Potential Contributions of PCBs to Stormwater from Electrical Utilities in the San Francisco Bay Area

Overview and Information Needs

Prepared for:
Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)

Prepared by:
EOA, Inc.
1410 Jackson St.
Oakland, CA 94612

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ACCWP	Alameda Countywide Clean Water Program
Bay	San Francisco Bay
BASMAA	Bay Area Stormwater Management Agencies Association
Cal OES	California Office of Emergency Services
CCCWP	Contra Costa Clean Water Program
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
DTSC	Department of Toxic Substances Control
FSURMP	Fairfield-Suisun Urban Runoff Management Program
IGP	Industrial General Permit
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Sewer System
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
PCBs	Polychlorinated Biphenyls
RMC	Regional Monitoring Coalition
ROW	Right-Of-Way
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
OFEE	Oil-filled Electrical Equipment
PG&E	Pacifica Gas and Electric Company
ppm	parts per million
RQ	reportable quantity
RCRA	Resource Conservation and Recovery Act
SF Bay Water Board	San Francisco Bay Regional Water Quality Control Board
SFEI	San Francisco Estuary Institute
SIC	Standard Industrial Classification
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasure
VSFCD	Vallejo Sanitation and Flood Control District
TMDL	Total Maximum Daily Load
TSCA	Toxic Substances Control Act
USEPA	United States Environmental Protection Agency

1.0 Introduction

1.1 Background

Fish tissue monitoring in San Francisco Bay (Bay) has revealed the bioaccumulation of Polychlorinated Biphenyls (PCBs), mercury, and other pollutants in Bay sportfish. The levels found are thought to pose a health risk to people consuming these fish. As a result, in 1994, the state of California issued a sport fish consumption advisory cautioning people to limit their consumption of fish caught in the Bay. The advisory led to the Bay being designated as an impaired water body on the Clean Water Act (CWA) "Section 303(d) list" due to elevated levels of PCBs. In response, in 2008, the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) adopted a Total Maximum Daily Load (TMDL) water quality restoration program targeting PCBs in the Bay[1]. The general goals of the TMDL are to identify sources of PCBs to the Bay, implement actions to control the sources, and restore water quality.

The PCBs TMDL estimates baseline loads to the Bay from various source categories. The largest source category, at 20 kilograms (kg) per year, was estimated to be urban and non-urban stormwater runoff. This category includes all sources to small tributaries draining to the Bay. The PCBs TMDL indicates that a 90% reduction in PCBs from urban stormwater runoff to the Bay is needed to achieve water quality standards and restore beneficial uses. The TMDL states that the wasteload allocation for urban stormwater runoff of 2 kg per year shall be achieved within 20 years (i.e., by 2028). The TMDL is being enforced through National Pollutant Discharge Elimination System (NPDES) stormwater permits issued to municipal and industrial dischargers of stormwater. The initial Municipal Regional Stormwater NPDES Permit (MRP), issued in 2009, required Permittees to implement pilot-scale control measures to reduce PCBs from Municipal Separate Storm Sewer Systems (MS4s). These pilot studies were implemented by members of the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC)[2] and enhanced our collective knowledge about the costs and benefits of different control measures to reduce the levels of PCBs in urban stormwater.

The MRP was reissued in 2015 and now requires municipal agencies (i.e., Permittees) to move from pilot-scale work to focused implementation and the achievement of defined load reduction goals. The strategies and control measures that will be applied to meet the load reduction goals are anticipated, at a minimum, to include:

- Source property identification and referrals to regulatory agencies for further investigation and abatement;

[1] The PCBs TMDL was approved by the US Environmental Protection Agency (USEPA) on March 29, 2010 and became effective on March 1, 2010.

[2] The BASMAA RMC is a consortium of San Francisco Bay Area municipal stormwater programs that joined together to coordinate and oversee water quality monitoring and several other requirements of the MRP. Participating BASMAA members include Alameda Countywide Clean Water Program (ACCWP), Contra Costa Clean Water Program (CCCWP), Fairfield-Suisun Urban Runoff Management Program (FSURMP), San Mateo Countywide Water Pollution Prevention Program (SMCWPPP), Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), and City of Vallejo and Vallejo Sanitation and Flood Control District (VSFCD).

