BRAKE PAD LEGISLATIVE REPORT

THE IMPACT OF CALIFORNIA'S BRAKE PAD LAW

REPORT TO THE LEGISLATURE

DECEMBER 30, 2022

Prepared by the Department of Toxic Substances Control and The State Water Resources Control Board

The Impact of California's Brake Pad Law: Report to the Legislature

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EXECUTIVE SUMMARY

Copper is toxic to many aquatic organisms, and vehicle brake pads are a major source of copper pollution in urban runoff. In 2010, Governor Schwarzenegger signed the California Motor Vehicle Brake Friction Material Law (Brake Pad Law) to reduce the amount of copper and other toxic substances in brakes from entering California's streams, rivers, and marine environment. Since 2010, the Department of Toxic Substances Control (DTSC) has worked to facilitate compliance with this law by developing criteria for testing, certification, and marking of brake pads, and establishing requirements for and approving testing of certification agencies. The Brake Pad Law contains a wide exemption for replacement brake pads that DTSC and The State Water Resources Control Board (Water Board) recommend narrowing.

Compliance with the Brake Pad Law appears to be widespread. As of 2021, more than 60 percent of brake pads on the market are copper-free,[*] which corresponds to an estimated 28 percent decrease in copper entering urban runoff. Further reductions of copper releases to the aquatic environment are expected as manufacturers continue to come into compliance, new cars and brakes enter the California fleet, and previously accumulated copper is flushed out of watersheds. Limited long-term monitoring in California waterways makes it difficult to determine the impact of the Brake Pad Law on meeting copper Total Maximum Daily Load (TMDL) allocations. California could better assess trends in water pollution and progress toward meeting TMDLs by implementing a targeted surface water contaminant monitoring program.

[*] Brake pads containing less than 0.5% copper are generally referred to as copper-free.

INTRODUCTION

Whenever a driver brakes, particles of copper and other harmful constituents are released from brake pads and into the surrounding environment. These particles cause hundreds of thousands of pounds of copper to enter California waterways each year and are among the largest sources of copper released into urban watersheds.[1] Copper is toxic to many aquatic organisms, including salmon.[2] Numerous waterbodies throughout the state are classified as impaired under the federal Clean Water Act because of elevated copper levels, and U.S. EPA and the Water Board have developed Total Maximum Daily Load (TMDL) frameworks for several of these impaired waters to bring them into compliance with water quality standards.[3] Limiting the copper content of vehicle brake pads has been identified as an effective strategy for preventing copper pollution.[1]

To reduce the amount of copper and other toxic substances in brakes from entering California's waterways, Governor Schwarzenegger signed Senate Bill 346, known as the California Motor Vehicle Brake Friction Material Law (Brake Pad Law), in 2010. The Brake Pad Law banned brake pads containing more than trace amounts of heavy metals and asbestos in 2014, and new vehicle brake pads containing more than 5 percent copper in 2021. By 2025, the law reduces the amount of copper allowed on new vehicle brake pads to almost zero. The Brake Pad Law also requires DTSC and the Water Board to submit a report to the Legislature on the implementation of vehicle brake copper reduction efforts and related progress toward meeting copper TMDL allocations across the state. This report is being submitted in accordance with that requirement.

1. IMPLEMENTATION OF BRAKE PAD COPPER REDUCTION EFFORTS

Since the Brake Pad Law was adopted in 2010, DTSC has worked to ensure that stakeholders have the necessary information to comply with this law. The following list summarizes actions DTSC has carried out to implement the law.

- DTSC worked with the Washington Department of Ecology and the Society of Automotive Engineers (SAE) to develop a brake pad identification and marking system and a testing protocol for analyzing the heavy metal and asbestiform fiber content of brake pads. These documents were published as SAE Standard J 866:JUL2012 and SAE Standard J

2975:DEC2013 in 2012 and 2013, respectively. SAE Standard J 866:JUL2012 defines the following three compliance levels for brake pads:

SAE Marking Levels	Definition of SAE Marking Levels
A	Brake pads that contain no more than 0.1% by weight of asbestos, hexavalent chromium, lead and mercury, and no more than 0.01% by weight of cadmium. No restriction on copper content (commonly referred to as high copper).
B	Brake pads that meet the requirements for the "A" marking and contain no more than 5% by weight of copper (commonly referred to as low copper).
N	Brake pads that meet the requirements for the "A" marking and contain no more than 0.5% by weight of copper (commonly referred to as copper free).

