trading in response to lawsuits demonstrate, WQT constitutes a viable and effective compliance strategy.

EPA views trading between NPDES-permitted point sources—"point-to-point" trading—as the most straightforward form of WQT. Point-to-point source trading is considered "the most basic form of water quality trading [because it] is relatively straightforward, easily measurable, and directly enforceable."[7] EPA goes on to describe these trades as "the easiest type of trading to implement, to measure reductions from, and to ensure compliance and enforcement with because all sources have a permit, the effectiveness of removal technologies is relatively well known, and monitoring protocols are in place." Consistent with these formal pronouncements, EPA therefore continues to encourage states and tribes to develop robust, watershed-based WQT programs, particularly for nutrients. The agency consistently maintains that WQT represents a valuable tool for achieving water quality standards at lower overall cost while delivering real, verifiable environmental improvements. As such, EPA encourages states to develop and adopt WQT programs where the circumstances justify the approach.

b. *California Authorization for Trading*

California has continued to develop and permit trading programs on a case-by-case basis. California has not adopted any statewide regulations or official policies directed solely at WQT, but existing policies support trading and the discretion vested in the State Water Resources Control Board (SWRCB) and the Regional Water Boards enables the development and implementation of such programs.[8] The SWRCB's *Water Quality Control Policy for Addressing Impaired Waters* states that the "Water Boards are committed to [using] all means to ensure that the waters of the state are protected" and recognizes the "wide latitude" and "numerous options" available to Regional Water Boards to address water quality concerns through both regulatory and nonregulatory measures.[9] While the SWRCB has initiated a review of state water quality control plans and policies, that review has not produced a trading-specific statewide rule to date.

Despite lacking statewide guidance, there is support for WQT programs. For instance, two memos from the SWRCB's legal counsel support WQT and similar offset programs. One of those memos clarified that the "use of offsets, pollutant trading, or other market-based mechanisms . . . is clearly appropriate when implemented in the context of a TMDL" and is likely appropriate "in the context of regulating multiple sources with a single NPDES permit[.]"[10] Together these proclamations demonstrate not only that trading

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dischargers with confidence that compliance with the terms of their permit ensures compliance with the water quality provisions of the CWA. This certainty benefits dischargers using WQT for compliance.

[7] EPA TRADING TOOLKIT – FUNDAMENTALS, at 15.

[8] *See. e.g.,* NAT'L NETWORK ON WATER QUALITY TRADING, BUILDING A WATER QUALITY TRADING PROGRAM: OPTIONS & CONSIDERATIONS, 33–35 (2015), *available at* www.wri.org/research/building-water-quality-trading-program-options-and-considerations.

[9] Without detailing the specific actions, this policy clarifies that regulatory and nonregulatory measures can be utilized to achieve compliance with the water standards. CAL. CODE REGS. tit. 23, § 2917; Cal. State Water Resources Control Bd., Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options, Res. 2005-0050, 1-2 (June 2005), www.waterboards.ca.gov/water_issues/programs/tmdl/docs/iw_policy.pdf.

[10] Memo from Craig Wilson, Chief Counsel, to Arthur G. Baggett, Jr., Chair, Cal. SWRCB, on Legal Authority for Offsets, Pollutant Trading, and Market Programs to Supplement Water Quality Regulation in California's Impaired Waters (Oct. 16, 2001), www.waterboards.ca.gov/water_issues/ programs/tmdl/docs/iwguide_apxb.pdf. Memo from Michael A.M. Lauffer, Chief Counsel, to Arthur G. Baggett, Jr., Chair, Cal. SWRCB, on Updated Legal Authority for Offsets, Pollutant Trading, & Market Programs to Supplement Water Quality Regulation in California's Impaired Waters with Established TMDLs (Nov. 22, 2006).

constitutes a viable compliance option, but also that California regulators are actively "encouraged to be as innovative and creative as possible" in achieving a water quality goals.

The regulatory authority to approve WQT programs has been most visibly exercised by the North Coast Regional Water Board, which approved the Water Quality Trading Framework for the Laguna de Santa Rosa Watershed.[11] In conjunction with their individual discharge permits, this Framework enables the City of Santa Rosa and Town of Windsor to engage in nonpoint source trading to comply with their nutrient (total phosphorus) permit limits. Additionally, although a separate regulatory context, the California Water Commission's 2022 groundwater trading white paper signals growing comfort with market-based mechanisms so long as such approaches have sufficient safeguards.[12] In light of this context and the existing precedent, it is clear that, conceptually, WQT programs are viable in California, though they must be developed and approved on a case-by-case basis.

[11] North Coast Reg'l Water Quality Control Bd., Order R1-2018-0025, Approving Water Quality Trading Framework for the Laguna de Santa Rosa Watershed (2018), www.waterboards.ca.gov/northcoast/water_issues/programs/nutrient_offset_program/.

[12] California Water Comm'n, A State Role in Supporting Groundwater Trading with Safeguards for Vulnerable Users: Findings and Next Steps – Draft (May 2022), *available at* https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2022/05_May/May2022_Item_10_Attach_1_WhitePaper_Final.pdf.

