



CALIFORNIA DEPARTMENT OF  
FOOD & AGRICULTURE

# Nitrogen Tracking and Reporting Task Force

**FINAL REPORT**  
December, 2013

# Executive Summary

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Agriculture in California is highly diverse in terms of food production, crop management, ecosystems, and climate. Nitrogen fertilizer is essential for crop food production. Nitrogen fertilizer use over several decades in California has led to nitrates in groundwater. Recognizing that nitrates from agricultural nitrogen fertilizing materials have entered some California groundwater systems used for drinking water, CDFA convened the Nitrogen Tracking and Reporting Task Force in 2013 as part of a multi-pronged administration effort to address nutrient management and water quality.

This Task Force was charged with implementing Recommendation 11 of several recommendations made to the Legislature by the State Water Board: “CDFA, in coordination with the Water Boards, should convene a Task Force to identify intended outcomes and expected benefits of a nitrogen mass balance tracking system in nitrate high-risk areas. The Task Force should identify appropriate nitrogen tracking and reporting systems, and potential alternatives, that would provide meaningful and high quality data to help better protect groundwater quality.” (See Appendix C – Fact Sheet on State Water Resources Control Board Recommendations.) This charge was achieved through several measures including, among others, understanding and discussing the pros and cons of existing nitrogen tracking and reporting systems, identifying desirable components or elements of existing systems and evaluating the variability and complexity of California agriculture in relation to where existing systems have been implemented.

Through several meetings, presentations by subject matter experts and discussion, the Task Force members came to general agreement on several components of an effective nitrogen tracking and reporting system. The recommended system addresses eight key topics including: (1) System Structure; (2) Data Elements; (3) Roles, Responsibilities and Data Accessibility; (4) Benefits of Participation; (5) Verifiability; (6) Societal Benefits of the Recommended System; (7) Limitations and (8) System Phase-in. This report presents the Task Force’s discussions and recommendations including intended outcome and anticipated benefits of such a tracking and reporting system for nitrogen use.

The Task Force’s recommendations on a reporting system, and any resulting information from the implementation of such a system, will be utilized by CDFA and the Water Boards to further their efforts in protecting water quality and improving the efficiency of on-farm nitrogen management. The Task Force’s recommendations will also be presented to a panel of experts convened by the State Water Board, in coordination with CDFA, following Recommendation 14 of the State Water Board’s Legislative report. The expert panel will assess existing agricultural nitrate control programs and may propose new measures for consideration by the Water Boards for their on-going regulatory and non-regulatory efforts.

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CDFA and the State Water Board recognize that nitrates from both synthetic and organic nitrogen fertilizing materials used in agriculture have, over several decades, moved to some groundwater systems in California. Many communities in California rely on those same groundwater systems for drinking water. Thus, some drinking water supplies contaminated by nitrates from nitrogen fertilizing materials pose a public health concern to several communities in California. The State Water Board addressed this issue in its SBX2 1 report to the Legislature; this report contained a series of recommendations, one of which (Recommendation 11) is to identify intended outcomes and expected benefits of a nitrogen mass balance tracking and reporting system in nitrate high risk areas. To implement Recommendation 11, CDFA (in coordination with the State Water Board) convened a Task Force in summer of 2013 to identify appropriate nitrogen tracking and reporting systems, and potential alternatives that would provide meaningful and high quality data to help better protect groundwater quality.

This document characterizes the recommendations formulated through consensus-building to reach general agreement by the Task Force as of the conclusion of its fourth and final meeting. Given more time, Task Force members would have liked to continue refining and strengthening their recommendation. General agreement in this context should be understood to mean that Task Force members viewed the recommendation contained herein as a potentially viable way of establishing a nitrogen tracking and reporting system for nitrate high- risk areas. As described in this document, there are many related scientific and methodological uncertainties. The Task Force also emphasized the importance of further scientific research to strengthen available methods of quantifying nitrogen entering groundwater under various agronomic and environmental conditions.