- In 2013, DTSC published guidelines to assist brake pad manufacturers in selecting a testing certification agency that aligns with both California and Washington law.
- In 2016, DTSC developed the California Brake Friction Material Requirements regulations, which provide stakeholders with thorough information on brake pad testing, brake pad compliance marking, and SB 346's extension process.[4] These regulations became effective in 2017.
- In 2020, DTSC approved an application from Automotive Manufacturers Equipment Compliance Agency, Inc. to become the second testing certification agency under the California Brake Friction Material Requirements.
- DTSC continues to field compliance questions from brake pad manufacturers on a regular basis.
- DTSC has developed a compliance testing plan that includes actionable steps for conducting market surveillance, educating stakeholders, offering compliance assistance, and otherwise enforcing the Brake Pad Law.

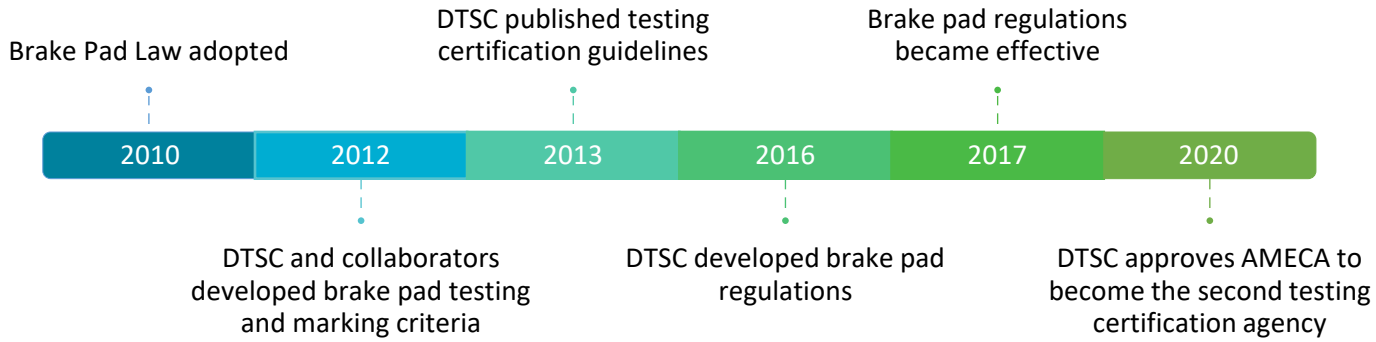

FIGURE 1 – TIMELINE OF DTSC'S BRAKE PAD LAW IMPLEMENTATION EFFORTS

As a result of DTSC's efforts, brake pads are now marked with an easy to decipher three-leaf symbol (shown below) and brake pad compliance certifications are publicly available on the approved registrars' websites.

FIGURE 2 – ENVIRONMENTAL COMPLIANCE MARKINGS FOR HIGH COPPER, LOW COPPER, AND COPPER FREE BRAKE PADS

1.1 Exemptions and Extensions

The Brake Pad Law provides manufacturers with a few options to avoid the deadlines for reducing copper in their brake pads. Specifically, certain types of brake pads are exempt, and

manufacturers of non-exempt pads may apply for deadline extensions. As part of this report, DTSC and the Water Board are required to comment on whether it is necessary to impose additional restrictions on these exemptions and the extension process. DTSC and the Water Board recommend narrowing the replacement brake pad exemption to align with Washington State's to accelerate the reduction of copper pollution.

The Brake Pad Law exempts several types of brakes from its provisions, including brakes for motorcycles, certain military vehicles, and those produced for vehicles manufactured by small volume manufacturers. More significantly, replacement brakes for vehicles produced before January 1, 2021, and January 1, 2025, are also exempt from those respective deadlines. Most brake pads are produced for the replacement market rather than for use in new vehicles, so the exemption for replacement pads may be allowing a substantial share of the market to avoid the Brake Pad Law's copper reduction requirements. Given that copper-free brake pads have been safe and widely available since at least 2016,[5] we recommend that the Legislature narrow the replacement exemption so that it is only applicable to pads produced through original equipment service contracts. Doing so will better align the Brake Pad Law with Washington State's Better Brakes Law and U.S. EPA's copper-free brake memorandum of understanding.[5,6] This action could prevent hundreds of thousands of pounds of copper from entering California waterways each year unnecessarily.

The Brake Pad Law also outlines a process through which manufacturers may apply for extensions to the January 1, 2025, deadline requiring that all new brakes be copper free. The Brake Pad Law names DTSC as the facilitator of the extension process and states that the CalEPA secretary will appoint the members of an advisory committee who will review extension applications. As of December 2022, DTSC has not received any extension requests. However, the results of a survey conducted by DTSC in 2021 indicate that manufacturers may submit up to 50 extension applications before the 2025 deadline. Even if DTSC receives fewer extension applications than expected, it would need to re-prioritize existing resources and commitments or request a budget augmentation to effectively fulfill its role as facilitator.