APPENDIX B: TYPES OF WQT PROGRAMS

Every WQT program is unique as such programs are developed to suit the unique circumstances and needs of a particular watershed and the dischargers within that watershed. However, WQT programs generally fall into two overarching categories. The first, point-to-point source trading, involves transactions between point sources with CWA discharge permits. The second, point-to-nonpoint source trading, involves permitted point sources purchasing credits generated by actions that improve pollutant loading from nonpoint sources (e.g., agricultural practices, watershed restoration).[1] Notably, for WQT programs involving multiple participants, whether multiple point sources or nonpoint sources, a broker or intermediary may be involved to help facilitate to trades, though this is not required and does not change the underlying trading program structure.

a. *Point-to-Point Source Trading*

Point-to-point source water quality trading involves exchanges of pollution reduction obligations among regulated dischargers, such as wastewater treatment plants. Dischargers that can cost-effectively reduce their load below the applicable discharge limit can generate credits, which represent the additional reductions. Those credits can then be sold to dischargers facing higher marginal treatment costs, allowing the watershed as a whole to meet a collective cap or set of allocations. In this way, dischargers with lower-cost reduction options can sell credits, and those facing higher costs can buy them, while the overall pollutant load in the watershed still meets or exceeds target conditions. Successful point-to-point WQT programs in places like the Long Island Sound and the Chesapeake Bay have used watershed-based permitting to facilitate trading and, through this strategy, have achieved substantial nutrient reductions while preserving flexibility for individual dischargers to pursue the strategy most appropriate for their unique circumstances.

EPA has identified three general types of point-to-point trades: 1) a single point source trading with another point source; 2) a group of point sources within one basin operate under a single trade agreement; and 3) a group of point sources that purchase credits from a central exchange as needed to comply with individual effluent limitations.

Figure B-5. Programmatic Options for Point-to-Point Trading Program[2]

[1] Nonpoint-to-nonpoint trading also exists, though it is rare due to the lack of a regulatory driver in most cases. However, one example is the Los Angeles MS4 Program that allows stormwater agencies to jointly achieve compliance with the MS4 permit.

[2] EPA TRADING TOOLKIT – FUNDAMENTALS, at 15–17. See *2017 TFT Trading Report*, Sections 1 & 3, for discussion of program structures.

There is much similarity between these types of trading programs—the distinctions largely involve the size of the program, the number of participants, and the permitting approach. Smaller programs (i.e., single point source trading) generally operate as part of the individual permit for the entity that is purchasing credits. In contrast, larger programs involving multiple point sources usually occur under a broader, watershed-based permit that applies to multiple dischargers within a watershed or discrete geographic area.

b. *Point-to-Nonpoint Source Trading*

Point-to-nonpoint source trading extends this idea to include unregulated or less-regulated sources, such as agriculture, forestry, urban runoff, or other projects/practices that result in water quality benefits.[3] In these programs, nonpoint sources generate credits by implementing practices or projects that measurably reduce pollutant loading (e.g., land management changes, habitat restoration, or improved stormwater controls) beyond a defined baseline or improve instream water quality (e.g., shellfish aquaculture). Regulated point sources can then purchase these credits to help meet their own obligations. Because nonpoint reductions can sometimes be achieved at lower cost than additional treatment at point sources, particularly given the costs of advanced treatment technology, this form of trading can provide a flexible pathway to improve watershed conditions while encouraging investment in broader landscape and watershed improvements.

However, WQT involving nonpoint sources is a more complex undertaking. Given the dispersed nature of nonpoint source practices, a more robust system of project monitoring and tracking is usually required. For instance, whereas the pollutant reductions from point sources can be directly measured and the credits quantified using the same approach as the permit, most nonpoint source water quality benefits must be modeled. As EPA has explained, regulators "should adopt methods to account for the greater uncertainty in estimates of nonpoint source loads and reductions."[4] As a result, it is necessary to establish clear standards for nonpoint source projects to define eligible project types and establish quality standards, credit characteristics, trading ratios, baseline, and monitoring obligations and verification protocols. In many cases, these matters are practice specific as the considerations will vary for different practices. These standards can be developed independently or incorporated into a pre-existing point-to-point WQT framework.

Despite the comparative complexity, the effort to establish such standards and pursue more dispersed projects is often worthwhile in light of the cost effectiveness and longevity of many nonpoint source projects. As a result, many point-to-point WQT programs eventually allow for nonpoint source credits as well (e.g., Virginia and Maryland WQT Programs). Furthermore, nonpoint trading can provide a backstop of credit supply for a point-to-point WQT program, ensuring that there is an available compliance alternative if credits from point sources are unavailable.[5] Nonpoint projects can also provide a mechanism for adaptive management by facilitating projects and practices that improve the watershed and address causes of impairment beyond the reach of treatment technologies.

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[3] EPA Trading Toolkit – Water Quality Trading Scenario: Point Source–Nonpoint Source Trading.

[4] EPA Trading Policy, at 9.

[5] For example, the Virginia WQT Program allows point sources to pay into a Nutrient Offset Fund that generates nonpoint credits if there are no credits available from other point sources.

c. *Example Water Quality Trading Programs*

Long Island Sound Nutrient Credit Exchange, Connecticut – Point-to-Point

The Long Island Sound has long suffered from hypoxia driven largely by excess nitrogen from wastewater treatment plants. In response, Connecticut and New York developed a TMDL in 2001 that required point sources achieve reductions of approximately 64%.[6] To cost-effectively- meet these limits, Connecticut's legislature called for the issuance of a general permit for nitrogen discharges from all publicly owned treatment works (POTWs; same as dischargers), a subset of wastewater utilities, and the creation of a point-to-point source nitrogen trading program.[7] The resulting Nitrogen Credit Exchange Program was launched in 2002 and facilitates point-to-point source WQT between Connecticut dischargers regulated by the general permit. Dischargers that reduce discharges below their effluent limit can credit and sell the excess reductions to other dischargers to achieve permit compliance. The Exchange is a centralized state-run credit bank. It purchases all available credits based on a uniform credit price established annually by the governing board using a statutory formula.[8] The program has been successful—as of 2023, Connecticut dischargers have achieved the TMDL reductions in 7 out of the previous 9 years.

