Buena Vista Coalition

Annual Monitoring Report

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Abbreviations

A/R ..... Total Nitrogen Applied/Nitrogen Removed
A/Y ..... Total Nitrogen Applied/Crop Yield
AMR ..... Annual Monitoring Report
BSK ..... BSK & Associates
BVC ..... Buena Vista Coalition
C ..... Degrees in Celsius
CCA ..... Certified Crop Advisor
CGQMP ..... Comprehensive Groundwater Quality Monitoring Report
CIMIS ..... California Irrigation Management Information System
Coalition ..... Buena Vista Coalition
CVRWQCB ..... Central Valley Regional Water Quality Control Board
CWDC ..... Cawelo Water District Coalition
DDE ..... Dichlorodiphenyldichloroethylene
DWR ..... California Department of Water Resources
GAR ..... Groundwater Quality Assessment Report
General Order ..... Tulare Lake Basin General Order R5-2013-0120
HVA ..... High Vulnerability Area
ILRP ..... Irrigated Lands Regulatory Program
KRWCA ..... Kern River Watershed Coalition Authority
MPEP ..... Management Practices Evaluation Program
MRP ..... Monitoring and Reporting Program
NMP ..... Nitrogen Management Plan
PCA ..... Pest Control Advisor
PUR ..... Pesticide Use Reports
QAPP ..... Quality Assurance Project Plan
SQMP ..... Surface Water Quality Management Plan
SWAMP ..... Surface Water Ambient Monitoring Program
SWMP ..... Surface Water Monitoring Plan
SSJVWQC ..... Southern San Joaquin Valley Water Quality Coalition
TBWQC ..... Tule Basin Water Quality Coalition
TDS ..... Total Dissolved Solids
TIE ..... Toxicity Identification Evaluation
TLHR ..... Tulare Lake Hydrologic Region

TMW ..... Trend Monitoring Workplan
WDR ..... Waste Discharge Requirements
WQT ..... Water Quality Threshold
WWQC ..... Westside Water Quality Coalition
WY ..... Water Year
Y ..... Crop Yield

Executive Summary

This Annual Monitoring Report (**AMR**) has been prepared on behalf of the Buena Vista Coalition (**BVC** or **Coalition**) in response to Waste Discharge Requirements General Order for Growers in the Tulare Lake Basin that are Members of a Third-Party Group, Order No. R5-2013-0120-07 (**General Order**). The BVC has been approved by the Executive Officer to conduct monitoring and reporting on behalf of its members as a third-party representative. The purpose of the AMR is to meet reporting requirements of the General Order as described in Attachment B to Order R5-2013-0120-07, Monitoring and Reporting Program (**MRP**) Section V.C which requires the BVC to summarize monitoring activities, grower outreach and education, and grower-member submittals to the Coalition. An AMR must be submitted by the Coalition annually to the Central Valley Regional Water Quality Control Board (**RWQCB**).

The BVC covers the Kaweah River watershed in northern Tulare County, which is a geographic area of approximately 1 million total acres in the Tulare Lake Basin of California. The area covered is the cumulative total of the various public and private entities that manage surface water for the agricultural interests within the basin. The BVC was formed in 2013 as a California non-profit mutual benefit corporation as the successor organization of the Kaweah and St. Johns Rivers Association (**KSJRA**). The KSJRA represented the Kaweah sub-watershed portion of the former Southern San Joaquin Valley Water Quality Coalition (**SSJVWQC**), until the valley-wide coalition dissolved and the BVC was formed in 2013.

Summary of the 2018 AMR

Surface Water Monitoring Summary

The primary objective of the BVC's monitoring efforts is to maintain compliance with requirements of the General Order, which requires the BVC to characterize surface water quality in the Main Drain in the BVC boundary. It is understood that this water operates as a Districtwide tailwater drain and the primary concern is how it impacts waters outside the District/Coalition Boundary. The Main Drain historically flowed an average of 10,000 a-f north of Highway 46, with a peak of 30,000 a-f. No drain water has flowed out of the District since May of 2013. Sometimes the tailwater in the Main Drain has exceedances, especially in drier years, as more well/ground water is used. The groundwater in the northwest portions of the District is of poorer quality, especially high in TDS. Throughout the District the groundwater frequently includes boron and arsenic, two undesirable elements in surface water. That is why it is important to capture and recycle this water and not blend it with water outside of the District.

The Main Drain has little to no flow from the surface/storm water, nearly 100% field drain water. As the growers in the Coalition convert to permanent crops using drip irrigation from flood and furrow irrigation the need for the drain system diminishes. The surface water in the Main Drain is measured one mile south of Highway 46 but referred to as the Highway 46 test site. This site has seen very little water or testing since 2013. The 7th Standard sample location was added to help locate the source of contaminants. This location has flows requiring sampling 2-6 times a year.

Groundwater Monitoring Summary

The primary objective of the BVC's monitoring efforts is to maintain compliance with requirements of the General Order, which requires the BVC to characterize water quality within the BVC region. Groundwater monitoring is intended to be used to evaluate long term trends in groundwater quality, reflective of potential impacts from agricultural practices. However, collected data are also reflective of larger aquifer characteristics and potential influences (e.g., septic systems and other dischargers). Additionally,

collected data may also reflect potential longstanding impacts which are not from current land management practices.

The 13-well trend monitoring network detailed in the Groundwater Quality Trend Monitoring Workplan (GQTMP) Response was conditionally approved by the RWQCB on August 30, 2018, and initial groundwater sampling took place during August of 2018. The conditional approval was contingent on the BVC providing further information on sanitary well seals for their selected monitoring wells.
As required in Attachment B, MRP Section IV.E.3 and MRP Section V.B, groundwater monitoring results (formatted as an Excel workbook) of all data records uploaded to the State Water Resources Control Board's GeoTracker database are attached in **Appendix B**.

Field parameters are recorded on field sheets and attached in **Appendix B**. Collected field parameters required by the MRP include pH, electrical conductivity, temperature, and dissolved oxygen. Additionally, field notes and purge volumes are recorded on field sheets. Tabulated field parameters are also reported in **Appendix B**.

Grower-Member Reporting

The 2018 water year is the third year that both the Farm Evaluation Surveys and Nitrogen Management Plan (**NMP**) Summary Reports were submitted to the BVC. The results of those reports are summarized in this AMR.

NMP Summary Reports and Farm Evaluation Surveys were due to the BVC by March 1, 2018. NMP Summary Reports and Farm Evaluations were required for all farms of any size with enrolled high vulnerability area (**HVA**) parcels. One hundred percent of the required NMP Summary Reports and Farm Evaluation Surveys, respectively, were submitted for summary in this report. Overall, the results indicate that the majority of BVC members applied nitrogen within agronomic rates. After filtering out potentially incorrect or erroneous data, approximately 99% of the reported fields still applied less than 250 lbs N/acre. BVC members also have a very high implementation rate of practices protective of surface and groundwater water quality. Specifically, 87% of reported acreage implements four nitrogen management practices.

Education and Outreach Reporting

The 2018 Water Year (October 1, 2017 through September 30, 2018) consisted of educating growers on the completion of Nitrogen Management Plan Worksheets and Nitrogen Management Plan Summary Reports; preparing and submitting Farm Evaluations, summary reports for Farm Evaluations, and Nitrogen Management Summary Reports from the 2017 Water Year; and discussing priority practices, useful tools, and resources. All grower education/outreach meetings were held jointly with Kern River Watershed Coalition Authority (**KRWCA**), Cawelo Water District Coalition (**CWDC**), and Westside Water Quality Coalition (**WWQC**).

Education and outreach efforts during the water year continued to include outlining the requirements of the General Order, communicating the role of the BVC, supporting member registration and compliance, describing the methodologies employed in the various technical reports developed by BVC, and assisting members in understanding and meeting the Nitrogen Management Plan and Summary Report and Farm Evaluation reporting requirements. ILRP annual re-enrollment and reporting requirements were publicized through direct mailings, email blasts, notifications on the BVC website, and by holding grower education meetings at locations throughout Kern County. Additionally, agricultural organizations throughout Kern County shared BVC meeting notifications, as well as ILRP requirements and reporting deadline information, with their members.

With approximately 40 growers and 60 members the BVC knows every grower and staff is located in the middle of the land area. Growers frequently will come by the office if they have questions or are having difficulties completing a form. It is this close connection which allows the BVC to typically receive 100% participation in any requirement.

1 Introduction

This Annual Monitoring Report (**AMR**) has been prepared on behalf of the Buena Vista Coalition (**BVC** or **Coalition**) in response to Waste Discharge Requirements (**WDR**) General Order, for Growers in the Tulare Lake Basin that are Members of a Third-Party Group, Order No. R5-2013-0120 (**General Order**). The Executive Officer (**EO**) of the Regional Water Quality Control Board (**RWQCB**) has approved the BVC as a third-party group to conduct monitoring and reporting on behalf of enrolled grower members within the Coalition's boundaries. The AMR is required to be submitted for each water year to describe and summarize activities and monitoring within the Coalition. The 2018 Water Year (**WY**) is defined as October 1, 2017 to September 30, 2018. In accordance with the specifications detailed in Attachment B, Monitoring and Reporting Program (**MRP**), to the General Order, the AMR must describe and summarize;

- Monitoring well data.
- Surface water monitoring data.
- Quality assurance evaluations.
- Nitrogen Management Plan summary information.
- Farm Evaluation information.
- Mitigation monitoring.
- Education and outreach activities.

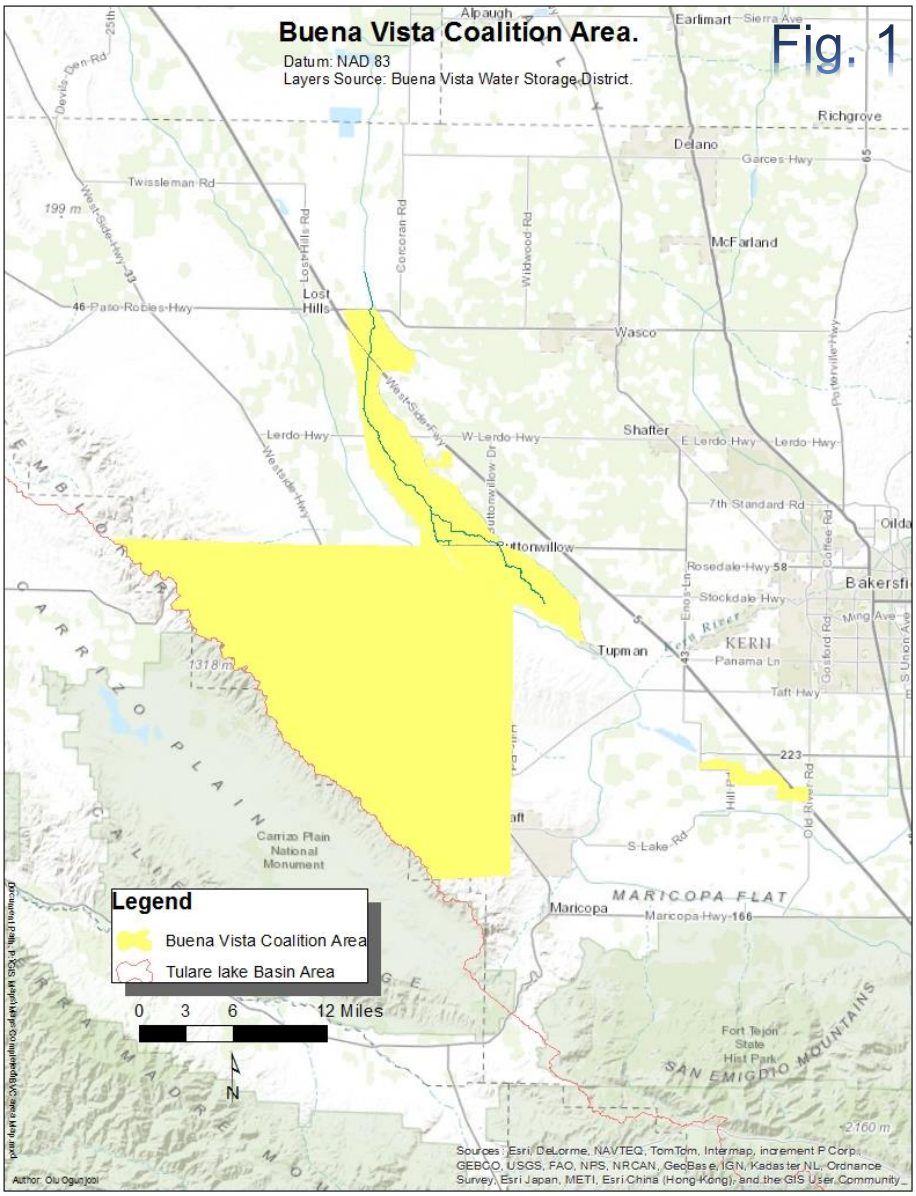
The MRP requires the AMR to report surface water quality results. However, with the incorporation of Nitrogen Management Plan Summary Report data and Farm Evaluation Survey data the AMR now includes various reporting periods. Reporting periods for this 2018 AMR are defined as follows:

Table 1-1. Reporting Periods for the 2018 Annual Monitoring Report

AMR Section Title	AMR Section Number	Reporting Period Start	Reporting Period End
Surface Water Quality Results	Section 2	Oct. 1, 2017	Sept. 30, 2018
Groundwater Quality Results	Section 3	Sept. 2018	Dec. 2018
Nitrogen Management Plan Summary Report Analysis	Section 4	Jan. 1, 2018	Dec. 31, 2018
Farm Evaluations	Section 5	Jan. 1, 2018	Dec. 31, 2018
Education and Outreach	Section 7	Oct. 1, 2017	Sept. 30, 2018

1.1 Geographic Area

The original BVC service area is in southwest area of the Kern River watershed in Kern County and approximately sixteen miles westerly of the City of Bakersfield, see **Figure 1**. The area is in the trough of California's southern San Joaquin Valley and is separated into two noncontiguous areas: the northern Buttonwillow Service Area (BSA) comprising 45,800 acres, and the southern Maples Service Area (MSA) comprising 4,350 acres. These two areas are separated by about 15 miles, see Fig.1.



Approximately 33,000 acres of irrigated farmland almost all of which fall within the boundaries of Buena Vista Water Storage District (BVWSD,) are represented in the coalition. The BVC has been expanded under Order R5-2013-0120 to cover additional lands to the west and south. It is anticipated that all, or nearly all the lands within the Buena Vista Water Storage District will enroll in the BVC. It is also expected that some adjacent lands to the original BVC boundary will choose to enroll in the BVC.

Of the actual acres enrolled in the BVC service area, 32,930 only about 12,000 acres - all within the BSA and the BVWSD discharge irrigation tail water.

The remaining lands are either uncultivated (about 12,000 acres of conservation wetland and fallowed land) or irrigated with drip systems or sprinklers which produce no tailwater. Drip systems are used on all permanent crops planted within the BVC, both trees and vines, as well as some specialty crops, like tomatoes. 20.000 acres of trees and vines are presently cultivated with several thousand acres in preparation for planting of permanent crops. Row crops that utilize row or flood irrigation are predominantly cotton, wheat, and alfalfa. Onions are grown using sprinklers, which produce essentially no run-off. The Maples Service Area has no lands which run-off.

The Kern River is the main source of water to the coalition area with secondary sources being waters from the California Aqueduct and the Friant-Kern Canal system. Both these delivery systems have their sources from the Sacramento-San Joaquin River Delta. However, in 2018 the primary source of water was groundwater. Close to 50% of the water used in the District was surface water supplied by the State Water Project. The BVWSD often exchanges Kern River water for SWP water to allow for efficiencies, minimizing recharge in unlined canals.

BVWSD uses a discharge network of drains with the Main Drain Canal being the main artery which collects and transports tail irrigated water within the boundary of the district. The flows in this have reduced tremendously in the last few years. Flows leaving the District in the Main Drain Canal have averaged about 10,000 acre-feet annually, see Table 3. During the 2018 year the drainage flows leaving the District were zero. This was the sixth year in a row with zero drainage flow leaving the District year.

The Main Drain Canal is shown in Fig 2. It runs along the center and lowest elevation of the BSA and forms a natural conduit for draining tail water. It also has served as conveyance for flood water in wet years and for wheeling irrigation water within the district. It is also used to wheel water from the California Aqueduct to the Kern National Wildlife Refuge (KNWR) and other privately-owned duck clubs north of Highway 46, outside of the District and Coalition boundary.

The Main Drain Canal also serves as the storm drainage system of the District lands. In 2018 there were no major rain incidents which caused flows in the Main Drain Canal. So, although it remains the storm drain for the “Main Drain Canal” watershed it’s locally produced storm flows are insignificant to zero.

The portion of the Main Drain inside the BVC is approximately 20 miles long. It leaves the BVC boundary at Hwy 46, ties with the Goose Lake Canal from where both canals can convey irrigation runoff and flood water to and beyond the Kern National Wildlife Refuge about 8 miles north of Hwy 46. In the 2018 calendar year no drainage wastewater left the BVC.

The map below (Fig 2) and the accompanying table show the location details of the sampling sites. Of the 12 months in 2018, there was sampling at both locations: July and August at Highway 46, although no water left the District, and from February through September at 7th Standard Road.

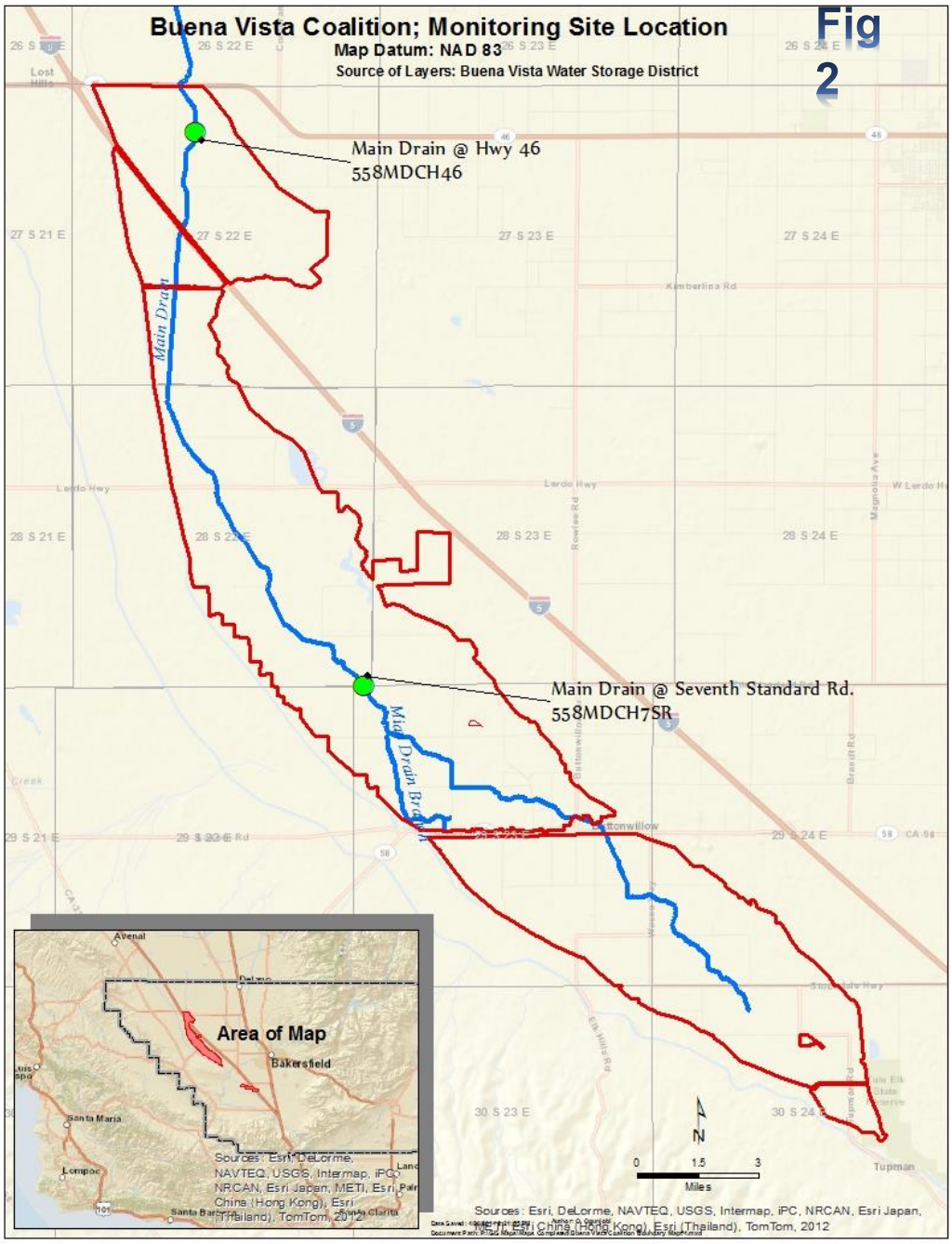


Fig 2: Monitoring Site Location

Site name	CEDEN Code	Latitude	Longitude
Main Drain @ Hwy 46	558MDCH46	35.60139	-119.60970
Main Drain @ 7th Standard Rd	558MDCH7SR	35.44177	-119.54997

2 Surface Water Monitoring Report

2.1Monitoring Objectives & Design

To develop a successful monitoring plan there are four primary considerations:

1. *Location*
2. *Frequency*
3. *Water Quality Issues*
4. *Quality Assurance*

The Main Drain has had samples which exceeded limits, which required the development of a Surface Water Management Plan. This plan involved both monitoring the Main Drain for water quality/exceedances and a management plan to identify sources and eliminate or control them in an acceptable manner.

Since the Main Drain Canal is a combined system waterway it operates under a wide range of flows and conditions. Historically, the Buena Vista Slough drained through the land of the BVWSD towards Tulare Lake. In the mid 1800's the Main Drain Canal was built to drain the swamp, as it was the low point in the swamp. The flows in the channel were based strictly on rainfall, and primarily rainfall and snow melt in the mountains. The traditional peak flows were in April through July. As agriculture developed, water was diverted from the Kern River, reducing flows in the channel. In the 1880's a diversion channel, the Kern River Flood Channel Canal, was built to carry the high flow river water around the lands of the BVWSD.

When the Isabella Dam was built flows were regulated and high flows became rare. The river flow never enters the Main Drain Canal. However, it still is the storm drain conveyance canal for the lands of the BVWSD. Due to its historical nature, the Main Drain Canal has been classified as a tributary of the Waters of the US. This was because it had waters which flowed into Tulare Lake and then combined to flow out to the San Francisco Bay. But as time has passed, Tulare Lake rarely has water, the Main Drain Canal rarely has flows which reach the lake, and these flows rarely combine to reach other Waters of the State.
As farming developed initially in the 1870's on BVWSD lands, there was one major landowner. They allowed for the Main Drain Canal to take tailwater from all lands to carry it north, out of the District. With both surface water and well water available to irrigate crops the Main Drain would operate as a tailwater system about 10 months a year.

Ultimately the concern for water quality issues centers on the Main Drain Canal at Highway 46. This is where waters leave the District and possibly join other Waters of the State. With flow often ten months a year, a plan for monitoring was to test monthly at the Main Drain and Highway 46. A Second location at Seventh Standard was also added, at about the midpoint of the Main Drain Canal in the BVWSD. This would give information to help identify sources and trends of quality issues and just in general be a second data point. On the occasions when the Canal was dry, the tests would just be skipped.

The plan has an extensive series of chemicals, elements, and other tests to be performed. See Appendix A for a complete list of tested constituents. Groundwater is the primary source of some of the constituents which are tested for, as such they are identified in the lab analysis of in elevated quantity or as exceedance. If the quantity of such constituents is in exceedance, it may still be accepted under the Surface Water Management Plan as an acceptable and controllable quality of water.

The design of the quality control portion of developing a monitoring plan is discussed in greater detail later in this report.

2.2 Surface Water Monitoring Site Descriptions

Main Drain Canal at Highway 46 is one of two existing water quality monitoring sites. See Fig 2. This site was chosen since it is where the tailwater, if flowing in the Main Drain Canal, would be leaving the BVC. Since the BVWSD was originally developed as one farm in the 1870's, it made sense to use the Main Drain Canal as a District wide tailwater system. It is not the system one would design now if developing the lands for the first time, both for efficiency reasons, as well as environmental reasons. As the waters leave the District they can no longer be classified as tailwater, as there are no further opportunities to reclaim the water.

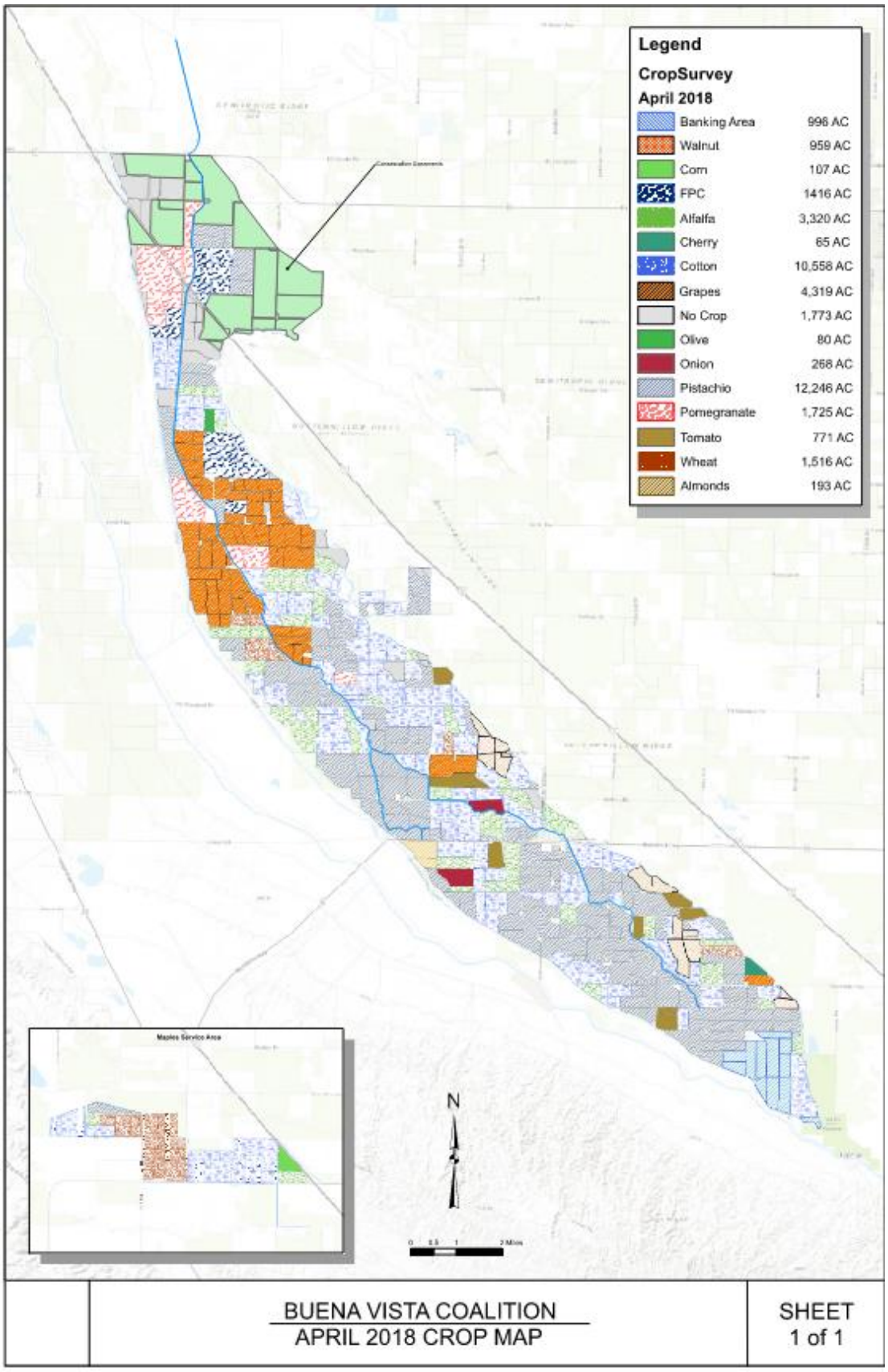
Flows in the Main Canal at Highway 46 follow the irrigation season. With the three primary row crops, cotton, alfalfa, and wheat, it usually means water is flowing in portions of the Man Drain Canal 10 months of the year. Because most of the crops grown in BVWSD were field crops, the Main Canal system can be dry during the non-irrigation season. The second testing location is at Seventh Standard Road in the Main Drain. This site was selected as it is approximately midway between the beginning of the Main Drain and the northern boundary of the District. It was felt that this secondary location could help identify issues in resolving any exceedance problem. The testing at this location will be addressed to the RWQCB in a subsequent document. Current Coalition staff does not see any benefit to this additional testing location.

2.3 Sediment Erosion Assessment Report

Since no surface water leaves the Coalition lands, there is no degradation of surface water due to agriculture in the BVC area. The lands of the BVC have a very mild slope, as this is land where the Kern River lost energy and formed a swamp versus flowing in a river channel. Hence there is essentially no erosion from rainwater events.

The various irrigation methods for the crops can influence sediment run-off or erosion. The crops which use flood or furrow irrigation; wheat, cotton, alfalfa, typically have run-off into drains. However all drain water is captured and returned for agricultural use, and never blends with other water or degradates other surface water.

Below is a copy of the crop map for 2018.


Legend
CropSurvey
April 2018
Banking Area 996 AC
Walnut 959 AC
Corn 107 AC
FPC 1416 AC
Alfalfa 3,320 AC
Cherry 65 AC
Cotton 10,558 AC
Grapes 4,319 AC
No Crop 1,773 AC
Olive 80 AC
Onion 268 AC
Pistachio 12,246 AC
Pomegranate 1,725 AC
Tomato 771 AC
Wheat 1,516 AC
Almonds 193 AC
Maples Service Area
N
BUENA VISTA COALITION
APRIL 2018 CROP MAP
SHEET
1 of 1

2.4 Climate

Table 3-1, below, shows the quantity of rainfall/precipitation in 2018 as measured at the Buena Vista Water Storage District.

Table 3-1: Average Monthly Precipitation in 2017 in Inches.

Monthly Precipitation

Month	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul 18	Aug-18	Sep-18	Total
Inches	0.00	0.19	0.06	1.32	0.31	2.82	0.30	0.03	0	0.01	0	0.01	4.96
Remarks													

One will note that in the area of Buttonwillow and the BVC the rainfall was very normal. However, the Kern River flow was sixth highest ever recorded. Also this precipitation came primarily as rain in the winter versus the more traditional snowpack, with a late spring, summer run-off.

2.5 Water Quality Results

Discussion of Sample Data

During 2018, the Main Drain was sampled at the 2 sites as stipulated in in the 2012 Water Quality Management Plan. Attempts were made to sample the water each of the 12 months. However, there was never a measurable flow at the northern sample location. The 7th Standard location was successfully sampled on two occasions.

Main Drain at 7th Standard Rd (CEDEN Code 558MDCH7SR)

This site was introduced in 2009 to help identify potential sources of water quality issues and has since been sampled monthly. A picture of the site is below.

Main Drain at Hwy 46 (CEDEN Code 558MDCH46)

This site represents the site of importance to the success of the implementation of the Main Drain MP. It is the last downstream sampling station and it shows the constituents of water leaving the area through the Main Drain. No flows flowed through or around the BVC. The deliberate ongoing effort by the BVC growers and BVWSD staff to reduce and eventually permanently stop irrigation tail water from leaving the area was again successful. Various successful measures were taken in this regard with the most important being the recycling and efficient reuse of the tail water. Also, growers were using water more carefully. A picture looks north from the sampling location to the measurement flume, see below.

Figure 5

2.6 Laboratory and Field Quality Control Sample Results

BSK follows the EPA mandated methods of reporting limits, detection limits for each constituent. See Appendix A for a table of Limits and Analytical methods as well as lists of all tested constituents.
In accordance with guidelines from the MRP for Order R5-2008-0005 BSK followed appropriate sample collection methods.

Water samples are grab samples, sediment samples are composite samples. Grab samples are collected from the canal bank in lab provided containers. Collections are done with the sampler facing upstream direction (direction of flow) with every precaution taken to collect only water that has not been affected by the disturbed sediment in the canal. Containers are briefly filled, dumped and refilled prior to sealing for transport.

A cleaned stainless-steel scoop is used to collect sediment sample with the scoop working upstream. Samples are homogenized by the lab prior to the beginning of the toxicity and grain size tests. Samples collected are immediately kept cool using blue ice until they are packed in wet ice for transport to the lab.