The extension process is resource-intensive, and any approval of extension applications would slow California's progress toward reducing copper releases. Thus, the Legislature could prevent unnecessary government spending and further limit copper pollution by removing the extension application process from the Brake Pad Law. While DTSC and the Water Board are not formally recommending this, it is something the Legislature may want to consider.

2. EFFECTIVENESS OF BRAKE PAD LIMITS

The Brake Pad Law has resulted in reduced use of copper in vehicle brake pads, both in California and across the country. Washington State joined California and passed a law in 2010 mandating similar restrictions of brake pad copper content. Because California makes up an important portion of the overall U.S. motor vehicle market, and because of the interconnectedness of the automotive parts supply chain throughout the country, manufacturers chose to lower the copper content of brake pads for the entire U.S. market rather than produce brake pads specifically for California.[1] In 2015, brake pad manufacturing groups signed a copper-free brake memorandum of understanding with U.S. EPA that effectively expanded the California and Washington copper phaseouts nationwide.[6]

To assess industry's progress toward reducing brake pad copper content, DTSC conducted a review of publicly available brake pad certification data registered with NSF International.[7] NSF International was the only Testing Certification Agency approved to certify brake pad formulations from 2012 through early 2022, so it is the best available source of data for understanding trends in brake pad copper content. Further information on our approach is in Appendix A.

DTSC found that the proportion of copper free (certification level "N") brake pads more than doubled from 29 percent in 2012 to 62 percent in 2021. The proportion of high copper (certification level "A") pads decreased from 68 percent to around 20 percent in the same period. There are uncertainties in the available data, and it is possible that this estimate understates the progress that manufacturers have made in transitioning to copper free and low copper brake pads. For instance, our analysis counts every brake pad formulation equally and does not account for the likelihood that some pads are used with far higher frequency than others.

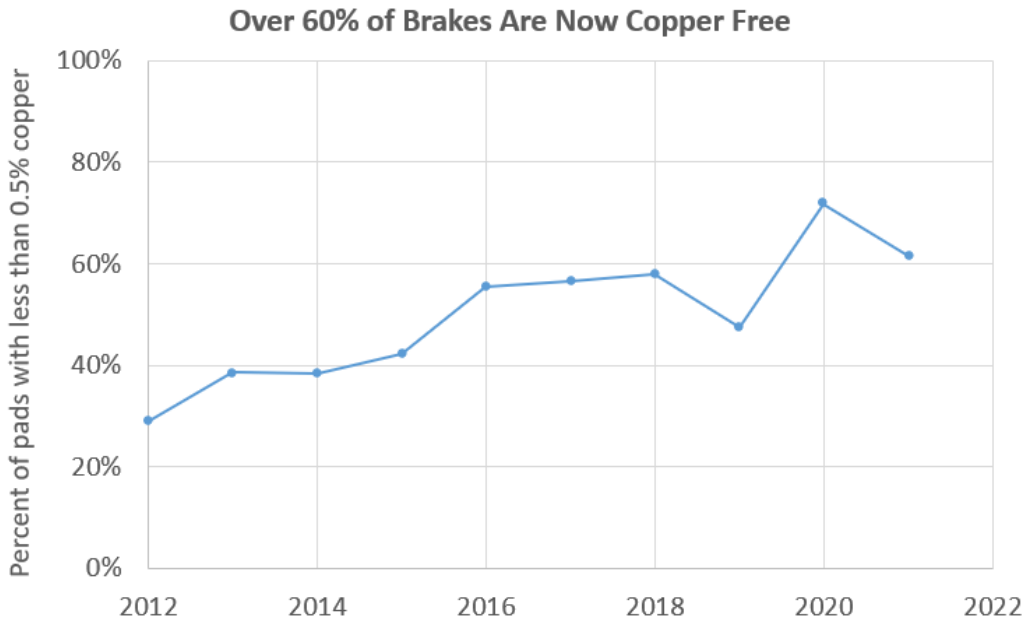

FIGURE 32: PROPORTION OF VEHICLE BRAKE PADS THAT ARE COPPER FREE, 2012-2021

3. MODELING COPPER REDUCTION IN URBAN RUNOFF

To determine the effect of reduced brake pad copper content on copper emissions to urban runoff, DTSC used a modified version of the model developed by California Stormwater Quality Association (CASQA) in 2016.[1] We first determined the average copper content of brake pads in use in California for each year from 2013 to 2021 using our estimates of the proportion of "A", "B", and "N" pads and assumptions about the age distribution of vehicles on the road and the frequency of brake pad replacement. We then used the reduction in on-road average brake pad copper content to estimate the reduction of copper releases to urban runoff, assuming that brake pads account for 62 percent of anthropogenic copper entering urban watersheds and that copper emitted from brake pads is flushed from urban watersheds into surface waters in one year.[1]

We calculated that the shift to lower copper brake formulations has reduced copper releases to urban runoff by 28 percent as of 2022, which equates to more than 360,000 pounds of copper

per year statewide.[‡] Copper releases to urban runoff are expected to continue to decline in the coming years as brake pad manufacturers continue to come into compliance with the Brake Pad Law, new cars and brakes enter the California fleet, and diminished levels of copper accumulate in watersheds.

