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2024 ARSENIC SOURCE IDENTIFICATION STUDY- KERN RIVER WATERSHED COALITION AUTHORITY

In accordance with the approved Surface Water Monitoring Plan and the Monitoring and Reporting Program for Waste Discharge General Order R5-2013-0120, the Kern River Watershed Coalition Authority (KRWCA) submitted a 7 September 2024 Source Identification Report (SIS) for total arsenic. The purpose of the SIS was to provide insight into whether exceedances of total arsenic are caused by naturally occurring environmental processes or irrigated agriculture within the KRWCA region.

Based on the SIS and peer-reviewed published research, it is likely that exceedances at the monitoring site are being triggered by local geology, precipitation patterns and drought, improper disposal of mine tailings from historic mining operations along the Kern River and not from irrigated agriculture.

The development and implementation of a Surface Water Quality Management Plan for total arsenic is not required at this time. The Coalition shall continue to monitor for arsenic in accordance with the General Order's Monitoring and Reporting Program. If additional data indicates irrigated agriculture is degrading water quality, a Surface Water Quality Management Plan would be required. The enclosed memorandum provides a summary regarding Central Valley Water Board staff's review of the SIS Report with staff comments and recommendations.

If you have any questions regarding this letter, please contact Marco Rodriguez at (559) 445-6187, or by email at Marco.Rodriguez@waterboards.ca.gov.

For Patrick Pulupa
Executive Officer

Enclosure: Staff Review of the Kern River Watershed Coalition Authority's 2024 Arsenic Source Identification Report

Central Valley Regional Water Quality Control Board

TO: Eric Warren, PE
Senior Water Resource Control Engineer
IRRIGATED LANDS REGULATORY PROGRAM

FROM: Marco Rodriguez
Engineering Geologist
IRRIGATED LANDS REGULATORY PROGRAM

DATE: 06 March 2025

SUBJECT: **REVIEW OF THE KERN RIVER WATERHSED COALITION AUTHORITY'S 2024 ARSENIC SOURCE IDENTIFICATION STUDY REPORT FOR THE KERN RIVER**

On 7 September 2024, the Kern River Watershed Coalition Authority (KRWCA) submitted a report entitled *2024 Arsenic Source Identification Study – Kern River* (SIS Report) to the Central Valley Water Board. This memorandum provides background, summary, and staff comments regarding the subject report.

BACKGROUND

The KRWCA conducts surface water quality monitoring of the Kern River in accordance with an approved Surface Water Monitoring Plan and the Monitoring and Reporting Program for Waste Discharge General Order R5-2013-0120 (General Order). Where monitoring constituents exceed applicable Water Quality Objectives or Trigger Limits more than once in a three-year period (and irrigated agriculture may cause or contribute to the exceedances), the General Order requires development of a Surface Water Quality Management Plan to address the water quality issue.

In response to observed exceedances of the California Maximum Contaminant Level of 10 micrograms per liter (µg/L) for total arsenic (As), the KRWCA developed and implemented a Source Identification Study workplan to better understand the factors influencing the observed total arsenic levels. The workplan was conditionally approved by the Executive Officer on 7 September 2023, and its findings are documented in the SIS Report.

SOURCE IDENTIFICATION STUDY SUMMARY

The following sections provide a summary of the Coalition's Source Identification Study and are supplemented by staff commentary regarding local geology, potential arsenic sources, and the supporting evidence presented in the Source Identification Study.

Constituent of Concern

Arsenic is a naturally occurring element in the earth's crust, widely distributed in the environment through the air, water, and land. Arsenic was also a common ingredient in pesticides but has mostly been discontinued. Arsenic can exist in solid, aqueous, and gas states due to its unique bonding properties. Inorganic arsenic in water is mostly found as arsenite (As III), or arsenate (As V). Arsenate tends to bind with minerals such as ferrihydrite and alumina, resulting in decreased bioavailability. In contrast, arsenite is more prevalent in reducing conditions and is generally more difficult to remove from water compared to arsenate.

Sampling Site Location

The Kern River sampling location was approved as a monitoring site on 3 July 2019 and is the central-most monitoring site within the KRWCA region. It is located just west of Rancheria Road near California State Route 178, east of Bakersfield, CA. Citrus crops are the predominant irrigated agricultural crop in the area.