2.7 Flow Monitoring

Flow rates vary throughout the length of the Main Drain Canal due to its many inputs of flow. Flow rates can be determined in multiple ways. At the end of 2013 a new measurement flume was installed in the Main Drain Canal just less than one mile south of Highway 46. This Measuring Flume is just north of the Highway 46 sampling location (which too is 1 mile south of Highway 46.) This will allow for very accurate flow measurement leaving the District. Prior to this, a weir located 1 mile south of Hwy 46 was used to measure flow. The flow at the weir is called the flow at Hwy 46, although as shown in 2017 it is possible for there to be flow at the measuring weir without having flow in the Main Drain Canal at Highway 46 actual.

There is no structure near 7th Standard Rd., and these flows are approximations based on measurements using a flow meter and approximate area at the testing location. The relative low flows even at 7th Standard Road are diminishing. The BVWSD does have plans to build a pump station just north of 7th Standard Road, at Milan Road and Main Drain Road. When this is built there will be delivery flows in the Main Drain Canal, which will be substantially higher than the drain flows.

Below are the estimated flows at the monitoring sites when monitored. Note how low and inconsequential the flows are at 7th Standard Road.

Table 2: Flow Rate at Sample Sites

Flow in CFS	16-Oct	16-Nov	16-Dec	17-Jan	17-Feb	17-Mar	17-Apr	17-May	17-Jun	17-Jul	17-Aug	17-Sep
7th Std. Road	0	0	0	0	0	0	0	0	0.8	0	0.4	0
Hwy. 46	0	0	0	0	0	0	0	0	0	0	0	0
Remarks												

2.8 Water Quality Objective Exceedances

Below is a table showing the exceedances in the Main Drain Canal at the monthly sampling in 2018. The sample flows were extremely small, so the exceedances when actually quantified are not as significant as they seem. In 2018 all surface water delivered into BV was from the SWP. The TWP water was about 48% of the water used by the growers, and groundwater was the other 52%. Independent of the water source, the exceedances in the Main Drain were fairly consistent.

The typical flow onto a field from a canal is 5 cfs. So this drain water would represent about 20% of the water, maximum at a turnout as it is blended. Regardless, this water is still much better quality than the typical well water in this area, even with these exceedances.

A complete data evaluation is in the attached spreadsheets, which will be submitted with the report.

2018 Main Drain Water Quality Exceedances

Sample Location	Sample Da	Lab ID	Testing Lab	Flow (CFS)	Arsenic	Boron	Molybdenum	Selenium	Conductivity	TDS	pH	Dissolved Oxygen	Chlorpyrifos	Diuron	Fecal Coliform	Ceriodaphnia Bioassay	Hyalella azteca
					ug/L	ug/L	ug/L	ug/L	umhos/cm	mg/L		mg/L	ug/L	ug/L	MPN/100r	% Survival	
					10	700	10	5	700	450	6.5-8.3	>5	0.015	2	400 (235	[illegible]	
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	1/15/2018	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK														
MDC @ Hwy 46 558MDCH46	#######	no sample	BSK	0													
MDC @7th Std. Rd. 551MDC7	#######	no sample	BSK														
MDC @7th Std. Rd. 551MDC7	#######	no sample	BSK														
MDC @7th Std. Rd. 551MDC7	#######	no sample	BSK														
MDC @7th Std. Rd. 551MDC7	1/15/2018	no sample	BSK														
MDC @7th Std. Rd. 551MDC7	#######	no sample	BSK														
MDC @7th Std. Rd. 551MDC7	#######	no sample	BSK														
MDC @7th Std. Rd. 558MDC	#######	no sample	BSK														
MDC @7th Std. Rd. 558MDC	#######	no sample	BSK														
MDC @7th Std. Rd. 551MDC7	#######	A8F1283	BSK	0.8 fps	12				710								
MDC @7th Std. Rd. 558MDC	#######	no sample	BSK														
MDC @7th Std. Rd. 551MDC7	#######	A8H1706	BSK	0.4 cfs	12				710		4.64						
MDC @7th Std. Rd. 551MDC7	27-Sep	no sample	BSK	0													

3 Groundwater Monitoring Report

This groundwater quality data and information was collected in August of 2018.

3.1 Groundwater Monitoring Objectives & Design

The primary objective of the BVC's monitoring efforts is to maintain compliance with requirements of the General Order, which requires the BVC to characterize water quality within the BVC region. Groundwater monitoring is intended to be used to evaluate long term trends in groundwater quality, reflective of potential impacts from agricultural practices. However, collected data are also reflective of larger aquifer characteristics and potential influences (e.g., septic systems and other dischargers). Additionally, collected data may also reflect potential longstanding impacts which are not from current land management practices.

The 13-well trend monitoring network detailed in the Groundwater Quality Trend Monitoring Workplan (GQTMP) Response was conditionally approved by the RWQCB on August 30, 2018, and initial groundwater sampling took place during August of 2018. The conditional approval was contingent on the BVC providing further information on sanitary well seals for their selected monitoring wells.

3.2 Groundwater Sampling Methods & Procedures

3.2.1 Groundwater Well Monitoring Site Selection

The selection criteria for the monitoring wells included in the Coalition's GQTM Workplan are intended to meet the requirements identified in Attachment B, Section IV.C of the General Order, which include:

- Be implemented over both high and low vulnerability areas;
- Employ shallow wells, but not necessarily wells completed in the uppermost zone of first encountered groundwater.
- Consider using wells in existing monitoring networks;
- Consist of a sufficient number of wells to provide coverage in the Third-Party geographic area so that current water quality conditions of groundwater and composite regional effects of irrigated agriculture can be assessed. Rationale for the distribution of trend monitoring wells shall be included in the Workplan.

Due to the long-term monitoring requirement, it is anticipated that the well network will need to be modified over time. Necessary changes will be made to maintain a regional representation of groundwater quality. The BVC supports the concept presented in Section 3.6, "Dynamic Network: Adaptive Design and Refinement", of the Central Valley Groundwater Monitoring Collaborative (**CVGMC**) Technical Workplan. The initial well network design will require ongoing evaluation of the spatial representation and sufficiency to fulfill the requirements of the General Order.

3.2.2 Well Site Locations

The spatial representation of wells included in the Coalition's GQTM Workplan is designed to meet the requirements identified in Attachment B, Section IV.E (page 21) of the General Order, which include:

- The variety of agriculture commodities produced within the Third-Party boundaries (particularly those commodities comprising the most irrigated agricultural acreage);

- The conditions discussed/identified in the GAR related to the vulnerability prioritization within the Third-Party area;
- The areas identified in the GAR as contributing significant recharge to urban and rural communities where groundwater serves as a significant source of supply.

A variety of factors were considered when identifying monitoring locations to be included in the GQTM network that would adequately monitor groundwater quality trends:

Two HVAs within the BVC were mapped as vulnerable to groundwater quality impacts in the Groundwater Quality Assessment Report (GAR), and specific Groundwater Quality Management Plans were prepared for each of these areas. Each plan recommended wells to monitor groundwater quality trends within its subject area with the Shallow Groundwater GQMP identifying seven piezometers and the Southern Area GQMP identifying four deep wells. As these plans have been approved by the RWQCB, the BVC recommends that the GQTM network for the Coalition's two HVAs rely on the monitoring locations proposed in the two specific GQMPs.

To provide additional spatial coverage within the Coalition boundary the BVC has proposed using two of the BVWSD's existing deep wells, DMW-4 and DMW-8.

3.2.3 Groundwater Trend Monitoring Sampling Timeline

As specified in Attachment B, MRP Section IV.E.3 of the General Order, trend monitoring wells must be sampled, at a minimum, annually at the same time of year. Sampling of the proposed network was conducted during August of 2018 in accordance with the terms provided in the Regional Board's letter "Conditional Approval of Buena Vista Coalition Groundwater Quality Trend Monitoring Work Plan and Response" dated August 30, 2018. Moving forward, the BVC will sample annually in coordination with the CVGMC, between the months of May and August. Sampling will include the constituents and timeframe listed in **Table 3-1** as required in Attachment B, MRP Section IV.E of the General Order.

Table 3-1. Groundwater Trend Monitoring Constituent Sampling Schedule

Frequency			Indicator Parameter	Reporting Units	Field Measurement	Laboratory Analysis	Analysis Method
Initial Sample	5-Year	Annual	Electrical Conductivity (EC)	µmhos/cm	●		Field Instrument
			pH	pH units	●		Field Instrument
			Dissolved Oxygen (DO)	mg/L	●		Field Instrument
			Temperature	°C	●		Field Instrument
			Nitrate as Nitrogen	mg/L		●	Method 300.0
			Total Dissolved Solids (TDS)	mg/L		●	Method 2540C
			General Minerals - Anions (carbonate, bicarbonate, chloride, sulfate)	mg/L		●	Method 2320B
			General Minerals - Cations (boron, calcium, sodium, magnesium, potassium)	mg/L		●	Method 200.7

3.3 Groundwater Quality Results

Groundwater quality results are reported as required by the General Order.

3.3.1 Tabulated Data

As required in Attachment B, MRP Section IV.E.3 and MRP Section V.B, groundwater monitoring results (formatted as an Excel workbook) of all data records uploaded to the State Water Resources Control Board's GeoTracker database are attached in **Appendix B**.

Field parameters are recorded on field sheets and attached in **Appendix B**. Collected field parameters required by the MRP include pH, electrical conductivity, temperature, and dissolved oxygen. Additionally, field notes and purge volumes are recorded on field sheets. Tabulated field parameters are also reported in **Appendix B**.

3.3.2 Summary of Groundwater Quality Exceedances

Groundwater quality monitoring data are included in **Appendix B**. A total of 10 wells were sampled; 1 domestic well, 5 agricultural wells, and 4 piezometers. For nitrate, results were compared against the Primary Maximum Contaminant Level (**MCL**) for nitrate as nitrogen (N).

3.3.3 Groundwater Spatial Trends & Patterns

The first year that groundwater quality samples were collected was 2018, so there are no trends or patterns to report at this time.

3.3.4 Explanation of Missing Components

The Regional Board conditionally approved 13 wells to be sampled in the fall of 2018. Due to the constant fluctuation of groundwater conditions and changes in well suitability, the submitted GQTMP network was, and continues to be, considered dynamic. Three wells in the initial BVC GQTMP network were not sampled during the 2018 sampling season. Due to insufficient water 3 of the proposed piezometers were not sampled in 2018.

3.4 Groundwater Quality Assurance Evaluation

Data quality objectives were evaluated using criteria defined in the CVGMC Quality Assurance Programmatic Plan (**QAPrP**).

3.4.1 Summary of Precision and Accuracy

Due to equipment failure in the field, QA/QC failures occurred which resulted in 94% QA/QC completeness. Qualified laboratory results were reported on rare occasions (3%). All other results appear accurate and were reported to the proper level of precision. Many of the contracted lab's equipment can analyze constituents to a lower level than the minimum detection and reporting levels, which allows the BVC to have confidence that adequate precision is achieved.

3.4.2 Results Not Meeting QAPrP Criteria

For the 2018 water year, nearly all BVC results appear to meet the QAPrP criteria. Some laboratory results were qualified, but the results were still acceptable. Results failing to meet QAPrP criteria only represented 6% of the total results. These failures were due to equipment failure and will be remedied in future sampling.

3.4.3 Data Validity and Corrections

The BVC believes all laboratory results met QAPrP criteria and were valid. If future sampling deems necessary, the BVC will take corrective actions as described in the QAPrP to address potential issues and work to prevent them from reoccurring.

3.4.4 Completeness

Groundwater quality results collected in fall of 2018 reached 94% QA/QC completeness. The 94% completeness exceeds the minimum completeness requirement of 90% specified in the General Order. Parameter completeness also reached 99% for the first year of groundwater monitoring, while unsampled wells resulted in 77% sampling completeness. Tables showing quality control completeness are provided in **Appendix B**.

3.5 Actions to Address Water Quality Exceedances

Item V.E.16 of Attachment B to General Order R5-2013-0120-07 requires a description of actions taken to address water quality exceedances, such as changes in management practices. The BVC is currently implementing a Groundwater Quality Management Plan (GQMP) to address exceedance of water quality objectives.

The BVC has submitted to the RWQCB two GQMPs, one for the southern HVA and another for the shallow water vulnerability area.

3.6 Management Practice Evaluation Program

The Management Practice Evaluation Program (**MPEP**) is required by the General Order. The intent of the MPEP is to evaluate different conditions that could affect the discharge of waste from irrigated lands to groundwater (e.g., soil type, depth to groundwater, irrigation practice, crop type, nutrient management practices). The CWDC has elected to meet requirements of the MPEP by participating in the Southern San Joaquin Valley MPEP. The MPEP Annual Report is attached in **Appendix B**.

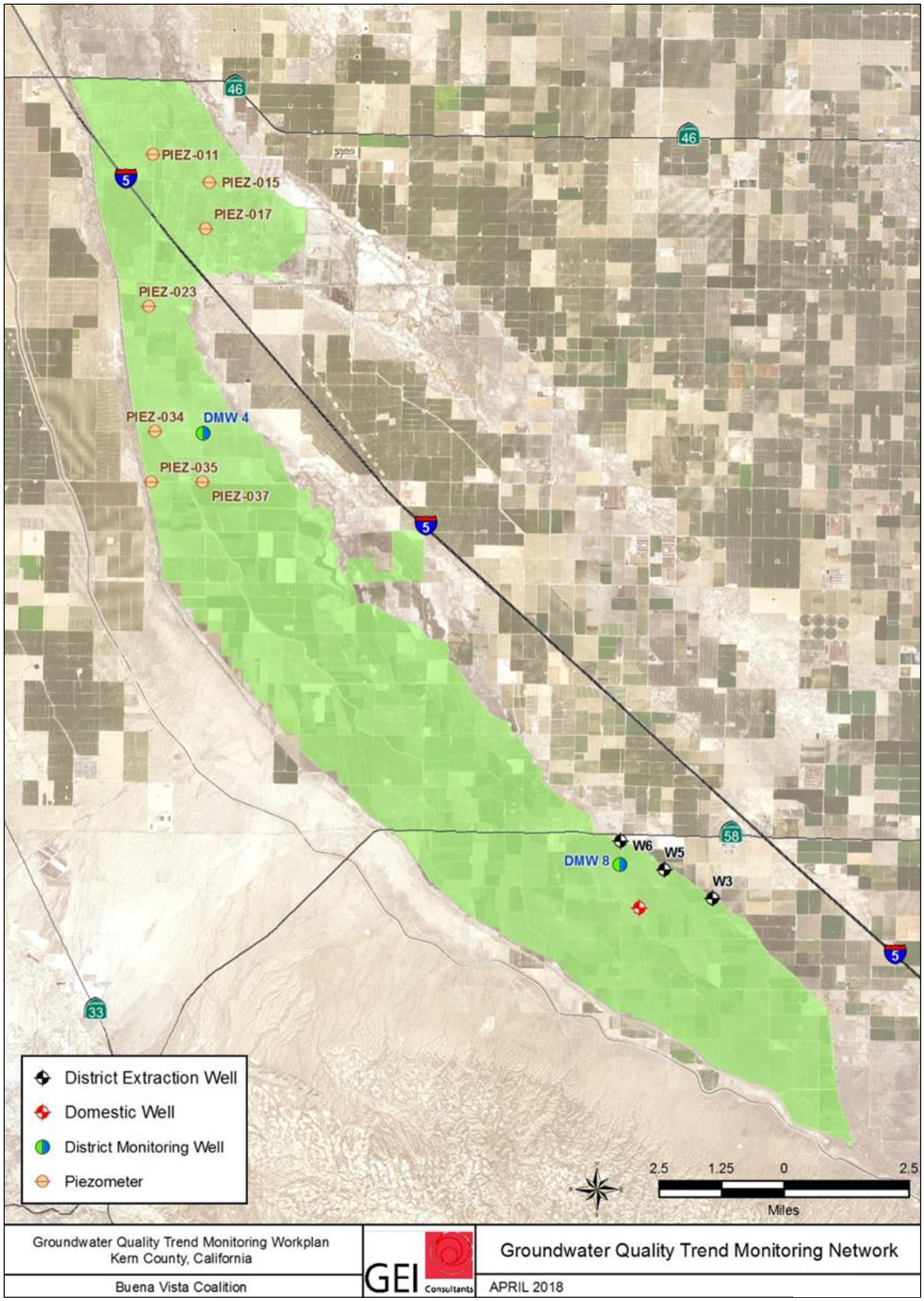
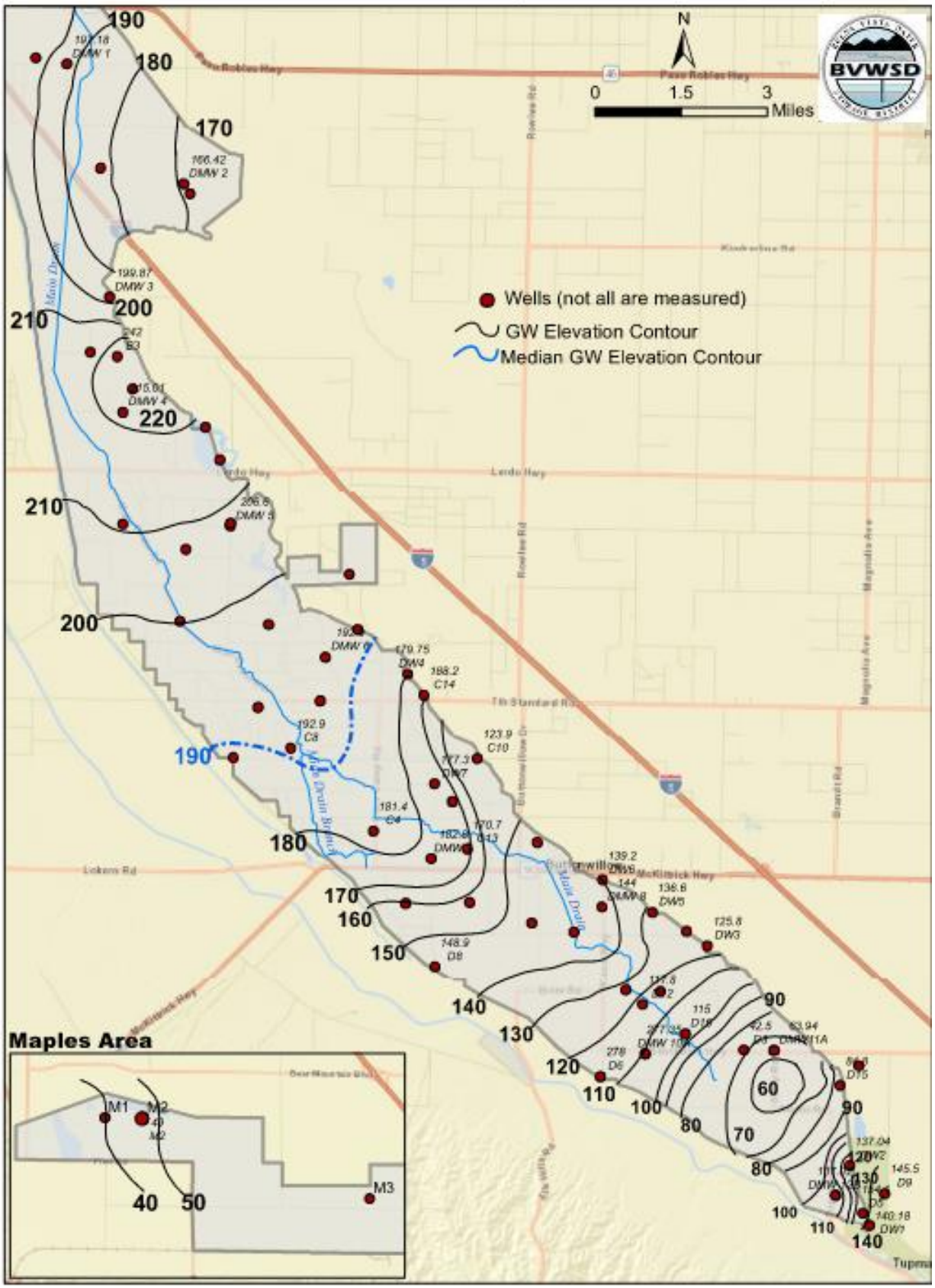


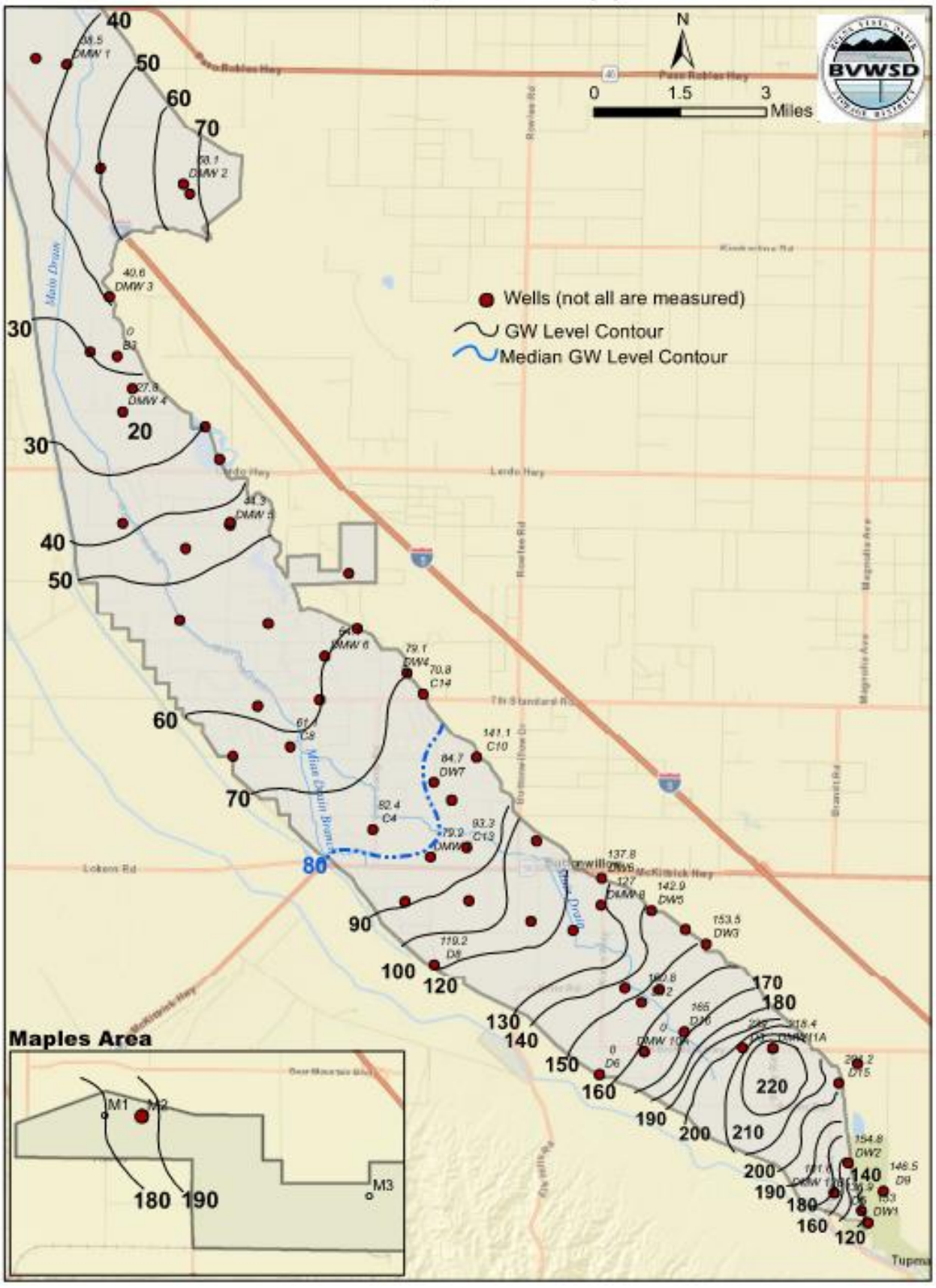
Figure 3-1. Groundwater Quality Trend Monitoring Network

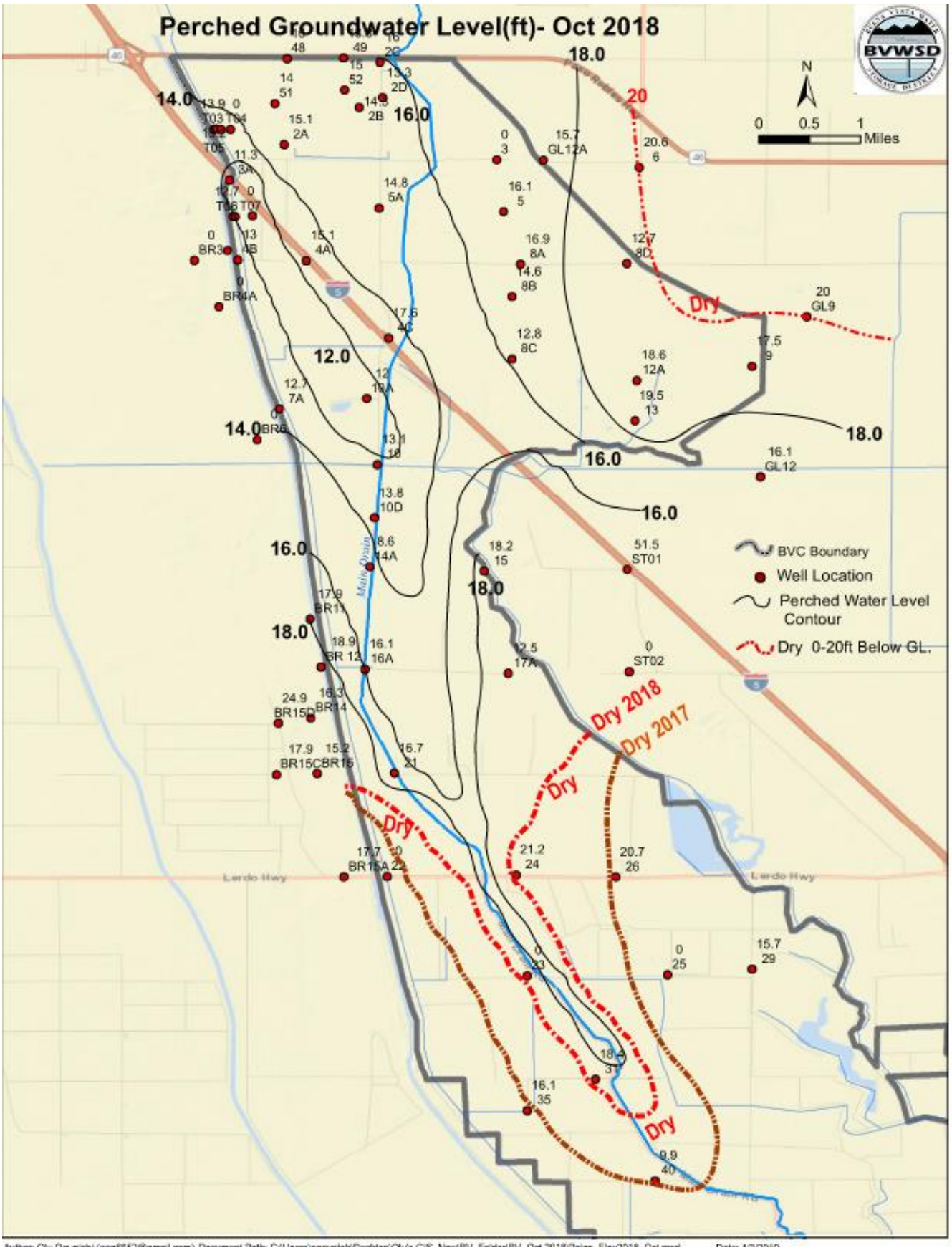
Table 3-2. Well Field Data

Well ID/Field Point Name	Well Location ID	GeoTracker Global ID	State Well Number	Well Completion Report Number	Well Type	Well Depth	Well Depth Unit	Year Drilled	Latitude	Longitude
BVCWD00001	W3	AGC100012323	T25SR24E29B	373832	Irrigation	460	ft	1991	35.38106	-119.4152
BVCWD00002	MW4	AGC100012323	T29SR24E29	--	Irrigation	374	ft	1992	35.513731	-119.598401
BVCWD00003	W5	AGC100012323	T29SR24E19	--	Irrigation	485	ft	pending	35.39773	-119.4326
BVCWD00004	W6	AGC100012323	T29SR23E24	--	Irrigation	480	ft	pending	35.39731	-119.448
BVCWD00005	Domestic	AGC100012323	T29SR24E30	--	Domestic	pending	ft	pending	35.37812	-119.441
BVCWD00006	MW8	AGC100012323	T29SR24E24	--	Irrigation	404	ft	1994	35.390536	-119.448123
BVCWD00007	PZ-11	AGC100012323	T27SR22E08H	--	Piezometer	20	ft	1991	35.59445	-119.61765
BVCWD00008	PZ-15	AGC100012323	T27SR22E15D	--	Piezometer	20	ft	1991	35.58645	-119.59748
BVCWD00009	PZ-17	AGC100012323	T27SR22E15N	--	Piezometer	20	ft	1991	35.57297	-119.59866
BVCWD00010	PZ-23	AGC100012323	T27SR22E29J	--	Piezometer	20	ft	1991	35.55035	-119.61831
BVCWD00011	PZ-34	AGC100012323	T28SR22E04N	--	Piezometer	20	ft	1991	35.51404	-119.61546
BVCWD00012	PZ-35	AGC100012323	T28SR22E16D	--	Piezometer	20	ft	1991	35.49936	-119.61649
BVCWD00013	PZ-37	AGC100012323	T28SR22E09R	--	Piezometer	20	ft	1991	35.49958	-119.59816

Groundwater Elevation Contour Map -Oct 2018 (ft above SL)




Groundwater Level Contour Map -Oct 2018 (ft)
N
0 1.5 3 Miles
BVWSD
Wells (not all are measured)
GW Level Contour
Median GW Level Contour
Maples Area
M1
M2
M3
180 190
40
50
60
70
30
20
80
90
100
120
130
140
150
160
190
200
210
220
170
180
Paso Robles Hwy
Lokern Rd
McKitrick Hwy
Tupman


Perched Groundwater Level(ft)- Oct 2018
BVWSD
N
0 0.5 1 Miles
BVC Boundary
Well Location
Perched Water Level Contour
Dry 0-20ft Below GL.
Dry
Dry 2018
Dry 2017
Lerdo Hwy
14.0
16.0
18.0
12.0
20

4 Nitrogen Management Plans

4.1 Introduction and Background

The Nitrogen Management Plan (NMP) Worksheet was approved by the Executive Officer of the CVRWQCB on December 23, 2014, for 12 water quality coalitions in the Central Valley, excluding the California Rice Commission and the Grassland Drainage Area. It is intended to assist growers with nitrogen management. The NMP Worksheet must be kept on farm and be available for inspection by the CVRWQCB. The NMP Crop/Harvest year is determined by the year in which harvest was *completed*. For example, navel oranges harvested from October 2017 through April 2018 would be considered the 2018 Crop/Harvest year.

The NMP Worksheet has two main sections: crop nitrogen planning and post-production actuals. The planning phase should generally be completed in advance of the irrigation and fertilization season. The general process of the planning phase involves determining a projected yield to develop a nitrogen requirement, and accounting for any nitrogen credits from the soil and irrigation water. The difference between the calculated nitrogen requirement and nitrogen credits is the amount of additional nitrogen that is required from fertilizers. The planning phase of the NMP Worksheet is a projection of the upcoming season, but actual yields and fertilizer rates may vary. Certification by a qualified professional (such as a Certified Crop Adviser [**CCA**] with the California Nitrogen Certification) or a self-certified grower is required for certain coalition members depending on the farm size and groundwater quality vulnerability designation. After harvest is completed, the post-production actuals information of the NMP Worksheet is completed, but certification of this information is not required.

The NMP Summary Report was approved by the Executive Officer of the CVRWQCB on December 23, 2015. Some of the information from the NMP Worksheet is required for the NMP Summary Report: site location information, crop, total acres, total available nitrogen applied (**A**), ratio of applied nitrogen and actual yield (**Y**) [known as the **A/Y ratio**], and crop harvest production units. The BVC also requires reporting of moisture content of field crops such as corn silage and the approximate planting date for permanent crops which is used to calculate crop age. This additional information allows more accurate calculation of crop yield and nitrogen removal, in addition to comparison of permanent crops across different age groupings [e.g. three groups of almonds: 1) up to 5 years, 2) 6 to 19 years, and 3) 20+ years].

The NMP Summary Report does not require certification, but it is a required submittal to the coalitions for farms in high vulnerability areas (**HVAs**). BVC members have been informed of their vulnerability designation, farm size classification, and the required reporting schedules. Members submit their NMP Summary Reports via a web-based data management tool for evaluation, analysis, and summarization in this AMR, and related outreach.