Virginia Nutrient Credit Exchange, Chesapeake Bay – Point-to-Point & Point-to-Nonpoint

The Virginia Nutrient Credit Exchange is an association of over 100 wastewater dischargers that are working collaboratively to reduce nutrient loading to the Chesapeake Bay through WQT. Virginia adopted a law in 2005 directing the development of a watershed general permit (issued in 2006) to regulate nutrients from all point sources and creating the Exchange to facilitate WQT.[9] The resulting trading program prioritizes point-to-point trading, either through the exchange or peer-to-peer transactions, but also allows nonpoint trading in certain situations. Buyers and sellers generally must be in the same basin and transactions receive a 1-to-1 trading ratio—some inter-basin trades can occur but are subject to a higher 1.3-to-1trading ratio. If point source credits are unavailable, a facility may pay into the Nutrient Offset Fund, which is used to

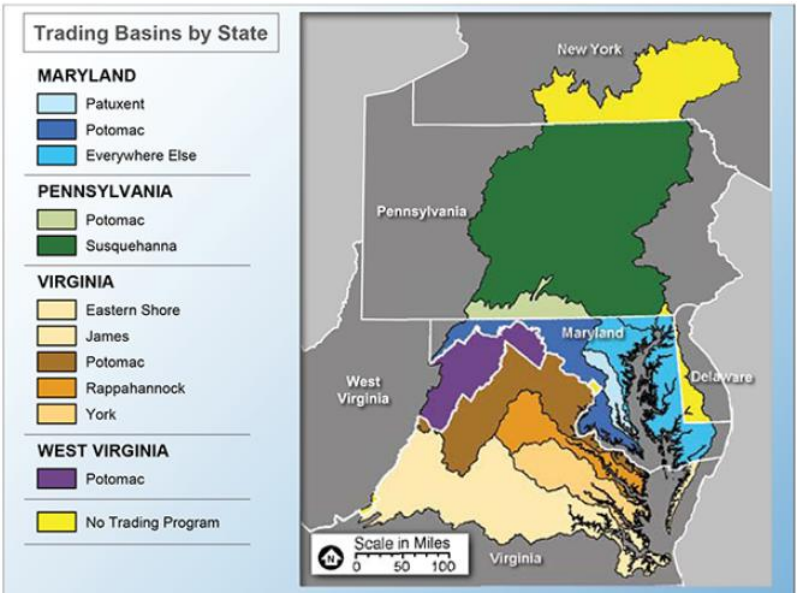

Figure B-6. Map of Chesapeake Bay Trading Areas.

[6] N.Y. DEP'T OF ENVTL. CONSERVATION & CONN. DEP'T OF ENVTL. PROT., TMDL ANALYSIS TO ACHIEVE WATER QUALITY STANDARDS FOR DISSOLVED OXYGEN IN THE LONG ISLAND SOUND (Dec. 2000), https://lispartnership.org/wp-content/uploads/2010/03/Tmdl.pdf/.

[7] 2001 Conn. Legis. Serv. 01-180 (S.S.B. 1012), www.cga.ct.gov/2001/act/pa/2001pa-00180-r00sb-01012-pa.htm. Conn. Dep't of Energy & Envtl. Prot., General Permit for Nitrogen Dischargers (Jan 1, 2024), https://portal.ct.gov/deep/municipal-wastewater/nitrogen-control-program-for-long-island-sound.

[8] CONN. GEN. STAT. § 22a-527(b). The pricing formula considers the actual capital and O&M costs of nitrogen-removal projects and Clean Water Fund financing. Information on the Nitrogen Credit Advisory Board, including annual rates for 2024 are available at: https://portal.ct.gov/deep/municipal-wastewater/nitrogen-credit-advisory-board/nitrogen-credit-advisory-board.

[9] VA. CODE ANN. §§ 62.1-44.19:12–19; 9 VA. ADMIN. CODE § 25-820-70. The General Permit was reissued in 2012, 2017, and 2021.

generate nonpoint source reductions.[10] New point sources are authorized to purchase nonpoint source credits to offset their discharges, subject to a 2-to-1 trading ratio. The trading program has been expanded to allow nonpoint source trading for compliance with other permits as well, including MS4 permits, construction general permits, and industrial stormwater permits.[11]

Maryland Water Quality Trading Program, Chesapeake Bay – Point-to-Point & Point-to-Nonpoint
Like other Chesapeake Bay states, Maryland has developed a WQT program. The Maryland program facilitates point-to-point and point-to-nonpoint source trading of nitrogen, phosphorus and sediment credits between agricultural, stormwater, wastewater, and on-site sewage disposal sectors. Credits can even be generated through oyster aquaculture. State regulations provide the core legal framework for the trading program.[12] The program uses a minimum trading ratio of 1-to-1 for point source trades and 2-to-1 for nonpoint source trades, with an additional 5% reserve ratio and a participant-specific Edge of Tide ratio to account for attenuation of pollutants through the watershed.[13] Although the Maryland program does not use a mandatory credit exchange, the state certifies all credits before they can be used for compliance and maintains a registry, a ledger of certified credits and their current trading status, and a web-based market board for potential sellers and buyers to publicize their interest.[14] To support the trading program and ensure progress towards the Chesapeake Bay TMDL goals, the state purchases millions of dollars' worth of nonpoint source nitrogen reductions annually.