- Green stormwater infrastructure/treatment controls; and
- Management of PCBs in building materials during demolition.

One aspect of **source property identification** is the designation of a **categorical source property**. The categorical source property designation was developed specifically to address potential sources of PCBs that are widespread and distributed across multiple jurisdictions, such as electrical utility applications and rail lines. MRP Permittees, as a group, can refer an entire source category to the Regional Water Board in order to facilitate a regional approach to addressing PCBs from a categorical source.

1.2 Problem Statement

PCBs were historically used in many applications, including electrical utility equipment. Some of the equipment still contains PCBs, and properties owned and operated by electrical utilities may have elevated concentrations of PCBs in surface soils due to past spills. Electrical utility applications present special challenges for source identification and abatement due to the quantity, dispersed nature, difficulty in sampling, and the general lack of Permittee control over the property or equipment. Release of PCBs from electrical utility applications has proved particularly difficult to quantify or control when private utility companies (such as Pacific Gas and Electric, PG&E) are involved. Because releases or spills of PCBs to stormwater from these properties or equipment may be occurring at levels approaching a significant portion of the 2 kg per year waste load allocation, this potential source of PCBs may limit the ability of municipalities to meet the goals of the PCBs TMDL.

1.3 Purpose of Document

This document presents a summary of the Santa Clara Valley Urban Runoff Pollution Prevention Program's (SCVURPPP's) current state of knowledge about PCBs used by electrical utility companies, the potential mass of PCBs released into the environment from this source, and the regulatory programs implemented for the purposes of managing PCBs and reporting and cleaning up spills. This document focuses on PG&E because this private company owns and operates the vast majority of electrical utility properties and equipment in the Bay Area. This document is intended to provide background information on electrical utility applications as potential sources of PCBs to stormwater in order to support Bay Area MS4s and the Regional Water Board in future efforts to develop and implement a region-wide approach for quantifying and controlling the release of PCBs from this source. Bay Area MS4s look to the Regional Water Board to assist in information gathering to better understand the current use of PCBs and control measures implemented by electrical utilities, in order to develop improved procedures and practices that will limit releases to stormwater.

1.4 Document Organization

This document is organized into the following sections:

Section 2.0 presents background information on PCBs, including current and historic sources and use, and estimates of the mass of PCBs used in the Bay Area. This section identifies the primary sources of PCBs to stormwater, including electrical utility applications.

Section 3.0 presents a brief overview of electrical utility systems in the Bay Area and identifies how and where PCBs are used within those systems. This section also describes the efforts made to date to remove PCBs from electrical utility applications, and highlights data gaps on how much or where PCBs may still exist in the system.

Section 4.0 describes the existing state and federal regulations that guide management of PCB-containing electrical utility equipment, spill cleanup and reporting. These standards are compared to the more stringent thresholds that would be needed to meet the load reduction requirements of the PCBs TMDL.

Section 5.0 establishes the case that electrical utility applications are a current source of PCBs to the MS4. This section summarizes the information provided by 24 years of electrical utility equipment spill records to document that releases of PCBs from electrical utility equipment still occur today. This section highlights the inadequacy of current reporting, and identifies the need for more accurate, complete, and timely spill reporting.

Section 6.0 identifies the issues faced by Bay Area MS4s trying to control PCB releases from electrical utility applications. This section outlines the need for a region-wide approach to address best management practices and spill cleanup and reporting procedures from the Bay Area's primary electrical utility, PG&E.

Section 7.0 provides SCVURPPP's recommendations for Bay Area MS4s and the Regional Water Board to implement in order to facilitate development of a regional approach to address the stormwater concerns posed by releases of PCBs from PG&E electrical utility equipment.

Section 8.0 includes the full list of references and citations.

2.0 Production, Use and Release of PCBs in the Bay Area

This section:

- presents background information on PCBs, including an overview of current and historic sources and use;
- estimates of the mass of PCBs used in the Bay Area;
- describes the sources of PCBs to stormwater; and
- identifies electrical utility applications as sources of PCBs to stormwater.