4.1.1 Timeline

In the Tulare Lake Basin, NMP Worksheets were first required in 2015 for large farms (≥ 60 acres) in HVAs, but certification was not required. By March 1, 2017, the NMP Worksheet for large farms in HVAs was to be completed and certified. The first NMP Summary Report was due to the coalitions by March 1, 2017, for large farms in HVAs for the 2017 Crop/Harvest Year. Small farms (≤ 60 acres) in HVAs were required to complete and certify an NMP Worksheet by March 1, 2017, and subsequently submit an NMP Summary Report by March 1, 2018. As of March 1, 2018, all farms in HVAs are required to complete NMP Worksheets and NMP Summary Reports annually. Farms of all sizes in areas of low groundwater quality vulnerability were required to complete an NMP Worksheet by March 1, 2017, and annually thereafter, but certification and NMP Summary Reports are not required.

4.1.2 Nitrogen Management Plan Summary Report Analysis

The NMP Worksheet stays on farm and is *not* submitted to the coalitions or the CVRWQCB. The NMP Summary Report that members submit to the coalitions provides *some* information on nitrogen management. Per the General Order, coalitions must summarize these data in their AMRs. The CVRWQCB will use this information to evaluate the reported nitrogen management trends and any possible impacts to water quality. The data are aggregated on a township (36 square miles) and crop basis within the BVC area. This is the second NMP Summary Report analysis for the BVC. The analysis covers the 2017 Crop/Harvest year for large *and* small farms in HVAs. The surface water monitoring sections of this AMR are strictly based on the 2017 Water Year (October 1, 2016, through September 30, 2017). The NMP Summary Report data summarized in this section come from crops in which harvest was completed between January 2017 through December 2017. This reporting timeframe overlaps the 2017 Water Year (October 1, 2016 through September 30, 2017) and the 2018 Water Year (October 1, 2017 through September 30, 2018), and slightly differs from the surface water monitoring timeline.

In general, this report describes the analysis of nitrogen applications, **A/Y** ratios, and applied nitrogen over nitrogen removal (**A/R**) ratios. Where possible, analysis is further broken down by crop, soil characteristics, and irrigation systems on a township basis. Some of the data are also summarized by crop on a coalition-wide basis. The BVC believes that summarizing these data by crop on a coalition-wide basis is the best way to evaluate the information. For many crops, the sample sizes are too small to provide meaningful summary statistics or box and whisker plots on a township basis. Moreover, statistical outliers by crop are not consistent between townships. Depending on the spread of the population data, an outlier in one township may not be an outlier in another township, and an outlier in a township may not be an outlier on a coalition basis for a given crop. This could create confusion and frustration among growers and make the information less impactful. Overall, township analysis has little value and the BVC would prefer to omit this analysis in future reporting and focus on crop statistics by coalition instead.

Although the reported NMP Summary Report data do provide some insight into estimated nitrogen application rates, crop yields, and metrics of nitrogen efficiency, the data are general and aggregated, and do *not* define potential mass loading of nitrogen to groundwater. The data should only be used to evaluate general trends by crop across multiple years, as recommended by the Agricultural Expert Panel (Burt et al., 2014). The most effective use of this information will be for grower and adviser outreach and education and as inputs for the Southern San Joaquin Valley Management Practices Evaluation Program (**SSJV MPEP**) analyses and modeling. Regulatory metrics or thresholds of A/Y, A/R, or other metrics should not be developed from these data.

Nitrogen management is highly complex and depends on many factors such as location, weather, irrigation infrastructure and management, soils, crop type and cultivar, rootstocks, pest management, cultural practices, nitrogen consumption rates vs. nitrogen removal rates, and other factors. The complex interactions of these factors cannot be sufficiently interpreted by simple metrics. Moreover, averaged single value nitrogen removal coefficients based on relatively limited data do not account for the substantial variability in nitrogen demand and removal rates, nitrogen required to grow permanent tissues, secondary harvest, etc. Undoubtedly, many sophisticated growers in Kern County will outperform average nitrogen removal rates in the Central Valley, and therefore the summary of nitrogen removal in this report may not be accurate for many growers. An ongoing process of education and outreach via individual grower Nitrogen Analysis Reports (**NAR**), coalition meetings, the MPEP, and other outlets is the best use of this information.

4.2 Data Quality Assessment, Rationale, and Methods

4.2.1 Submitted Data

For the 2018 Crop/Harvest Year members with at least one HVA parcel enrolled were required to submit an NMP Summary Report to the BVC. A total of 11 members representing 15,241 irrigated acres with at least one enrolled HVA parcel from January 1 to December 31, 2018, were required to submit an NMP Summary Report to the BVC. A total of 11 of the 11 (100%) required members submitted NMP Summary Reports to the BVC (**Table 4-1**).These impressive completion statistics are reflective of the diligence of BVC members and of the effort the BVC puts into achieving extensive compliance with the ILRP.

Table 4-1. Required and Completed NMP Summary Report Statistics

	# Members	Total Enrolled Irrigated Acres[1]
Required	11	15,241
Completed	11	15,241
Percent Completed	100%	100%

[1] Includes total acreage of enrolled parcels to memberships farming with at least one HVA parcel.

4.2.2 Cropping Summary

Three categories of acreage must be considered to evaluate the submitted NMP Summary Reports and Farm Evaluation. All acreage values are reported via the Farm Evaluation on BVC's online reporting tool.

- **Irrigated Acres**: Enrolled acreage that is irrigated to produce commercial crops.
- **Field Acres:** Irrigated or production acreage of distinctly managed and named fields. Multiple crops may be grown on one field in a calendar year. Small discrepancies may exist between irrigated acres and field acres due to enrollment issues or incomplete reports.
- **Commodity Acres:** The acreage per crop as reported on the Farm Evaluation or NMP Summary Reports. For example, 80 field acres double cropped with 80 commodity acres of corn and 80 commodity acres of wheat in a reporting year would result in a total of 160 commodity acres.

This NMP Summary Report analysis uses reported commodity acreage for all statistical summaries. This year, zero field acres were double or triple cropped in the 2018 Crop/Harvest Year for reported Farm Evaluations (**Section 5.3.7**). If double or triple cropping occurs, this results in the total commodity acres being greater than the total field or irrigated acres.

A summary of the reported cropping is provided in **Figure 4-1**. Four crops account 95% of the total reported commodity acreage. The total reported commodity acreage from the 2018 Crop/Harvest year was 9,727 acres. Raisin Grapes were the largest acreage crop with a total of 3,476 reported commodity acres (35.7% of the total). Pima Cotton was the second largest acreage crop with 3,078 reported commodity acres (31.7% of the total). Pomegranates and Pistachios were the third and fourth largest acreage crops with 1,631 (16.8%) and 1,093 (11.2%) reported commodity acres. Alfalfa-Hay was the fifth largest acreage crops with 224 (2.3%) reported commodity acres. Olives were the smallest acreage crop with 66 reported commodity acres (0.7%). Results for all crops are tabulated in **Table 4-2**. The BVC continually works to update and refine its crop listing based on grower feedback and other information.

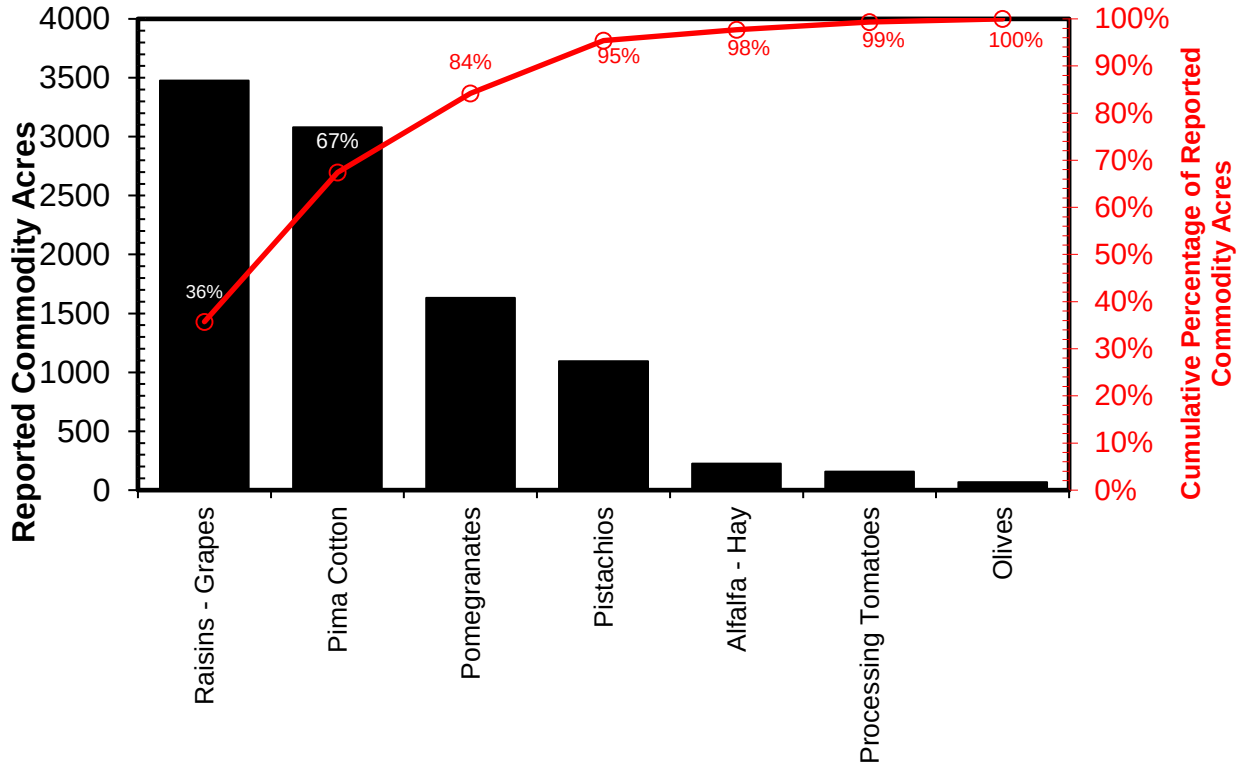


Figure 4-1. Cropping Summary of Submitted NMP Summary Reports

4.2.3 Data Quality and Corrective Actions

The BVC carefully evaluated the quality of the submitted NMP Summary Report data. The 2018 Crop/Harvest Year represents the third submission of NMP Summary Report data for some BVC members (large HVA farms). Overall, most of the data were of reasonable quality, but some data were questionable. This may be attributable to typographic errors by BVC members prior to submittal which could change the order of magnitude of a reported variable, or a misunderstanding of the reporting requirements. For example, some of the reported A/Y ratios resulted in calculated yields that were impossibly high for a given crop. There was also some uncertainty on the reported production units, nitrogen applications, and other issues, such as:

- Reporting pounds of nut kernels verses pounds of in-shell nuts per acre, and vice-versa
- Entering total pounds of nitrogen applied rather than pounds of nitrogen applied per acre
- Reporting total mass of fertilizer applied (e.g. pounds of calcium nitrate) rather than mass of nitrogen applied
- Incorrect calculation of A/Y: calculation errors, inconsistent usage of units, entering the total nitrogen applied or yield as A/Y, using total yield rather than yield per acre

To address these inconsistencies, the BVC developed and continually refines multiple data “filters” or “bounds” to flag the potentially incorrect or erroneous data from the bulk data prior to analysis. These filters visually flag entered data in the BVC’s online reporting tool and recommend that members review and correct the information as appropriate before submission of their NMP Summary Reports. These filters generally consist of minimum and maximum values by crop for the following variables:

- Total nitrogen applied
- Yield

- Moisture
- Nitrogen applied values of zero with A/Y ratios greater than zero

Data reported as non-bearing (**NB**), no yield (**NY**), or A/Y values of zero were summarized separately from bearing data for each crop in this report. Non-bearing fields generally represent young permanent crops that are in production, irrigated, and fertilized, but have not yet produced a crop that is economically worth harvesting. Fields reported as NY represent crops that were in production and expected to produce a viable crop but were ultimately not harvested. This could be due to crop failure because of pest and/or environmental damage, or other factors. Fields that reported A/Y values of zero may or may not have applied nitrogen. It is uncertain if those fields should have been reported as NB, NY, or if the A/Y values were meant to be greater than zero. The BVC will continue to work with its members to address reporting inconsistencies.

4.2.3.1 Grower Outreach Process

To address the flagged data, the BVC completed an extensive grower outreach process. Phone calls were made to all members that had flagged data. During the phone call, the BVC explained the issues, the data in question, and requested a careful review and, as appropriate, resubmission of corrected information. Members were given approximately three weeks to complete this process. The BVC then reviewed the data quality again to determine any remaining issues. This process was largely successful, with no data remaining flagged and excluded, as discussed below.

4.2.3.2 Data Quality Results

Table 4-2 provides a comprehensive summary of the submitted data and data quality by crop for the BVC. Of the 15,169 total reported commodity acres representing 134 fields, 5,443 acres (35.9%) representing 55 fields were reported as NB, NY, or had A/Y values of zero. These data are summarized separately from bearing data for each crop in this report. Of the 15,169 reported commodity acres, no acres were excluded from this analysis due to potentially incorrect or inaccurate data as described above. **These results indicate that the NMP Summary Report dataset that the BVC collected and submitted to the CVRWQCB is of very high quality with few mistakes or errors.** This is a substantial accomplishment that is indicative of the diligence of BVC members and of the efforts of the BVC to achieve compliance with the ILRP with the best quality data that is reasonably possible.

Typical sources of misunderstanding and errors were noted by the BVC, and those items will be emphasized during future outreach events to minimize these issues in the future. All reported commodity acres summarized in this report were provided along with all other submitted data as an ESRI ArcGIS shapefile.

Table 4-2. Summary of Reported Data and Overall Data Quality

Grouped Crop Name	All Reported Data			Bearing - Inside Bounds			Bearing - Outside Bounds			NB, NY, and A/Y = 0			Total Summarized in AMR		
	Fields	Acres	% Rptd Acres	Fields	Acres	% Rptd Acres	Fields	Acres	% Rptd Acres	Fields	Acres	% Rptd Acres	Fields	Acres	% Rptd Acres
Pistachios	31	4,632	30.5%	9	1,093	23.6%	-	-	0.0%	22	3,539	76.4%	31	4,632.00	100.0%
Raisins - Grapes	19	3,476	22.9%	19	3,476	100.0%	-	-	0.0%	0	-	0.0%	19	3,476.00	100.0%
Pima Cotton	36	3,078	20.3%	36	3,078	100.0%	-	-	0.0%	0	-	0.0%	36	3,078.00	100.0%
Pomegranates	9	1,631	10.8%	9	1,631	100.0%	-	-	0.0%	0	-	0.0%	9	1,631.00	100.0%
Irrigated Acreage Enrolled - Fallow	13	954	6.3%	0	-	0.0%	-	-	0.0%	13	954	100.0%	13	954.00	100.0%
Walnuts	5	818	5.4%	0	-	0.0%	-	-	0.0%	5	818	100.0%	5	818.00	100.0%
Alfalfa - Hay	4	327	2.2%	3	224	68.5%	-	-	0.0%	1	103	31.5%	4	327.00	100.0%
Processing Tomatoes	2	158	1.0%	2	158	100.0%	-	-	0.0%	0	-	0.0%	2	158.00	100.0%
Olives	1	66	0.4%	1	66	100.0%	-	-	0.0%	0	-	0.0%	1	66.00	100.0%
No (0) Irrigated Acreage Enrolled - Fallow	13	28	0.2%	0	-	0.0%	-	-	0.0%	13	28	100.0%	13	28.00	100.0%
Almonds	1	1	0.0%	0	-	0.0%	-	-	0.0%	1	1	100.0%	1	1.00	100.0%
Grand Total:	**134**	**15,169**	**100%**	**79**	**9,726**	**64.1%**	**-**	**-**	**-**	**55**	**5,443**	**35.9%**	**134**	**15,169.00**	**100.0%**

4.2.4 Crop Yields and Moisture Content

The A/Y ratio represents the total nitrogen applied [**A**] divided by the total yield [**Y**] from the NMP worksheet, as shown in the equation below:

$$\frac{A}{Y} = \frac{total\ nitrogen\ applied\ per\ acre\ [A]}{total\ yield\ per\ acre\ [Y]}$$

This equation was algebraically solved for total yield [Y] as shown in the following equation:

$$Yield\ per\ acre\ [Y] = \frac{Total\ nitrogen\ applied\ per\ acre\ [A]}{\frac{A}{Y}}$$

To standardize all reported information, the BVC converted all yield units (e.g. bins, cartons, boxes, tons, cwt, bales, lugs, sacks, etc.) to pounds per acre. Therefore, the units for the A/Y ratios summarized in this report are as follows:

$$\frac{A}{Y} = \frac{pounds\ of\ nitrogen\ applied\ per\ acre}{pounds\ of\ yield\ per\ acre}$$

All reported yields were also calculated on a dry matter basis using grower defined moisture contents (if reported) or assumed standard moisture values, and ultimately adjusted to a standardized moisture content based on Geisseler (2016). Variations in moisture content can result in substantial errors in calculated yields and, subsequently, nitrogen removal values.

4.2.5 Nitrogen Removal Coefficients

4.2.5.1 Background and Evaluation of Nitrogen Removal Values

The Central Valley Water Quality Coalitions submitted a literature review on crop nitrogen removal values from Dr. Daniel Geisseler of UC Davis to the CVRWQCB on January 13, 2017 (Geisseler, 2016). A summary of the information from Geisseler (2016) that was used to develop this report is tabulated in **Table 4-3**.

To calculate nitrogen removal, the BVC used the ***average*** nitrogen removal values listed in **Table 4-3**. It is critical to note that the range of nitrogen removal values vary substantially, even for crops with excellent supporting datasets from the Central Valley. For example, the average nitrogen removal value for almonds is 136 pounds of nitrogen removed per ton of harvested kernels (lbs N/ton kernels). The minimum and maximum nitrogen removal values are 102 and 174 lbs N/ton kernels, respectively. Actual nitrogen removal values from grower fields will span the range provided by Geisseler (2016) and beyond. The calculations of nitrogen removal and A/R ratios using average nitrogen removal rates only provide a very general estimation of nitrogen removal on a landscape level, such as all almonds reported to the BVC. Assessing nitrogen removal on individual fields using these values is problematic as they likely do not reflect actual field conditions.

The BVC also evaluated the status of the nitrogen removal values to determine their validity (see the "N Removal Coefficient Status" column of **Table 4-3**). One of three qualitative categories were assigned to each crop: 1) Good, 2) Sufficient, or 3) Needs Improvement. "Good" represents nitrogen removal numbers that are reliable estimates supported by robust datasets from California. "Sufficient" represents reasonable estimates of nitrogen removal that could be improved with more data from the Central Valley. "Needs Improvement" represents rough estimates of nitrogen removal values. More data are needed from the Central Valley of California to refine those numbers.

Geisseler (2016) provided nitrogen removal values for 68 crops. Of those, the BVC defined 17 (25%) as "Good", 12 (18%) as "Sufficient", and 39 (57%) as "Needs Improvement." This information indicates that the nitrogen removal values for 51 of 68 crops (75%) could or should be improved. Moreover, even crops defined as having "Good" estimates of nitrogen removal values could use larger datasets consisting of more locations, years, soil types, varieties, etc. For permanent crops, there are also other potential pathways of nitrogen removal from the soil, such as nitrogen required for permanent tissue growth, abscised leaves, and prunings, that are not considered in the estimates provided by Geisseler (2016).

4.2.5.2 Future Work to Improve Nitrogen Removal Values

To address some of the deficiencies of the current state of knowledge of crop nitrogen removal, the Southern San Joaquin Valley Management Practices Evaluation Program (SSJV MPEP) committee applied for and received a California Department of Food and Agriculture Fertilizer Research and Education Program (CDFA FREP) grant in 2018 titled "Assessment of harvested and sequestered nitrogen content to improve nitrogen management in crops." This grant will provide approximately $223,000 over three years (2018-2020) to work with Dr. Daniel Geisseler on the following items:

- Sampling and analysis of additional crops to determine nitrogen removal rates
- Incorporation of additional datasets into the existing nitrogen removal database
- Establishment of nitrogen sequestration values for some permanent crops
- Comprehensive update of Geisseler (2016), as appropriate

The SSJV MPEP Committee has also allocated an additional $45,000 from the Natural Resources Conservation Service (NRCS) Conservation Innovation Grant (CIG) to support this work in addition to $15,000 for program and grant administration from the general SSJV MPEP budget. The BVC will utilize this updated information when it becomes available. Although this project will substantially improve current nitrogen removal values, many of the same caveats will remain and additional work on other crops will be needed after this project is complete. Refining the understanding of crop nitrogen removal is a perpetual process.

Table 4-3. Summary of Nitrogen Removal Information from Geisseler (2016)

Commodity	Nitrogen Removed with Harvested Parts			Units and Moisture	Number of Observations	Standard Deviation	Coefficient of Variation	Average Nitrogen in Harvested Parts	N Removal Coefficient Status
	Average	Low	High		n	SD	CV %	lbs N / lb yield	
Alfalfa - Hay	**62.3**	49.3	82.5	lbs N/ton at 12% moisture	49	7.8	12.5	**0.0312**	Good
Alfalfa - Silage	**24**	18.5	27.6	lbs N/ton at 65% moisture	6	4.2	17.5	**0.0120**	Good
Barley - Grain	**33.6**	19.6	48.7	lbs N/ton at 12% moisture	61	4.9	14.6	**0.0168**	Needs Improvement
Barley - Straw	**15.4**	6.8	16.9	lbs N/ton at 12% moisture	970	4.83	31.3	**0.0077**	Needs Improvement
Beans, dry - Blackeye	**73**	56.3	80.6	lbs N/ton at 12% moisture	164	7.6	10.4	**0.0365**	Needs Improvement
Beans, dry - Garbanzo	**67.2**	46.8	95.7	lbs N/ton at 12% moisture	108	7.6	11.3	**0.0336**	Needs Improvement
Beans, dry - Lima	**72.3**	63.3	90	L bs N/ton at 12% moisture	75	3.9	5.4	**0.0362**	Sufficient
Corn - Grain	**24**	6	53.6	lbs N/ton at 15.5% moisture	1775	5	20.8	**0.0120**	Needs Improvement
Corn - Silage	**7.56**	5	10.4	lbs N/ton at 70% moisture	72	0.8	10.5	**0.0038**	Good
Cotton	**43.7**	23.3	63.2	lbs N/ton lint & seed	80	12.9	29.5	**0.0219**	Good
Fescue, Tall - Hay	**50.8**	33.7	70.1	lbs N/ton at 12% moisture	260	8.24	16.2	**0.0254**	Needs Improvement
Oat - Grain	**37.7**	26.5	50.7	lbs N/ton at 12% moisture	134	3.61	9.6	**0.0189**	Needs Improvement
Oat - Straw	**14.8**	6.1	23.1	lbs N/ton at 12% moisture	526	5.2	34.7	**0.0074**	Needs Improvement
Oat - Hay	**21.7**	14.6	29.3	lbs N/ton at 12% moisture	49	4	18.2	**0.0109**	Good
Orchard Grass - Hay	**54.5**	38	76.3	lbs N/ton at 12% moisture	60	10.88	20	**0.0273**	Needs Improvement
Ryegrass, Perennial - Hay	**54.9**	36.2	75.8	lbs N/ton at 12% moisture	60	9.21	16.8	**0.0275**	Needs Improvement
Safflower	**56.8**	33.8	109.3	lbs N/ton at 8% moisture	149	11.4	20	**0.0284**	Needs Improvement
Sorghum - Grain	**33**	10.4	74	lbs N/ton at 13.5% moisture	256	9.8	29.7	**0.0165**	Needs Improvement
Sorghum - Silage	**7.34**	3.9	11.9	lbs N/ton at 65% moisture	260	1.55	21	**0.0037**	Good
Sunflower	**54.1**	32.8	69.9	lbs N/ton at 8% moisture	208	7.76	14.3	**0.0271**	Needs Improvement
Triticale - Grain	**40.4**	29.5	50.9	lbs N/ton at 12% moisture	51	5.25	13	**0.0202**	Good
Triticale - Straw	**11.5**	5.5	29	lbs N/ton at 12% moisture	102	4.42	38.3	**0.0058**	Needs Improvement
Triticale - Silage	**9.03**	7.4	11.5	lbs N/ton at 70% moisture	19	1.24	13.7	**0.0045**	Good
Wheat, common - Grain	**43**	32.1	52.7	lbs N/ton at 12% moisture	113	4.45	10.3	**0.0215**	Good
Wheat - Straw	**13.8**	6.1	29.3	lbs N/ton at 12% moisture	494	4.56	33	**0.0069**	Needs Improvement
Wheat - Silage	**10.5**	6.7	14.5	lbs N/ton at 70% moisture	39	1.96	18.6	**0.0053**	Good
Wheat, durum - Grain	**42.1**	33.7	54	lbs N/ton at 12% moisture	41	1.56	3.7	**0.0211**	Good
Asparagus	**5.85**	3.92	8.88	lbs N/ton of fresh spears	19	0.82	14	**0.0029**	Needs Improvement
Beans, green (snap beans)	**5.78**	4.45	7.2	lbs/ton of fresh weight	122	1.49	25.7	**0.0029**	Needs Improvement
Broccoli	**11.2**	7.48	19.01	lbs N/ton of fresh weight	46	2.28	20.4	**0.0056**	Needs Improvement
Carrots	**3.29**	1.71	7.35	lbs/ton of fresh weight	167	0.74	22.4	**0.0016**	Needs Improvement
Corn, sweet	**7.17**	4.83	10.6	lbs/ton of fresh ears	50	0.94	13.1	**0.0036**	Needs Improvement
Cucumbers	**2.16**	1.6	2.84	lbs/ton of fresh weight	10	0.38	17.4	**0.0011**	Needs Improvement
Garlic	**15.1**	9.41	20.48	lbs/ton of fresh weight	12	2.94	19.5	**0.0076**	Needs Improvement
Lettuce, Iceberg	**2.63**	1.75	4.74	lbs/ton of fresh weight	68	0.44	16.7	**0.0013**	Good
Lettuce, Romaine	**3.62**	2.27	5.12	lbs/ton of fresh weight	26	0.49	13.7	**0.0018**	Good
Melons, Cantaloupe	**4.87**	1.97	7.02	lbs/ton of melons	31	0.76	15.5	**0.0024**	Sufficient
Melons, Honeydew	**2.95**	1.98	4.25	lbs/ton of melons	12	0.65	22.1	**0.0015**	Needs Improvement
Melons, Watermelons	**1.39**	0.95	2.04	lbs/ton of melons	6	0.33	23.9	**0.0007**	Needs Improvement
Onions	**3.94**	1.6	6.29	lbs/ton of fresh weight	45	0.78	19.7	**0.0020**	Needs Improvement
Pepper, Bell	**3.31**	2.18	6.13	lbs/ton of fresh weight	40	0.26	7.9	**0.0017**	Needs Improvement
Potatoes	**6.24**	4.08	9.22	lbs/ton of fresh weight	64	0.85	13.6	**0.0031**	Needs Improvement
Pumpkin	**7.36**	4.27	9.06	lbs/ton of fresh weight	13	0.74	10.1	**0.0037**	Needs Improvement
Squash	**3.67**	0.64	6.4	lbs/ton of fresh weight	74	0.82	22.4	**0.0018**	Needs Improvement
Sweet potatoes	**4.74**	3.43	6.37	lbs/ton of fresh weight	23	0.8	16.8	**0.0024**	Good
Tomatoes, fresh market	**2.61**	1.89	3.39	lbs/ton of fresh weight	34	0.43	16.5	**0.0013**	Needs Improvement
Tomatoes, processing	**2.73**	1.9	3.6	lbs/ton of fresh weight	24	0.3	11.1	**0.0014**	Good
Almonds	**136**	102	174	lbs/ton of kernels	31	5.6	4.1	**0.0680**	Good
Apples	**1.08**	0.6	3.23	lbs/ton of fruits	132	0.38	35.1	**0.0005**	Needs Improvement
Apricots	**5.56**	4.48	5.64	lbs/ton of fruits	22	6.35	114	**0.0028**	Needs Improvement

Commodity	Nitrogen Removed with Harvested Parts			Units and Moisture	Number of Observations	Standard Deviation	Coefficient of Variation	Average Nitrogen in Harvested Parts	N Removal Coefficient Status
	Average	Low	High		n	SD	CV %	lbs N / lb yield	
Cherries	**4.42**	2.7	6.67	lbs/ton of fruits	24	0.87	19.8	**0.0022**	Needs Improvement
Figs	**2.54**	2.4	4.21	lbs/ton of fruits	19	0.46	18.1	**0.0013**	Needs Improvement
Grapefruit	**2.96**	1.6	3.24	lbs/ton of fruits	27	0.23	7.8	**0.0015**	Sufficient
Grapes - Raisins	**10.1**	7.88	12.5	lbs/ton at 15% moisture	19	0.58	5.8	**0.0051**	Sufficient
Grapes - Table	**2.26**	1.78	2.81	lbs/ton of grapes	19	0.13	5.8	**0.0011**	Sufficient
Grapes - Wine	**3.6**	1.96	5.2	lbs/ton of grapes	38	0.47	13	**0.0018**	Needs Improvement
Lemons	**2.58**	2.3	3.87	lbs/ton of fruits	22	0.26	10	**0.0013**	Sufficient
Nectarines	**3.64**	1.65	5.55	lbs/ton of fruits	41	0.99	27.1	**0.0018**	Sufficient
Olives	**6.28**	4	11.1	lbs/ton of olives	29	1.43	22.8	**0.0031**	Sufficient
Pistachios	**2.96**	2.35	4.86	lbs/ton of fruits	82	0.32	10.9	**0.0015**	Sufficient
Peaches	**2.26**	1.38	3.69	lbs/ton of fruits	25	0.47	20.7	**0.0011**	Sufficient
Pears	**1.29**	0.7	2.1	lbs/ton of fruits	64	0.23	17.9	**0.0006**	Needs Improvement
Pistachios	**56.1**	54	58	lbs N/ton dry yield (CPC)	11	1.94	3.5	**0.0281**	Good
Plums	**2.83**	2.4	3.3	lbs/ton of fruits	11	0.32	11.2	**0.0014**	Needs Improvement
Pomegranate	**15.2**	12.1	18.7	lbs/ton of fruits	7	2.28	15	**0.0076**	Needs Improvement
Prunes	**11.2**	8.9	18	lbs/ton of dried fruits	18	1.83	16.3	**0.0056**	Sufficient
Tangerines	**2.54**	2.02	3.06	lbs/ton of fruits	2	0.74	29.2	**0.0013**	Needs Improvement
Walnuts	**31.9**	24	46	lbs N/ton with shells	18	3.56	11.2	**0.0160**	Sufficient

4.2.6 Soils Data

The General Order requires a comparison of NMP Summary Report information between similar soil conditions. The BVC utilized the United States Department of Agriculture (**USDA**) NRCS Soil Survey Geographic Database (**SSURGO**) for the soils data. For the 2018 Crop/Harvest Year, Hydrologic Soil Groups (HSGs) were used as a simple method to evaluate differences between different soil characteristics. Soils were originally assigned to Hydrologic Soil Groups based on measured rainfall, runoff, and infiltrometer data (Musgrave, 1955). After the original HSGs were established, soils are mostly assigned values based on the judgment of NRCS soil scientists. Hydrologic Soil Groups are generally determined by the saturated hydraulic conductivity (ksat) of the least transmissive layer, depth to a water impermeable layer, and depth to the high-water table.

There are four main categories of HSGs: A, B, C, and D, with runoff potential increasing from Group A to Group D. Dual HSGs also exist, such as "A/D", "B/D", and "C/D." The first letter applies to drained soil conditions (such as tile drained fields) and the second letter to undrained conditions. For the purposes of this NMP Summary Report analysis and the fact that all reported data comes from fields that were farmed, it was assumed that all data came from drained fields. Parcels that were assigned a dual HSG were reclassified to drained conditions or the first letter designation. For more information regarding HSGs, see the following website: https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba.

A detailed and thorough analysis of the impact of differing soil characteristics on nitrogen management is being completed under the SSJV MPEP. This AMR provides a very general and simplistic comparison of A/R values among varying soil characteristics.