Statewide Water Quality Trading Program, Wisconsin – Point-to-Point & Point-to-Nonpoint
Wisconsin's WQT program allows for sediment and nutrient credits to be created by both point and nonpoint sources (largely agriculture).[15] To engage in trading, a point source must develop a trading plan that defines their individual WQT program components (e.g., quantification, monitoring, reporting, etc.). The trading plan is approved by the state agency and added to the permit as enforceable conditions. This Credits can be transacted through peer-to-peer agreements, with the support of a credit broker, or through a privately operated central exchange, the Wisconsin WQT Clearinghouse. The state has developed guidance for defining the appropriate trading ratio, but the minimum ratio (for point-to-point trades) is 1.1-to-1 and the most common ratio is 2-to-1. Wisconsin's approach to WQT provides much flexibility to adapt to individual circumstances, but this is only possible because the legislature and state agencies offer significant support and guidance to interested parties (e.g., statutory authorization, program design guidance, example trade agreements).[16] Notably, the state also offers a similar but distinct compliance option, called adaptive management, which incentivizes long-term multi-party watershed restoration efforts to attain water quality standards, not just achieve effluent limits.

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[10] 9 VA. ADMIN. CODE § 25-820-70:1(J); VA. CODE ANN. § 10.1-2128.2 (Nutrient Offset Fund).
[11] Va. Dep't of Envtl. Quality, Nutrient Trading (visited Dec. 2025), www.deq.virginia.gov/news-info/shortcuts/permits/water/nutrient-trading. EPA, Region 3, *Water Quality Trading and Offset Programs in the Chesapeake Bay: 2021 Review and Summary* (2021), www.epa.gov/system/files/documents/2022-02/2021-chesapeake-bay-trading-and-offsets-summary_508-dec29.pdf.
[12] MD. CODE REGS. 26.08.11 (Maryland Water Quality Trading Program). The state Department of Agriculture adopted regulations for nonpoint source credit generation. MD. CODE REGS. 15.20.12 (Agricultural Nutrient & Sediment Credit Certification Program).
[13] The 5% reserve ratio supports a reserve pool to buffer against project under-performance or to ensure water-quality benefit.
[14] Md. Dept of the Envt., Water Quality Trading Registry and Marketplace (May 2025), https://mde.maryland.gov/programs/water/WQT/Pages/WQT_Registry_Market.aspx.
[15] WIS. STAT. § 283.84 (2025)
[16] Wi. Dep't of Natural Resources, Guidance for Implementing Water Quality Trading in WPDES Permits (2020, rev. 2023), https://dnr.wisconsin.gov/topic/Wastewater/phosphorus/tools.html. *See also* EPA, *Water Quality Trading Case Study — Wisconsin's Statewide Water Quality Trading Program*, EPA-833-F-22-010 (Feb 2024).

Temperature Trading Programs, Oregon – Point-to-Nonpoint

In 2011, the City of Medford, Oregon received approval to satisfy thermal effluent limits through nonpoint WQT. The City generates thermal credits by strategically replanting native trees across the Rogue River watershed. Modern analytics are used to quantify the solar load blocked by vegetation, and then high-impact, cost-effective sites are revegetated to create credits that the City uses to offset its discharges. The WQT program is governed by a WQT Plan, incorporated into the NPDES permit,[17] that establishes planting quality standards, credit life (20 years), monitoring and reporting obligations, credit accounting requirements (public credit registry[18]), trading ratios (2-to-1), and other requirements necessary to ensure sufficient transparency, certainty and accountability. Through the WQT program, the City has achieved and maintained permit compliance at less than half the cost of the next best facility treatment alternative. The success of Medford's WQT program has led the Cities of Ashland and Eugene-Springfield to develop comparable programs. These programs have also added additional credit generating practices, such as flow augmentation, side channel restoration, and cold-water reservoir releases.

Ohio River Basin Program, Ohio, Indiana & Kentucky – Point-to-Nonpoint

Since 2012, the Electric Power Research Institute (EPRI) and a collaboration of wastewater utilities, power companies, farmers, state and federal agencies, and environmental interests have been running an interstate WQT program in the Ohio River Basin.[19] The program is currently the largest (by geography) WQT program in the United States with a trading area including three states: Ohio, Indiana, and Kentucky. This program is set up to pay farmers for achieving nutrient reductions of nitrogen and phosphorus. EPRI relied on the USDA Nutrient Tracking Tool (NTT) and the Watershed Analysis Risk Management Framework to model reductions and benefits, developed performance standards for multiple practices, uses third party verification, and records all transactions on a public ledger. All credits are tracked via a credit trading registry, including farm-level verification report signed by state agencies.