2.1 What Are PCBs?

PCBs are commercially synthesized oily compounds consisting of carbon, hydrogen, and chlorine atoms. There are 209 possible arrangements of the atoms in PCB compounds. These are referred to as the 209 PCB congeners. PCBs were first manufactured in the United States (US) in 1929 and US production peaked in 1970. PCBs are non-flammable, chemically stable, have a high boiling point, and have electrical insulating properties. Therefore, they were used in hundreds of industrial and commercial applications. Most PCBs were manufactured as a mixture of several individual PCB congeners. The most common name for these mixtures in the US was the Aroclor series produced by Monsanto Company. There were more than ten common Aroclor mixtures.

Due to concern about their persistence in the environment, toxicity, and potential to cause cancer, the US Environmental Protection Agency (US EPA) banned the production and new use of PCBs in 1979. However, PCBs continue to be found in water and sediment collected from the San Francisco Bay, and urban stormwater runoff has been identified as a major source of PCBs to the Bay. Thus, PCBs are considered a legacy pollutant.

2.2 PCB Sources and Use

An undetermined amount of PCBs are still in use in products and materials that were produced before the 1979 ban. PCB-containing products and equipment can be divided into three source categories (Erickson 1992), including:

1. **Controllable closed systems** that are designed to remain closed for the life span of the product. These sources comprise about 60% of the PCBs that were commercially sold in the US. This category includes coolants and insulating fluids in electrical transformers and large capacitors (containing > 3.36 kg of dielectric fluid) operated by utility companies. Although these systems do not leak under normal circumstances, leaks can occur.
2. **Uncontrollable closed systems** are nominally closed, but leaks are expected to occur. These sources comprise about 10% of PCBs that were used in the US. This category includes small capacitors (including light ballasts), fluorescent light assemblies, and other devices that use hydraulic and heat transfer fluids and lubricants. These numerous devices are often designed to leak slowly and are difficult to track and regulate.

3. **Dissipative products** are in direct contact with the environment, with no way of recovering them when the product reached the end of its life. These sources comprise the remaining 30% of PCBs that were used in the US. This category includes plasticizers (the additives in plastics that maintain softness and pliability such as stabilizers in flexible PVC coatings of electrical wiring and electronic components and sealants/caulk), as well as other dissipative uses (pesticide extenders, reactive flame retardants, paints, inks, wood floor finishes, and carbonless copy paper) (Keeler et al. 1993).

PCBs can also occur as minor byproducts in some chemical industrial processes, during drinking water chlorination, and from thermal degradation during some industrial processes.

2.3 Sources and Loads of PCBs Entering the Storm Drain System in the Bay Area

The present day picture of PCB sources in the environment and the load of PCBs currently entering the storm drain system in the Bay Area is complicated. This is because, although production and new uses of PCBs were banned in 1979, 1) there is still legacy use that is gradually being phased out and 2) PCBs have been spread throughout the urban landscape in the 80-plus years since their introduction.

In an effort to understand the present day picture, McKee et al. (2006) conducted a mass balance analysis of PCBs entering the storm drain system. The "current" (2005) model was constrained by the estimated total mass of PCBs used in the Bay Area from all major sources during the historic period (1950 – 1990). The historic period represents the peak period of production and use of PCBs in the United States. This historic PCBs mass was calculated by scaling US totals to the Bay Area as a function of population. The total US PCB production for this time period was estimated to be 560,000 metric tons (560,000,000 kilograms), of which 12,300 metric tons (t) were assumed to be used in the Bay Area. A small fraction of the PCBs mass in the Bay Area during the 1950 to 1990 period was assumed to be from atmospheric sources. The distribution of uses among the three product categories during the 1950-1990 period was similar to the total US distribution:

- 62% in controlled closed systems (transformers and large capacitors);
- 2% in uncontrolled closed systems;
- 35% in dissipative products.

PG&E, the largest electric utility company in the Bay Area, was likely the largest single user of PCBs in the Bay Area.

Next, McKee et al. (2006) developed a transport and fate conceptual model that identified the "current" major sources of PCBs to stormwater conveyances, and described mass movement from these sources or source areas into the stormwater conveyance system. They estimated the mass of PCBs entering stormwater conveyances from each source based on extensive literature review, and applied conservative assumptions about spills, leaks, routine cleanup efficiencies, atmospheric releases, soil/sediment concentrations in contaminated areas, soil erosion, etc. For example, it was assumed that approximately 2% of transformers and 3% of large capacitors had leaks and that 0.05% of the total mass of PCBs in transformers and 0.35% of the total mass of PCBs in capacitors leaked annually. It was assumed that 99% was successfully cleaned up and only 1% of the remaining leaked PCBs were available for washoff. Of the total amount leaked, it was assumed that only a small fraction (0.01%) entered stormwater conveyances in a given year. A full description of the assumptions and inputs used to estimate loads for each major source category is provided in McKee et al. (2006), and the results are summarized below.