4.2.7 Irrigation Management

In addition to a comparison of NMP Summary Report information by HSG, the General Order also requires a comparison of the submitted information by irrigation management. There are six irrigation practices listed on the Farm Evaluations: drip, micro sprinkler, sprinkler, border strip, furrow, and flood (level basin). Two non-irrigated options are also provided: fallow and dry farming, but there were no reported dry farming fields in the 2018 Crop/Harvest Year. The BVC grouped these categories into three broad categories for a comparison of irrigation management: surface, sprinkler, and micro-irrigation (**Table 4-4**). A much more detailed and thorough analysis of the impact of irrigation management on nitrogen management is being completed under the SSJV MPEP. Further detail on reported irrigation system statistics is provided in **Section 5.**

Table 4-4. Irrigation Practices Categories

Specific Irrigation Practices from Farm Evaluation Surveys	General Irrigation Category
Drip	Microirrigation
Microsprinkler	Microirrigation
Sprinkler	Sprinkler
Border Strip	Surface
Furrow	Surface
Flood (level basin)	Surface

4.2.8 Data Analysis Methods

According to the General Order, the NMP Summary Report analysis must characterize the input, uptake, and loss of nitrogen by crop. This was achieved in part by comparing fields with the same crops, similar soil conditions, and similar irrigation practices. The primary reporting metrics used in this report were A/R and A/Y (for select crops), but a summary by crop of number of fields, commodity acres, and nitrogen applied is also provided. A combination of Microsoft Access and Excel, ESRI ArcGIS, BVC's online reporting tool, and "R" software for statistical computing were used to complete this analysis.

The reported information by crop is aggregated on a township basis, as required, and on a coalition-wide basis. In general, all A/R and A/Y values were computed by dividing the total pounds of nitrogen applied by township, or the entire coalition, by the total pounds of estimated nitrogen removed and calculated yield, respectively. This is the basis of the data aggregation and acreage-weighting. Summaries of nitrogen applied in pounds per acre were computed by dividing the total pounds applied by the total reported commodity acres of a township and the coalition.

Tabular summary statistics are provided that include the following percentiles: 10th, 25th, 50th, 75th, and 90th. Statistical outliers were quantified by using these percentiles and the interquartile range (**IQR**). The IQR is the difference between the 75th and 25th percentiles. The IQR was multiplied by 1.5 and added to the 75th percentile and subtracted from the 25th percentile to determine upper and lower statistical limits. Fields that were above or below these limits were considered statistical outliers. Only high statistical outliers that were above the 75th percentile plus the IQR multiplied by 1.5 are summarized in this report. Graphical representations of this information are also provided as follows:

- Box and whisker plots of A/R or A/Y (for select crops) on a township and coalition basis (using the exclusive median quartile calculation in Microsoft Excel 2017)
- Box and whisker plots comparing A/R or A/Y values by irrigation system and soil type
- For permanent crops, box and whisker plots comparing A/R values by age grouping

Tabular summaries are also provided for fields reported as NB, NY, and A/Y values of zero.
The box and whisker plots were created using a combination of the BVC's online reporting and database tool and the "Statistics Chart" box and whisker feature of Microsoft Excel 2017. The "exclusive median" quartile calculation option of Excel 2017 was used. The percentiles presented in the tabular summary statistics sections were generally computed to be consistent with the "percentile.exc" function in Microsoft Excel 2017. This is an "exclusive" function that uses linear interpolation to determine percentile values. This function uses a calculated ranking of k*(n+1), with k representing the desired percentile and n being the sample size. The exclusive function does not calculate percentiles in the following situations: $1/(n+1) \leq k \leq n/(n+1)$. This generally occurs with small datasets, such as townships with only a few fields of a given crop. In those cases, the percentile values are displayed as "n/a" in the tabular summaries and the median values were displayed on the box and whisker plots.

4.2.8.1 Description of Box and Whisker Plots

The top of each box in the box and whisker plots represents the 75th percentile. The "x" represents the mean, the middle line represents the median, and the bottom of the box represents the 25th percentile. For some townships, the sample size was too small to draw a complete box and whiskers, so only the mean and/or median was shown. In general, points that are outside the whiskers of the box plots are considered statistical outliers, but the endpoint of the whiskers does not necessarily represent the statistical limit that determines an outlier. The endpoints of the whiskers represent the highest and lowest numbers of the data set that are not statistical outliers. The actual upper and lower statistical limits may not coincide with the end points of the whiskers. In this case, the statistical limit would occur between the endpoint of a whisker and the first outlier point.

4.2.8.2 Interpretation of Statistical Outliers

Although this analysis quantifies high statistical outliers, interpretation of the results must be contextualized. According to the Engineering Statistics Handbook (NIST/SEMATECH, 2012), an outlier is an observation that lies an abnormal distance from other values in a random sample from a population. Determining statistical outliers is somewhat of a subjective process determined by the analyst. This statistical analysis used the methodology of multiplying the IQR by 1.5 as originally described by John Tukey in 1977, but other methods are possible. For example, some analyses define inner and outer fences of box plots to determine degrees of statistical outliers. Inner fences are calculated by multiplying the IQR by 1.5, and outer fences are calculated by multiplying the IQR by 3. Points beyond the inner fences are considered mild statistical outliers, and points beyond the outer fences are considered extreme statistical outliers (NIST/SEMATECH, 2012). Therefore, this analysis is somewhat conservative in that it does not differentiate between mild or extreme statistical outliers. There are also other methods such as the adjusted boxplot method that adjusts outlier thresholds based on data skewness (Brys, Hubert, and Struyf, 2004). Given the small sample size of several of the crop types in the BVC (less than 10 reported fields) per township, outliers indicated by calculated box and whisker plot quartiles should be interpreted with extreme caution. Small differences in A/R and A/Y values could easily be marked erroneously as an outlier due to the overall small sample size of fields reported.

The IQR and statistical limits also change as the spread of the data change, so A/R and A/Y statistical outliers will change from year-to-year and from township-to-township. Multi-year datasets (preferably five years) will be most useful to minimize the year-to-year variability of the reported NMP Summary Report data (Burt et al., 2014). Although the 2018 Crop/Harvest Year NMP Summary Report data provided the BVC with three years of data, three-year rolling averages were not computed in this report. NMP Summary Reports from the 2016 Crop/Harvest Year utilized generic crop list categories that are not comparable to the current BVC crop list, which is much more specific. For example, many crops were grouped into general categories, such as “grapes” and “citrus” rather than more specific categories of table grapes, wine grapes, raisins, and numerous citrus crops (e.g., oranges, mandarins, lemons, grapefruit, etc.). As a result, it is not possible to aggregate a general crop category of “grapes” with any of the more specific categories that are now used to compute three-year rolling averages. Moreover, data quality has dramatically improved from the 2016 Crop/Harvest Year, which was the first-year growers reported this information. Three-year rolling averages of key metrics such as A/R will be computed and reported in future Annual Monitoring Reports, as appropriate.

As described in **Section 4.1.2**, this information can be an effective grower outreach and education tool, but it should not be used to develop regulatory metrics. There are many reasons why certain fields could be statistical outliers. These reasons include young trees or vines that require nitrogen application rates exceeding the initial nitrogen removal rates, environmental issues such as prolonged drought, limited or poor-quality water supplies, unique soil or geographic features that require unique management practices, consistent pest management or weather issues, or fields that are simply managed in a more sophisticated manner than others.

4.2.8.3 A/R Example for Cotton

Burt (2017) from the Irrigation Training and Research Center (ITRC) at California Polytechnic State University (Cal Poly) provides an example calculation of possible nitrogen fertilization rates, nitrogen removal, and A/R of cotton using numbers from CDFA FREP (https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Cotton.html) and Geisseler (2016). He assumes a cotton yield of 2 bales/acre, which is equivalent to 1,000 pounds cotton lint/acre. Geisseler (2016) provides a nitrogen removal rate of 43.7 lbs N/ton of lint and seed. To get the assumed yield of 1,000 lbs lint/acre in terms of lint and seed per acre, a turnout rate (the percentage of lint in total harvested cotton seed, lint, and trash) of 35% was used as an approximation. Dividing 1,000 lbs lint/acre by 0.35 results in a yield of 2,857 lbs lint and seed/acre for the assumed 2 bales of lint/acre yield. Using this information, the nitrogen removal rate can be calculated as follows:

$$\frac{2{,}857\ lbs\ of\ lint\ and\ seed}{acre}\ x\ \frac{1\ ton\ of\ lint\ and\ seed}{2000\ lbs\ lint\ and\ seed}\ x\ \frac{43.7\ lbs\ N\ removed}{ton\ of\ lint\ and\ seed} = \boxed{\frac{62\ lbs\ N\ removed}{acre}}$$

The CDFA FREP California Fertilization Guidelines website (https://apps1.cdfa.ca.gov/FertilizerResearch/docs/Cotton.html) recommends application of approximately 115 lbs N/acre for a 2 bale/acre yield when residual soil nitrate-nitrogen levels are below 50 lbs/acre. Using this recommendation would result in an A/R ratio of 1.85 as follows:

$$\frac{A}{R} = \frac{115\ lbs\ N/acre}{62\ lbs\ N/acre} = 1.85$$

This example shows that the amount of nitrogen applied may be substantially more than what is removed even when using some of the best available nitrogen recommendations available in California. Variability in A/R ratios by crop could be attributable to multiple factors, including inaccuracies in the assumed nitrogen removal rate, nitrogen that remains in the field in non-harvested material such as cotton foliage, tomato vines, corn stover, roots, perennial woody tissue, or nitrogen that remains stored in the root zone for the next crop, atmospheric losses of nitrogen, and general environmental inefficiencies. These factors need to be carefully evaluated when comparing the A/R ratios between crops. The magnitude of the A/R ratios may vary substantially between crops, but high A/R ratios are not necessarily the result of nitrogen applications that exceed agronomic rates. Burt (2017) states that more work is needed on this subject.

4.3 Results and Discussion

The following subsections provide a summary of the reported NMP Summary Report data. A general summary is provided first and is followed by a detailed summary of all crops of the reported commodity acreage (**Figure 4-1**).

4.3.1 General Summary

A summary of nitrogen applications, A/Y, and A/R, by crop, is provided in **Table 4-5**. Total nitrogen (**N**) applied is provided in total pounds for the entire BVC, and total pounds divided by the total crop commodity acres (total nitrogen applied in lbs/acre). Approximately 99% of the reporting fields applied less than 250 pounds of nitrogen per acre. All the reported crop categories had acreage-weighted average nitrogen application rates of less than 300 pounds/acre (**Table 4-5**).

In general, across all crops, a nitrogen application rate of 300 lbs/acre is likely within reasonable agronomic rates when accounting for a nitrogen use efficiency factor of 50 to 70%, although higher rates are often necessary as well. Rosenstock et al. (2013) compiled published nitrogen fertilizer rate guidelines for 34 crops grown in California and the maximum rates ranged from 50 to 400 lbs/acre. An illustration of the filtered nitrogen application rates by crop is included as **Figure 4-4**.

The coalition-wide acreage-weighted average nitrogen application rate (total pounds of nitrogen applied divided by total commodity acres) was approximately 127 lbs/acre (**Table 4-5**). The maximum acreage-weighted average nitrogen application rate was 225 lbs/acre for processing tomatoes. The next highest nitrogen application rate is 175 lbs/acre for pima cotton. All fields applied less than 400 lbs of N/acre. These data indicate that in general, BVC members are applying nitrogen within appropriate agronomic rates.

Table 4-5. Summary of Nitrogen Application, A/Y, and A/R Ratios by Crop for the BVC

Crop	# Fields	Total Commodity Acres	Total N Applied		Total Yield			A/Y		Total N Removed (R)		A/R
	n		lbs	lbs/ac	lbs	lbs/ac	tons/ac	lbs N/lbs yield	lbs N/1,000 lbs yield	lbs	lbs/ac	
Raisins - Grapes	19	3,476	181,971	52	45,210,110	13,006	6.5	0.00	4.00	228,311.00	66.00	0.80
Pima Cotton	36	3,078	540,052	175	6,449,557	2,095	1.0	0.08	84.00	386,973.00	126.00	1.40
Pomegranates	9	1,631	252,546	155	13,372,814	8,199	4.1	0.02	19.00	101,633.00	62.00	2.48
Pistachios	9	1,093	223,428	204	1,775,657	1,624	0.8	0.13	126.00	49,807.00	46.00	4.49
Alfalfa - Hay	3	224	2,240	10	3,651,182	16,300	8.1	0.00	1.00	113,734.00	508.00	0.02
Processing Tomatoes	2	158	35,550	225	21,803,796	137,999	69.0	0.00	2.00	29,762.00	188.00	1.19
Olives	1	66	4,325	65	127,916	1,931	1.0	0.03	34.00	402.00	6.00	10.77
Sum	**79**	**9,727**	**1,240,112**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Min	**1**	**66**	**2,240**	**10**	**--**	**--**	**--**	**0.00**	**1.00**	**402.00**	**6.00**	**0.02**
Max	**36**	**3,476**	**540,052**	**225**	**--**	**--**	**--**	**0.13**	**126.00**	**386,973.00**	**508.00**	**10.77**
Range	**35**	**3,410**	**537,812**	**215**	**--**	**--**	**--**	**0.13**	**125.00**	**386,572.00**	**502.00**	**10.75**
Median	**9**	**1,093**	**181,971**	**155**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Aggregate Average	**11**	**1,390**	**177,159**	**127**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

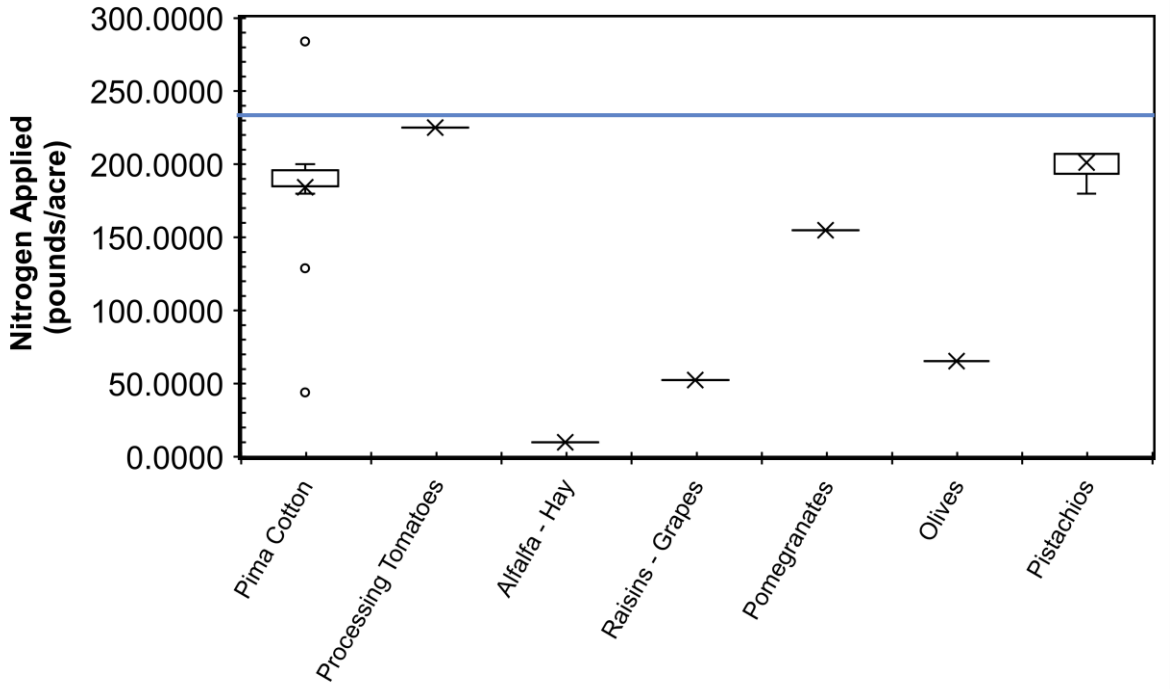


Figure 4-2. Box and Whisker Plot by Crop of Nitrogen Application from the Submitted NMP Summary Reports

Note: The horizontal blue line illustrates that 99% of the fields applied less than 250 pounds of nitrogen per acre. Due to small sample sizes for many crop types, complete box and whisker plots could not be drawn for some crop types.

A box and whisker plot of the A/Y ratios for the reported crops is provided in **Figure 4-3**. There is variability in A/Y ratios for some crops such as cotton and pistachios, but the spreads of much of the other data are relatively consistent.

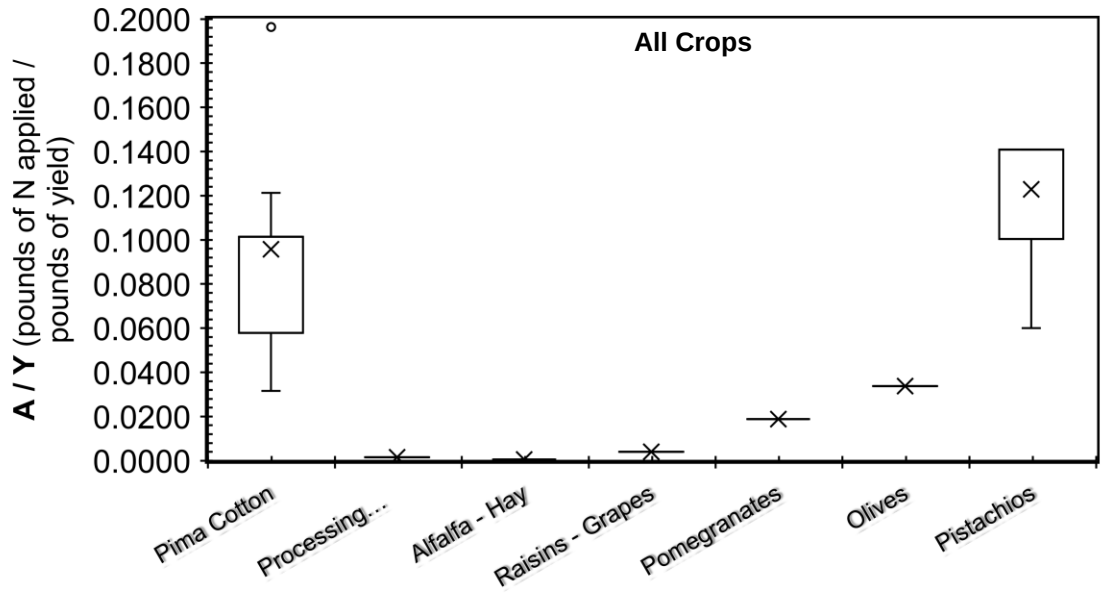


Figure 4-3. Box and Whisker Plot of A/Y Ratios by Crop for the Submitted NMP Summary Report Data

Note: Due to small sample sizes for many crop types, complete box and whisker plots could not be drawn for some crop types.

A box and whisker plot summarizing the available A/R data is included as **Figure 4-4**. Overall, most of the A/R ratios were less than 4.0. As previously discussed, over 100% of the reported nitrogen applications were less than 400 lbs/ac, which is reasonable for many crops (Rosenstock et al., 2013). It is possible that some of the average nitrogen removal coefficients that were used in this analysis are too low or are not reflective of the actual amount of nitrogen being removed from the field *and* consumed by the crop for growth.

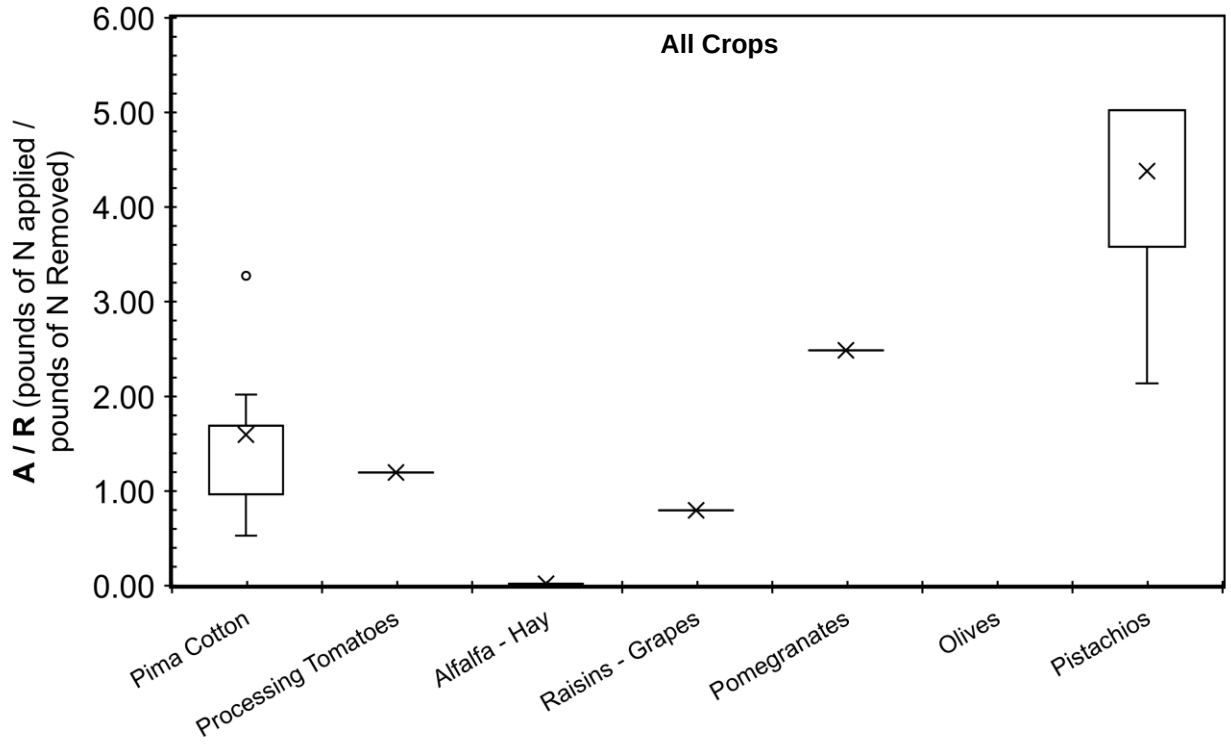


Figure 4-4. Box and Whisker Plot of A/R Ratios by Selected Crops from the Submitted NMP Summary Report Data

Note: Due to small sample sizes for many crop types, complete box and whisker plots could not be drawn for some crop types.

4.4 Grouping of Permanent Crops by General Age Group

General age groups were developed to more accurately compare nitrogen use and removal between younger and older permanent crops. Nitrogen management likely varies over the lifespan of permanent crops. Comparing nitrogen management within appropriate categories is more appropriate than comparing management of young trees to mature trees, for example. Age groups were developed with input from growers, industry professionals, packinghouses, soil scientists, agronomists, and professional judgment by the BVC. The groups were developed to generally represent physiological milestones in crop development. The broad categories for most crops were as follows: 1) young and developing, 2) mature and full production, and 3) older and possibly declining in production. For example, the age categories for almonds are as follows:

- Young and developing – Up to 5 years (bearing only)
- Mature and full production – 6 to 19 years
- Older and possibly declining Yield – 20+ years

Other crops such as pistachios and grape vines are only given two age categories at this time due to uncertainty regarding when production may start declining. The BVC will explore the reported data over the years for any yield trends vs. age and continue to work with growers and agricultural scientists to refine these groupings. Although this method somewhat over-simplifies the complexities of permanent crops, it is a starting point to complete a more meaningful analysis for growers and advisers. It is likely that A/R ratios of young and developing trees should be higher than full production trees due to the additional nitrogen that is required to grow the tree that is not removed from the field in a harvested product. Age grouping data are presented for each permanent crop summarized in the sections below.

4.5 Statistical Outliers and Grower Outreach

This NMP Summary Report Analysis evaluated all submitted data and identified statistical outliers (**Section 4.2.8**), as required. Although high and low statistical outliers were identified in an internal analysis, this report only summarizes high statistical outliers. Annual individual grower reports (called Nitrogen Analysis Reports, or **NAR**s, see **Section 4.7**) will be developed and delivered to all BVC members that submitted NMP Summary Reports after submittal of this AMR to the CVRWQCB. The NARs will summarize the reported information graphically and tabularly. The NARs should help growers with future nitrogen management planning, or at the very least, provide insights into nitrogen management trends for the crops each member grows. Selected results from this analysis will also be shared and discussed at future grower outreach meetings, as appropriate.

4.6 Analysis for Crops with Nitrogen Removal Coefficients

This section provides the results of the NMP Summary Report Analysis for crops that have nitrogen removal coefficients (**Table 4-3**). The results are presented in descending order of reported commodity acres so that the highest acreage crops are presented first. Box and whisker plots of A/R are provided on a township and coalition-wide basis, in addition to a comparison of those values by hydrologic soil group, irrigation type, and age grouping of permanent crops. Tabular summary statistics are also provided and include the number and percentage of high statistical outliers. A summary of data reported as NB, NY, or A/Y ratios of zero is included as **Table 4-6**.

Table 4-6. Summary of Crops Reported as Non-Bearing (NB), No Yield (NY), and A/Y=0 in the BVC

Grouped Crop Name	Non-Bearing (NB)					No Yield (NY)					A/Y = 0					Totals for NB, NY, and A/Y = 0					Unknown				
	Fields	Acres	Yield (lbs)	Total N Applied (lbs)	Average N Application Rate (lbs/acre)	Fields	Acres	Yield (lbs)	Total N Applied (lbs)	Average N Application Rate (lbs/acre)	Fields	Acres	Yield (lbs)	Total N Applied (lbs)	Average N Application Rate (lbs/acre)	Fields	Acres	Yield (lbs)	Total N Applied (lbs)	Average N Application Rate (lbs/acre)	Fields	Acres	Yield (lbs)	Total N Applied (lbs)	Average N Application Rate (lbs/acre)
Pistachios	22	3,539	-	287,533	81	-	-	-	-	-	-	-	-	-	-	22	3,539	-	287,533	81	-	-	-	-	-
Walnuts	5	818	-	45,081	55	-	-	-	-	-	-	-	-	-	-	5	818	-	45,081	55	-	-	-	-	-
Alfalfa – Hay	-	-	-	-	-	-	-	-	-	-	1	103	-	-	-	1	103	-	-	-	-	-	-	-	-
Almonds	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Pima Cotton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Processing Tomatoes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Raisins - Grapes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pomegranates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Olives	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Irrigated Acreage Enrolled – Fallow	12	864	-	-	-	1	90	-	-	-	-	-	-	-	-	13	954	-	-	-	-	-	-	-	-
No (0) Irrigated Acreage Enrolled – Fallow	2	28	-	-	-	11	-	-	-	-	-	-	-	-	-	13	28	-	-	-	-	-	-	-	-
Grand Total:	**41**	**5,250**	**-**	**332,614**	**63**	**13**	**91**	**-**	**-**	**-**	**1**	**103**	**-**	**-**	**-**	**55**	**5,444**	**-**	**332,614**	**61**	**-**	**-**	**-**	**-**	**-**

Notes:
Abbreviations: "A/Y" = applied nitrogen / crop yield; "N" = nitrogen, "NB" = non-bearing, "NY" = no yield.
All acre values represent reported commodity acres.

4.6.1 Raisin Grapes

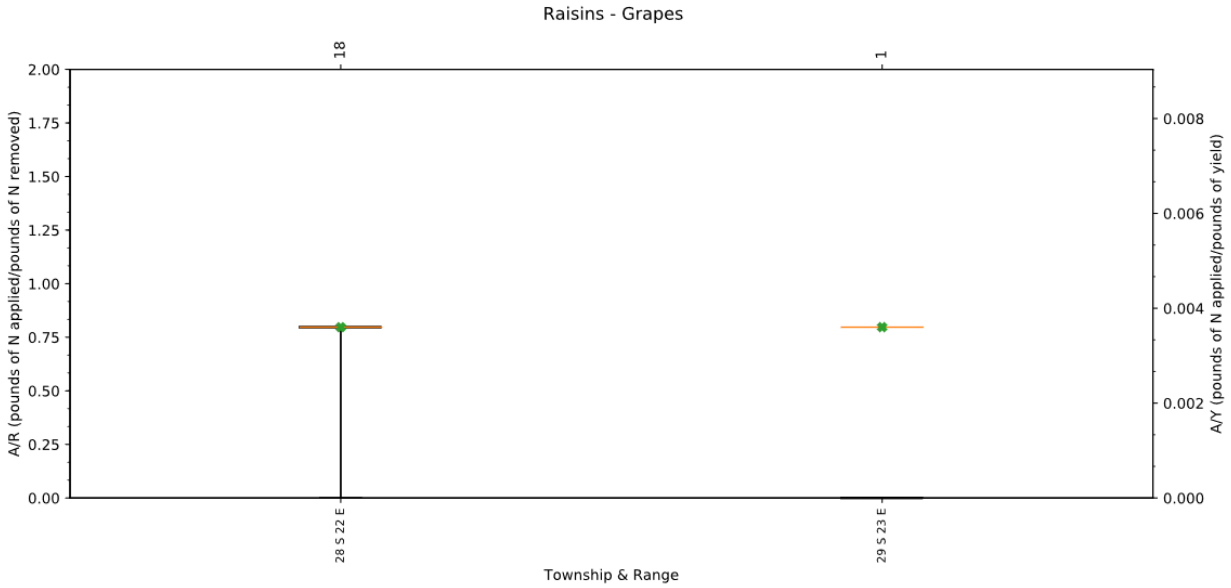


Figure 4-5. Box and Whisker Plots of A/Y and A/R for all Submitted NMP Summary Report Data for Raisin Grapes by Township and Range

Note: Due to small sample sizes for many crop types, complete box and whisker plots could not be drawn for some crop types.

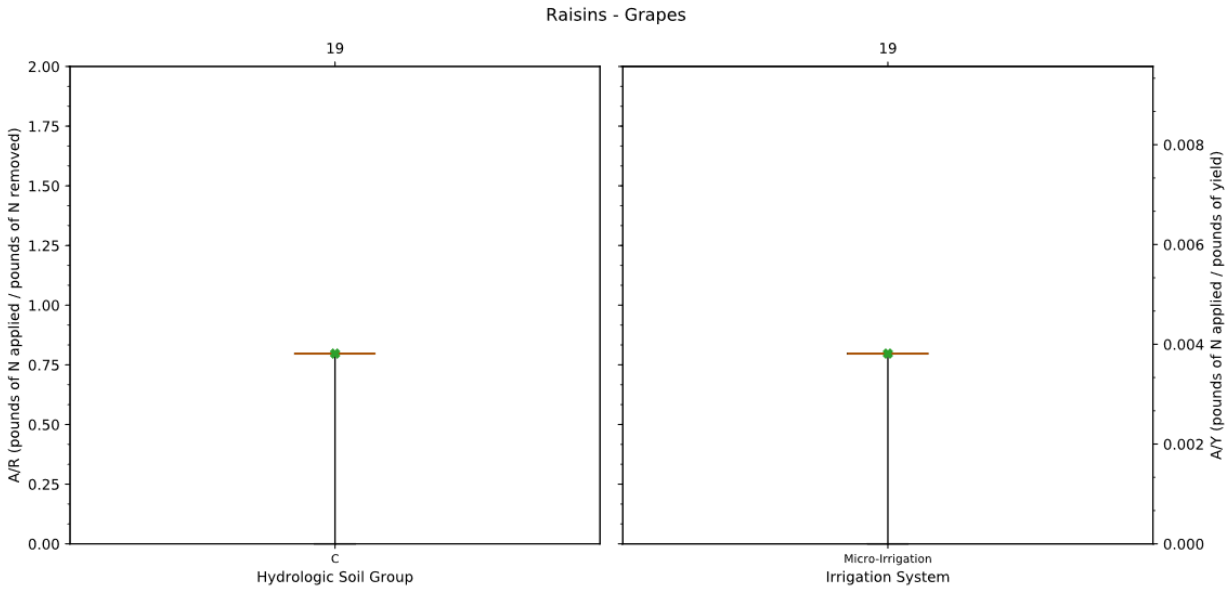


Figure 4-6. Box and Whisker Plots of A/R by Irrigation System and Hydrologic Soil Group for Reported Raisin Grapes Fields

Note: Due to small sample sizes for many crop types, complete box and whisker plots could not be drawn for some crop types.

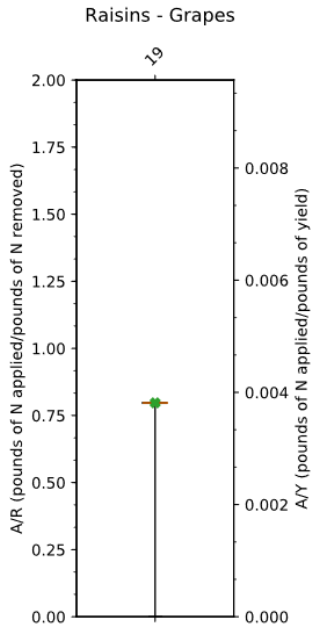


Figure 4-7. Box and Whisker Plot of A/R for all Reported and Bearing Raisin Grapes Fields in the BVC

Note: Due to small sample sizes for many crop types, complete box and whisker plots could not be drawn for some crop types.