The Task Force was charged in part with identifying the intended outcome of establishing a nitrogen tracking and reporting system; they identified that outcome as contributing to improved groundwater quality. The Task Force affirmed the importance of nitrogen tracking and reporting in nitrate high-risk areas.<sup>1</sup> The information provided by a nitrogen reporting and tracking system is an essential element in improving our understanding of the fate and transport of nitrogen. At the same time, the Task Force notes that a tracking and reporting system cannot, in and of itself, improve groundwater quality; it can only be expected to provide a portion of the information and understanding necessary to guide future decision making in this area.

An effective nitrogen tracking and reporting system must be broadly applied to produce data that are comparable across the geographic area in which they are used. However, at the same time, it must recognize and accommodate regional differences, such as in

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<sup>1</sup> The task of defining nitrate high-risk areas was assigned to the State Water Board. At the time of this final report's release, the State Water Board had initiated work on this task but has yet to start its public process.

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agricultural production and hydrogeology. It also must be flexible over time to accommodate changes as we learn more about nitrogen's movement in the environment. The Task Force recognized that the application of scientific knowledge to quantitatively estimate the magnitude of field scale movement of nitrogen past the crop root zone and the amount of nitrogen that is entering groundwater from an individual field or farm is currently limited, with estimates available on a large-scale basis, but not available on a field-by-field basis (except qualitatively). This limitation is due to the extensive scientific resources and instrumentation otherwise necessary for detailed, accurate estimation of nitrogen fluxes out of the root zone and into groundwater. Application of such monitoring systems is currently non-economic for field-by-field estimation of nitrogen fluxes across entire groundwater basins.

The elements of the Task Force's recommended tracking and reporting system are described below. The Task Force acknowledged that this system reflects a significant change for growers. As discussed later in this report, it may be appropriate to implement it in phases, with periodic adjustments, while all concerned learn what works. Task Force members believe that the particular approach suggested offers a number of benefits, which are enumerated in Section 6. Highlights include the belief that such a system will contribute to a better understanding of nitrogen fertilizer application and movement throughout the hydrologic system, will focus technical assistance where it is most needed to mitigate future nitrogen loading to groundwater and improve groundwater quality, and will reassure the public that growers are using nitrogen fertilizer in a manner consistent with best management practices to produce a safe, reliable, and affordable food supply. In so doing, the Task Force believes that establishing such a system will help to sustain agricultural productivity and sustainability in California.

Moreover, while the Task Force's recommended approach uses the concept of nitrogen mass balance as a key point of reference, this concept is only "one piece of the puzzle" in determining excess nitrogen that could potentially reach groundwater and in preventing that from happening. The nitrogen mass balance should be used in the larger context of informing improved use and efficiency of nitrogen application. Its use should be reviewed as part of Recommendation 14 of the State Water Board's SBX2 1 report to the Legislature -- which calls upon the Water Boards to convene an expert panel to assess existing agricultural nitrate control programs and develop related recommendations to ensure that these programs are protecting groundwater quality. These steps must also be complemented by further research (e.g., to establish a reliable methodology by which to quantify the amount of nitrogen reaching groundwater under various cropping systems, soil types, and agricultural practices; methods of preventing excess nitrogen from reaching groundwater, etc.).

1. **System Structure:** As depicted in Figure 1, the nitrogen tracking and reporting system can be described as a pyramid with one layer for tracking and several layers of reporting. Growers collect a number of types of crop and field-specific information

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on an event basis to enable calculation of nitrogen mass balance (the quantity of nitrogen applied minus the quantity of nitrogen removed). The difference represents nitrogen that is not currently accounted for, including but not limited to nitrogen available for leaching to groundwater.<sup>2</sup> Much of the tracking data are retained on farm; a subset is compiled by crop and field at the farm scale and annually reported upward to a data aggregator.