The "current" (i.e., 2005) sources of PCB mass movement into the storm drain system with estimated average annual loads included the following:

- Ongoing use of PCB products or equipment:
  - **Transformers and large capacitors (2.8 kg/yr)**
  - Plasticizers (1.1 kg/yr)
  - Small capacitors (0.5 kg/yr)
  - Other dissipative uses (0.06 kg/yr)
- PCB Contaminated Areas
  - Identified industrial contaminated areas (2 kg/yr)
  - PCBs still in use by large industrial users (4 kg/yr)
  - Railway lines (1.1 kg/yr)
- Other ongoing activities associated with PCBs
  - Building demolition and remodeling (4.1 kg/yr)
  - Auto-recycling (0.4 kg/yr)
- Legacy Use of PCBs
  - Watershed surface sediment erosion (30 kg/yr)
  - Bed and bank erosion (2.9 kg/yr)
  - Atmospheric deposition (2.8 kg/yr)

Not all of the PCB inputs to stormwater conveyances will reach the Bay. The mass balance model attempted to account for some PCB mass removal activities such as street sweeping, inlet maintenance, and channel de-silting. Factoring in estimates of these removal efforts, McKee et al. (2006) estimated the net mass input of PCBs to the storm drain system in the Bay Area in 2005 was approximately 28 kilograms per year (kg/yr). Of this total, roughly 29% (8 kg/yr) was estimated to have originated from controlled closed systems (transformers and large capacitors) and 71% (20 kg/yr) was from dissipative uses. This includes both current and legacy uses that resulted in widespread distribution of PCBs across watershed surfaces. In other words, these results indicate that because of both current and past use, transformers and large capacitors, which are both electrical utility applications, may continue to contribute nearly one-third of the net PCBs mass to storm drain systems in the Bay Area.

Because the PCBs TMDL wasteload allocation of 2 kg/yr for urban stormwater runoff is quite small, even minor spills and releases of PCBs are of great concern to MRP Permittees. If PCB spills from electrical utility equipment are not cleaned up to extremely low concentrations (e.g., less than 0.5 parts per million (ppm)), they could challenge the ability of MRP Permittees to meet TMDL requirements. Section 3 in this report explains how the federal cleanup requirements followed by electrical utility companies may result in soils contaminated with PCBs at concentrations acceptable to federal regulatory agencies (e.g., 5 ppm), but of concern to those responsible for stormwater management. For this reason, electrical utility equipment and facilities warrant attention as a potential source of PCBs to stormwater that requires additional controls.

3.0 Electrical Utility Systems in the Bay Area

This section provides an overview of the electrical utility systems in the Bay Area. PCB uses are used within those systems are identified and efforts to date to remove PCBs from these systems are summarized.

3.1 Electrical Utility System Overview

Electrical utilities produce or buy electricity from generating sources, and then distribute that electricity to users through two networks: the transmission system and the distribution system. The **transmission system** carries bulk electricity at high voltages, often across long distances, directly from generation sources to substations via high voltage power lines. Substations connect the transmission and distribution systems. Substations may increase the voltage from nearby generating facilities for more efficient transmission over long distances, or lower the voltage for transfer to the distribution system. Electricity at a typical substation flows from incoming transmission lines, to circuit breakers, to transformers (which step down the voltage), to voltage regulators and cut out switches (which protect the system from overvoltage), and finally to outgoing distribution lines.

The **distribution system** delivers lower voltage electricity from substations directly to homes and businesses over shorter distances. This system includes equipment mounted on poles, in underground vaults, and on cement pads (in green boxes often in the public right-of-way, ROW). The equipment is smaller, but more numerous in terms of the number of units.