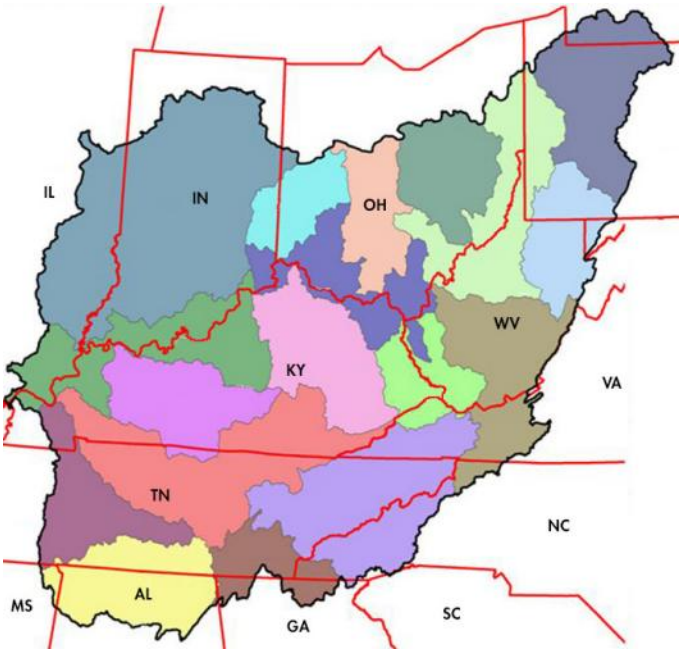

Figure B-7: HUC 4 Watersheds within Ohio River Basin WQT Program Trading Area.[20]

[17] City of Medford, OR, Medford Regional Water Reclamation Facility Thermal Credit Trading Program (2011), https://www.oregon.gov/deq/wq/wqpermits/pages/trading.aspx.

[18] Medford and other Oregon WQT programs use the S&P Global Registry: https://mer.markit.com/br-reg/public/index.jsp?entity=project&sort=project_name&dir=DESC&start=0&acronym=&limit=15&name=the+freshwater+trust&standardId=.

[19] Jessica Fox & Brian Brandt, *Protecting Ecosystems by Engaging Farmers in Water Quality Trading: Case Study from the Ohio River Basin* (2020), www.swcs.org/static/media/cms/75th_Book__Chapter_8_741AA7DBB222B.pdf.

[20] Electric Power Research Institute, Ohio River Basin Water Quality Trading Project (Mar. 2014), https://wqt.epri.com/pdf/3002001739_WQT-Program-Summary_2014-03.pdf

APPENDIX C: COMPONENTS OF WQT PROGRAMS

Although every WQT program is unique because it is designed in response to the individual circumstances present in a watershed, all trading programs have certain components to ensure sufficient rigor and accountability. The following is a brief discussion of these programmatic components. For a more thorough discussion, see the *2017 TFT Trading Report*.

a. *Eligibility*

For a trading program to be a feasible compliance strategy, there are a number of initial eligibility considerations that must be satisfied.

Regulatory Approval

To use WQT as a permit compliance strategy, trading must be included in the NPDES permit itself, either directly or by reference to a separate document (e.g., a trading framework). This establishes the trading rules and requirements and makes them enforceable permit conditions. While this can occur in an individual permit, particularly for point-to-nonpoint WQT programs involving a single discharger, for point-to-point programs involving multiple dischargers the more common approach is to use a watershed permit that regulates all of the potential participants. Incorporating these provisions into a permit can occur during a normal permit renewal, or it can occur during the permit term as a permit modification; in either scenario public notice and comment will precede formal regulatory approval.

Participant Eligibility

Trading is a potential compliance option once a permit incorporates the necessary WQT provisions. However, there are constraints on the discharge limits that can be satisfied through trading. NPDES permits can include two types of discharge limits: those based on the technology available to treat a pollutant (a technology-based effluent limit, or "TBEL"), and those necessary to meet the applicable water quality standards (a water quality-based effluent limit, or "WQBEL").[1] TBELs are developed for specific categories of dischargers and specific types of pollutants, whereas WQBELs are based on the water quality standards without regard to the treatment technologies. They are not mutually exclusive, often an effluent limit will reflect both a TBEL component and a WQBEL component. With limited exceptions, both EPA and California regulators prohibit satisfying TBELs through trading, WQT credits can only be used to achieve WQBELs.[2]

Pollutants Eligible for Trading

EPA "supports trading that involves nutrients (e.g., total phosphorus and total nitrogen) or sediment loads."[3] EPA has also acknowledged that trading for other pollutants can be appropriate and it may approve trading for other, non-toxic constituents on a case-by-case basis. However, the existing trading programs focus on nutrients, temperature, oxygen-demanding parameters, and sediment.

[1] 33 U.S.C. §§ 1311(b)(1) & 1312(a); 40 C.F.R. § 122.44(d). *See also* Nutrients Watershed Permit, at F-29.
[2] EPA Trading Policy, at 6.
[3] EPA Trading Policy, at 4.

Ensuring Environmental Benefit

The CWA includes several provisions designed to ensure permits will improve water quality. This includes the antidegradation provision[4] that serve to preserve and protect existing uses of the watershed are, as well as the anti-backsliding provision[5] that prohibits effluent limits from becoming less strict except in certain narrow circumstances. Since improving water quality is also a cornerstone of the EPA's support for WQT, all trading programs must improve water quality. For trading programs, the antidegradation and anti-backsliding requirements are usually satisfied where the result of trading is no net increase of nutrients entering the waterway and no change in localized impact of discharge, thereby maintaining the beneficial uses.[6]

Equity Considerations

Although not a determinative factor for WQT programs, the matter of equity for ratepayers and local populations is an important concern. Just as WQT cannot cause localized impairment of water quality, it should not contribute to the problems local populations face (environmental, financial, or otherwise). Due to the innate financial advantages of WQT, trading can often be financially beneficial to low-income communities by minimizing ratepayer increases. Even still, care must be taken in trading program development and operation to prevent undesirable and inequitable outcomes, and to identify and respond to any such developments should they occur (e.g., through adaptive management).