In turn, the data aggregator annually compiles and reports data submitted by numerous growers into a single combined report for a larger geographic area as designated by the relevant Regional Water Board.<sup>3</sup> The Regional Water Board provides to the State Water Board the information necessary to compile an annual report on “status and trends” with respect to management and the fate of nitrogen applied in irrigated agriculture. In accordance with current law, any information submitted to a State or Regional Water Board is available for public review, with the exception of information determined to be proprietary; this is also true in situations where a Regional Water Board serves the role of data aggregator.

Thus, the narrowing of the pyramid (Figure 1) reflects increasing consolidation of information and larger geographic units of analysis as the information moves upward through the system from grower to State Water Board. Such a system is designed to effectively maintain grower confidence in the reporting system, optimize limited state resources and ensure improvement of groundwater quality.

Data reporting by growers is electronic. However, aggregators should also provide the option for paper reporting where reporting electronically is a hardship, since some growers may not have ready access to electronic reporting. Resources should be available to help growers develop the capacity to report electronically, as necessary. Data aggregators should provide growers with written guidance to explain what to track, what to report, and acceptable methods for doing so; additionally, any guidance documents will define key terms, provide tracking and reporting templates, and identify the unit scale (e.g., field) for nitrogen tracking and reporting. The reporting system should be flexible enough to accommodate farm-level data management systems that may be used by growers as long as they meet the nitrogen reporting objectives.

The data aggregators’ reports, which include an analysis of the data collected, are submitted electronically to the Regional Water Boards. The scale of “reporting unit” -

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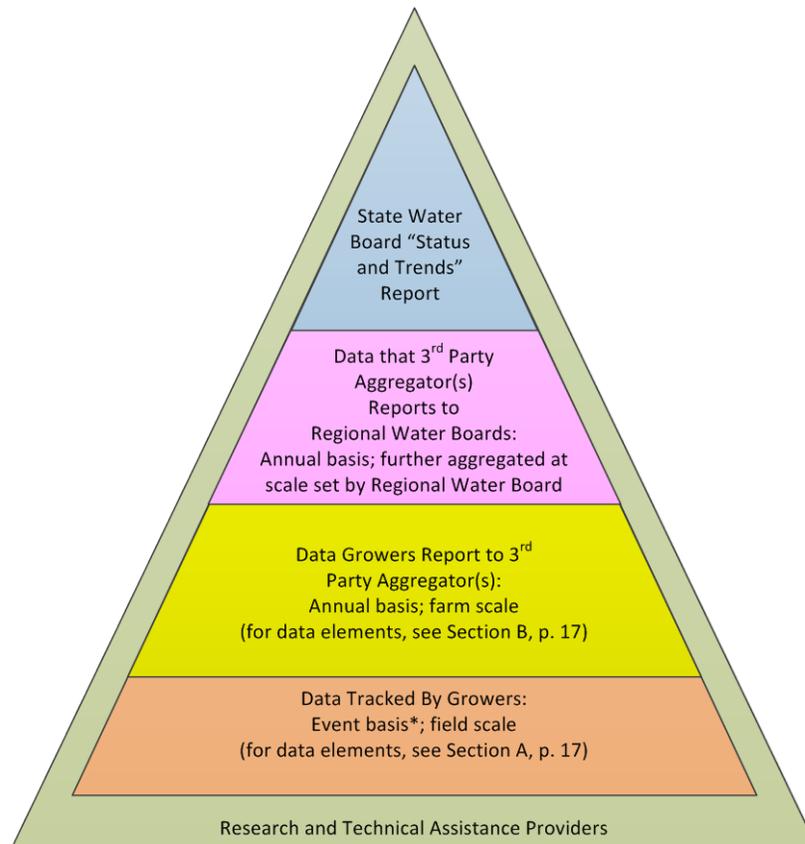
<sup>2</sup> There are many dynamics (e.g., other losses, transformations and additions) associated with the nitrogen cycle in addition to leaching. These include: denitrification, volatilization, atmospheric deposition, mineralization, immobilization, plant uptake and removal, assimilation, etc.). These processes are highly dependent on a variety of conditions (e.g., farm management, crop type, irrigation and drainage management, soil type, environmental conditions, etc.), can vary widely, and in some cases are unknown.