3.2 Bay Area Electrical Utility Companies

In the Bay Area, there are eight electric utility companies operating as of February 2015 (Appendix A). The primary utility company in the Bay Area is Pacific Gas & Electric. PG&E is an investor-owned utility that is not under the jurisdiction of Bay Area municipalities. There are also six small publicly-owned utilities in the Bay Area, three of which (Alameda Municipal Power, City of Palo Alto Utilities Department, and Silicon Valley Power owned by the City of Santa Clara) maintain their own substations and distribution lines. The other public utilities partner with PG&E to deliver energy through PG&E's equipment.

PG&E is by far the largest electrical utility company in the Bay Area. Because PG&E owns the vast majority of the electrical utility equipment in the Bay Area, they are the primary focus of this report. Currently, PG&E owns and operates several hundred electrical substations in the Bay Area, in addition to small electrical utility equipment that is widely disbursed throughout urbanized areas and along rural corridors (i.e., small transformers on utility poles or in utility boxes). The total number of these pieces of equipment that are in use across the Bay Area and that contain PCBs is not known, but is expected to be in the thousands. (Section 6.0 describes how the lack of regulatory authority over PG&E challenges the ability of Permittees to address potential leaks and spills from PG&E equipment.)

3.3 PCBs in Electrical Utility Equipment

In the past, PCBs were routinely used in electrical utility equipment that contained dielectric fluid in contact with electrical current. This is because prior to the 1979 PCBs ban, dielectric fluid was typically formulated with PCBs due to their high dielectric strength and flame-resistant properties. Because dielectric fluid is most often based on mineral oil, it is referred to as mineral oil throughout the remainder of this document. Electrical equipment containing dielectric fluid is typically identified as Oil-Filled Electrical Equipment (OFEE). Any OFEE that contained PCBs in the past could still potentially contain PCBs today.

The most common types of OFEE that may contain PCBs are transformers, capacitors, circuit breakers, reclosers, switches in vaults, substation insulators, voltage regulators, load tap changers, and synchronous condensers (PG&E 2000). Additional information on the most common OFEE that may contain PCBs is provided here:

- **Transformers.** Devices that convert low-voltage electricity to higher voltages for transmission to a load center (i.e., city, factory). With the capacity to hold 1,000 to 5,000 gallons of mineral oil, transformers at substations (i.e., the transmission system) are substantially larger than those found in the distribution system (PG&E 2000). Both pole-mounted and pad-mounted oil-filled transformers are common across the distribution system.
- **Circuit breakers**. Devices that are used to switch circuits and equipment in and out of a system at a substation. Oil-filled circuit breakers at substations hold less than 500 gallons of mineral oil (PG&E 2000). Circuit breakers are also common across the distribution system.
- **Capacitors**. Devices for accumulating and holding a charge of electricity, consisting of conducting surfaces separated by a dielectric fluid (e.g., mineral oil). US EPA defines “large” capacitors as those containing 1.36 kg (3 lbs) or more of mineral oil.

3.4 Removal of PCBs from Electrical Utility Equipment

Although the 1979 ban of PCBs did not require the immediate removal of PCBs from current applications, electrical utilities have made substantial efforts over the past 35+ years to reduce the amount of PCBs still used in their applications in the Bay Area. This section summarizes the actions that PG&E has implemented in the Bay Area to reduce in-use PCBs in their electrical utility applications. This summary is limited to publicly available information, or information PG&E has provided to public agencies, including:

- Letters from PG&E to the Regional Water Board in 2000 in response to a request for information;
- A talk given to the Contra Costa Clean Water Program in 2013 titled: “PG&E’s Management of Oil-Filled Electrical Equipment.” The PDF presentation is available here: *www.cccleanwater.org/wp-content/uploads/2013/01/CCCSD-PPT.ppt*; and
- Notes provided by Regional Water Board staff Jan O’Hara from meetings with PG&E representatives in 2012 and 2016. Information from these notes are referenced as “personal communications” in this document.

The number of PCB-containing OFEE that are still used by PG&E electrical utility applications in the Bay Area has gradually declined over the past four decades. PG&E efforts to reduce PCBs in OFEE have included:

- Voluntary replacement programs;
- Ongoing removal of PCBs from OFEE as units are serviced or replaced due to routine maintenance programs; and
- OFEE replacement due to unplanned actions (leaks, fires, etc.).