Trading Area

To participate in a trading program, both the credit seller and buyer must be located within a defined trading area. This represents the geographic boundaries of the program. The trading area should be a hydrologically connected area and "encompass the universe of sources that contribute to a specific water quality problem" that WQT aims to address.[7] The trading area is defined based on the unique conditions—the watershed characteristics, type of trade proposed, and specific NPDES permit will influence the appropriate geographic scope.[8] Commonly, particularly in the context of a watershed permit, the trading area encompasses the region covered by the permit.[9]

b. *Credit Characteristics*

A water quality credit represents a unit of pollutant reduction per unit of time at a specified location, accounting for quantification methodology, baseline requirements, and any adjustment factors.[10]

Unit of Trade

A trading program must clearly define the specific standardized units of trade. Credits may be expressed in rates or mass per unit time (e.g., flow concentration or discharge load) consistent with the time

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[4] 40 C.F.R. § 131.12(a)(1); Cal. State Water Resources Control Bd., Statement of Policy with Respect to Maintaining High Quality of Waters in California, Res. 68-16 (Oct. 28, 1968).

[5] 33 U.S.C. § 1313.

[6] EPA Trading Policy, at 7.

[7] EPA Trading Toolkit – Fundamentals, at 12. *See also* 2020 EPA Memo.

[8] This analysis looks to the hydrogeologic conditions, fate and transport of pollutants, ecological parameters, location and type of point source(s), type of pollutant(s), and regulations and management structures.

[9] The trading area should "encompass the universe of sources that contribute to a specific water quality problem that is to be addressed through trading." EPA Trading Toolkit – Fundamentals, at 12. See also EPA Trading Toolkit – WQT Scenario: Multiple Facility Point Source Trading, at 7 for a discussion of aggregate effluent limits in watershed permits.

[10] Nat'l Network on Water Quality Trading, Building a Water Quality Trading Program: Options & Considerations, 181 (2015); EPA Trading Toolkit, at Glossary-2.

periods used to determine compliance with permit limits or other regulatory requirements.[11] Thus, the credit unit should align with the permit effluent limit, both in terms of quantity and time.

Credit Quantification

To ensure the credit quantification methodology adequately tracks pollution reductions, the approach should be accurate, repeatable, sensitive, and transparent, as well as practical and economical.[12] The quantification approach is more complicated for nonpoint sources, as the water quality benefits generated from such sources are commonly modeled rather than measured. In contrast, for credits generated by point sources, credit quantification should mirror the existing permit approach (both in terms of units and monitoring) as this will provide certainty, consistency, and ease for participants.

Credit Duration

Credit duration refers to the period between when a credit becomes usable as an offset and when the credit is no longer valid. EPA has stated that "credits may be generated as long as the pollution controls or management practices are functioning as expected" and may be used to comply with an annual, seasonal, or monthly NPDES permit limit once they have been generated.[13] For point-to-point source trading, the credit duration is linked to the NPDES permit effluent limit. For example, if a permit uses seasonal limits, then the credit would be valid for that same period of time. This contrasts with project life, which represents the projected longevity of the credit generating practice. Treatment upgrades, which continue to function for many years can generate new credits year over year.

Baseline for Credit Generation

"Trading baseline" is the threshold improvement that a credit seller is required to meet before being able to generate credits. For point-to-point source trading, credits are generated when a discharger reduces their effluent below the applicable permit limit. Therefore, the baseline is expressed as the discharger's water quality-based effluent limit in the NPDES permit—any reductions beyond the NPDES permit limit may potentially be quantified and traded to other sources. For nonpoint source credit generators, the question of applicable baseline can be more complex, but generally requires compliance with local, state, and federal law (i.e., farm-level nutrient management plans), and sometimes can consider the pollutant control requirements that otherwise apply to a NPDES credit seller.[14]

Trading Ratios

Trading ratios are essentially a discount factor that reduce the number of credits generated by a seller *or* required by a buyer by a predefined proportion.[15] Ratios are a mechanism to ensure environmental benefits result from trading and account for a number of considerations such as delivery, location, equivalency, uncertainty, and retirement.[16] Trading ratios in nonpoint source trading programs are helpful to account for uncertainty in load reduction estimates (commonly quantified via models and calculators), while credits generated by point sources are generally based on direct measure. Still,

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[11] EPA Trading Policy, at 8.

[12] WILLAMETTE P'SHIP & THE FRESHWATER TRUST, REGIONAL RECOMMENDATIONS FOR THE PACIFIC NORTHWEST ON WATER QUALITY TRADING, 64 (2014).

[13] EPA Trading Policy, at 8.

[14] NAT'L NETWORK ON WATER QUALITY TRADING, BUILDING A WATER QUALITY TRADING PROGRAM: OPTIONS & CONSIDERATIONS, 54-56 (2015).

[15] Trading ratios can be applied to credit sellers to reduce the number of credits generated, applied to a buyer to increase the number of credits needed, or both. The approach and timing of applying ratios must be defined when establishing the program.

[16] EPA TRADING TOOLKIT – FUNDAMENTALS, at 30–32.

trading ratios exist in all WQT programs, including point-to-point programs, as a means of minimizing the risk of undesirable outcomes and providing additional certainty.