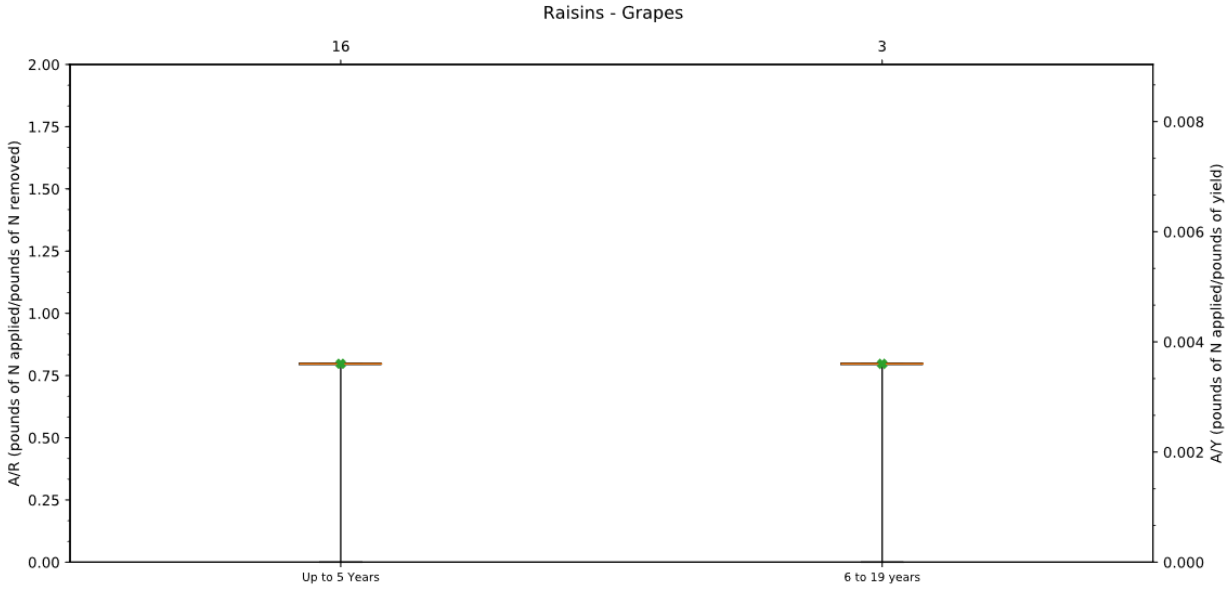


Figure 4-8. Box and Whisker Plot of A/R by Age Grouping for Reported Raisin Grapes Fields

Note: Due to small sample sizes for many crop types, complete box and whisker plots could not be drawn for some crop types.

Table 4-7. Summary Statistics of A/R for Raisin Grapes with Reported Yield

Township and Range	# Fields (n)	Total Commodity Acres	Min	Max	Range	A/R	Std. Dev.	10%	25%	50%	75%	90%	# High Outliers	% High Outliers
28 S 22 E	18	3,191	0.80	0.80	0.00	**0.80**	0.00	0.80	0.80	0.80	0.80	0.80	0	0%
29 S 23 E	1	285	0.80	0.80	0.00	**0.80**	0.00	n/a	n/a	0.80	n/a	n/a	0	0%
Raisin Grapes Coalition-Wide:	**19**	**3,476**	**0.80**	**0.80**	**0.00**	**0.80**	**0.00**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0**	**0%**

Note: Data set is too small to correctly calculate percentiles for box and whisker plots.

Table 4-8. Summary Statistics of A/R for Raisin Grapes with Reported Yield by Age Category

Age Category	# Fields	Total Commodity Acres	Acreage-Weighted Average Nitrogen Application Rate	Acreage-Weighted Average Yield	Min	Max	Range	Acreage-Weighted Average A/R	Std. Dev.	Percentiles					# High Outliers	% High Outliers
	n		pounds/acre							10th	25th	50th	75th	90th		
Up to 5 Years	16	2,578	52	81	0.80	0.80	0.00	**0.80**	0.00	0.80	0.80	0.80	0.80	0.80	0	0%
6 to 19 years	3	899	52	43	0.80	0.80	0.00	**0.80**	0.00	n/a	0.80	0.80	0.80	n/a	0	0%

4.6.2 Pima Cotton

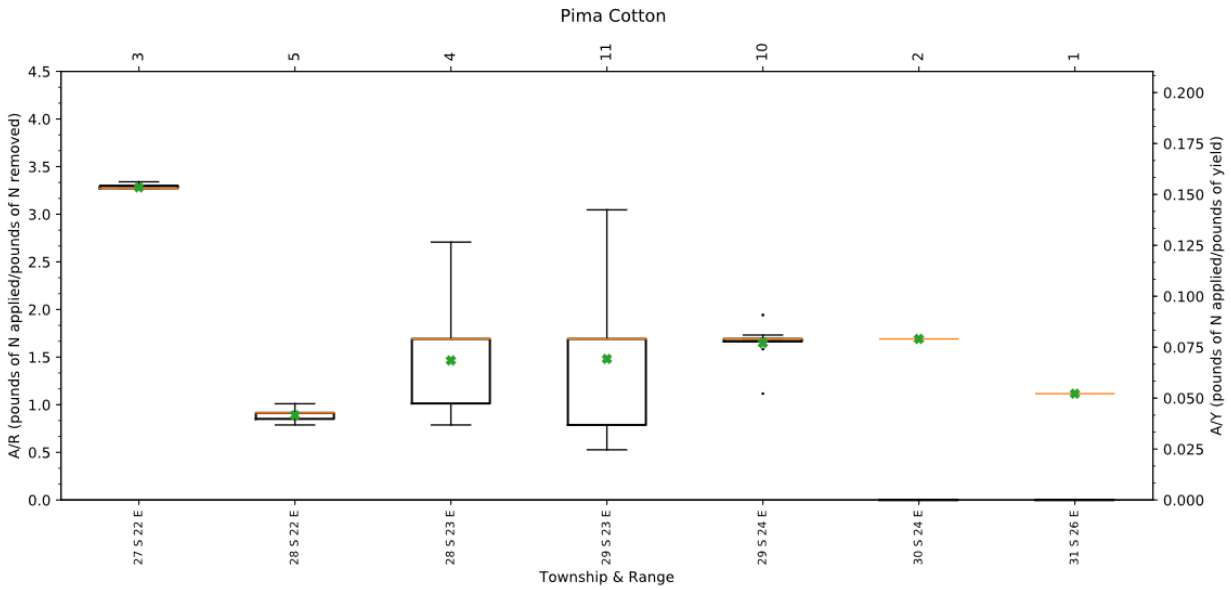


Figure 4-9. Box and Whisker Plots of A/Y and A/R for all Submitted NMP Summary Report Data for Pima Cotton by Township and Range

Note: Due to small sample sizes for some townships, complete box and whisker plots could not be drawn for some townships.

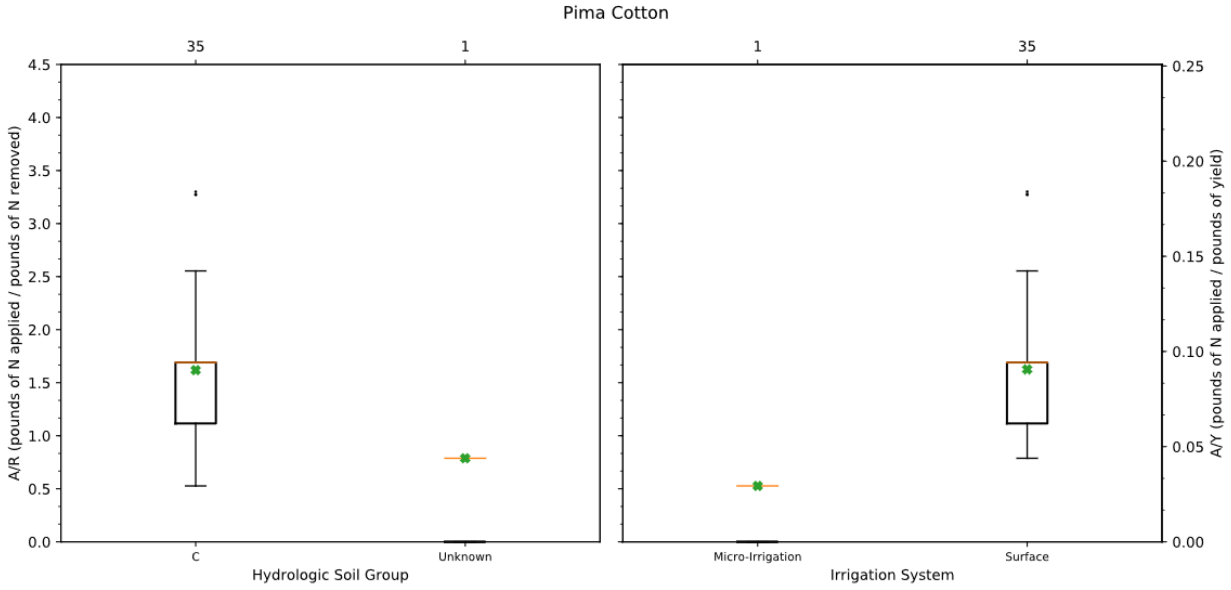


Figure 4-10. Box and Whisker Plots of A/R by Irrigation System and Hydrologic Soil Group for Reported Pima Cotton Fields

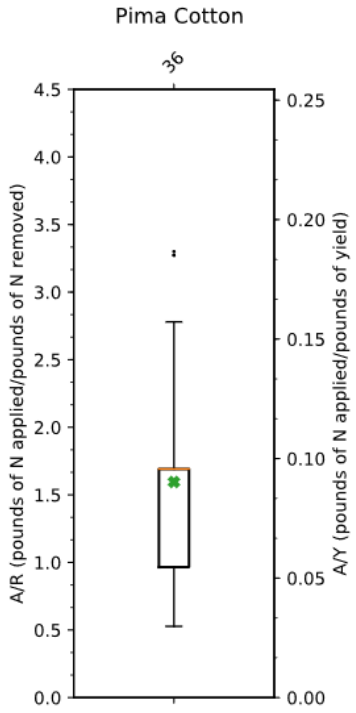


Figure 4-11. Box and Whisker Plot of A/R for all Reported and Bearing Pima Cotton Fields in the BVC

Table 4-9. Summary Statistics of A/R for Pima Cotton with Reported Yield

Township and Range	# Fields (n)	Total Commodity Acres	Min	Max	Range	A/R	Std. Dev.	10 %	25%	50%	75%	90%	# High Outliers	% High Outliers
27 S 22 E	3	359	3.27	3.30	0.03	**3.28**	0.01	n/a	3.27	3.27	3.30	n/a	0	0%
28 S 22 E	5	537	0.79	0.91	0.13	**0.88**	0.05	n/a	0.85	0.91	0.91	n/a	0	0%
28 S 23 E	4	224	0.79	1.69	0.90	**1.37**	0.39	n/a	1.01	1.69	1.69	n/a	0	0%
29 S 23 E	11	1,143	0.53	2.02	1.49	**1.54**	0.50	0.58	0.79	1.69	1.69	2.02	0	0%
29 S 24 E	10	529	1.12	1.94	0.83	**1.53**	0.20	1.16	1.66	1.69	1.69	1.92	1	10%
30 S 24 E	2	75	1.69	1.69	0.00	**1.69**	0.00	n/a	n/a	1.69	n/a	n/a	2	100%
31 S 26 E	1	211	1.12	1.12	0.00	**1.12**	0.00	n/a	n/a	1.12	n/a	n/a	0	0%
Pima Cotton Coalition-Wide:	**36**	**3,078**	**0.53**	**3.30**	**2.77**	**1.40**	**0.65**	**0.79**	**0.97**	**1.69**	**1.69**	**2.40**	**3**	**8%**

4.6.3 Pistachios

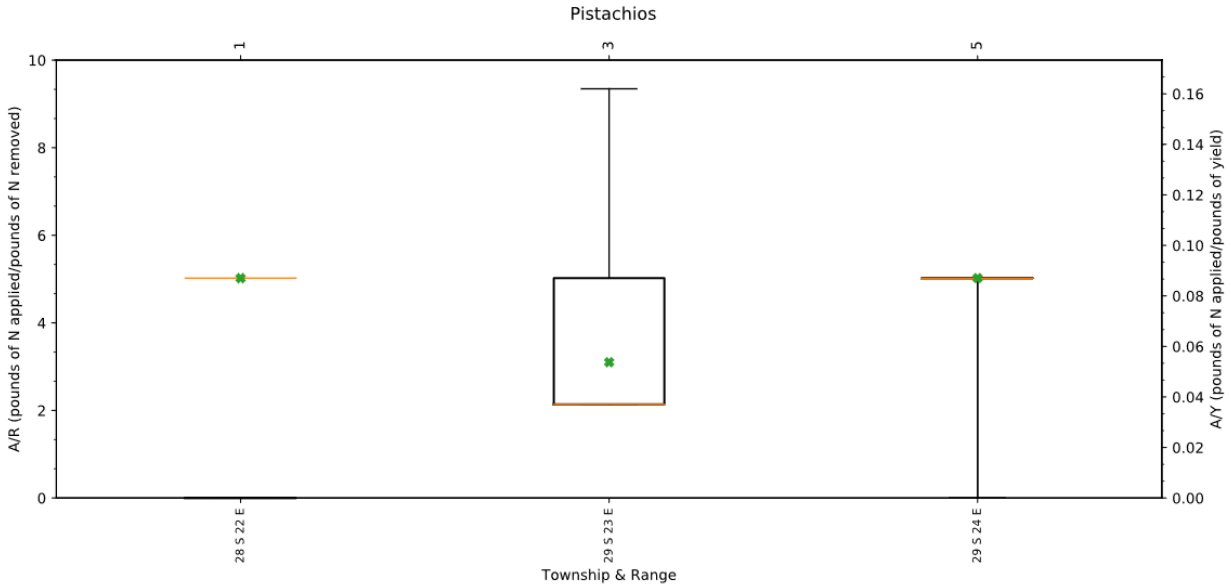


Figure 4-12. Box and Whisker Plots of A/Y and A/R for all Submitted NMP Summary Report Data for Pistachios by Township and Range

Note: Due to small sample sizes for some townships, complete box and whisker plots could not be drawn for some townships.

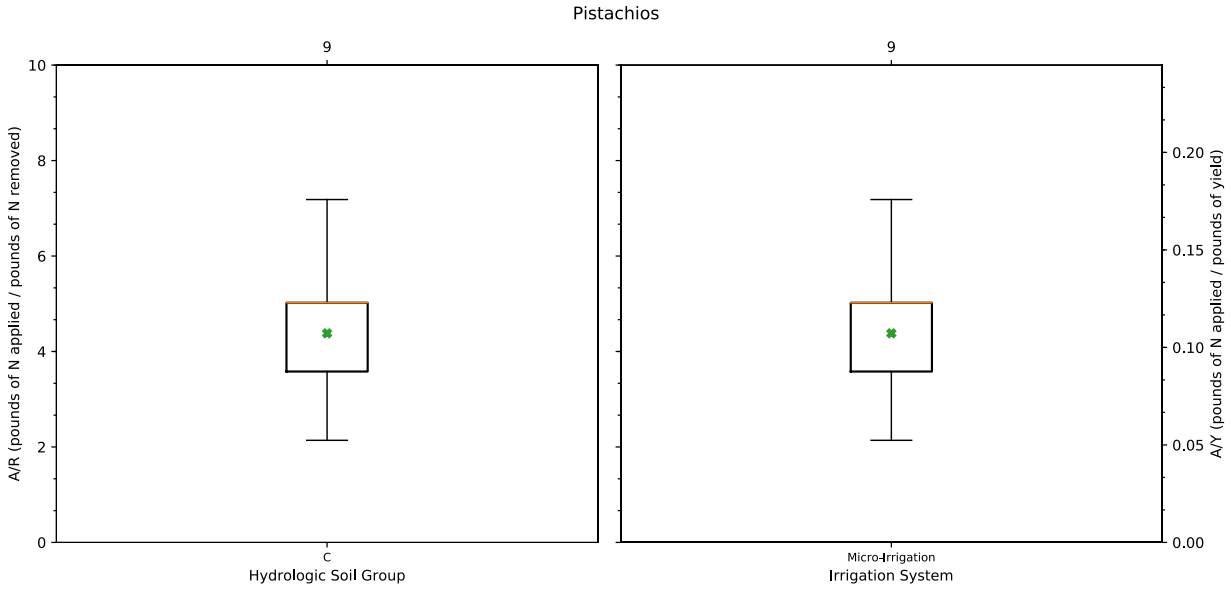


Figure 4-13. Box and Whisker Plots of A/R by Irrigation System and Hydrologic Soil Group for Reported Pistachio Fields

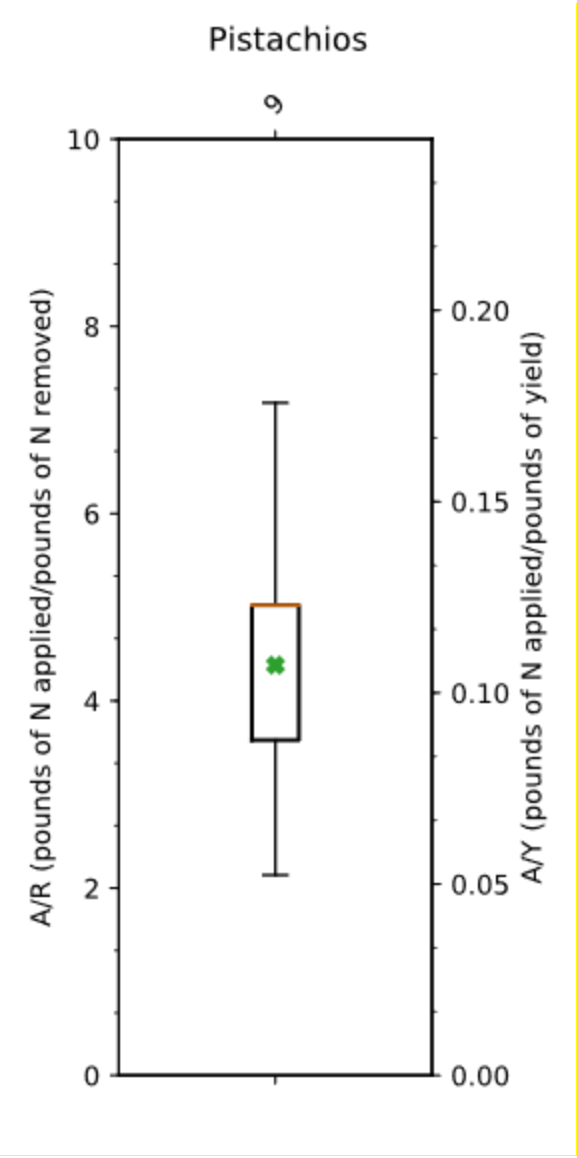


Figure 4-14. Box and Whisker Plot of A/R for all Reported and Bearing Pistachio fields in the BVC

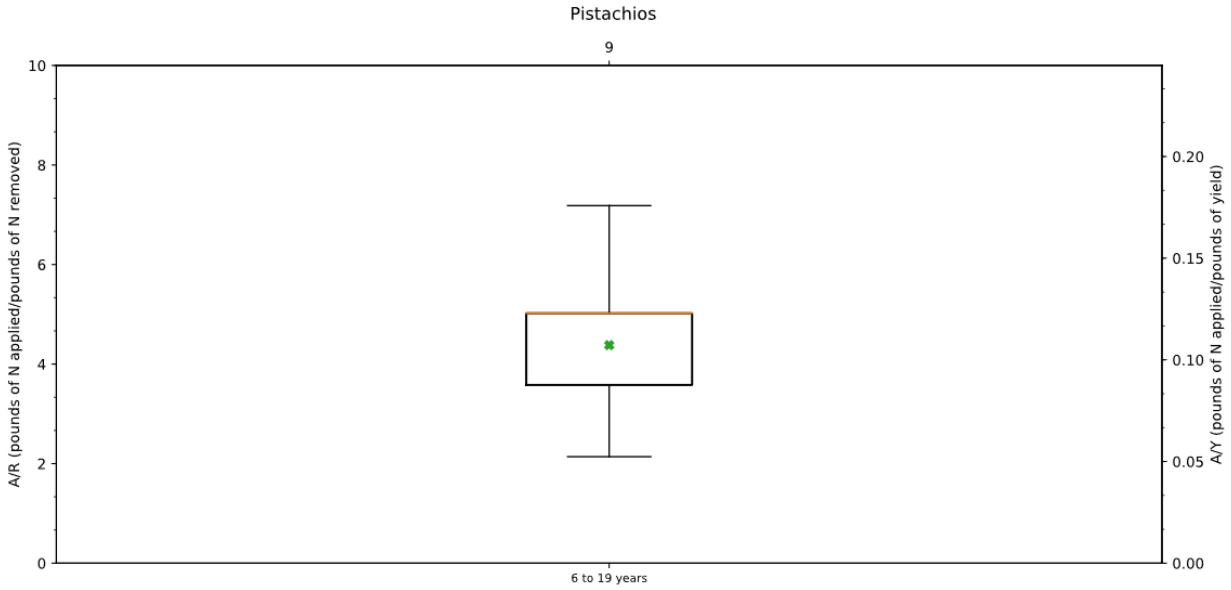


Figure 4-15. Box and Whisker Plot of A/R by Age Grouping for Reported Pistachio Fields

Table 4-10. Summary Statistics of A/R for Pistachios with Reported Yield

Township and Range	# Fields (n)	Total Commodity Acres	Min	Max	Range	A/R	Std. Dev.	10%	25%	50%	75%	90%	# High Outliers	% High Outliers
28 S 22 E	1	435	5.02	5.02	0.00	**5.02**	0.00	n/a	n/a	5.02	n/a	n/a	0	0%
29 S 23 E	3	126	2.14	5.02	2.88	**2.33**	1.36	n/a	2.14	2.14	5.02	n/a	0	0%
29 S 24 E	5	532	5.02	5.02	0.00	**5.02**	0.00	n/a	5.02	5.02	5.02	n/a	0	0%
Pistachios Coalition-Wide:	**9**	**1,093**	**2.14**	**5.02**	**2.88**	**4.49**	**1.20**	**2.14**	**3.58**	**5.02**	**5.02**	**5.02**	**0**	**0%**

*Data set is too small to correctly calculate percentiles for box and whisker plots.

Table 4-11. Summary Statistics of A/R for Pistachios with Reported Yield by Age Category

Age Category	# Fields	Total Commodity Acres	Acreage-Weighted Average Nitrogen Application Rate	Acreage-Weighted Average Yield	Min	Max	Range	Acreage-Weighted Average A/R	Std. Dev.	Percentiles					# High Outliers	% High Outliers
	n		pounds/acre							10th	25th	50th	75th	90th		
6 to 19 years	9	1,093	204	15	2.14	5.02	2.88	**4.49**	1.20	2.14	3.58	5.02	5.02	5.02	0	0%

4.6.4 Alfalfa Hay

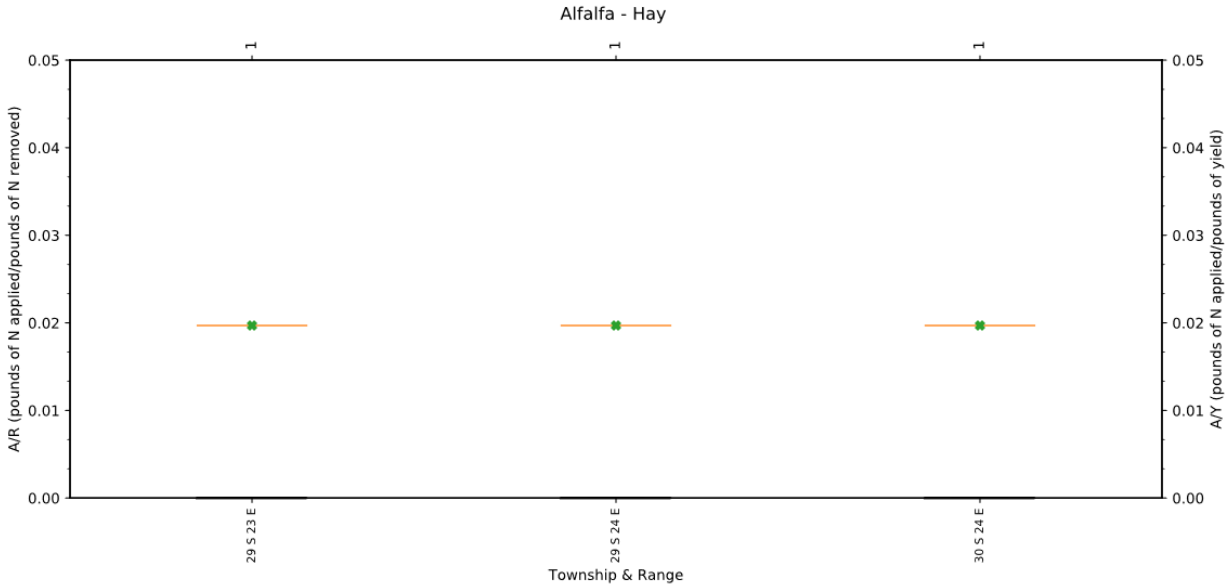


Figure 4-16. Box and Whisker Plots of A/Y and A/R for all Submitted NMP Summary Report Data for Alfalfa Hay by Township and Range

Note: Due to small sample sizes for some townships, complete box and whisker plots could not be drawn for some townships.

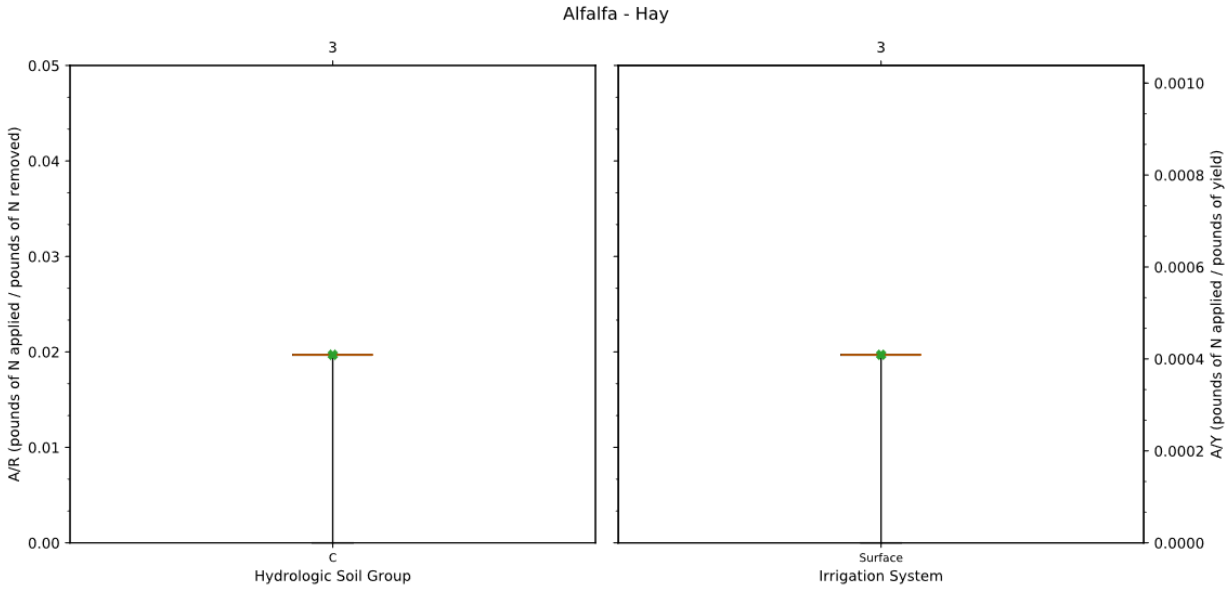


Figure 4-17. Box and Whisker Plots of A/R and A/Y by Irrigation System and Hydrologic Soil Group for Reported Alfalfa Hay Fields

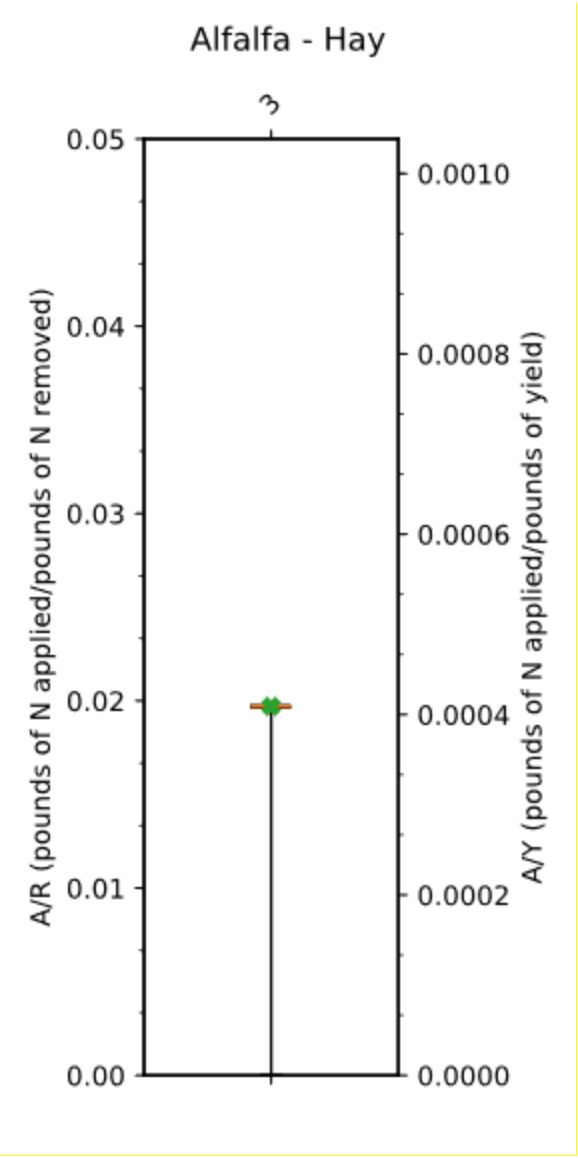


Figure 4-18. Box and Whisker Plot of A/R and A/Y for all Reported and Bearing Alfalfa Hay Fields in the BVC

Note: Due to small sample sizes for Alfalfa Hay, complete box and whisker plots could not be drawn.

Table 4-12. Summary Statistics of A/R for Alfalfa Hay with Reported Yield

Township and Range	# Fields (n)	Total Commodity Acres	Min	Max	Range	A/R	Std. Dev.	10%	25%	50%	75%	90%	# High Outliers	% High Outliers
29 S 23 E	1	95	0.02	0.02	0.00	**0.02**	0.00	n/a	n/a	0.02	n/a	n/a	0	0%
29 S 24 E	1	75	0.02	0.02	0.00	**0.02**	0.00	n/a	n/a	0.02	n/a	n/a	0	0%
30 S 24 E	1	54	0.02	0.02	0.00	**0.02**	0.00	n/a	n/a	0.02	n/a	n/a	0	0%
Alfalfa Hay Coalition-Wide:	**3**	**224**	**0.02**	**0.02**	**0.00**	**0.02**	**0.00**	**0.00**	**0.02**	**0.02**	**0.02**	**0.00**	**0**	**0%**

*Data set is too small to correctly calculate percentiles for box and whisker plots.

4.6.5 Pomegranates

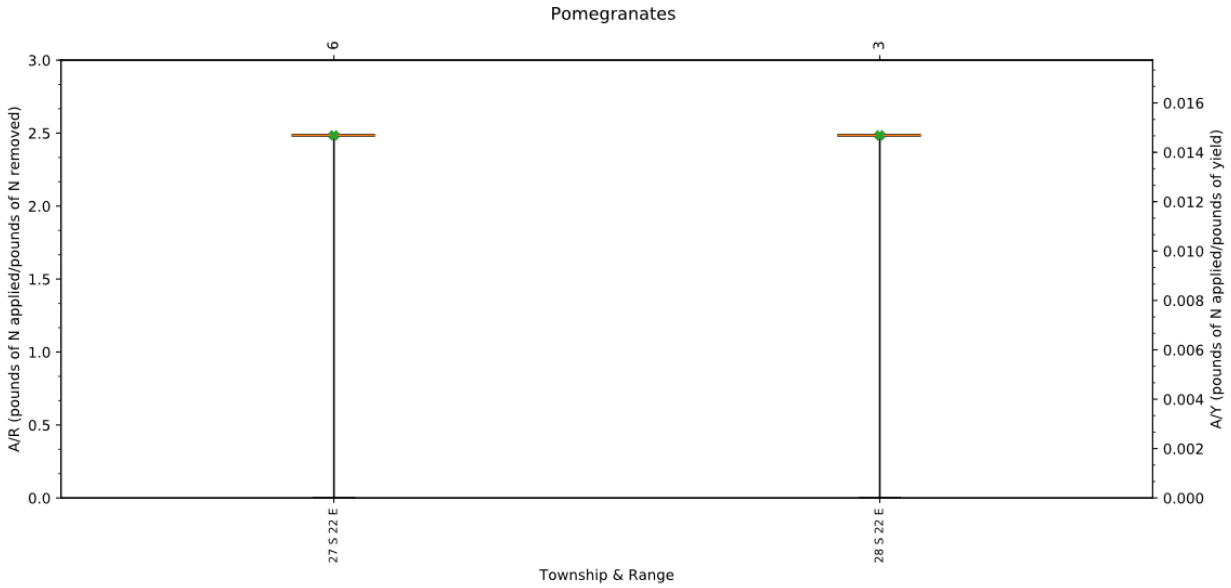


Figure 4-19. Box and Whisker Plots of A/Y and A/R for all Submitted NMP Summary Report Data for Pomegranates by Township and Range

Note: Due to small sample sizes for some townships, complete box and whisker plots could not be drawn for some townships.