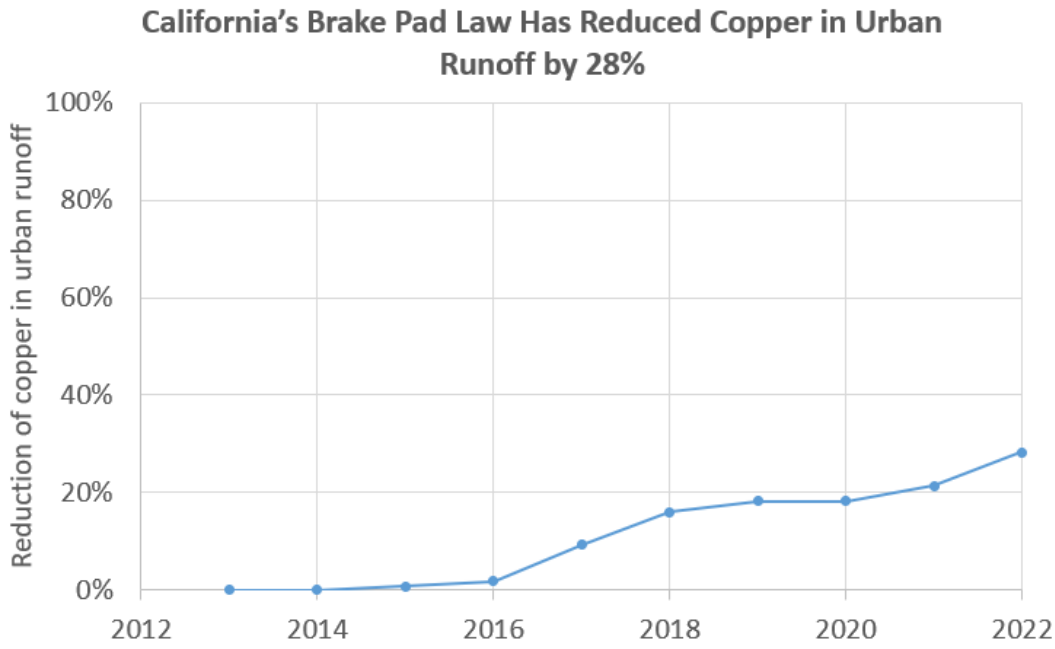

FIGURE 43: REDUCTION OF COPPER IN URBAN RUNOFF DUE TO CALIFORNIA'S BRAKE PAD LAW

[‡]EPA states that 1.3 million lb of copper were released from vehicle brakes to the California environment each year prior to implementation of the Brake Pad Law.[6] 28% of this amount is 364,000 lb of copper per year.

4. ENVIRONMENTAL MONITORING DATA AND PROGRESS TOWARD TMDLs

While our modeling suggests that the Brake Pad Law has been successful in reducing copper inputs to urban watersheds, we found mixed evidence for whether copper concentrations in the environment are decreasing. We reviewed environmental monitoring efforts throughout California, including those conducted by the State Water Resources Control Board and Regional Water Quality Control Boards, San Francisco Estuary Institute, the Southern California Coastal Water Research Project, the UC Davis Granite Canyon Lab, as well as data collected by individual municipalities, and stormwater permittees subject to TMDL requirements. Brief summaries of these datasets are provided in Appendix B. Our review found that some data sets show copper decreasing over time, others show increases in copper, and some show no trend. An overarching explanation may be that it is too soon for changes in the brake pad marketplace to be reflected in the environmental data. The following sections examine other factors that make it difficult to evaluate the linkage between reductions in brake pad copper and copper trends in the environment.