According to PG&E, the majority of PCB-filled electrical equipment has already been removed in the Bay Area due to voluntary actions conducted primarily in the mid-1980's, including the PCB distribution capacitor replacement program and the PCB network transformer replacement program (PG&E 2000). In the 1990's, PG&E implemented a program to remove oil-filled circuit breakers and replace them with equipment that contains sulfur hexafluoride gas (PGE 2000). Current ongoing PG&E efforts to remove PCB-containing equipment are conducted primarily through maintenance programs. Past maintenance of older equipment may have included draining PCB-containing mineral oil and refilling the equipment with oils that did not contain PCBs. Currently, as maintenance staff identify older equipment in-use, it is scheduled for replacement. However, PG&E has provided limited documentation of any of their past and current removal efforts. There remains much uncertainty on where PCB transformers, PCB capacitors, oil-filled circuit breakers, and PCB-containing distribution system equipment were originally located, and which ones have already been removed or replaced.

3.5 Estimates of Remaining In-Use Electrical Utility Equipment Containing PCBs

Despite the removal efforts described above, PCBs may still be found in older OFEE, particularly OFEE located throughout the distribution system. In a recent meeting with Regional Water Board Staff, PG&E noted that any equipment installed prior to 1985 could contain PCBs, as it would have come from equipment stockpiled prior to the ban and was installed prior to the voluntary replacement programs (*personal communication*, Daniel Sanchez 2016). Because OFEE are not typically tested for PCBs until the fluid is removed during servicing or disposal, or in the event of a spill, the total number of PCB-containing OFEE that remain in use is unknown. However, in a letter to the Regional Water Board in 2000, PG&E provided information that can be used to make some preliminary estimates, including the following (PG&E 2000):

- There are over 900,000 pieces of OFEE in service in the distribution system;
- In 1999, 22,000 pieces of equipment were serviced at the main PCB-handling facilities in Emeryville;
- Approximately 10 percent of the units serviced and tested annually contain PCBs at concentrations of 50 parts per million (ppm) or greater, and fewer than 1 percent contained PCBs at concentrations of 500 ppm or greater;
- The number of equipment containing PCBs > 50 ppm has declined over time.

The information above was used to calculate the following:

- Assuming the count of equipment processed in 1999 in Emeryville represents an average annual processing rate, it would take over 40 years for all of PG&E's 900,000 pieces of equipment in the distribution system to be replaced;
- At the 1999 processing rate, of the 900,000 pieces of equipment in the distribution system in 1985, approximately 175,000 pieces have not yet been serviced or replaced as of 2018;
- Even if only 10% of the 175,000 pieces of equipment remaining in-use contain PCBs > 50 ppm, there would still be 17,500 pieces of PCB-containing equipment that remain in-use in 2018.

Although based on limited information, the above estimates demonstrate that a potentially large number of equipment containing PCBs over 50 ppm (i.e., 17,500) may remain in-use in the electrical utility distribution system. And up to 175,000 pieces of equipment may contain lower concentrations of PCBs that are still of concern to Permittees in their efforts to meet TMDL requirements. Please note that these estimates are likely low because PG&E has not provided any information on the number of equipment remaining in the system that contain PCBs at concentrations below 50 ppm.

4.0 Regulations

This section describes the existing state and federal regulations that govern the ongoing management of in-use PCB-containing electrical utility equipment, spill cleanup and reporting. Current regulatory cleanup thresholds are compared to the more stringent requirements that would be needed to meet the stormwater load reduction requirements of the PCBs TMDL.

4.1 Regulation of In-Use PCBs, PCB Wastes, and PCB Clean Up

In California, both federal and state laws regulate in-use PCBs, PCB wastes, and PCB clean up. At the federal level, the Toxic Substances Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA) are used to regulate PCBs and PCB wastes. PCB cleanup sites may also be subject to regulation by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In addition, discharges from electrical utility applications are regulated under the NPDES program authorized by the CWA and implemented through the State and Regional Water Quality Control Boards. State PCB regulations are primarily implemented under the California Health and Safety Code.

TSCA is the primary regulatory tool that addresses most aspects of PCB management and cleanup. Passed into law in 1976, TSCA banned the continued manufacture and commercial distribution of PCBs in the US after July 2, 1979, and prohibited the continued use of PCBs outside of totally enclosed systems. TSCA also governs the ongoing management of PCBs that remain in use that are present at 50 ppm or greater, including labeling, handling, distribution, storage, cleanup of contaminated properties, spill response and disposal (Title 40 CFR Part 761). The federal TSCA regulations are enforced by the US EPA.