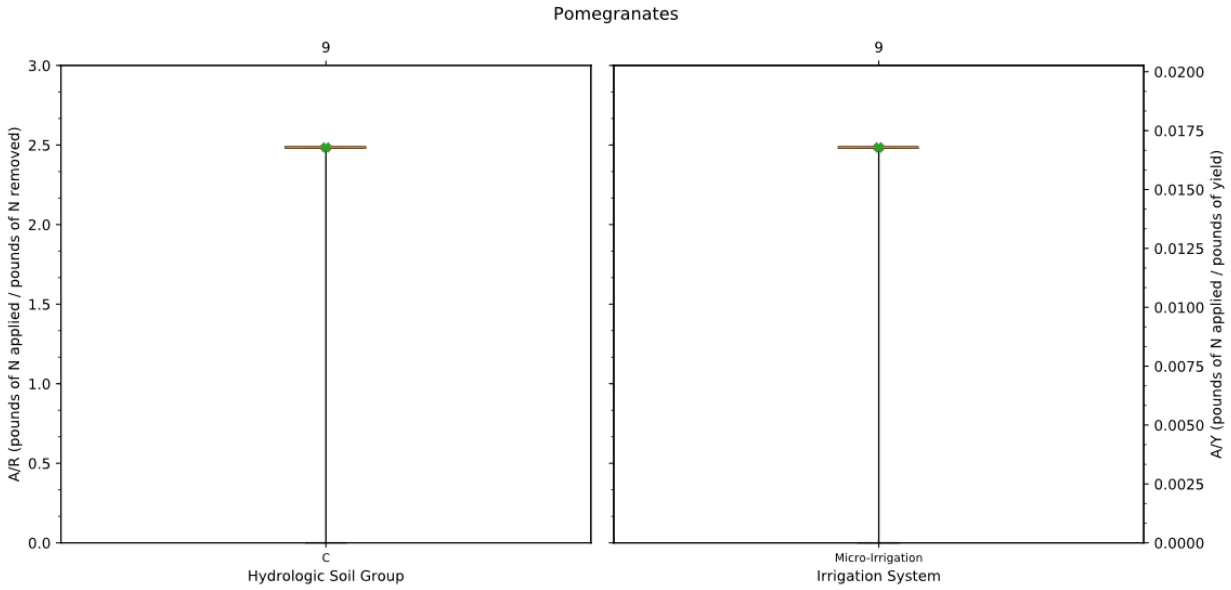


Figure 4-20. Box and Whisker Plots of A/R by Irrigation System and Hydrologic Soil Group for Reported Pomegranate Fields

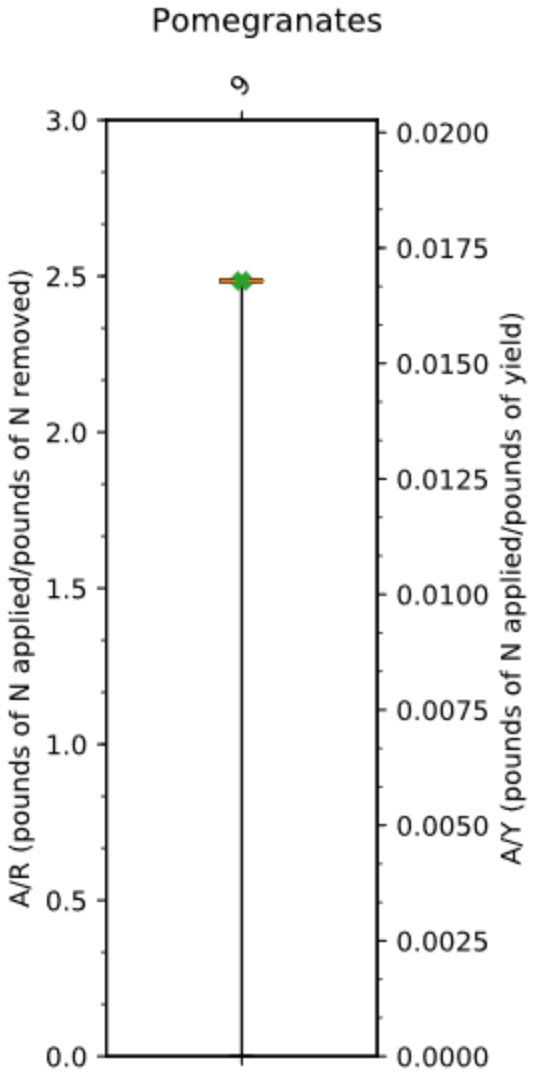


Figure 4-21. Box and Whisker Plot of A/R for all Reported and Bearing Pomegranate Fields in the BVC

Note: Due to small sample sizes for pomegranates, complete box and whisker plots could not be drawn.

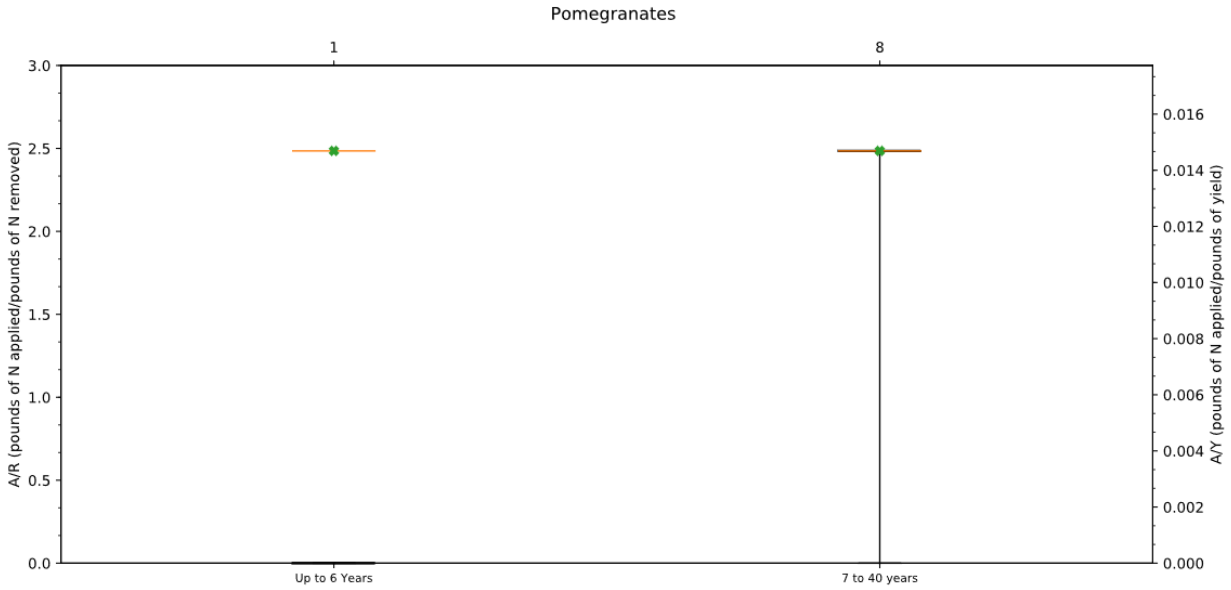


Figure 4-22. Box and Whisker Plot of A/R by Age Grouping for Reported Pomegranate Fields

Note: Due to small sample sizes for pomegranates, complete box and whisker plots could not be drawn.

Table 4-13. Summary Statistics of A/R for Pomegranates with Reported Yield

Township and Range	# Fields (n)	Total Commodity Acres	Min	Max	Range	A/R	Std. Dev.	10%	25%	50%	75%	90%	# High Outliers	% High Outliers
27 S 22 E	6	1,057	2.48	2.48	0.00	**2.48**	0.00	n/a	2.48	2.48	2.48	n/a	0	0%
28 S 22 E	3	574	2.48	2.48	0.00	**2.48**	0.00	n/a	2.48	2.48	2.48	n/a	0	0%
Pomegranates Coalition-Wide:	**9**	**1,631**	**2.48**	**2.48**	**0.00**	**2.48**	**0.00**	**n/a**	**2.48**	**2.48**	**2.48**	**n/a**	**0**	**0%**

*Data set is too small to correctly calculate percentiles for box and whisker plots.

Table 4-14. Summary Statistics of A/R for Pomegranates with Reported Yield by Age Category

Age Category	# Fields	Total Commodity Acres	Acreage-Weighted Average Nitrogen Application Rate	Acreage-Weighted Average Yield	Min	Max	Range	Acreage-Weighted Average A/R	Std. Dev.	Percentiles					# High Outliers	% High Outliers
	n		pounds/acre							10th	25th	50th	75th	90th		
Up to 6 Years	1	36	155	227	2.48	2.48	0.00	**2.48**	0.00	n/a	n/a	2.48	n/a	n/a	0	0%
7 to 40 years	8	1,595	155	41	2.48	2.48	0.00	**2.48**	0.00	n/a	2.48	2.48	2.48	n/a	0	0%

4.6.6 Processing Tomatoes

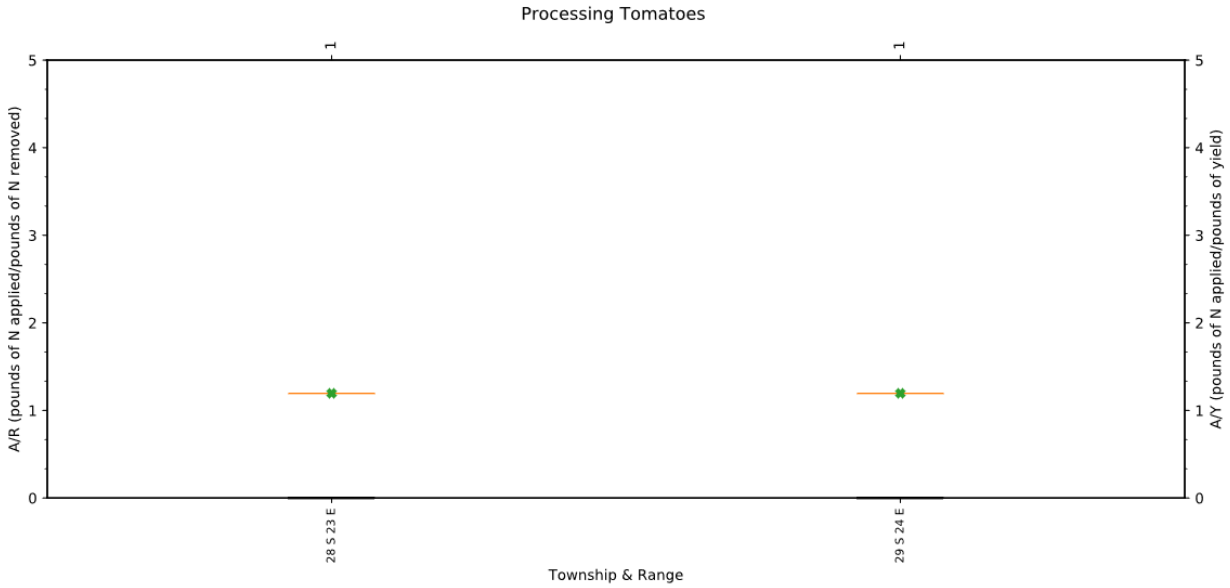


Figure 4-23. Box and Whisker Plots of A/Y and A/R for all Submitted NMP Summary Report Data for Processing Tomatoes by Township and Range

Note: Due to small sample sizes for processing tomatoes, complete box and whisker plots could not be drawn.

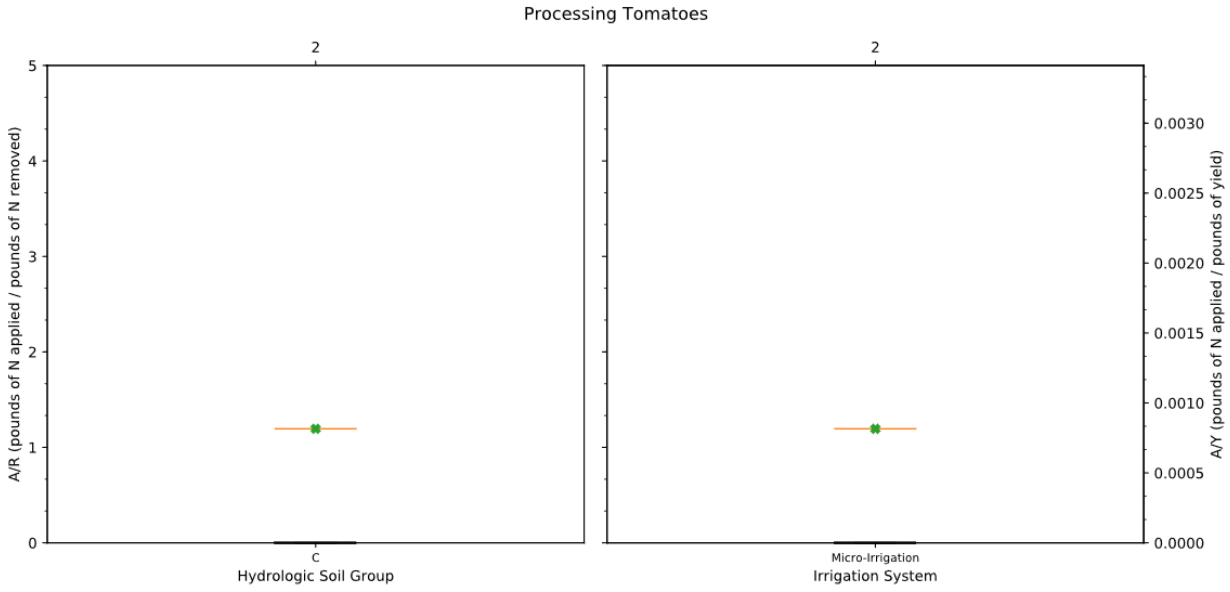


Figure 4-24. Box and Whisker Plots of A/R by Irrigation System and Hydrologic Soil Group for Reported Processing Tomato Fields

Note: Due to small sample sizes for processing tomatoes, complete box and whisker plots could not be drawn.

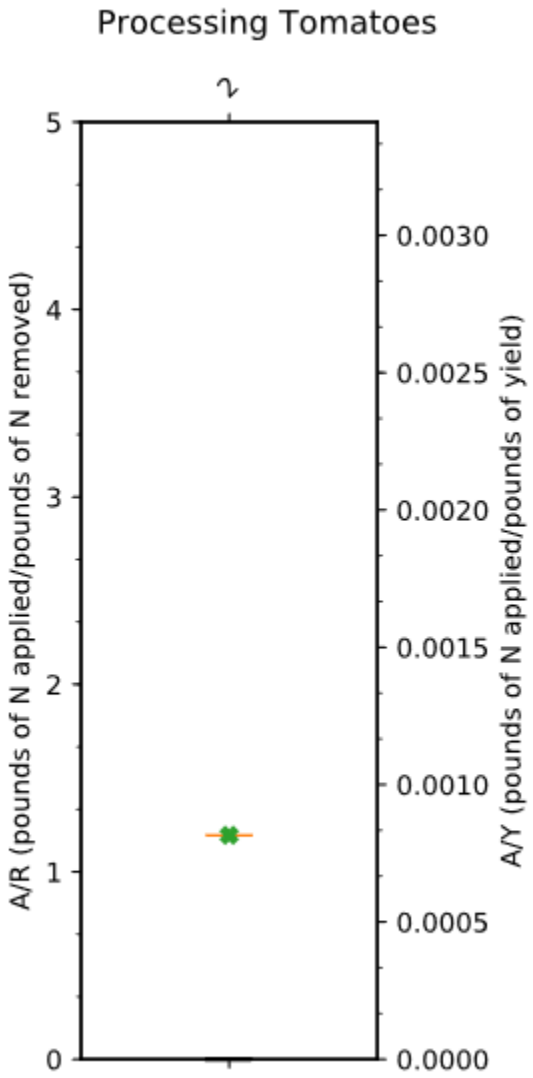


Figure 4-25. Box and Whisker Plot of A/R for all Reported and Bearing Processing Tomato Fields in the BVC

Note: Due to small sample sizes for processing tomatoes, complete box and whisker plots could not be drawn.

Table 4-15. Summary Statistics of A/R for Processing Tomato with Reported Yield

Township and Range	# Fields (n)	Total Commodity Acres	Min	Max	Range	A/R	Std. Dev.	10%	25%	50%	75%	90%	# High Outliers	% High Outliers
28 S 23 E	1	90	1.19	1.19	0.00	**1.19**	0.00	n/a	n/a	1.19	n/a	n/a	0	0%
29 S 24 E	1	68	1.19	1.19	0.00	**1.19**	0.00	n/a	n/a	1.19	n/a	n/a	0	0%
Processing Tomatoes Coalition-Wide:	**2**	**158**	**1.19**	**1.19**	**0.00**	**1.19**	**0.00**	**0.00**	**0.00**	**1.19**	**0.00**	**0.00**	**0**	**0%**

*Data set is too small to correctly calculate percentiles for box and whisker plots.

4.6.7 Olives

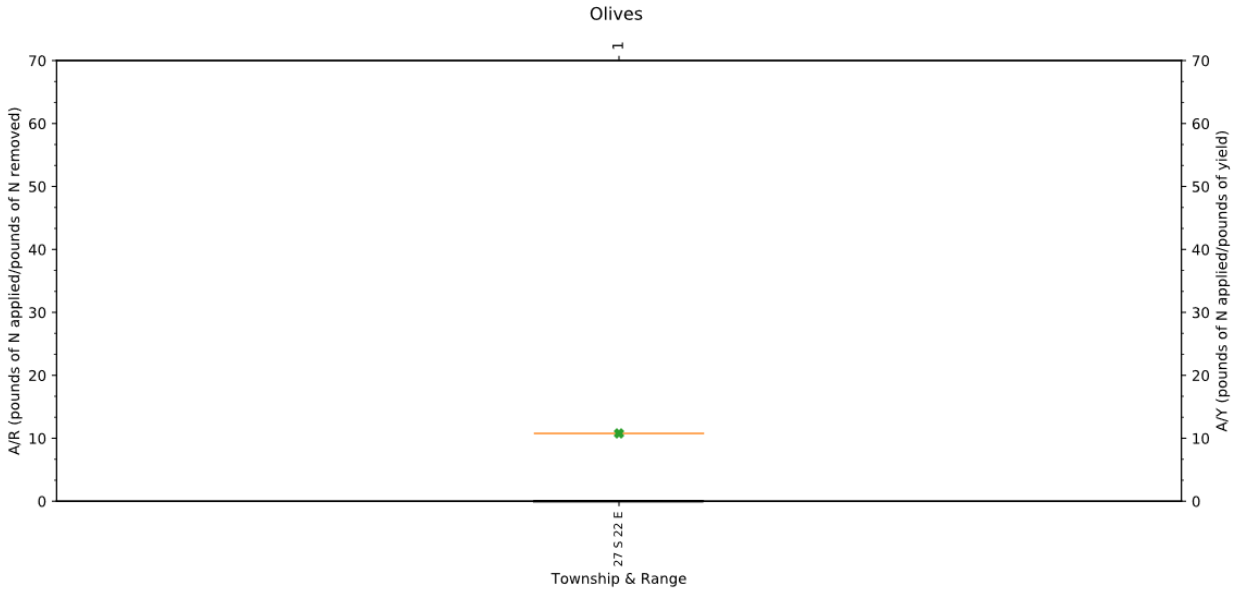


Figure 4-26. Box and Whisker Plots of A/Y and A/R for all Submitted NMP Summary Report Data for Olives by Township and Range

Note: Due to small sample sizes for olives, complete box and whisker plots could not be drawn.

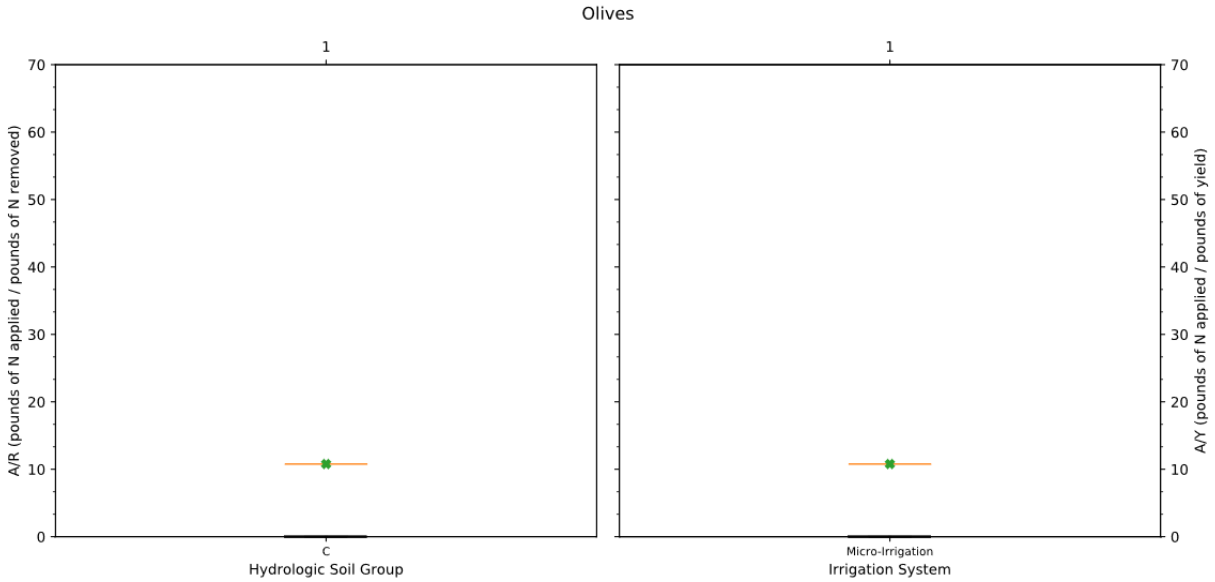


Figure 4-27. Box and Whisker Plots of A/R by Irrigation System and Hydrologic Soil Group for Reported Olive Fields

Note: Due to small sample sizes for olives, complete box and whisker plots could not be drawn.

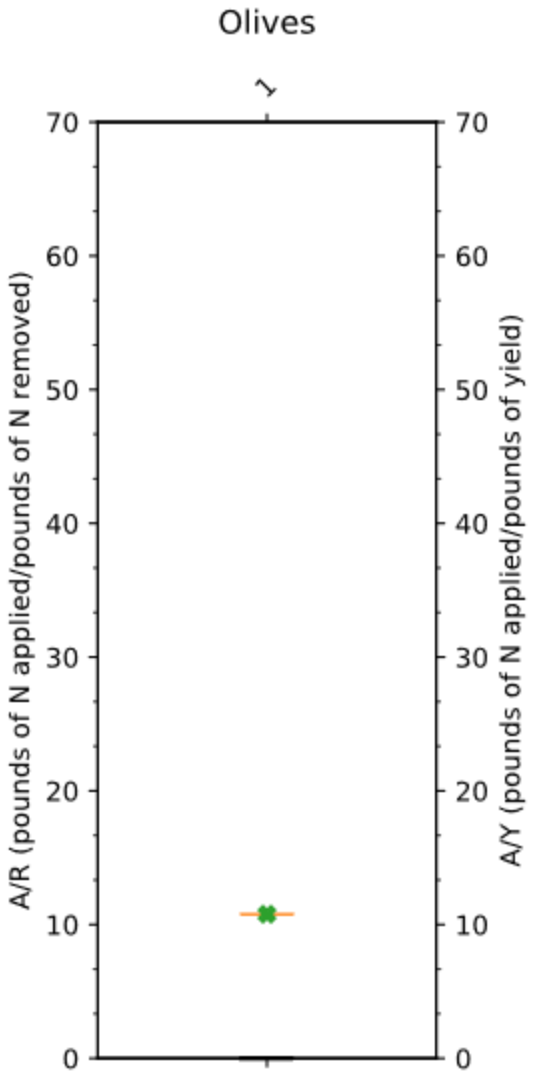


Figure 4-28. Box and Whisker Plot of A/R for all Reported and Bearing Olive Fields in the BVC

Note: Due to small sample sizes for olives, complete box and whisker plots could not be drawn.

Figure 4-29. Box and Whisker Plot of A/R by Age Grouping for Reported Olive Fields

Note: Due to small sample sizes for olives, complete box and whisker plots could not be drawn.

Table 4-16. Summary Statistics of A/R for Olives with Reported Yield

Township and Range	# Fields (n)	Total Commodity Acres	Min	Max	Range	A/R	Std. Dev.	10%	25%	50%	75%	90%	# High Outliers	% High Outliers
27 S 22 E	1	66	10.77	10.77	0.00	**10.77**	0.00	n/a	n/a	10.77	n/a	n/a	0	0%
Olives Coalition-Wide:	**1**	**66**	**10.77**	**10.77**	**0.00**	**10.77**	**0.00**	**0.00**	**0.00**	**10.77**	**0.00**	**0.00**	**0**	**0%**

*Data set is too small to correctly calculate percentiles for box and whisker plots.

Table 4-17. Summary Statistics of A/R for Olives with Reported Yield by Age Category

Age Category	# Fields	Total Commodity Acres	Acreage-Weighted Average Nitrogen Application Rate	Acreage-Weighted Average Yield	Min	Max	Range	Acreage-Weighted Average A/R	Std. Dev.	Percentiles					# High Outliers	% High Outliers
	n		pounds/acre							10th	25th	50th	75th	90th		
9 to 49 years	1	66	65	29	10.77	10.77	0.00	**10.77**	0.00	n/a	n/a	10.77	n/a	n/a	0	0%

4.7 Example Nitrogen Analysis Report (NAR)

An example NAR is provided below. This report is mailed to every BVC member that submitted an NMP Summary Report each year after submission of the AMR to the CVRWQCB. The objectives of the NAR are to provide individual feedback on the data that growers submitted to the BVC, provide a comparison of individual grower nitrogen use to all other growers of the same crop in the BVC, and to possibly improve nitrogen management, if necessary.

ILRP NITROGEN ANALYSIS REPORT (NAR)

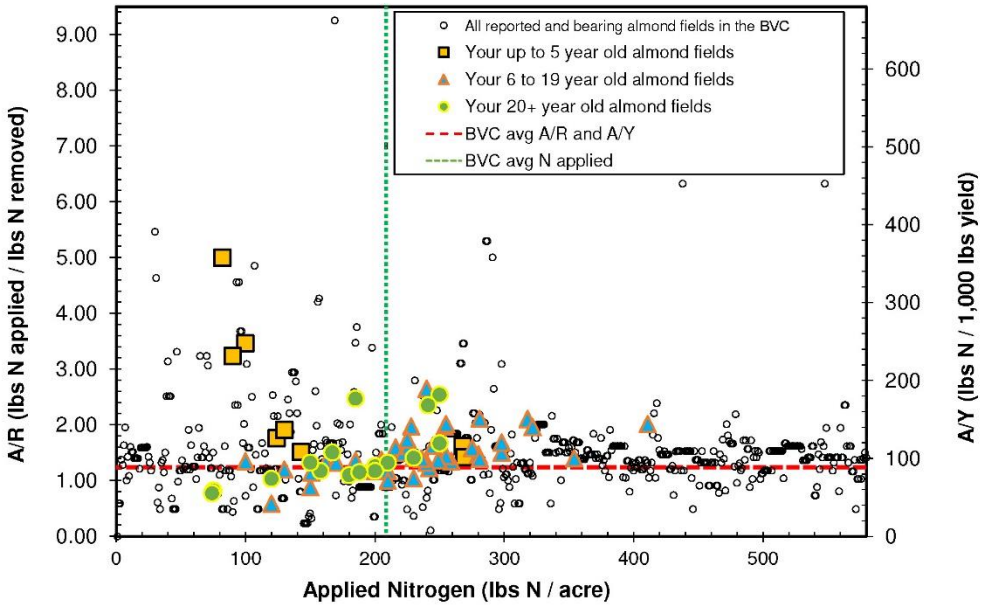
Buena Vista Coalition (BVC)

Crop/Harvest Year: 2017 **Member ID:** xxxxx **Member Name:** Example Farms

Summary and analysis of your Nitrogen Management Plan (NMP) Summary Report
A summary and analysis of your submitted nitrogen (N) information is provided below. Note that the units for the ratio of N applied over crop yield (A/Y) has been converted to pounds (lbs) of N applied over 1,000 pounds of crop yield, which will not match the information you submitted.

The scatterplot (s) below illustrates the relationship between total N applied and the ratios of N applied over N removed (A/R) and A/Y for all reported and bearing fields in the BVC and your fields by crop. As defined in the graph legend, your fields are illustrated as colored symbols, and all other reported fields in the BVC are illustrated with **black circles**. The horizontal red line is the average A/R and A/Y for all reported and yielding data for the specified crop. The vertical green line shows the average N application rate. In general, fields that are lower on the vertical axis of the graph were likely more efficient with their N management than fields higher on the graph. Fields to the right of the green line applied more N than fields to the left. Note that these lines are only averages and not represent limits, regulatory thresholds, or recommendations.

Crop: Almonds



NOTE: The black circles in the graph above represent all *bearing* fields in the BVC. Any non-bearing (NB) or no yield (NY) fields that you may have were graphed with A/R and A/Y ratios of zero (0) for comparison of nitrogen application rates only.