<sup>3</sup> Task Force members noted that aggregation of data can compound errors if not done appropriately.

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- e.g., watershed, township, section, or other appropriate unit – is set by each Regional Water Board in collaboration with the aggregators to best reflect regional

Figure 1  
**CDFA Nitrogen Tracking and Reporting Task Force**  
Nitrogen Tracking and Reporting System for Nitrate High Risk Areas in California:  
Structure, Roles, and Data Elements



**Notes:**

- Bottom of pyramid represents data tracked by grower.
- Moving toward top of pyramid corresponds with process of reporting data up to higher levels of decision-makers.
- Research and technical assistance providers support all aspects of tracking and reporting system.

*\* / "Event" to be defined by Regional Water Board, in consultation with data aggregator(s); more frequent than annual.*

agricultural and aquifer characteristics. All regions should report data with reference to acres for consistency purposes, thus enabling comparisons across the geographic area in which this system is implemented.

2. **Data Elements:** The specific data elements recognized by the Task Force as elements to track and report are provided below in Sections A, B, C, D and E and

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correspond to the different levels of the graphic in Figure 1, moving from the bottom to the top. The Task Force recognized that many of the data elements proposed are listed in templates under development as part of the Central Valley Regional Water Quality Control Boards Long Term Irrigated Lands Regulatory Program.

### Section A. Data tracked by growers:

- Name of owner/manager
- Assessor Parcel Number (APN)
- Field identification number
- Crop type
- Crop age
- Total acres per crop
- Expected yield (Estimated. Documented as pounds of production per acre)
- Actual yield (Measured. Documented as pounds of production per acre)
- Nitrogen needed by crop (Measured or estimated. Documented in pounds of nitrogen per acre)
- Nitrogen removed (Measured or estimated. Documented as pounds of nitrogen harvested in the crop yield per acre; also includes material removed or harvested that is not the primary product, such as wheat straw bailed and removed after wheat is harvested, orchard prunings, almond hulls, etc.)
- Total nitrogen applied to field. Includes:
  - Foliar, conventional, and organic fertilizers (Measured. Documented as pounds per acre, dry and liquid combined);
  - Nitrogen in irrigation water (Measured. Documented as pounds per acre)
  - Nitrogen in organic amendments, including manure, biosolids, compost, and non-marketable plant biomass<sup>4</sup> -- e.g., crop residue (Measured. Documented as pounds of nitrogen applied per acre)
- Residual soil nitrogen credits (Measured. Documented as pounds of nitrogen per acre)
- Irrigation method

### Section B. Data reported by grower to data aggregator(s):\*/

- Management unit (e.g., Assessor Parcel Number, field number, or other suitable management unit decided by the Regional Water Board in consultation with the aggregator in the context of determining the reporting unit)

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<sup>4</sup> Growers will need guidance on how to capture non-marketable plant biomass in calculations of “expected yield” and “nitrogen needs” of their crops.

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- Crop year
- Grower identification number
- Crop type
- Crop age
- Total acres per crop
- Nitrogen removed (as defined in Section A above)
- Total nitrogen applied (as defined in Section A above).
- Residual soil nitrogen credits (as defined in Section A above)
- Annual nitrogen ratio (calculated by total nitrogen removed divided by total nitrogen inputs)

*\*/ Where there is no third party data aggregator approved by the Regional Board or where the Regional Board requires reporting by individual growers, growers submit their annual reports to the pertinent Regional Water Board directly.*

Section C. Data reported by aggregator(s) to Regional Water Board: Aggregated data referenced in section “B,” at the “reporting unit” determined by the Regional Water Board and in coordination with growers/data aggregators. Data aggregation should be carried out by professionals familiar with California agricultural water quality regulations and with technical backgrounds in agronomy, GIS systems, statistical analysis, and other related disciplines.

Section D. Data reported by Regional Board to State Water Boards: Status and trends of nitrogen applied and harvested in nitrate high-risk areas within pertinent Regions, as well as potential loading to groundwater under various cropping systems, soil types, and agricultural practices.