KRWCA Area

Physical Setting

The KRWCA is separated into two separate boundaries. The primary boundary spans the southern San Joaquin Valley floor, an area that is largely composed of recent alluvium, and a secondary boundary, which includes varied upland geological environments, mostly in the Sierra Nevada Mountain Range. The secondary boundary contains a small amount of irrigated acreage located near the Kern River sampling site and east of Lake Isabella. This boundary holds almost the entire Upper Kern River Watershed. Lake Isabella captures flow from the north and south forks of the Kern River. The north fork is a perennial stream, while the south fork is ephemeral in nature and flows predominantly during winter and spring months. From Lake Isabella, the Kern River flows southwest through the Kern River sampling site, east of Bakersfield, CA, to the Central Valley floor.

Staff commentary:

Local Geology

The area within the Upper Kern River Watershed boundary is comprised of mostly pre-Cretaceous metamorphic and Mesozoic granitic rocks with smaller amounts of volcanics (Smith, 1964). Tertiary and Pliocene age volcanic rocks can be found in the eastern and northern areas of the watershed boundary. Quaternary age alluvium and non-marine sedimentary deposits are found throughout the watershed boundary (Smith, 1964), particularly at Lake Isabella and areas to the east and the Kern River sampling site.

Potential Sources of Arsenic

Geologic Conditions

Geological processes may significantly affect arsenic distribution, with concentrations found in up to 200 minerals (Radke et al, 2019), especially arsenopyrite (Frankenberger, 2002). Erosion of arsenic-rich minerals and the weathering of volcanic and metamorphic rocks lead to increased arsenic levels in alluvial sediments (Radke et al, 2019; Welch et al, 2006). This arsenic can be transported by smaller streams to larger bodies of water and may enter groundwater under certain conditions (Radke et al, 2019; Welch et al, 2006). Kern County is known for high arsenic levels due to various processes such as the desorption of iron oxides from volcanic rocks (Welch et al, 2006).

Historic Mining Operations

Five different Mining Districts were investigated near the Kern River and Lake Isabella (Table 1). The focus of this investigation was on historic gold mines because they are known to contain arsenic-bearing minerals such as arsenopyrite and arsenian pyrite (Goodyear, 1888; Alpers, 2017). Improper disposal of mining byproducts led to environmental concerns, prompting funding from programs like the Comprehensive Environmental Response, Compensation, and Liability Act and Abandoned Mines Land to mitigate the impact of arsenic-baring tailings in forested areas. Troxel and Morton (1962) emphasize the widespread historical mining activity as a likely source of arsenic contamination. The KRWCA suggests that tailings from gold and tungsten ore processing contribute to elevated arsenic levels in the Kern River, along with other heavy metals such as cadmium and lead.

Table 1: Mining Districts and Their Geological and Chemical Characteristics

Mining District	Location	Local Geology	Potential arsenic-bearing minerals
Cove	2-4 miles south of Kernville, CA	Mesozoic granodiorite	arsenopyrite
Keyesville	Approximately 2 miles southwest of Lake Isabella Dam	quartz diorite, quartz stringers and fault gouge	pyrrhotite, pyrite, and arsenopyrite
Greenhorn Mountain	Approximately 4 miles northwest of Miracle Hot Springs, CA	quartz granodiorite, small roof pendants of pre-Cretaceous metasedimentary rocks	
Clear Creek	Approximately 5 miles south of Bodfish	quartz diorite, quartz gabbro with roof pendants of metasedimentary rocks	pyrite, arsenopyrite
Erskine	Approximately 4 miles southeast of Lake Isabella Dam	pre-Cretaceous metasedimentary rocks, roof pendants of pre-Cretaceous metamorphic rocks, Mesozoic granitic rock	varying amounts of sulfides

Big Blue Mill Site (Cove Mining District)

A study completed by the United States Department of Agriculture Forest Service (Graham-Wakoski, 2020) focused on the Big Blue Mill Site, located about two miles upstream of Lake Isabella on the west bank of the north fork of the Kern River. This site is a former gold ore processing facility dating back to the 1860s. The site was sold to the US Army Corps of Engineers in 1957, then exchanged to the USDA Forest Service in 1991. The Kern floodplain, located across the Big Blue Mill and the north fork of the Kern River, is where mill deposits were discarded during operation. The study provided aerial images showing tailings within the north fork of the Kern River and laboratory results showing arsenic concentrations of 400 milligrams per kilogram (mg/kg) - 60,000 mg/kg.