4.1 Suitability of Existing Environmental Data

One explanation is that some of the available environmental monitoring data is currently unsuitable for identifying long-term trends in urban runoff copper concentrations. The largest, longest-running source of information on copper levels in runoff is monitoring data collected by stormwater permit holders such as cities and counties. There are several challenges in using stormwater permit data to look for long-term trends, including changing sampling locations, varying sample types (e.g., stormwater outfall vs. river channel), and differing flow regimes (i.e., dry season vs. rainy season).[8] There are other factors that make it difficult to conduct trend analysis. For example, storm intensity and duration and variations in drainage area conditions cause significant variability in pollutant levels in stormwater runoff. These conditions that may affect data variability and drainage area characteristics are not reported and only some monitoring data is reported electronically.

Another large, long-term dataset is collected by the Stream Pollution Trends Monitoring Program (SPoT), which is a joint effort of the State Water Resource Control Board and the UC Davis Granite Canyon Laboratory. SPoT was designed expressly for the purpose of assessing long-term, statewide trends in stream water quality and relating those trends to management efforts such

as the Brake Pad Law. However, SPoT measures contaminants in stream sediments rather than in the water column. Sediment measurements are useful indicators of water quality because they aggregate pollution information over time, but they typically respond slowly to changes in stream water quality. This may explain why copper reductions resulting from the Brake Pad Law are not yet evident in the SPoT data.

4.2 Drought

A second explanation is drought. Flushing copper from roadways and adjacent land surfaces into the aquatic environment requires precipitation. The state has been experiencing a historic drought for most of the period since the Brake Pad Law went into effect. The lack of precipitation is likely increasing the lag time between when copper is phased out of brake pads and when copper levels in runoff exhibit a measurable decrease.

4.3 Reductions in Other Copper Sources

A third factor that complicates interpretation of the environmental data is reductions in other copper sources. For example, data collected by SFEI shows that copper levels in San Francisco Bay water decreased consistently during the 2010s.[10] Because this decrease began before the Brake Pad Law went into effect, it is likely a result of efforts that took place in previous decades, including work done to reduce copper discharges from businesses, restriction of copper-based sewer root killers by the Department of Pesticide Regulation, and process improvements at wastewater treatment plants.[9]

4.4 TMDL Compliance

TMDLs are calculations that determine the maximum amount of a pollutant that can enter a waterbody without that waterbody exceeding water quality standards.[11] They also include pollutant reduction targets and implementation plans for achieving those reductions. Of the 124 California waterbodies listed as impaired for copper in 2022, TMDLs have been developed for 28. All 28 are for waterbodies in Southern California, within the jurisdictions of the Los Angeles, Santa Ana, and San Diego Regional Water Quality Control Boards.

Responsibility for complying with the copper TMDLs falls to dischargers such as wastewater treatment plants and stormwater permit holders, and compliance is overseen by the Regional Water Quality Control Boards (Regional Boards). In the case of stormwater permit holders,

discharge limits for the copper TMDL are typically written into the stormwater permits, which are also overseen by the Regional Boards. Most of the available copper environmental data are from TMDL implementation monitoring requirements. However, because of the challenges with identifying long-term trends in environmental monitoring data, the contribution of the Brake Pad Law to meeting copper TMDL targets is currently unclear.

4.5 The Need for a Strategic and Targeted Contaminant Monitoring Program

The lack of evidence for copper reductions in urban runoff is due in part to limitations in monitoring programs designed to detect them. California could solve this problem by creating a strategic monitoring program for contaminants in urban runoff and receiving waters. Such a program would enhance the state's ability to evaluate progress toward meeting TMDLs. A targeted surface water contaminant monitoring program would complement the sediment monitoring efforts performed by the SPoT program. It would also help fill the void left by the end of the US Geological Survey's National Water Quality Assessment, which was, until recently, the primary federal program for monitoring contaminants in US surface waters.[14]

Part of the mandate of DTSC's Safer Consumer Products (SCP) Program is to mitigate water quality impacts from harmful chemicals in consumer products. Targeted and strategic surface water contaminant data would aid SCP in prioritizing product-chemical combinations for potential regulation. It could also serve as a metric for the efficacy of SCP's work to remove harmful product-chemical combinations from commerce. Without a strategic contaminant monitoring program, evaluating the linkages between California's green chemistry efforts, and resulting water pollution reductions will continue to be challenging.

5. SUMMARY AND RECOMMENDATIONS

California's Brake Pad Law has been successful in reducing the amount of copper, other heavy metals, and asbestos in brake pads sold in California and throughout the U.S. This change is expected to reduce the amount of copper entering California's environment by hundreds of thousands of pounds per year, and thus, contribute to healthier aquatic ecosystems. These reductions are not yet consistently reflected in environmental monitoring data but will likely become more evident as time progresses. Developing a strategic approach to surface and stormwater contaminant monitoring could enhance the state's ability to track the impact of the Brake Pad Law and other pollution prevention measures. Updating data systems to include

geographic information system data and modern database tools may allow the state to better evaluate progress toward stormwater program compliance.