Crop/Harvest Year: 2017 Member ID: XXXXX Member Name: Example Farms

Table Summary

The table below provides detailed information for each field reported on your NMP Summary Report. The first six columns are a summary of the information you submitted, and the other two columns provide information on N removal and A/R, when available. Overall crop averages for your fields are included at the bottom of the table for comparison with BVC averages. ***Note*** *that fields highlighted in a shade of red had A/R ratios that were significantly higher than the averages for that Age Category.*

Crop: Almonds

Field ID	Primary APN	Age Category	Field Acres	Total N Applied lbs/ac	A/Y lbs N/1,000 lbs yield	Est. N Removed lbs/ac	A/R N App/N Removed
1	xxx-xxx-xx	Up to 5 Years	38	269	96.3	190	1.42
2	xxx-xxx-xx	Up to 5 Years	38	100	235.2	29	3.46
3	xxx-xxx-xx	Up to 5 Years	39	268	110.0	166	1.62
4	xxx-xxx-xx	Up to 5 Years	45	124	120.0	70	1.76
5	xxx-xxx-xx	Up to 5 Years	47	124	120.0	70	1.76
6	xxx-xxx-xx	Up to 5 Years	60	269	96.3	190	1.42
7	xxx-xxx-xx	Up to 5 Years	60	124	120.0	70	1.76
8	xxx-xxx-xx	Up to 5 Years	74	82	340.0	16	5.00
9	xxx-xxx-xx	Up to 5 Years	77	130	130.0	68	1.91
10	xxx-xxx-xx	Up to 5 Years	90	90	220.0	28	3.24
11	xxx-xxx-xx	Up to 5 Years	146	143	103.0	94	1.51
12	xxx-xxx-xx	6 to 19 Years	9	185	80.0	157	1.18
13	xxx-xxx-xx	6 to 19 Years	10	230	71.0	220	1.04
14	xxx-xxx-xx	6 to 19 Years	10	200	80.0	170	1.18
15	xxx-xxx-xx	6 to 19 Years	10	200	80.0	170	1.18
16	xxx-xxx-xx	6 to 19 Years	11	230	96.0	163	1.41
17	xxx-xxx-xx	6 to 19 Years	13	200	80.0	170	1.18
18	xxx-xxx-xx	6 to 19 Years	13	200	80.0	170	1.18
19	xxx-xxx-xx	6 to 19 Years	15	240	180.0	91	2.65
20	xxx-xxx-xx	6 to 19 Years	16	130	81.3	109	1.20
21	xxx-xxx-xx	6 to 19 Years	18	230	96.0	163	1.41
22	xxx-xxx-xx	6 to 19 Years	19	200	80.0	170	1.18
23	xxx-xxx-xx	6 to 19 Years	20	354	95.2	253	1.40
24	xxx-xxx-xx	6 to 19 Years	20	318	143.0	151	2.10
25	xxx-xxx-xx	6 to 19 Years	31	354	95.2	253	1.40
26	xxx-xxx-xx	6 to 19 Years	32	228	134.0	116	1.97
27	xxx-xxx-xx	6 to 19 Years	34	259	91.9	192	1.35
28	xxx-xxx-xx	6 to 19 Years	35	100	91.6	74	1.35
29	xxx-xxx-xx	6 to 19 Years	36	259	91.9	192	1.35
30	xxx-xxx-xx	6 to 19 Years	36	254	134.2	129	1.97
31	xxx-xxx-xx	6 to 19 Years	37	230	96.0	163	1.41
32	xxx-xxx-xx	6 to 19 Years	37	255	97.8	177	1.44
33	xxx-xxx-xx	6 to 19 Years	38	216	108.5	135	1.60
34	xxx-xxx-xx	6 to 19 Years	39	100	91.6	74	1.35
35	xxx-xxx-xx	6 to 19 Years	39	280	100.0	190	1.47
36	xxx-xxx-xx	6 to 19 Years	47	230	71.0	220	1.04
37	xxx-xxx-xx	6 to 19 Years	54	275	108.0	173	1.59
38	xxx-xxx-xx	6 to 19 Years	55	249	93.0	182	1.37
39	xxx-xxx-xx	6 to 19 Years	57	255	136.8	127	2.01
40	xxx-xxx-xx	6 to 19 Years	58	242	83.6	197	1.23
41	xxx-xxx-xx	6 to 19 Years	59	281	143.5	133	2.11
42	xxx-xxx-xx	6 to 19 Years	64	298	102.0	199	1.50
43	xxx-xxx-xx	6 to 19 Years	66	130	81.3	109	1.20
44	xxx-xxx-xx	6 to 19 Years	75	281	94.9	201	1.40
45	xxx-xxx-xx	6 to 19 Years	75	222	102.0	148	1.50
46	xxx-xxx-xx	6 to 19 Years	75	205	93.4	149	1.37
47	xxx-xxx-xx	6 to 19 Years	76	322	133.2	164	1.96
48	xxx-xxx-xx	6 to 19 Years	77	245	110.7	150	1.63
49	xxx-xxx-xx	6 to 19 Years	78	230	96.0	163	1.41
50	xxx-xxx-xx	6 to 19 Years	78	226	110.0	140	1.62
51	xxx-xxx-xx	6 to 19 Years	78	230	96.0	163	1.41
52	xxx-xxx-xx	6 to 19 Years	79	210	80.0	179	1.18
53	xxx-xxx-xx	6 to 19 Years	79	210	67.6	211	0.99
54	xxx-xxx-xx	6 to 19 Years	79	411	136.9	204	2.01
55	xxx-xxx-xx	6 to 19 Years	93	185	80.0	157	1.18
56	xxx-xxx-xx	6 to 19 Years	100	162	90.0	122	1.32

5 Farm Evaluations

5.1 Introduction

This Summary of Farm Evaluations for the 2018 Crop/Harvest Year has been prepared by the BVC in accordance with Waste Discharge Requirements (**WDR**) General Order R5-2013-0120-07 (**General Order**). Section V.C (Component 19) of the Monitoring and Reporting Program (**MRP**) requires a summary of submitted Farm Evaluations and the submission of individual data in an electronic format compatible with ArcGIS, identified to the township level.

5.1.1 Required Grower Submittals

The General Order designates requirements for members of a third-party group, including submission of required reports and notices. Member required reports include Farm Evaluations, Sediment and Erosion Control Plans (SECPs), Nitrogen Management Plan Worksheets (**NMP**s), and NMP Summary Reports. Note that the NMP Worksheet is not submitted to coalitions.

On November 3, 2014, the Executive Officer issued a Farm Evaluation Template to be completed by Members. These data allow coalitions to monitor farm level and field level management practices by members in high and low groundwater vulnerability areas. Information gathered reflects general farm practices, active and abandoned irrigation well information, as well as field specific irrigation management, nutrient management, and sediment and erosion control practices. Implementation of management practices will be monitored over time to evaluate trends as defined in the SSJV MPEP and the BVC Comprehensive Groundwater Quality Monitoring Plan (**CGQMP**). Many of the management practices surveyed in the Farm Evaluation are protective of surface and/or groundwater quality.

Submission requirements and timelines are dependent on groundwater vulnerability, surface water vulnerability, and farm size designations. The BVC GAR was submitted on February 4, 2015 and included evaluation of high and low vulnerability areas. Growers were informed of their vulnerability designation, farm size classification, and the required reporting schedules.

5.1.2 Schedule of Grower Submittals

Farm Evaluations for the 2018 Crop/Harvest Year were due by March 1, 2019, for all members with enrolled HVA parcels. The 2018 Crop/Harvest Year provided information on management practices for crops harvested between January 1 and December 31, 2018. An updated General Order (Order R5-2013-0120-07) for the Tulare Lake Basin was adopted on February 7, 2019, revising the Farm Evaluation due dates. The due dates for future Farm Evaluations can be found in **Table 5-1**.

5.1.3 Farm Evaluation Outreach & Submission Process

Member requirements and guidelines to complete the Farm Evaluation for the 2018 Crop/Harvest Year were reviewed in multiple BVC workshops in 2018 through early 2019. Outreach and education attendance for these events will be documented in the 2019 Water Year BVC AMR, which includes activities conducted from October 1, 2018 to September 30, 2019. The outreach activities to support completion of the 2017 Crop/Harvest Year Farm Evaluations are documented in the following sections of the 2018 Water Year BVC AMR.

Growers were mailed notification letters detailing their requirements and instructions to complete Farm Evaluations. Members were directed to maintain an on-farm record and submissions were accepted via an online database.

The BVC sought to directly address potential inconsistencies in submitted data. For the BVC's online database to designate a submission complete a member must report all farm level questions and field level questions for all enrolled parcels. The online database also restricts submissions based on the following data quality checks:

- All parcels enrolled to the member from January 1 to December 31 of the Crop/Harvest year must be accounted for and associated with reported fields;
- The total enrolled irrigated acreage from January 1 to December 31 of the Crop/Harvest Year must equal the cumulative field acres reported;
- All reported fields must be assigned valid crops and irrigation systems as defined by the BVC;
- A field may be assigned up to three crops, but only annual crop types may be reported for multi-cropped fields; and,
- A member who reports they have irrigation wells or abandoned wells on their enrolled parcels must enter information for at least one well.

Members who had incomplete Farm Evaluations were given immediate feedback and were followed up with directly by the BVC to finalize entries and submit the Farm Evaluation.

Table 5-1. Subsequent Due Dates for Member Submissions

Member Report	Vulnerability	Farm Size	Due Date	Frequency
Farm Evaluation	**High (Groundwater or Surface Water)**	All Sizes	March 1, 2021	Every 5 Years Starting on March 1, 2021
	Low (Groundwater or Surface Water)	Large (≥ 60 ac)	March 1, 2021	
		Small (<60 ac)	March 1, 2021	

5.2 Submission Statistics for 2018

Members with HVA parcels were identified to complete the 2018 Farm Evaluation Summary Report. A total of 11 members were identified as farming an HVA parcel from January 1 to December 31, 2018. Of those required, a total of 11 Farm Evaluations (100%) were received by the BVC for the 2018 Crop/Harvest Year. Memberships with high vulnerability parcels provided Farm Evaluation responses for all enrolled low vulnerability parcels as well. As such, all enrolled irrigated acreage for the 2017 Crop/Harvest Year were reported via the Farm Evaluations. **Table 5-2** outlines the percent of total enrolled irrigated acres required to complete a farm evaluation, and total enrolled irrigated HVA acres that were reported.

Table 5-2. Required Farm Evaluation Submission Irrigation Acreage and HVA Acre Coverage

	Enrolled Irrigated Acreage	HVA - Irrigated Acreage Required to Report
Acres with Farm Evaluation Submitted	14,431	14,431
Total Enrolled Irrigated Acres	33,346	14,431
Submission Percentage	43%*	100%

*Submission percentage as a total of irrigated acreage is 43% because the 2018 Harvest Year only required HVA parcels to report.

5.3 Farm Evaluation Summaries for 2018

5.3.1 Approach

Growers completed parts A, B, C, D, and E of the Farm Evaluation. Parts A and B are related to farm-level practices, whereas parts C and D are related to field-level practices. Growers were not required to submit a farm map, Part D, but were required to confirm that they maintained a farm map onsite.

Farm Evaluation data were compiled and analyzed. The following sections summarize the results of submitted responses for the BVC. For parts A and B, all responses for farm-level practices were evaluated per submission and summaries can be found in **Section 5.3.2** and **Section 5.3.3**. For parts C and E, grower responses were analyzed per field for single-cropped fields, multi-cropped fields, and fallow fields. **Section 5.3.5** presents a summary of submitted single-cropped field and multi-cropped field evaluation information.

5.3.2 General Farm Practices (Part A)

General Farm Practices were reported on a membership basis. Part A of the evaluation includes:

1. Pesticide Application Practices;
2. If you have one or more nutrient management plans, who helped prepare the plan?
3. Complete Part E on the sediment and erosion control practices used on farm fields; and,
4. Does your farm have the potential to discharge sediment to off-farm surface waters?

Figure 5-1 indicates the percentage of respondents that indicated use of the various pesticide application practices. One hundred percent of members responded as employing at least three application practices, and 91% of members implemented eight or more practices. Member selections indicated that members followed appropriate pesticide application guidelines; one hundred percent of respondents indicated that they attended trainings and followed label restrictions and county permits. Ninety-one percent of respondents indicated that they avoid surface water when spraying, use PCA recommendations, monitor wind and rain forecasts, and use end of row shutoff when spraying.

Figure 5-2 indicates that all members use a Certified Crop Adviser (**CCA**) to prepare nutrient management plans. In addition, 91% of respondents also use a Pest Control Advisor (PCA). All members also reported they did not have the potential to discharge sediment to off-farm surface water.

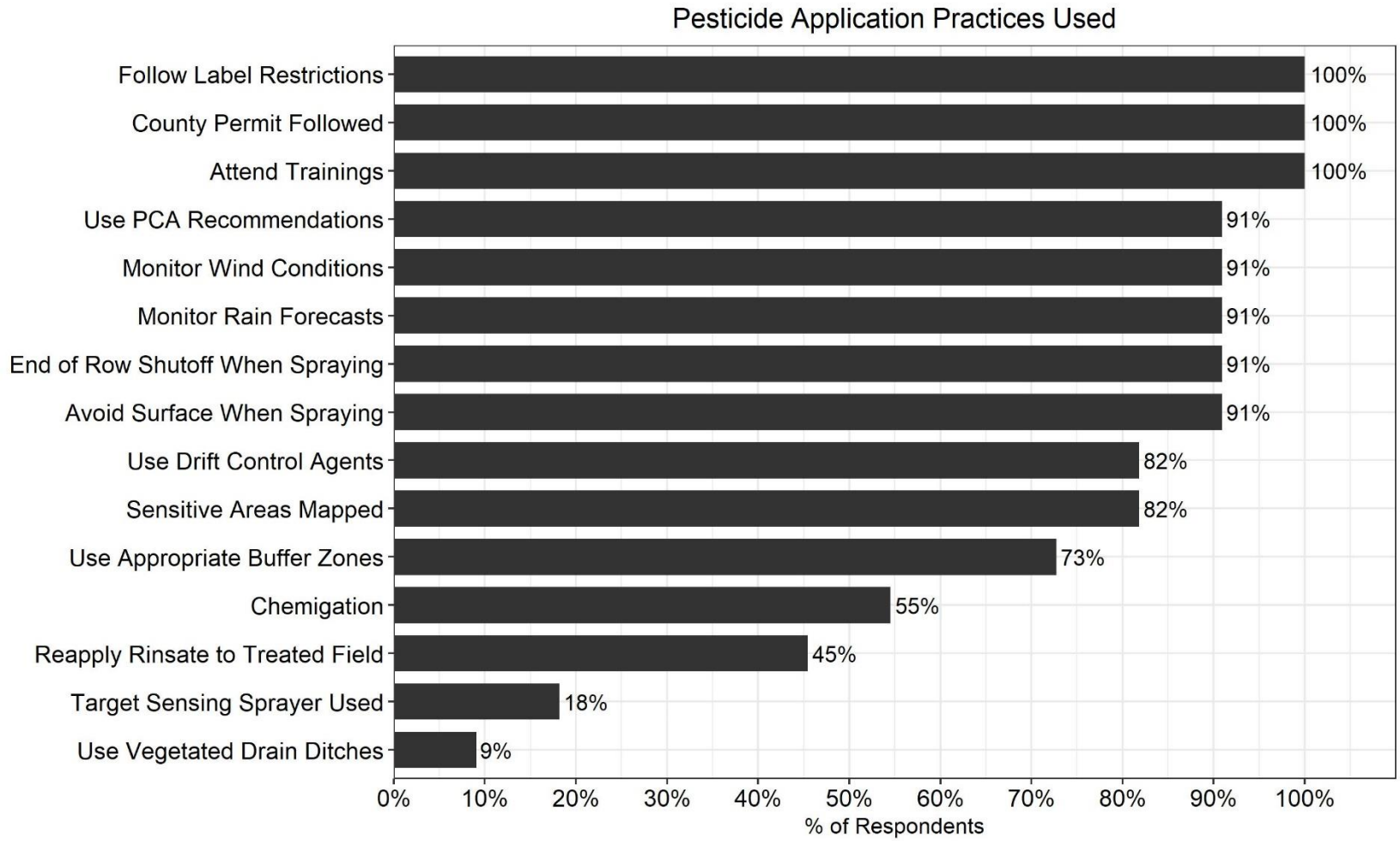


Figure 5-1. Pesticide Application Practices Used (Part A- 1)

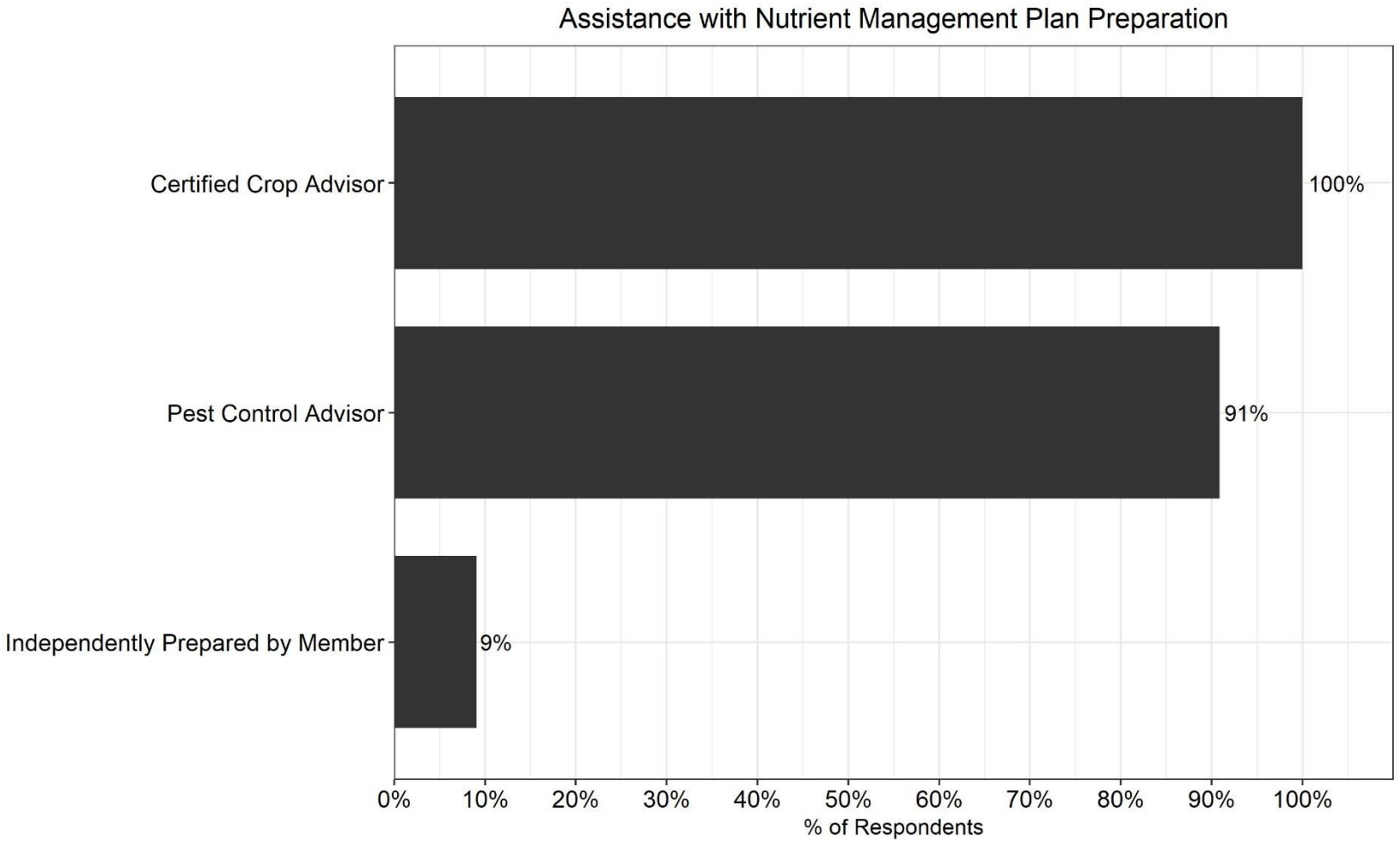


Figure 5-2. Assistance with Nutrient Management Plan Preparation (Part A-2)

5.3.3 Irrigation & Abandoned Well Information (Part B)

Irrigation, abandoned, and monitoring well information was collected in Part B of the Farm Evaluation. Growers were asked to indicate if they have any irrigation wells or abandoned irrigation wells associated with enrolled parcels and to report associated practices. Appropriate wellhead protection practices and well destruction methods are instrumental in reducing potential direct transport of potential constituents of concern to groundwater. Critical wellhead protection practices and appropriate well abandonment practices are emphasized at all outreach events (Section 7).

5.3.3.1 Irrigation Well Information (Part B1)

Responses indicated that 100% of BVC members had irrigation wells on their property. All members identified at least one protective wellhead practice for each reported well. For all reported wells, the most commonly implemented practices were good housekeeping (100%), avoidance of standing water around the wellhead (98%), and using a concrete pad (91%). Rates of additional protective practices for all reported wells can be found in Figure 5-3.

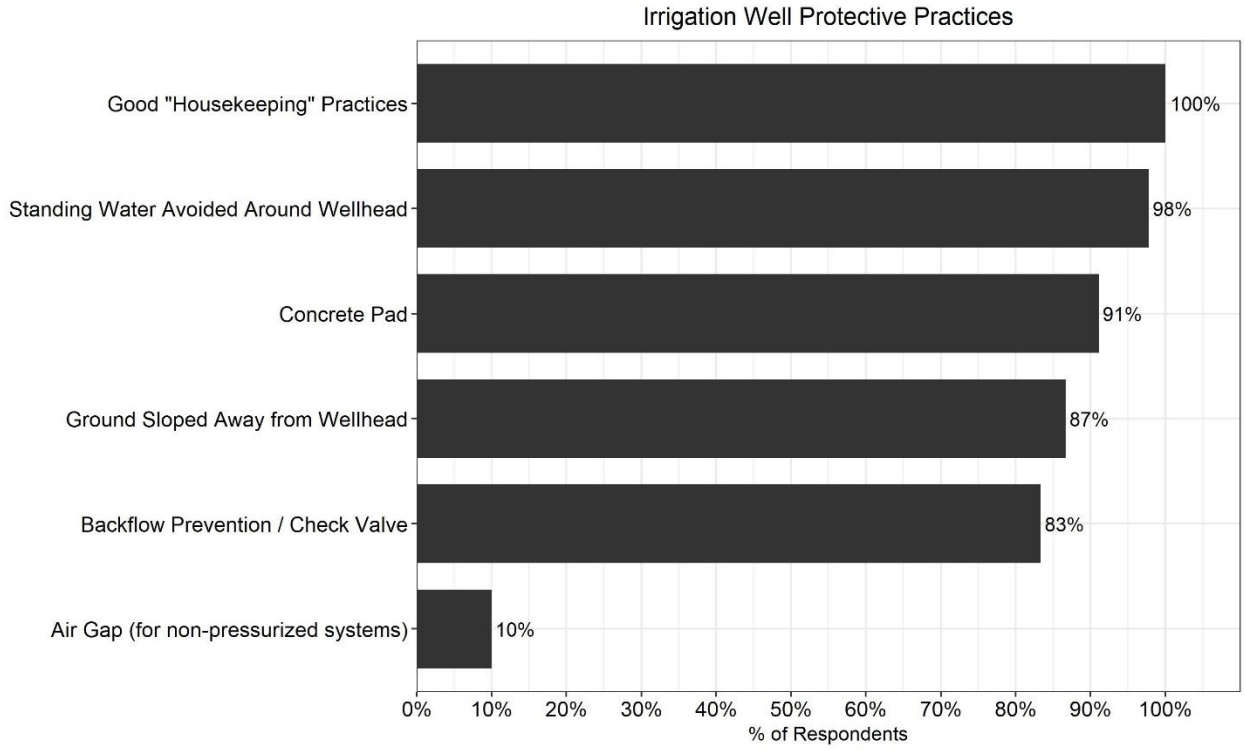


Figure 5-3. Wellhead Protection Practices for Irrigation Wells Associated with Farm Evaluations (Part B-1)

5.3.3.2 Abandoned Well Information (Part B2)

Twenty-seven percent of the submitted Farm Evaluations indicated that abandoned wells were on parcels associated with their BVC membership. Respondents designated 15 known abandoned wells. Of the 15 abandoned wells, 53% of them were certified as destroyed by the county (Figure 5-4).

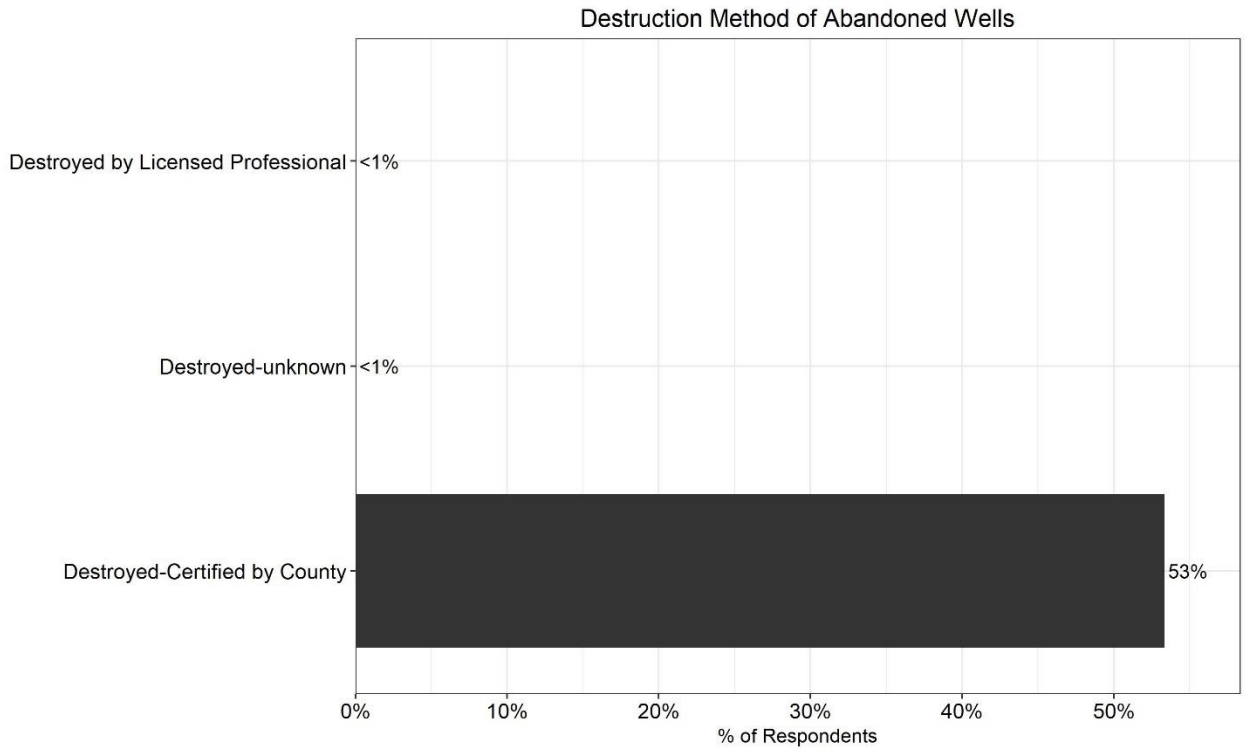


Figure 5-4. Destruction Method of Abandoned Wells and Associated with Submitted Farm Evaluations (Part B-2)

5.3.4 Field Specific Evaluation (Part C & E)

Field-level responses on parts C and E of the Farm Evaluation were analyzed for single-cropped fields, multi-cropped fields, transition fields, and fallow fields. Transition fields include fields with enrolled irrigated acreage which were not ultimately farmed or underwent significant management changes within the Crop/Harvest Year. Fallow fields are those with no enrolled irrigated acreage for the duration of the year, therefore they have zero associated field acres but serve to account for enrolled APNs. The data were split into these categories to more accurately define spatial coverage of practices.

Member reported irrigated acreage should be equal to the total field acres reported by members to account for all enrolled commercial agricultural lands. Commodity acreage includes the acres of double and triple cropped fields, which may result in a commodity acreage that exceeds the irrigated acres of enrolled parcels. In the BVC, there were zero reported double or triple cropped commodity acres. Member field evaluations report on both field acres associated with fields identified by growers, and the commodity acreage of all crops grown on identified fields.

Table 5-3 outlines the total reported fields, field acres, percent of required irrigated acres, and commodity acres from reported Farm Evaluations. The total reported acreage on field evaluations for the below categories are slightly below the total enrolled irrigated acres that were required to submit a farm evaluation. Additional required field acreage was reported for fields including APNs which were transferred between two memberships in the year. Fields containing these duplicated APNs were excluded from analysis in the following sections due to the duplicated acreage and the changes in APN management producing inconsistent reports.

Table 5-3. Required Field Evaluation Submission of Field Acreage Coverage

	Fields	Field Acres	% Irrigated Acres	Commodity Acres
Single-Cropped Fields	109	14,431	94	14,431
Double/Triple Cropped Fields	-	-	-	-
Transition Fields	7	982	6	14,431
Fallow Fields	20	-	-	-
Total Reported Fields:	**136**	**15,413**	**100**	**28,862**

5.3.5 Single-Cropping

BVC respondents defined field acres of single-cropped fields associated with Farm Evaluations for the 2018 Crop/Harvest Year. This reported acreage accounts for 94% of the total irrigated acreage enrolled on reported parcels. **Figure 5-5** outlines the percent of reported acreage of crops on single-cropped fields for significant cropping categories. Pistachios (4,623 field acres), Raisin Grapes (3,476 field acres), Pima Cotton (3,321 field acres), Pomegranates (1,631 field acres), Walnuts (818 field acres), and Alfalfa-Hay (327 field acres) represent the largest share of reported single-cropped fields in the BVC area.

Figures in the following sections present a summary of management practices selected for single-cropped fields. Field acres reported for each question associated with the field evaluations are provided in **Error! Reference source not found.**.

5.3.6 Multi-Cropping

Multi-cropping, double and triple-cropping, was not reported for any fields.

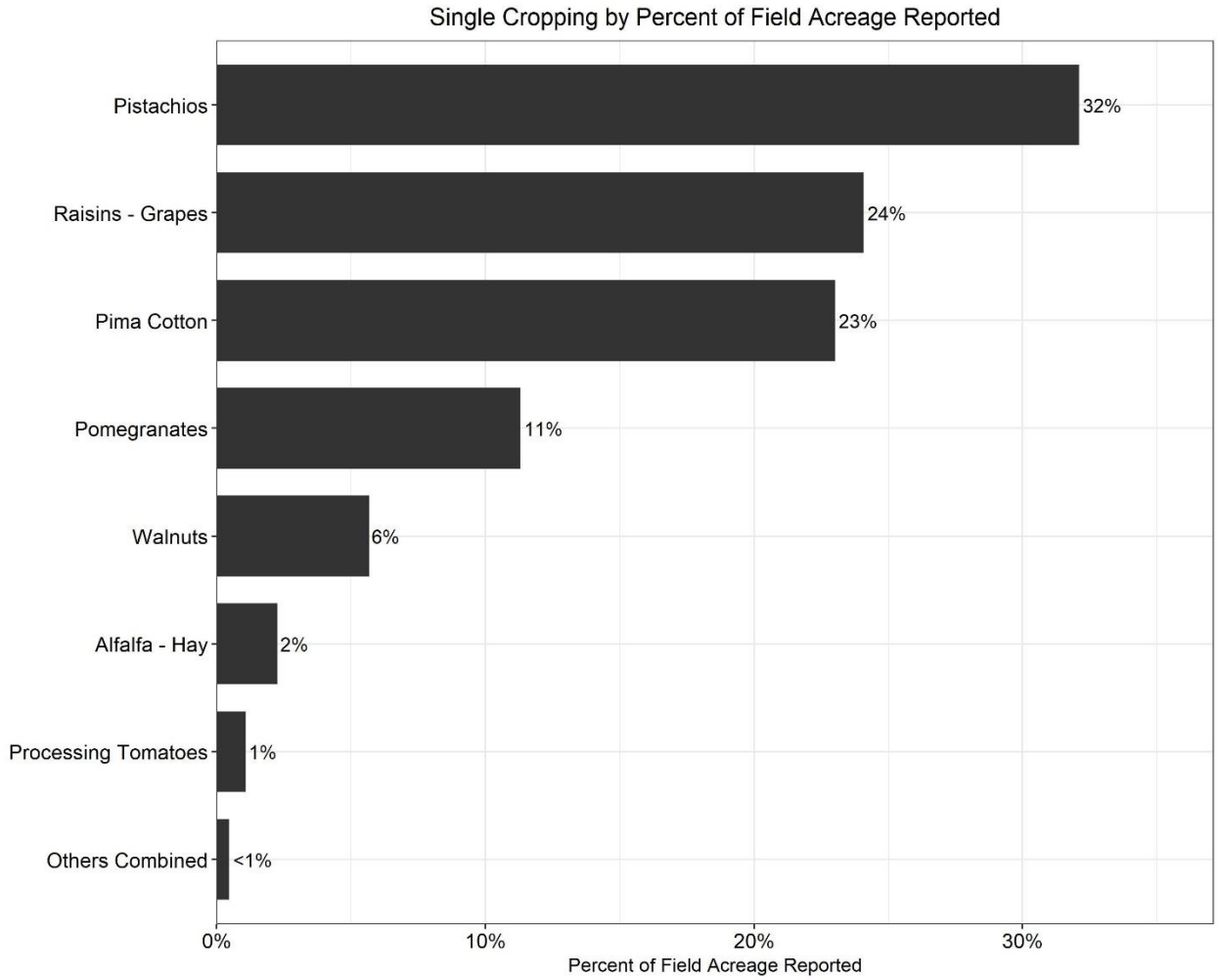


Figure 5-5. Single-Cropping by Percent of Field Acreage Reported (Part C-1/E-1)

5.3.7 Irrigation & Nitrogen Management Practices

Irrigation practices are surveyed in Part C, questions 2 and 3 of the Farm Evaluation. Members are required to report primary irrigation systems, secondary irrigation systems, and irrigation efficiency practices.

The primary irrigation practices on single-cropped fields reported on the 2018 Crop/Harvest Year Farm Evaluations are presented in **Figure 5-6**. A total of 10,122 field acres (70% of single-cropped fields) use drip irrigation, with the next largest proportion being 2,715 field acres (19%) using furrow systems. Responses indicate that 6% of field acres use micro-spray and 4% of field acres use level basin flood irrigation. One percent of fields utilize border strip irrigation.

While pressurized irrigation systems are typically considered to be more efficient, it is important to note that surface irrigation systems can be very well suited to certain site conditions and achieve high efficiencies and uniformities in properly designed and operated systems. Specifically, high efficiency can be attained on finer-textured soils that are appropriately graded, and/or with the proper use of tailwater return systems. Altogether BVC has reported 23% of field acres employing surface irrigation, including border strip, furrow, and level basin flood irrigation systems. Pressurized irrigation systems, (drip, micro-spray, and sprinkler systems) were reported on 77% of field acres. Two percent of the reported field acres

use a sprinkler system as a secondary irrigation system, typically used for frost protection, crop cooling, salinity control, or germination. Overall, 98% of field acres reported no secondary irrigation type in use.