Staff commentary:

From 1934 to 1943, tailings from the Big Blue Mill were deposited across the Kern River through a pipeline onto the Kern Floodplain site, a former tailings pond area about 4.1 acres in size (Graham-Wakoski, 2020). Analytical results from the October 2016 Final Engineering Evaluation and Cost Analysis Report at the Kern Floodplain Site by ECM consultants showed that of the 31 sediment samples collected, arsenic concentrations ranged from 0.5 to 4,200 mg/kg. The study concluded that elevated concentrations of Arsenic were present at the site as a result of improper mineral processing. It also provided photographic documentation of unvegetated, contaminated areas at the banks of the Kern River, showing signs of erosion.

The Erskine Creek District

Bright Star Mine, located near Erskine Creek's headwaters, was deemed a contributor to arsenic exceedances in the creek. Arsenic levels in surface water samples recorded from 2011 to 2015 ranged from 6.44 µg/L to 21.3 µg/L (KCWA, 2016). The report recommended sampling other tributaries to assess the impact of historical mining on water quality, prompting the KRWCA to conduct tests in adjacent streams for the Source Identification Study. Notably, arsenic concentrations of 22 µg/L at Clear Creek and 62 µg/L at Bradshaw Creek were found.

Active Hot Springs

Five thermal hot springs along the Kern River, downstream of Lake Isabella, were documented in Figure 2-1 of the Source Identification Report, and are summarized below (Table 2).

Table 2: Reported Thermal Hot Springs Along the Kern River

Thermal Hot Spring	Temperature Category	Latitude	Longitude
Democrat Hot Springs	Hot	35.528	-118.665
Spring (Hot)	Warm	35.536	-118.651
Delonegha Hot Springs	Hot	35.558	-118.612
Miracle Hot Springs, Hobo Hot Springs	Hot	35.575	-118.534
Scovern Hot Springs	Hot	35.620	-118.473

Hot springs can affect water quality by introducing groundwater with high levels of silica, sulfate, arsenic, and possibly radioactive elements into surface waters. This impact is especially notable when a hot spring discharges into a river with lower flow (KCWA, 2016).

Staff Commentary:
The 1888 "Eighth Annual Report of the State Mineralogist" describes thermal hot springs just a few miles north of Kernville on the west bank of the Kern River. Here, there were once powerful sulfur springs that could catch fire due to sulfur accumulation. By the time the report was written, the area was a dry, sunken spot covered in a crust likely made of alkaline sulfates and some free sulfur and several hot springs near the mouths of canyons on the east side of the north fork of the Kern River, just above Kernville, still contained sulfur.

Drought

The SIS Report notes that drought patterns in California are variable, and recent years have seen more severe droughts due to climate change. This has led to water levels in the Kern River watershed being lower than usual. Since the 2020 Water Year (WY), the Central Valley has faced exceptional drought, with reduced precipitation and snowmelt runoff resulting in lower water levels in many creeks and streams. The SIS Report states that this decline may be an indicator for increased arsenic concentrations, which have been found to exceed safe levels during the dry season and periods of severe drought when Kern River flow was minimal. Monthly sampling at the Kern River sampling site in WY2021 and WY2022 triggered a Source Identification Study. Both WY2021 and 2022 showed elevated concentrations of Arsenic over the California Primary Maximum Contaminant Level of 10 µg/L during the drier summer months (Table 3).