In conclusion, DTSC and The Water Board make the following recommendations:

1. Consider narrowing the exemption for replacement brake pads so that it is only applicable to brake pads produced as part of an original equipment service contract.
2. Consider establishing a targeted and strategic statewide monitoring program for contaminants in urban runoff and receiving waters.
3. Consider modernizing statewide stormwater data systems to develop a comprehensive data management system for stormwater contaminants, which may allow regulatory agencies to track the effectiveness of the Brake Pad Law and other regulations.

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APPENDIX A – ANALYSIS OF BRAKE PAD CERTIFICATION DATA

To assess the brake pad industry's progress toward reducing brake pad copper content, we determined the fraction of certified brake pads falling into compliance levels "A", "B", and "N" over time.

Using the nearly 18,000 brake pad certification listings on the NSF International Brake Friction Registration website,[1] we calculated the number of brake pads certified to each of the three compliance levels in every year from 2012-2021. We then calculated the cumulative number of brake pads certified to each compliance level for each year. Because certifications expire three years after they are issued, we also calculated the number of brake pads that expired each year as well as the cumulative number of brake pads that had expired as of every year. Next, we determined the cumulative number of brake pads certified but not expired for each compliance level for each year. Finally, we calculated the percentage of all pads that were certified but not expired in each of the three compliance levels for each year. See Figure A1.

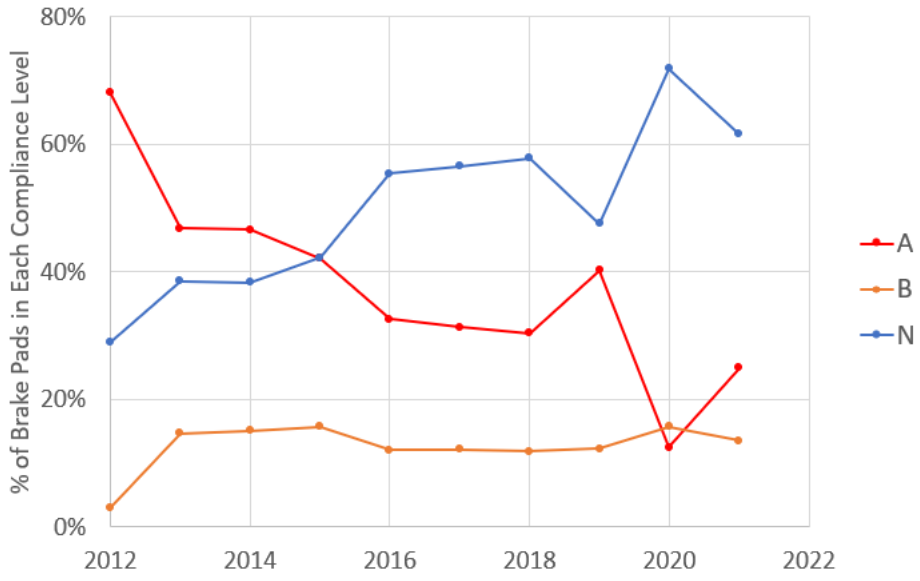

FIGURE A1: CHANGE IN FRACTION OF BRAKE PADS CERTIFIED TO COMPLIANCE LEVELS A, B, AND N

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Appendix B – SUMMARY OF ENVIRONMENTAL MONITORING DATA FOR COPPER

B.1 San Francisco Estuary Institute (SFEI)

SFEI is an independent research institute that conducts "science to assess and improve the health of the waters, wetlands, wildlife and landscapes of San Francisco Bay, the California Delta and beyond." [1] Data collected by SFEI indicate that dissolved copper concentrations are decreasing in San Francisco Bay. Specifically, three-year rolling average dissolved copper concentrations decreased consistently from 2010-2019 at five monitoring locations throughout the Bay.[2] These data represent copper concentrations in San Francisco Bay water rather than in urban runoff, so they likely reflect copper contributions from wastewater treatment plant discharges, antifoulant boat paint, and other sources, in addition to runoff. SFEI staff stated that wastewater treatment plant effluent is expected to be the largest source of copper to the San Francisco Bay and that most of the observed reductions likely result from source reduction efforts and wastewater treatment plant process improvements made over the past two decades.[3]

B.2 Southern California Coastal Water Research Project (SCCWRP)

SCCWRP is a public research agency that conducts research to "improve management of aquatic systems in Southern California and beyond." [4] SCCWRP's Southern California Bight Regional Monitoring Program has measured copper in marine surface sediments every five years since the 1990s. Because the measurements are made in coastal sediments rather than in streams or stormwater conveyances, they are unlikely to reflect changes resulting from the Brake Pad Law for many years.[5]

B.3 Stream Pollution Trends Monitoring Program (SPoT)

SPoT is part of the State Water Resources Control Board's Surface Water Ambient Monitoring Program.[6] It was designed expressly for the purpose of assessing long-term, statewide trends in stream water quality and relating those trends to management efforts such as the Brake Pad Law.