Section E. Reported by State Water Board: Status and trends of nitrogen applied and harvested in State’s nitrate high-risk areas, as well as potential loading to groundwater under various cropping systems, soil types, and agricultural practices.

### **3. Roles, Responsibilities, and Data Accessibility:**

- A. Grower: Responsible for data tracking and reporting (to aggregator). The field-level, event-specific<sup>5</sup> data tracked by grower stays on farm, accessible only to the grower, but is subject to the data aggregator and the Water Boards’ review upon request.

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<sup>5</sup> To be defined by the Regional Water Board in consultation with aggregator(s); more frequent than annual.

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- B. Aggregator: Responsible for data collection from growers and reporting to Regional Water Boards; quality control regarding accuracy of grower data via outreach, technical assistance, written guidance for growers on implementing tracking and reporting requirements; and education outreach efforts to bring identified “outliers” into compliance through improved management practices. The data aggregator normally has access to farm-level data reported by growers and the data that the aggregator synthesizes at the designated reporting unit scale to report to the Regional Water Board; if the Regional Water Boards request access to more fine-grained data for quality control or problem-solving purposes, the data aggregator can reach down to access grower’s original raw data at the field scale (where there is no third party data aggregator, the grower will indicate to the Regional Water Board what information, if any, in his/her annual report is confidential business information. The Water Boards will determine if this information is exempt from public access under the Public Records Act).
- C. Regional Water Boards: Responsible for implementing and enforcing regulatory program and data reporting to the State Water Board and to the public on a regional scale. Aggregated reports submitted by a discharger of aggregator are maintained and used by the Regional Board for regulatory determinations and are available to the public; however, if access to more fine-grained data is needed for quality control or problem-solving purposes, the Water Boards can reach down to access growers’ original raw data at field scale.
- D. State Water Board: Data analysis and trends in nitrogen mass-balance on a state-wide scale. Normally has access only to reports submitted by Regional Water Boards; however, if access to more fine-grained data is needed for quality control or problem-solving purposes, the Water Boards can reach down to access growers’ original raw data at field scale.
- E. CDFR: Funds research (e.g., through Fertilizer Research and Education Program) and provides technical education (e.g., through Certified Crop Advisers’ Nitrogen Management Training Program) and outreach.
- F. USDA: USDA ARS and USDA NIFA conduct research. USDA NRCS provides grower incentive funds competitively through Environmental Quality Incentive Program.
- G. Institutions and Research Professionals: Research, technical education and development of grower tools for effective nitrogen crop uptake and management. Educational opportunities will be assessed and developed as appropriate to support grower education data collection needs and reporting.
- H. Professional Advisers: Certified source of continuing education on nitrogen management and methods of improving nitrogen usage and crop results.

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- I. **Public:** The public has access to status and trends related to nitrogen mass-balance reported annually by the State Water Board, using a geographic scale deemed appropriate. The data reported to the Regional Water Boards and State Water Board is available to the public (unless it is confidential business information), and will typically be posted on their website.
4. **Benefits for Growers Who Participate in this Suggested Nitrogen Tracking and Reporting System:** Growers who participate will have:
- A. Effective documentation and increased public confidence that growers are making all reasonable effort to minimize nitrate loading to groundwater and maximize water quality protection so as to be in compliance with regulatory requirements.
  - B. Opportunities to learn improved nitrogen management practices that may enable growers to increase the efficiency of their nitrogen fertilizer usage. Aggregators will provide follow-up on nitrogen management for conditions where the nitrogen ratio is considered an outlier in reported values.
  - C. The opportunity to demonstrate effective nitrogen regulation and influence future regulations.
  - D. Assistance from the data aggregator in meeting tracking and reporting requirements (e.g., technical assistance and training).
  - E. Protection of confidential business information.
  - F. Increased confidence that, in most instances, they will be able to retain field-specific information on-farm.
5. **Verifiability:** The nitrogen tracking and reporting system will include mechanisms enabling the data aggregator and the Regional Water Boards to verify the accuracy of the data that the system generates (consistent with available methods), including:
- A. Growers retain their field-level data (Section 2.A.) for the term required by existing laws and regulations, and make records available to the data aggregator and the Water Board upon request.
  - B. The data aggregator is responsible for ensuring the accuracy of the data it reports, and to that end, investigates apparent exceptions in reporting patterns. The aggregator assists growers in implementing appropriate nitrogen management practices to improve water quality.