Irrigation Efficiency Practices include practices to increase irrigation distribution uniformity (e.g. laser leveling) and a variety of practices to more precisely match applications to water requirements. The largest proportion of acreage reported utilization of water application scheduled to need (98%), followed by 78% of respondents utilizing soil moisture probes (**Figure 5-7**). Members also reported a variety of additional irrigation efficiency practices through the "other" category.

Members reported field level nitrogen management methods to minimize leaching past the root zone in question 3 of part C. Growers implemented six practices over 80% of reported acreage (**Figure 5-8**). These practices, in order of reported acreage, include:

- Soil Testing (13,704 field acres, 95%)
- Split Fertilizer Applications (13,593 field acres, 94%);
- Tissues/Petiole Testing (13,164 field acres, 91%);
- Irrigation Water Nitrogen Testing (12,523 field acres, 87%);
- Fertigation (11,928 field acres, 83%); and,
- Foliar N Applications (11,652 field acres, 81%).

Members also reported a variety of additional nitrogen management practices in the other category.

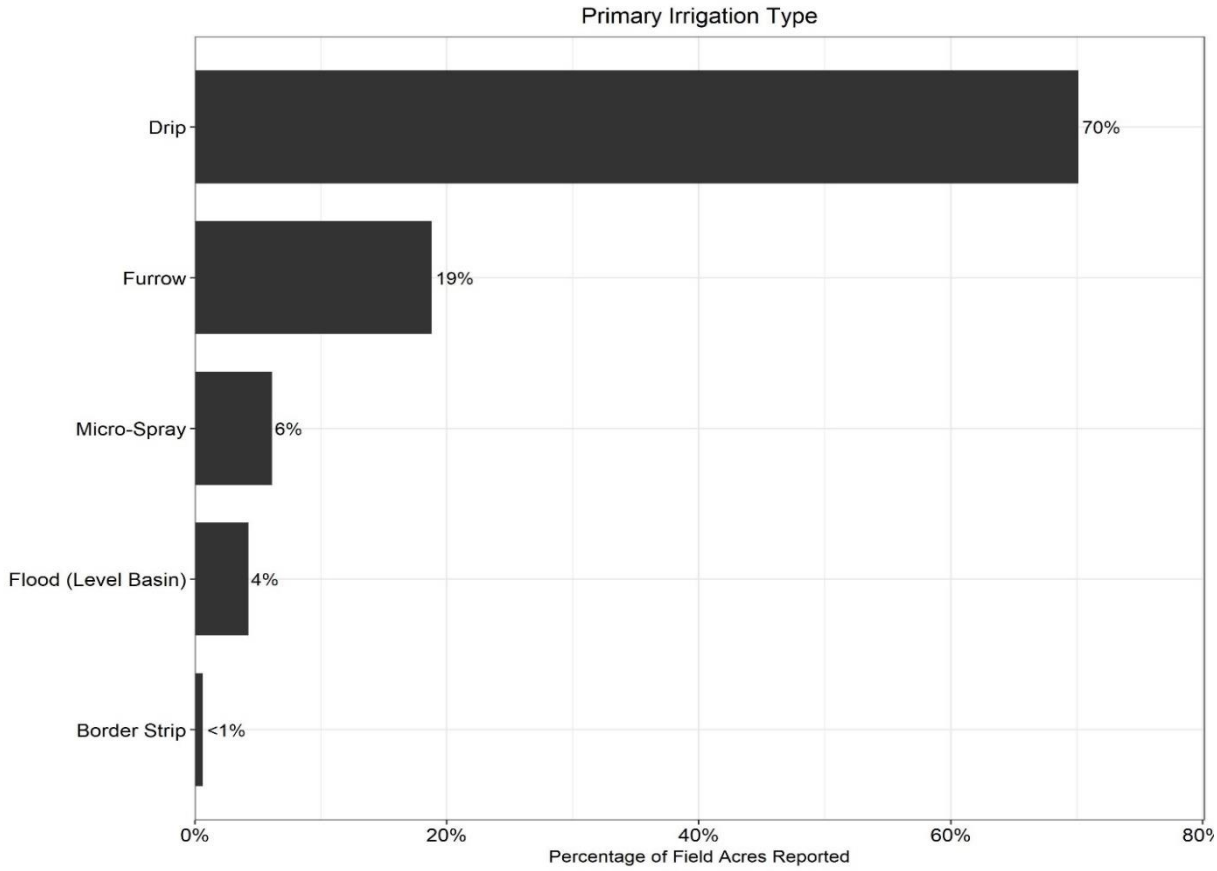


Figure 5-6. Primary Irrigation Practices by Percent of Field Acreage Reported for Single-Cropped Fields in Submitted Farm Evaluations (Part C-2)

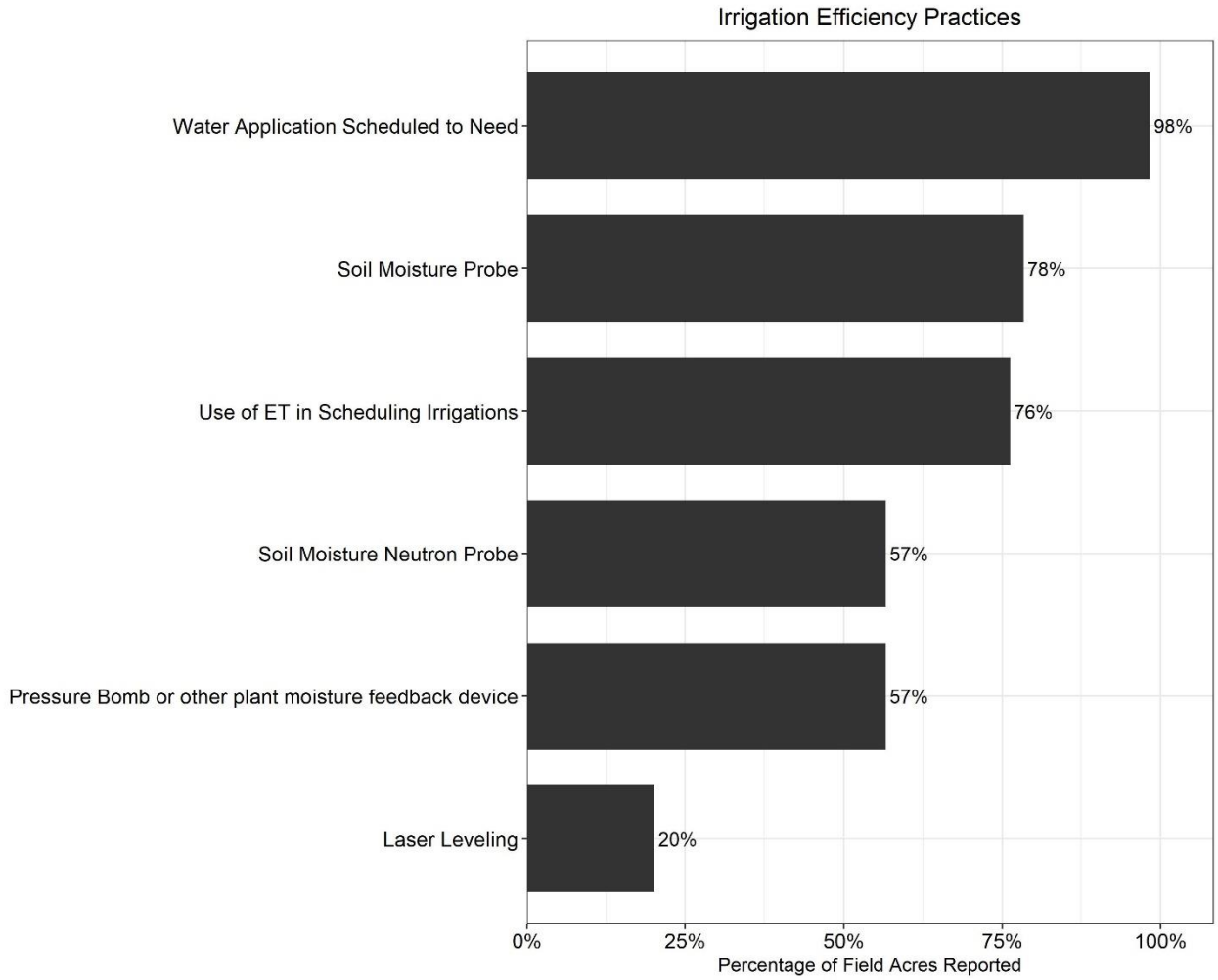


Figure 5-7. Irrigation Efficiency Practices by Percent of Field Acreage Reported for Single-Cropped Fields (Part C-3)

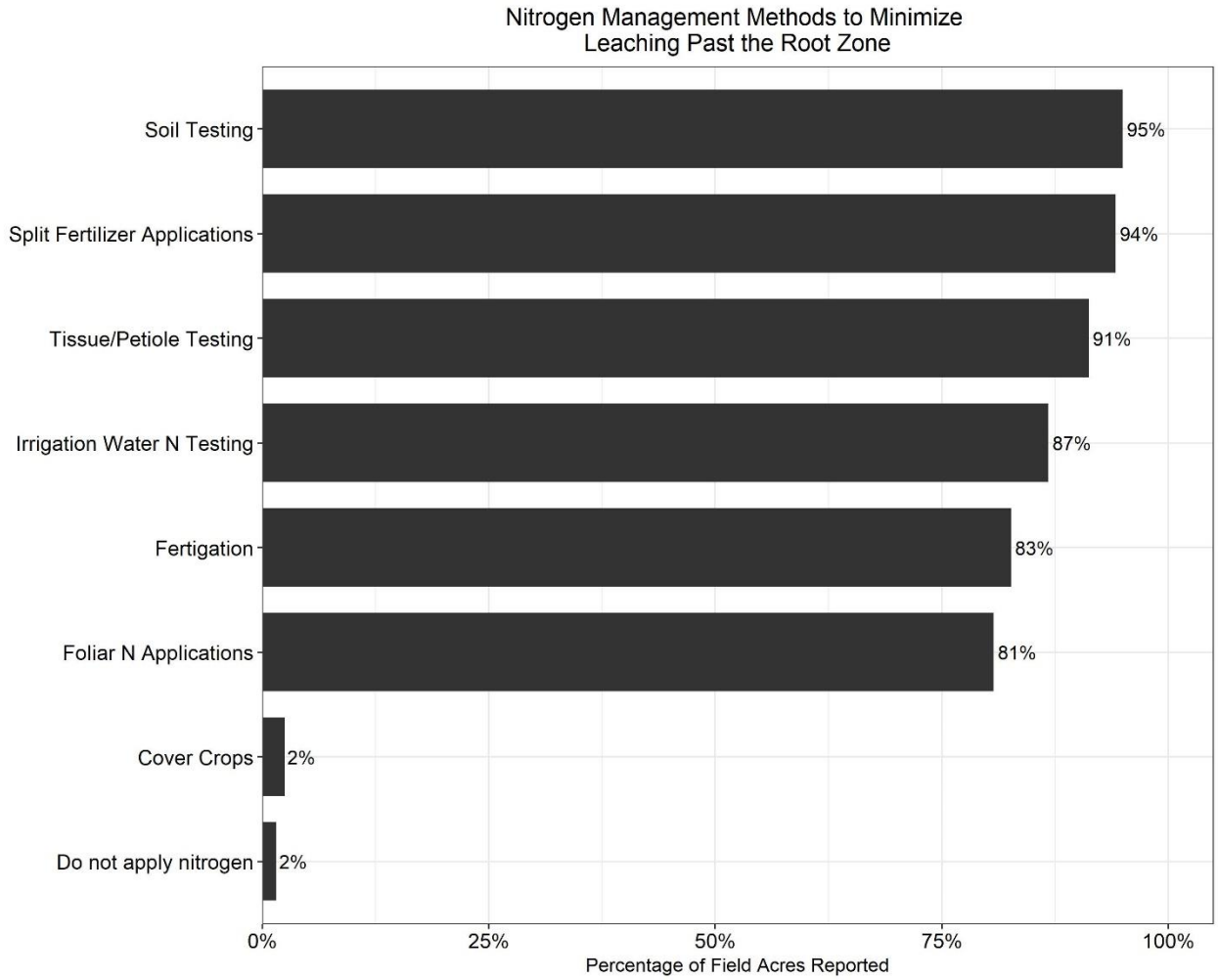


Figure 5-8. Nitrogen Management Methods to Minimize N Leaching Past the Root Zone by Percent Total Field Acreage Reported for Single-Cropped Fields (Part C-4)

5.3.8 Sediment and Erosion Control Practices (Part E)

On part E of the Farm Evaluation, BVC members provided responses for field-level practices to manage sediment and erosion, including irrigation practices (question 2) and cultural practices (question 3). A large proportion of the respondents (86%) indicated that their farms have no irrigation runoff. The irrigation practices to manage sediment and erosion with the most significant field acreage reported include maximizing the time between pesticide applications and the next irrigation set (26%) and the use of drip or micro-irrigation (20%). The percentage of total field acreage reported for each irrigation practice used for managing sediment discharge and erosion is provided in **Figure 5-9**.

Overall, 91% of BVC members reported that their fields have no storm drainage due to field or soil conditions. Additional cultural practices with the largest reported implementation by acreage are an increase in soil water penetration (34%) followed by storm water being captured using field borders (19%). Cultural practices for managing sediment discharge and erosion are presented in **Figure 5-10**.

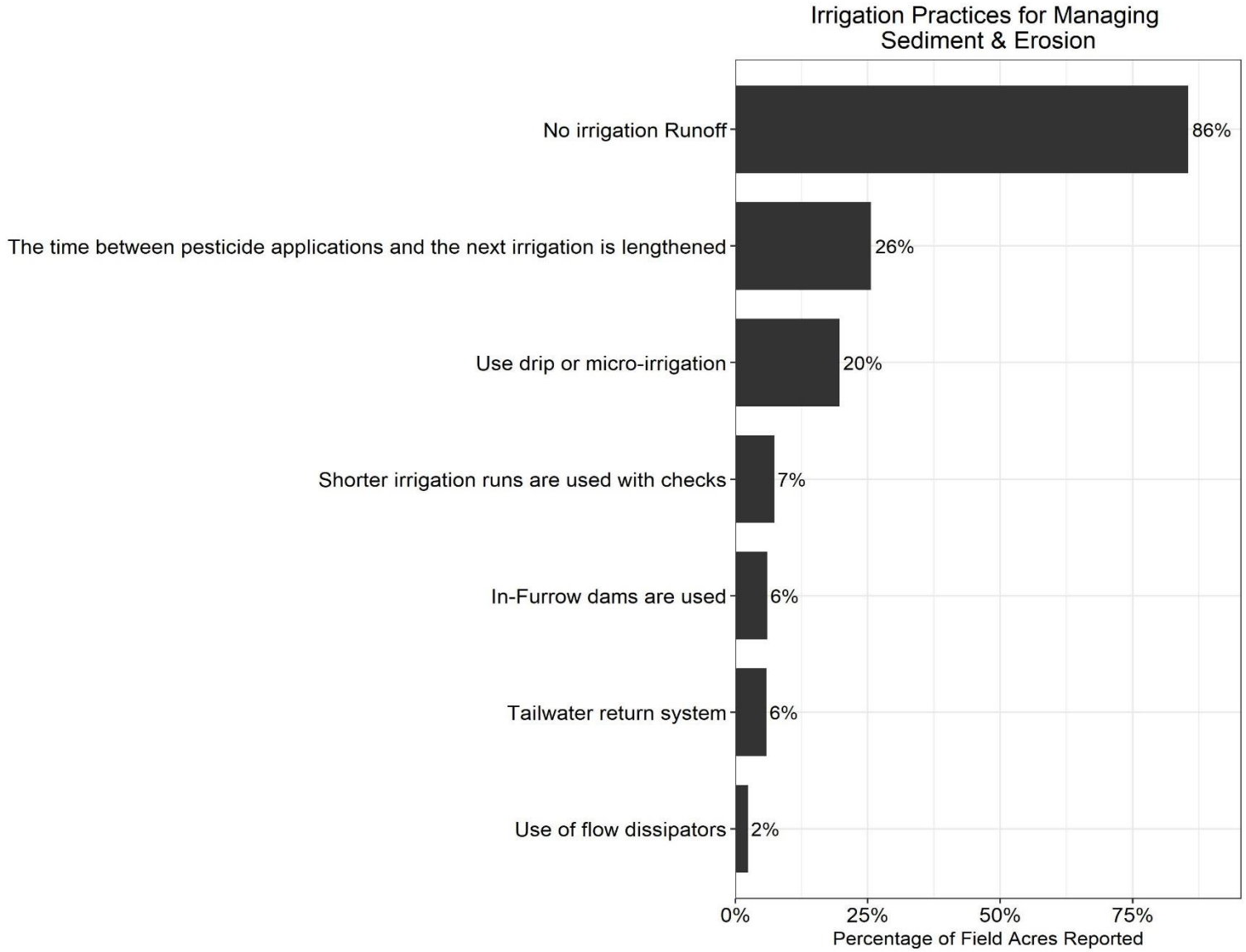


Figure 5-9. Irrigation Practices for Managing Sediment & Erosion by Percent of Total Field Acreage Reported for Single-Cropped Fields (Part E-2)

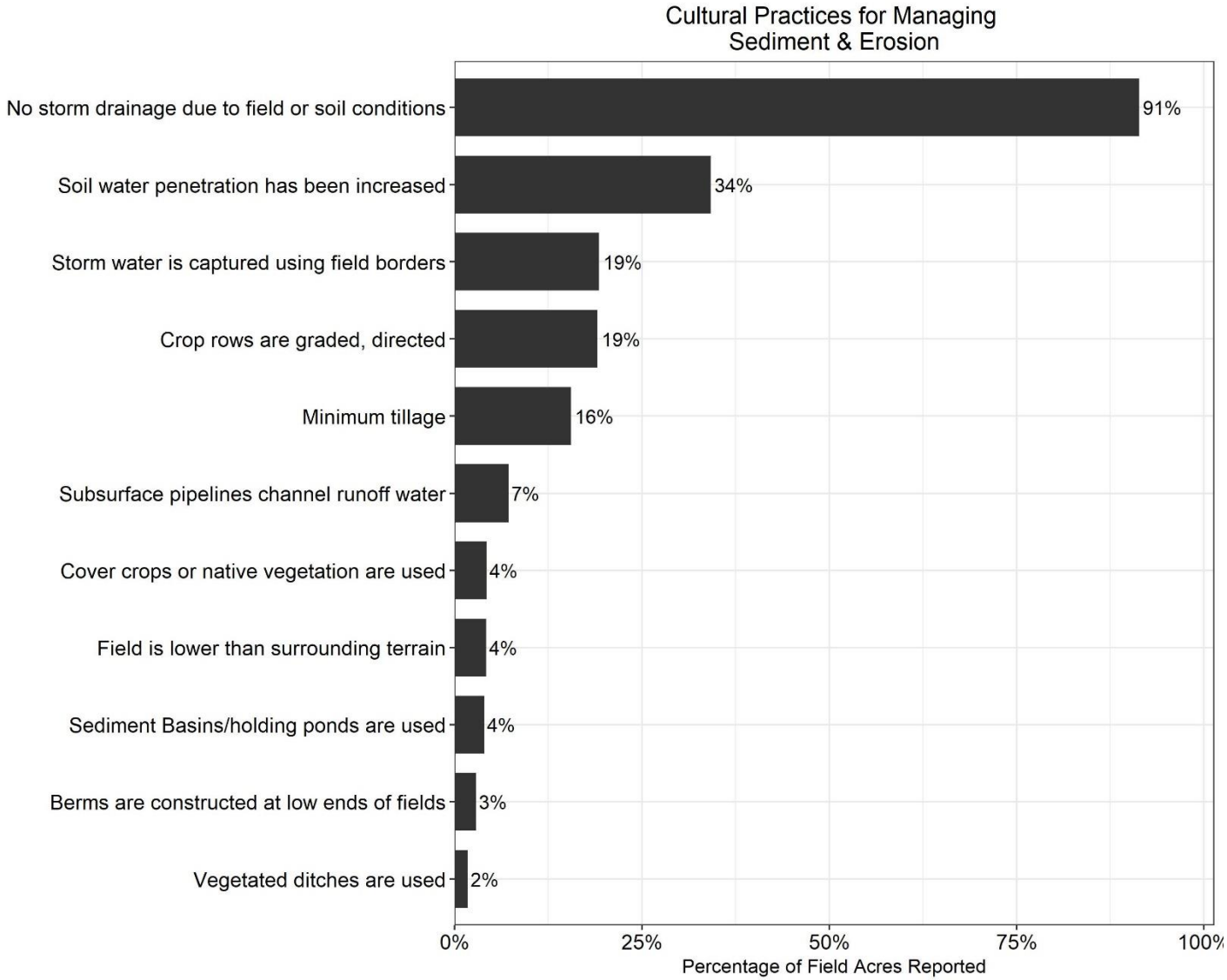


Figure 5-10. Cultural Practices for Managing Sediment & Erosion by Percent of Field Acreage Reported for Single-Cropped Fields (Part E-3)

5.4 Data Analysis

The 2018 Crop/Harvest Year Farm Evaluation submissions provided the fourth data set for members with an enrolled HVA parcel. The BVC will track the implementation of management practices over time as defined in the SSJV MPEP Workplan and the BVC CGQMP. For this summary, Farm Evaluation data were evaluated for quality and consistency. Throughout the Farm Evaluation submission period, the BVC worked with its members to address potential errors in reported data, as described in **Section 5.3**.

5.4.1 Data Gaps

The inconsistencies noted in farm evaluation data were isolated and evaluated. These inconsistencies were related to defining fields for all enrolled APNs and discrepancies between enrolled irrigated acreage and reported field acreage. These issues yield data gaps related to fields transitioned between memberships and fallow fields.

5.4.1.1 Transition Fields

Members defined 982 transition field acres, representing 7 fields. Transition fields are identified as those which had irrigated acreage enrolled initially but were not ultimately farmed under the enrolled memberships or were not managed as initially enrolled. The BVC continues to work with members to ensure only current commercially irrigated agriculture is enrolled in the ILRP as appropriate for a given crop/harvest year.

Table 5-4. Statistics for Single-Cropped Fields Reported on 2018 Farm Evaluations

	Field Acres Reported	% Total Field Acres Reported
Acreage Per Crop		
Pistachios	4,632	32%
Raisins - Grapes	3,476	24%
Pima Cotton	3,321	23%
Pomegranates	1,631	11%
Walnuts	818	6%
Alfalfa - Hay	327	2%
Processing Tomatoes	158	1%
Olives	66	<1%
Primary Irrigation Practices		
Pressurized Systems		
Drip Irrigation	10,122	70%
Micro Irrigation	885	6%
Sprinkler	-	-
Surface Systems		
Furrow	2,715	19%
Flood (Level Basin)	614	4%
Border Strip	95	<1%
Dry Farming	-	-

	Field Acres Reported	% Total Field Acres Reported
Irrigation Efficiency Practices		
Laser Leveling	2,907	20%
Water Application Scheduled to Need	14,188	98%
Soil Moisture Probe	11,311	78%
Use of ET in Scheduling Irrigations	11,008	76%
Soil Moisture Neutron Probe	8,177	57%
Pressure Bomb or other plant moisture feedback device	8177%	57%
Nitrogen Management Methods to Minimize Leaching Past the Root Zone		
Soil Testing	13,704	95%
Split Fertilizer Applications	13,593	94%
Tissue/Petiole Testing	13,164	91%
Irrigation Water N Testing	12,523	87%
Fertigation	11,928	83%
Foliar N Applications	11,652	81%
Do not apply nitrogen	359	2%
Cover Crops	225	2%
Variable Rate Applications using GPS	-	-
Irrigation Practices for Managing Sediment & Erosion		
No irrigation Runoff	12,339	86%
The time between pesticide applications and the next irrigation is lengthened	3,699	26%
Use drip or micro-irrigation	2,830	20%
Shorter irrigation runs are used with checks	1,068	7%
In-Furrow dams are used	877	6%
Tailwater return system	852	6%
Use of flow dissipators	348	2%
PAM (polyacrylamide) used in furrow and surface irrigated fields	-	-
Catchment Basin	-	-
Cultural Practices for Managing Sediment & Erosion		
No storm drainage due to field or soil conditions	13,180	91%
Soil water penetration has been increased	4,934	34%
Storm water is captured using field borders	2,787	19%
Crop rows are graded, directed	2,755	19%
Minimum tillage	2,247	16%
Subsurface pipelines channel runoff water	1,039	7%
Cover crops or native vegetation are used	619	4%
Field is lower than surrounding terrain	613	4%
Sediment Basins/holding ponds are used	572	4%
Berms are constructed at low ends of fields	418	3%
Vegetated ditches are used	260	2%
Hedgerows or trees are used	-	-

	Field Acres Reported	% Total Field Acres Reported
Creek banks/stream banks stabilized	-	-
Field is terraced or benched	-	-
Other	-	-
Vegetative filter strips and buffers are used	-	-

6 Mitigation Monitoring

No mitigation monitoring was reported during the 2018 water year.

7 Education & Outreach

The 2018 Water Year (October 1, 2017 through September 30, 2018) consisted of educating growers on the completion of Nitrogen Management Plan Worksheets and Nitrogen Management Plan Summary Reports; preparing and submitting Farm Evaluations, summary reports for Farm Evaluations, and Nitrogen Management Summary Reports from the 2017 Water Year; and discussing priority practices, useful tools, and resources. All grower education/outreach meetings were held jointly with Kern River Watershed Coalition Authority (**KRWCA**), Cawelo Water District Coalition (**CWDC**), and Westside Water Quality Coalition (**WWQC**).

Education and outreach efforts during the water year continued to include outlining the requirements of the General Order, communicating the role of the BVC, supporting member registration and compliance, describing the methodologies employed in the various technical reports developed by BVC, and assisting members in understanding and meeting the Nitrogen Management Plan and Summary Report and Farm Evaluation reporting requirements. ILRP annual re-enrollment and reporting requirements were publicized through direct mailings, email blasts, notifications on the BVC website, and by holding grower education meetings at locations throughout Kern County. Additionally, agricultural organizations throughout Kern County shared BVC meeting notifications, as well as ILRP requirements and reporting deadline information, with their members.

7.1 Events

Grower Education Meetings – Nitrogen Analysis Reports: BVC co-hosted a special round of four grower education meetings in three locations throughout Kern County (two meetings in Bakersfield, one in Wasco, and one in Buttonwillow) between October 17 and October 26, 2017. The agenda focused on Nitrogen Analysis Reports (NARs) and all four meetings were identical. Attendees were given a copy of the PowerPoint presentation as a handout (included in **Appendix B** along with a copy of the meeting notification). The meeting presentation included a reminder of upcoming member reporting deadlines, with a detailed tutorial on how to submit online, a summary of the first year of NMP Summary Report results, and a breakdown of how to read results of the individual NARs each member received. The presentation also included a discussion on priority practices and Management Practices Evaluation Program (MPEP) resources.

Annual Grower Education Meetings: BVC's annual grower education meetings (in conjunction with the KRWCA, CWDC, and WWQC) were conducted between January 9 and January 17, 2018, in three locations throughout Kern County (two meetings in Bakersfield, one in Wasco, and one in Buttonwillow, for a total of four meetings). Attendees were given a copy of the PowerPoint presentation as a handout. The agenda was identical for all four meetings and provided reporting deadlines for the coming year; a summary of Farm Evaluation results from the 2017 Water Year; and refresher instructions on how to complete the Farm Evaluation, Nitrogen Management Plan Worksheet, and Summary Report. The presentation also included tools and resources and MPEP links, and priority practices. A copy of the presentation and meeting notifications can be found in **Appendix B**.

CV-SALTS and Senate Bill (SB) 623 Grower Outreach Meeting: The BVC co-hosted a grower outreach meeting at the Kern Ag Pavilion in Bakersfield on April 10, 2018. The meeting featured guest speakers from Somach Simmons & Dunn, and a presentation entitled "Farming and Water Quality: Finding the Right Balance," which overviewed Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS), groundwater quality, the Nitrate Control Program, the Salinity Control Program, and achieving balance. The second segment of the meeting featured an overview of SB 623 and how it will affect agriculture and coalition members. A copy of the agenda, PowerPoint presentation, and meeting notifications are included in **Appendix A**.

7.2 Attendance

The BVC's education and outreach events held during the 2018 Water Year reached a large portion of the Kern County agricultural community and BVC members. Attendance is summarized in **Table 7-1**.

Table 7-1. Attendance Summary of BVC Education and Outreach Events

Date	Event	Location	Total Attendance
October 17, 2017	Grower Education Meeting – NAR	Kern Ag Pavilion, Bakersfield	3
October 18, 2017	Grower Education Meeting – NAR	Wasco Elks Lodge, Wasco	1
October 24, 2017	Grower Education Meeting – NAR	Kern Ag Pavilion, Bakersfield	3
October 26, 2017	Grower Education Meeting – NAR	Buttonwillow Recreation Center, Buttonwillow	5
January 9, 2018	Annual Grower Education Meeting	Kern Ag Pavilion, Bakersfield	4
January 11, 2018	Annual Grower Education Meeting	Wasco Elk's Lodge, Wasco	1
January 16, 2018	Annual Grower Education Meeting	Buttonwillow Recreation Center, Buttonwillow	10
January 17, 2018	Annual Grower Education Meeting	Kern Ag Pavilion, Bakersfield	7
April 10, 2018	Grower Outreach Meeting – CV-SALTS/SB 623	Kern Ag Pavilion, Bakersfield	5
Total Outreach Attendance for 2018 Water Year Events:			**39**

In October 2017, 12 memberships were represented at the four NAR-focused grower education meetings. For the annual grower education meetings held in January 2018, 22 memberships were represented; and five memberships were represented at the CV-SALTS/SB 623 grower outreach meeting in April 2018. A combined total headcount of 500 attended the 2018 grower outreach and education events hosted by the BVC and the other three Kern County coalitions, some representing more than one membership in one or more coalition.

7.3 Resources & Accessibility

All materials produced for grower education and outreach events are routinely posted online at https://www.bvh2o.com/. These resources and materials include meeting notifications, and copies of Power Point presentations and handouts. To ensure adequate exposure of grower education and outreach events and 2018 reporting deadlines, informational letters and/or postcards were sent to all BVC members via email blasts and direct mailings. Copies of these resources and materials are organized in chronological order, as distributed, in **Appendix B.**

8 Conclusions & Recommendations

Section holder for text.

8.1 General Order Compliance

During the 2018 monitoring year the BVC continued to conduct surface water quality monitoring and reporting. The BVC also initiated groundwater quality monitoring and reporting. Groundwater quality monitoring results met QAPP and QAPrP acceptance criteria and completeness requirements. The BVC will complete data analysis as additional water quality data are collected in future years.

8.2 Nitrogen Management Plans

One hundred percent of the required BVC members submitted NMP Summary Reports. In general, the data indicates that growers applied nitrogen within agronomic rates in the 2018 Crop/Harvest year, with over 99% of members applying less than 250 lbs N/acre. The submitted data was of reasonable quality, but some potentially erroneous or incorrect data requires outreach to verify the information, or when necessary, updating. The reported information was summarized tabularly and graphically and high statistical outliers were identified for future outreach. The BVC will develop individual grower reports that summarize the reported information and its relationship with other growers of the same crop on a township and coalition-wide basis.

8.3 Farm Evaluations

Members' HVA parcels were identified for the 2018 Farm Evaluation Summary Report. A total of 14,431 acres were reported as HVA acreage from January 1 to December 31, 2018, the harvest year. Farm Evaluations encompassing a total of 14,431 acres of these HVA acres were received by the BVC for the 2018 year; a 100% submission rate. Overall responding members indicated a high rate of implementation of protective practices on enrolled acreage, for irrigation wells on enrolled parcels, and in general farm management. Specifically, four nitrogen management practices were reported on over 87% of single-cropped irrigated acreage. Farm evaluation data presented in the AMR will be used for additional analysis of potential impacts to groundwater in the MPEP program, and changes will be analyzed over time in the CGQMP.

BVC will continue to work to refine data collection to eliminate data gaps and ensure reliable long-term analysis of implemented management practices.

9 References

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Appendix A

Surface Water Quality Data

Appendix B

Groundwater Quality Data

Appendix C

Public Outreach Materials

Appendix D

Shape Files

(included on CD in "Appendices" folder)