A 2020 analysis of SPoT data collected between 2008 and 2017 found no significant statewide trends in sediment copper concentrations.[7] Because copper reductions resulting from the Brake Pad Law are expected to be concentrated in urbanized watersheds with greater levels of vehicle

traffic, DTSC conducted its own analysis of SPoT data from sampling sites in areas of Southern California under the jurisdiction of the three Regional Water Boards that have TMDLs for copper. This analysis was conducted on data collected between 2008-2020. We conducted Mann-Kendall statistical tests on SPoT data from the 22 sites in this region for which at least five years of monitoring data was available. Four of these sampling sites are located in waterbodies with TMDLs for copper. We found no statistically significant (α=0.05) trends in copper concentrations at any of the sites. See Appendix C.

B.4 TMDL Report Cards

The Regional Water Resources Control Boards publish one-page Water Quality Report Cards that summarize TMDLs and other water quality improvement projects.[8] Because the report cards are published sporadically it is difficult to use them to evaluate possible linkages between the Brake Pad Law and changes in aquatic copper concentrations. Table B1 summarizes information from the Water Quality Report Cards that is relevant to copper TMDL projects.

Table B1: Summary of Water Quality Report Cards published by the State Water Resources Control Board for copper TMDL projects.

TMDL	Year Report Card Published	Presents Copper Concentration Data?	Trends Noted	Notes
Dissolved Copper in Shelter Island Yacht Basin	2013	Yes, for 2011 and 2012	Decreasing trend in copper concentrations from 2011 to 2012	Primary concern is leaching of copper-based antifouling boat hull paint
Copper in Ballona Creek	2014	Yes, for 1997-2012	Decreasing copper during dry weather; increasing copper during wet weather	Decreasing copper during dry weather attributed to lower storm water volumes and newly installed storm water best management practices

Zinc and Copper in Marina Del Rey Harbor	2014	Yes, for 2010-2012	None	N/A
Metals in Los Cerritos Channel	2015	Yes, for 2001 to 2015	None	Notes that wet weather and dry weather impairments for copper still persist
Metals and Selenium in San Gabriel River Watershed	2015	No	N/A	Notes that wet weather copper exceedances in Coyote Creek have decreased as have dry weather exceedances in San Gabriel River Estuary
Copper, Lead, and Zinc in Chollas Creek	2016	No	The number of copper exceedances shows a slight decrease from 2006 to 2015	N/A
Metals and Selenium in Los Angeles River Watershed	2016	Yes, for 2008 to 2015	None	N/A
Toxic Pollutants in Los Angeles and Long Beach Harbors	2018	No	N/A	Notes that dissolved copper is above water quality criteria in Consolidated Slip, Cabrillo Marina, Inner Long Beach

				Harbor, and Los Angeles River Estuary
Metals and Selenium in Calleguas Creek Watershed	2020	Yes, from 2008 to 2018	Copper concentration increasing	Copper TMDL targets are being met

B.5 Stormwater Permits

Because of the heterogeneity associated with this type of monitoring data, The Water Board limited its analysis of data collected under stormwater permits to data obtained from Los Angeles County Flood Control District. In addition, DTSC reviewed the only published summary of this type of data that we could identify, from Chollas Creek in San Diego.

B.5.1 Chollas Creek

Chollas Creek is one of two waterbodies within the jurisdiction of the San Diego Regional Water Quality Control Board for which a copper TMDL has been developed.[9] Under the TMDL, stormwater permittees within the watershed are jointly responsible for conducting copper monitoring and issuing reports to the San Diego Regional Water Quality Control Board. The FY 2019 Annual Report submitted by the San Diego Bay Responsible Parties shows that exceedances of the TMDL targets for copper in Chollas Creek are decreasing and attributes this change to increased street sweeping, inspection and cleaning of storm drains, and installation of stormwater best management practices.[10]

B.5.2 Los Angeles County

The Los Angeles County Flood Control District provided stormwater sampling data from stations located in the Upper and Lower Los Angeles River, Dominguez Channel, Santa Monica Bay, and the Upper and Lower San Gabriel River.[11] Stations were selected if they had been sampled for at least two years prior to 2018 (to allow for trend analyses before and after the Brake Pad Law), and the data was comprised of composite, wet weather samples. Staff utilized the Adaptive Management Web Application,[12] which is a tool developed by the Southern California Coastal

Water Research Project and the San Francisco Estuary Institute that allows stormwater managers to visualize trends in data over time. Of the 11 stations selected for analysis, three demonstrated a trend of decreasing copper concentrations, four demonstrated increasing copper concentrations, three demonstrated no change in copper concentrations, and one did not demonstrate any trend. Stormwater monitoring programs are not generally designed to answer questions about copper concentrations associated with brake pad wear. As such, there is not enough information to directly relate the trends from Los Angeles County to changes in brake pad formulation.