Table 3. Monthly sample results of Arsenic for Water Year 2021-2023 (µg/L)

2021 WY											
Oct-2020	Nov-2020	Dec-2020	Jan-2021	Feb-2021	Mar-2021	Apr-2021	May-2021	Jun-2021	Jul-2021	Aug-2021	Sep-2021
6.6	5.2	4.2	3.7	3.4	3.6	4.4	5.2	6.8	12	9.9	7.4
2022 WY											
Oct-2021	Nov-2021	Dec-2021	Jan-2022	Feb-2022	Mar-2022	Apr-2022	May-2022	Jun-2022	Jul-2022	Aug-2022	Sep-2022
5.8	5.4	4.4	4.6	4.6	4.7	4.7	5.1	5.7	11	13	14
2023 WY											
Oct-2022	Nov-2022	Dec-2022	Jan-2023	Feb-2023	Mar-2023	Apr-2023	May-2023	Jun-2023	Jul-2023	Aug-2023	Sep-2023
9.6	5.1	5.7	-	-	-	-	-	-	ND	ND	ND

Precipitation and stream flow data from the same time period showed that there may be correlation between higher concentrations of arsenic and drier months.

Agricultural Operations

The Source Identification Study assessed baseline management practices implemented by 11 KRWCA members with parcels near the Kern River sampling site and upstream of Lake Isabella on the south fork of the Kern River (collectively referred to as the Represented Area). Data from the 2020 Crop Harvest Year and reported via Irrigation and Nitrogen Management Plan Summary Reports was used to evaluate whole-farm practices across these parcels. The SIS Report states that members implemented best management practices in pesticide, irrigation, and nutrient management. Specifically, 100% of members practiced some form of pesticide management, with 82% using multiple methods. Drip irrigation was the predominant technique, with various efficiency practices used to prevent over-irrigation and nutrient runoff. Additionally, members followed Sediment and Erosion Control Plans to mitigate sediment discharge and erosion risks.

SAMPLING RESULTS

As part of the Source Identification study, sampling events were conducted on 5 February 2024 and 26 July 2024 to observe any seasonal changes in water quality. Table 4 shows the sampling location, date, and results. Four sediment and nine water quality samples were collected during the February sampling event, with one sample at the Clear Creek sampling site resulting in a concentration above 10 µg/L. During the July sampling event only three out of the 12 planned samples were collected. The KRWCA planned to spot sample along the Kern River as a contingency, but the Borel Fire and associated road closures did not allow access to the sites along Highway 178. Out of the three samples collected there were two that exceeded 10 µg/L (Upper Bradshaw Creek at 62 µg/L and Upper Erskine Creek at 17 µg/L).

Table 4: Sampling Sites and Arsenic Results for the Source Identification Study

Sampling Sites	Sample ID	Water Sample	Sediment Sample	Units
February 2024				
Upstream of Cove District	MSC240202-1	4.2		µg/L
Cove District	MSC240202-2	4.5		µg/L
Kern River	MSC240202-3		<2.0	mg/kg
Downstream Cove District	MSC240202-4	4.4		µg/L
Downstream Cove District	MSC240202-5		<2.0	mg/kg
Cove District	MSC240202-6		<2.0	mg/kg
Upper Erskine Creek	MSC240202-7	7		µg/L
Lower Erskine Creek	MSC240202-8	6.9		µg/L
Kern River Upgradient of Erskine Creek Drain	MSC240202-9	3.5		µg/L
Clear Creek	MSC240202-10	22		µg/L
Kern River Sampling Site	MSC240202-11	3.5		µg/L
Kern River Sampling Site	MSC240202-11 DUP	3.8		µg/L
Kern River Sampling Site	MSC240202-11 BLANK	ND		µg/L
Kern River Sampling Site	MSC240202-12		ND	mg/kg

Sampling Sites	Sample ID	Water Sample	Sediment Sample	Units
July 2024				
Upper Bradshaw Creek	MSC240726-1	62		µg/L
Kern River Upgradient of Erskine Creek	MSC240726-3	6.4		µg/L
Upper Erskine Creek	MSC240726-5	17		µg/L

STAFF COMMENTS/RECOMMENDATIONS

The findings of the SIS Report indicate that arsenic exceedances are likely not due to irrigated agricultural discharges but rather naturally occurring geological processes, precipitation and drought patterns, and the influence of historic mining operations in the region.

Staff recommend the approval of the request to grant and exemption from the General Order requirement to develop and implement a Surface Water Quality Management Plan for total arsenic. Implementation of effective sediment discharge and erosion control practices should continue to occur as required by the General Order. Additionally, pesticide use report data evaluated during annual Pesticide Evaluation Protocol updates should reveal any significant changes in the use of arsenic-containing products.

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