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- C. The Regional Water Boards are responsible for ensuring the accuracy of the data they receive and may consider developing an audit mechanism.
  - D. Technical assistance providers, such as Certified Crop Advisors and staff from the Resource Conservation Districts, can play a valuable role in assisting growers and data aggregators to implement the nitrogen tracking and reporting system effectively (e.g., through assistance in developing nitrogen management plans for growers).
6. **Societal Benefits of the Suggested System**: There was general agreement among Task Force members that the nitrogen tracking and reporting system described herein potentially offers numerous intended benefits. It will:
- A. Contribute to a better understanding of nitrogen fertilizer application and movement.
  - B. Focus technical assistance where it is most needed to mitigate future nitrogen loading to groundwater and improve groundwater quality.
  - C. Reduce methodological uncertainties and increase the precision of results over time.
  - D. Reassure the public that growers are using nitrogen fertilizer in a manner consistent with best management practices to produce a safe, reliable, and affordable food supply.
  - E. Help growers increase their efficiency by better managing nitrogen use where appropriate, with a potential for cost savings.
  - F. Stimulate research and technological advancements to aid in increasingly effective and efficient use of nitrogen fertilizer.
  - G. Better enable technical assistance providers, such as Certified Crop Advisors and Resource Conservation Districts, to help growers with well-informed recommendations.
  - H. Potentially generate incentives that better align water and nitrogen usage.
  - I. Encourage innovation in nitrogen fertilizer formulations and irrigation technology.
  - J. Help to sustain agricultural productivity and sustainability in California.
  - K. Offer a successful model for California that can also be adopted elsewhere.
7. **Limitations**: The above benefits of the recommended nitrogen tracking and reporting system are intended, but unproven. Limitations can also be anticipated. Primary among these is the fact that the scientific knowledge currently available for

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understanding nitrogen's movement beyond the root zone for the many crops growing in California is limited and in some cases non-existent, particularly in terms of calculating exact amounts of nitrogen lost to air and groundwater. Additionally, it is recognized that the timing and amount of water applied can be critical to water/nitrogen moving below the root zone and is not tracked as part of these recommendations. Current and future technology adoption by growers will provide better knowledge and management in this area. There is a strong need for further scientific research to improve the existing data for nitrogen uptake and movement for California's many crops. It should also be emphasized that the Task Force was not charged with considering the costs of implementing a nitrogen tracking and reporting system, and did not consider cost in its deliberations. Clearly, costs will need to be factored into policy-makers' decisions concerning the path forward.

- 8. System Phase-In:** The Task Force recognizes that implementing this system represents a significant request of growers, and that it will take time for them to adjust. All implementing parties will be learning about aspects of the proposed system that works and that need adjustment. Thus, the Task Force acknowledges that development of this program will need to proceed in phases, both to allow for ongoing, supporting scientific analysis and to help growers become accustomed to the program. The results of initial efforts should be periodically reviewed to inform subsequent phases with the system's design and implementing guidance modified adaptively as needed to ensure that it is effective in improving and protecting groundwater quality. Items discussed for possible inclusion in later phases included reporting the timing and volume of irrigation and the timing of fertilizer application. The "phase-in" approach should include a timeline and milestones to ensure consistent progress toward full implementation. The pace of implementation will be driven by trend analysis, research results, and best available science. The timeline will be structured to accommodate the collection and validation of the best available science. Over time, the Task Force envisions this system as reducing methodological uncertainties, increasing the precision of results, and establishing a successful system for tracking and reporting of nitrogen to help minimize nitrate loading and maximize protection of water quality.