Lacking any state policy on trading ratios, they must be established on a case-by-case basis taking into account factors such as uncertainty, quantification approach, biogeochemical assimilation factors through the watershed (i.e., attenuation), temporal variability, and any other relevant considerations. For WQT programs that minimize uncertainty (i.e., via direct measure of credits), the EPA Trading Policy supports using trading ratios of at least 1-to-1 when there is minimal attenuation between buyers and sellers. Trading ratios of 2-to-1 (or more) are common for nonpoint source WQT programs.[17]

Credit Reserve Pool

It is often advisable to maintain a small reserve pool of credits (i.e., insurance pool) to manage uncertainty. This pool can be used to cover unexpected shortfalls in credit generation and help buffer temporary compliance gaps.[18] Even when not necessary for compliance, this reserve pool creates added water quality improvements. A common way to create such a reserve is to apply a slightly higher trading ratio and set aside a portion of each traded credit into the reserve pool.

c. *Credit & Program Tracking*

To provide the necessary assurances that a WQT program is achieving the desired results and ensure the required transparency and accountability, trading programs must include accounting and reporting systems, as well as a process for adaptive management.

Tracking & Reporting

A critical component of a WQT program is the accounting system, which tracks each credit from its creation through its final use and reports those activities to the regulators.[19] A robust accounting and reporting system provides the trading participants, regulators, and stakeholders with certainty that the credits represent actual water quality improvements and that credits have not been double counted. Credit accounting can involve the use of an independent third-party registry or brokerage, often with a publicly accessible web-based platform, to verify the credit generation, track transactions, and document credit use. Alternatively, accounting can also be undertaken by trading participants, subject to regulatory oversight. The appropriate accounting and reporting approach will depend on the specific circumstances and will generally reflect the complexity of a WQT program.

Thus, programs with more complexity (e.g., more participants, more credit generating actions) will require more robust accounting and reporting to provide sufficient accountability and transparency. For point-to-point trading programs, credit accounting and reporting may be done via an NPDES permit's existing monitoring and discharge monitoring report (DMR) requirements. For example, dischargers must submit DMRs, which can be used to document credit generation and use. In contrast, WQT programs involving nonpoint sources often require more robust monitoring and reporting to reflect the dispersed and multifaceted nature of those programs (i.e., farm practices, riparian or wetland restoration, etc.).

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[17] EPA Trading Policy, at 9. For example, the nonpoint thermal trading programs in Oregon generally use a 2-to-1 ratio.

[18] NAT'L NETWORK ON WATER QUALITY TRADING, BUILDING A WATER QUALITY TRADING PROGRAM: OPTIONS & CONSIDERATIONS, 78-80 (2015).

[19] EPA Trading Policy, at 8 (procedures should be developed "to account for the generation and use of credits in NPDES permits and [DMRs] in order to track the generation and use of credits between sources and assess compliance").

d. *Adaptive Management*

WQT programs must be founded on scientifically replicable and defensible methods. They must also generate demonstrable water quality benefits. This requires a systematic approach for monitoring programmatic outcomes and responding if the desired outcomes are not being realized. EPA suggests that "[p]eriodic assessments of environmental and economic effectiveness should be conducted and program revisions made as needed."[20] The appropriate strategy will depend on the specific circumstances, but can involve approaches such as watershed monitoring, recurring economic evaluations, annual programmatic reporting, and alternative actions to help backstop a program. For instance, for a point-to-point WQT program, an annual report on trading activities and costs could be used to monitor high-level trends and the identification of a potential problem could trigger responsive programmatic approaches. For example, if annual program reporting reveals actual or potential credit shortfalls, the program could be expanded to include nonpoint sources to increase credit supply and satisfy the demand.

[20] EPA Trading Policy, at 11.

APPENDIX D: BACWA MEMBER OUTREACH AND INTERVIEW QUESTIONS

Individual Outreach Meetings

TFT began with outreach to individual large and medium dischargers believed to have interest in WQT, potentially as a buyer or seller of credits. The initial communication process used the following email and invited the discharger's staff to schedule a meeting using the web-based Microsoft Bookings platform.

Introductory Outreach Email

"The Freshwater Trust (TFT) has been retained by BACWA to support the assessment of the feasibility of a water quality trading (WQT) program for the San Francisco Bay that BACWA's members could use to address upcoming nutrient discharge permit limits.

As part of this effort, we are engaging with BACWA members to learn about individual circumstances, potential interest in trading, and any questions or reservations. The goal of this initial outreach is to gauge interest and better define opportunities to incorporate WQT as a component of the available compliance strategies. We are reaching out to BACWA members to better understand current priorities, discuss how WQT might fit into future planning, and determine the viable structures for a potential trading program to recommend to BACWA.

We would like to schedule a brief introductory meeting with you and your team. During this meeting, we can provide an overview of WQT concepts and context and answer initial questions. We are particularly interested in your perspectives on trading and any concerns you may have about WQT that will help inform the design of a credible, legally durable, and functional program."

Outreach Meetings

After responding to the invitation and scheduling a meeting, TFT would send a confirmation email within a week of the meeting date. This confirmation email was intended to serve as a reminder, ensure that all relevant staff were included, help identify any potential technical issues with the meeting invitation, and provide an advance copy of TFT's presentation.

At the individual outreach meetings, TFT provided the discharger's staff with a short presentation (example included below). This presentation concluded with the following questions, which were designed to foster discussion among the participants.

1. What is the current state of your agency's planning for nutrient permit compliance?
2. How familiar are your agency's staff with WQT and have you encountered concerns about WQT?
3. Is your agency interested in participating in a WQT program?
4. Are you aware of any perceived limitations to WQT?
5. Have you considered the structure/operation of a WQT program?
6. What additional information would you need (e.g., technical, legal, financial) to evaluate participating in a WQT program?
7. Who else within your agency would need to be briefed to advance these discussions?
8. What does your organization need to make trading a viable option?