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APPENDIX C – TREND ANALYSIS OF COPPER CONCENTRATIONS AT SOUTHERN CALIFORNIA SPoT SITES

DTSC performed Mann-Kendall statistical tests on data collected by the Stream Pollution Trends (SPoT) Monitoring Program to test for site-specific trends in sediment copper concentrations.

- SPoT data collected between 2008 and 2018 was obtained through the California Environmental Data Exchange Network.[1] SPoT data collected in 2020 was unavailable in CEDEN and was received from UC Davis Granite Canyon Lab.[2]
- We limited our analysis to data collected at sites within the jurisdiction of the Los Angeles, Santa Ana, and San Diego Regional Water Resources Control Boards, because all copper TMDLs in California are located within these regions.
- Statistical trend testing was only conducted for the 22 sites in these regions for which at least five years of monitoring data was available.
- During some sampling events two separate copper measurements were made: one for total copper and another for copper in the fraction of sediment with a diameter of less than 63 microns. Only the total copper results were included in the trends analysis, per the practice of the SPoT program.[3]
- SPoT sampling campaigns typically occur early in the dry season, between late April and early July. The data for some sampling sites contains a few measurements made at other times of the year, but these were excluded from trends analysis.
- If duplicate total copper measurements were taken on the same date, the results were averaged and treated as one value.
- The Mann-Kendall test was used to test for statistical significance of trends, using alpha = 0.05. This method was chosen because it was used to test for trends by SPoT in its 10-year report.[4] One-sided Mann-Kendall tests were calculated in Excel and checked using EPA's ProUCL Statistical Software.[5]

Results:

DTSC found no statistically significant (α=0.05) trends in copper concentrations at any of the sites.

Table C1: Mann-Kendall tests for trends in copper concentrations at selected SPoT sampling sites in Southern California.

SPoT Station Name	Station Code	TMDL?	Mann-Kendall test statistic*	p-value	Statistically Significant Trend? (Mann-Kendall, α=0.05)
Ballona Creek Downstream of Sawtelle (Centinella)	404BLNAxx	Yes	8	0.23	No
Bouquet Canyon Creek	403STCBQT	No	-17	0.08	No
Calleguas Creek Below Camrosa WWTP, Site 6	408CGCS06	Yes	-17	0.08	No
Los Angeles River at Willow	412LARWxx	Yes	-8	0.19	No
San Gabriel River RA-2	405SGRA2x	Yes	8	0.19	No
Santa Clara River Estuary	403STCEST	No	-4	0.38	No
Sespe Creek	403STCSSP	No	-10	0.13	No
Ventura River Bio 0	402VRB0xx	No	10	0.13	No
Escondido Creek at Camino del Norte	904ESCOxx	No	-11	0.18	No
Los Penasquitos Creek 6	906LPLPC6	No	0	0.50	No

Salt Creek	901INTSC5	No	-4	0.23	No
San Diego River at Ward Road	907SDRWAR	No	-6	0.30	No
San Dieguito River 9	905SDSDQ9	No	0	0.50	No
San Juan Creek 9	901SJSJC9	No	3	0.40	No
San Luis Rey River at Benet Road Bridge	903SLRRBB	No	6	0.11	No
Santa Margarita at Basilone Rd	902SSMR07	No	-11	0.19	No
Sweetwater River at Willow Street	909SWRWSx	No	-3	0.35	No
Tijuana River at Hollister Rd	911TJHRxx	No	-8	0.23	No
Chino Creek (San Antonio Ck) at Euclid/Hwy 83 bridge	801CCPT12	No	0	0.50	No
San Diego Creek at Campus	801SDCxxx	No	-13	0.18	No
San Jacinto River - Reference Site	802SJCREF	No	-3	0.38	No
Santa Ana River at Prado Basin Park Rd	801SARVRx	No	-4	0.36	No

**Large positive values of the Mann-Kendall test statistic indicate that later measurements tend to be larger than earlier values and reflect an increasing trend. Large negative values of the Mann-Kendall test statistic indicate a decreasing trend. Values near zero indicate no trend.*

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