During the outreach meeting, TFT took notes to capture the conversation and perspectives of the participants. Following the meetings, TFT would provide any requested follow-up and would respond to any outstanding questions that were not resolved during the meeting. TFT ultimately held 13 individual outreach meetings with 12 dischargers, which included the participation of nearly 50 individual staffers.

Group Webinars

TFT also conducted two group webinars in early December 2025 to provide a forum for engaging with the small and medium dischargers that had not been contacted individually. The group outreach process used the following message to invite dischargers' staff to register to attend one of two webinars hosted on the Microsoft Teams platform.

Webinar Invitation

"The Freshwater Trust (TFT) has been retained by BACWA to help assess the feasibility of a potential water quality trading program for nutrient discharges to the San Francisco Bay. As part of this assessment, it is important for TFT to gather input and perspectives from regulated agencies, including small and medium agencies.

TFT is hosting two informational webinars on **Tuesday, December 2nd at 3:00 pm** and **Friday, December 5th at 10:00 am**. In these webinars TFT will provide an overview of nutrient trading, discuss the potential applicability of a trading program for the San Francisco Bay, and respond to any questions. The webinars are specifically intended to provide information relevant for small and medium agencies. We are offering two meetings to help accommodate schedules – please join us for ONE of the discussions if you are able.

Registration for Webinar on Tuesday, December 2nd

Registration for Webinar on Friday, December 5th

Please feel free to share the webinar details and registration links with other interested people within your organizations. Agencies that are interested in separate follow up conversations are encouraged to reach out to TFT directly."

Webinar: Water Quality Trading, a Potential Compliance Strategy for Nutrients Watershed Permit

TFT sent webinar invitations to 16 dischargers, resulting in 35 registered participants and 29 actual attendees. On December 1, 2025, the day before the first webinar, TFT also sent a message to all invitees to remind registrants about the webinars and encourage additional registrations.

The webinars were structured similarly to the individual outreach meetings. TFT began by providing a short presentation (example included below) then transitioned into an open discussion. To foster the conversation, the presentation concluded with the same questions as the individual outreach meetings.

After the webinar, TFT staff sent a follow-up message to provide the presentation slides. This message also encouraged all attendees to contact TFT if they had any questions or would like to schedule an individual meeting.

Example of Outreach Meeting Presentation by The Freshwater Trust

Bay Area Clean Water Agencies Water Quality Trading Feasibility Assessment

David Primozich, Vice President of Water
Chris Thomas, Sr. Attorney & Policy Specialist
Jessica Fox, Sr. Program Manager

2025

THE FRESHWATER TRUST

1

Who Is The Freshwater Trust?

A 501(c)(3) working to incorporate basin-wide water quality management strategies into Clean Water Act compliance programs

Watershed Analytics | Compliance Program Design & Permit Support | Compliance Program Administration

THE FRESHWATER TRUST

2

2025 Workplan

1. Outreach to BACWA Members, Experts & Stakeholders
   - Meet BACWA members to provide WQT information and document individual circumstances, interest in trading, and their questions and concerns
2. Initial Technical Analysis & Data Gap Investigation
   - Identify existing tools, information, partners and data gaps that are relevant to the development of a functional WQT program for the San Francisco Bay
3. Evaluate WQT Compliance Program for Nutrients
   - Analyze options and considerations and define the characteristics of a WQT program tailored to the circumstances
4. Propose Next Steps for Pursuing a WQT Program
   - Identify pathways to resolve outstanding questions, build support for WQT program among stakeholders and regulators, and establish structures necessary for a functional WQT program

THE FRESHWATER TRUST

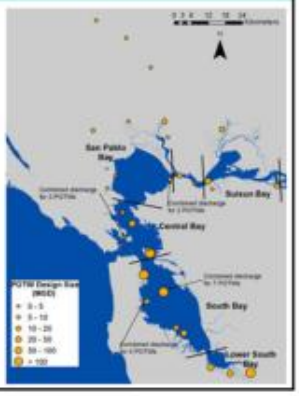
3

What Is Water Quality Trading?

Watershed-based approaches enable permittees to coordinate actions to deliver better water quality outcomes faster and more cost efficiently.

Permittees participating in a trading program can:

- Sell reductions beyond permit discharge limits
- Buy credits from willing sellers to achieve permit compliance
- Coordinate investments to achieve permit compliance



4

Basics of Water Quality Trading

Many options for WQT program structure and operation

To be technically credible and legally durable, WQT programs must have:

- **Standards** for eligibility
- Clear **permit terms** that define tradable discharges
- **Transparent systems** for facilitating transactions, tracking and reporting performance and custody of credits

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5

Point-to-Point Source Trading Scenarios

** A facilitator or broker can be used to help arrange transactions*
*** Transactions may be formalized with a contract between trade participants*

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6

Infrastructure for Credibility & Transparency

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7

Tracking & Reporting Outcomes

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8

Discussion Questions

1. What is the current state of your agency's planning for nutrient permit compliance?
2. How familiar are your agency's staff with WQT and have you encountered concerns about WQT?
3. Is your agency interested in participating in a WQT program?
4. Are you aware of any perceived limitations to WQT?
5. Have you considered the structure/operation of a WQT program?
6. What additional information would you need (e.g., technical, legal, financial) to evaluate participating in a WQT program?
7. Who else within your agency would need to be briefed to advance these discussions?
8. What does your organization need to make trading a viable option?

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9