In addition to the TSCA regulations, other federal regulations under authority of the Clean Water Act are in place to prevent oil spills from reaching navigable waters, and provide for appropriate and efficient cleanup of any oil spills that do occur (40 CFC part 112). These regulations require Spill Prevention Control and Countermeasure (SPCC) Plans for facilities that could potentially discharge oils to navigable waters (including storm drains and drainage ditches) if the facility also meets one or more of the following criteria: aboveground oil storage > 1,230 gallons; and/or underground oil storage > 42,000 gallons; and/or storage of containerized PCB-contaminated liquid wastes for disposal between 50 and 500 ppm. Electrical utility substations may fall into the category of facilities that require such SPCC plans.

In California, hazardous waste regulations detailed in the California Code of Regulations (CCR) Title 22 are more stringent for PCBs than federal rules. CCR Title 22 designates oils or other liquids containing PCBs concentrations ≥ 5 ppm as non-RCRA hazardous waste requiring special handling and disposal. The California Department of Toxic Substances Control (DTSC) enforces the additional hazardous waste rules that apply to PCBs less than 50 ppm, including spill cleanup, disposal and reporting requirements. DTSC also regulates closure requirements for PCB sites under CERCLA.

4.1.1 PCB Classification and Labeling Requirements

Under both federal and state regulations, all required management of in-use PCBs and PCB-containing equipment, including labeling, disposal, site cleanup, spill response, and reporting is based on classifications of PCB concentrations. Table 4.1 defines the federal and state PCB classifications.

- TSCA regulations apply to PCBs 50 ppm or greater, while California regulations apply to PCBs between 5 and 50 ppm. Under TSCA, PCB concentrations greater than 500 ppm are classified as high PCBs, while PCB concentrations between 50 ppm and 500 ppm are classified as low PCBs. PCB concentrations below 50 ppm are classified by TSCA as non-PCB.
- In California, PCB concentrations in liquids between 5 ppm and < 50 ppm are classified as non-RCRA hazardous waste and governed by state regulations.
- If PCB concentrations are not known, neither federal nor state regulations require testing of in-use equipment or materials for PCB concentrations to determine the appropriate classification. Instead, a number of assumptions are applied to determine the appropriate PCB classification.

Table 4.1 Current Federal and State Regulatory Classifications of PCBs Concentrations.

PCB Concentration (known or assumed)	Label	Classification	Regulatory Requirements
Federal Requirements			
≥ 500 ppm (in original source)	PCB	TSCA - High PCB Concentration	Waste remediation required by federal law
50 to < 500 ppm (in original source)	PCB-Contaminated	TSCA - Low PCB Concentration	Waste remediation required by federal law
> 0 to < 50 ppm	Non-PCB	Non-PCB	No waste remediation required
0 ppm	No PCBs	Contains no PCBs, and was manufactured after July 1, 1978	No waste remediation required
State Requirements			
≥ 5 ppm (liquid) ≥ 50 ppm (solids)	PCB-Contaminated	California Hazardous Waste	Waste remediation required by State Law
< 5 ppm (liquid) < 50 ppm (solid)	Non-PCB	California Non PCB	No waste remediation required

PCB-containing equipment is required to be labeled according to its PCB classification. When removed from service, all transformers, large capacitors (high and low voltage), and voltage regulators that are known or assumed to have PCB concentrations equal to or greater than 500 ppm at the time of manufacture require a “PCB” label. Other electrical equipment known or assumed to contain PCBs between 50 and <500 ppm are labeled as “PCB-Contaminated”. In California, equipment determined to have PCBs < 5 ppm can be labeled as “Non-PCB”; however, because federal regulations were enacted prior to state regulations, some “Non-PCB” labels may have been applied to equipment that fit the non-PCB category for federal regulations (< 50 ppm). This lends uncertainty to the “Non-PCB” label if other information is not also available. Electrical equipment that was manufactured after July 1, 1978, and that does not contain any concentration of PCBs can be labeled as "No PCBs".

4.1.2 Spill Response and Site Cleanup

Both state and federal regulations require cleanup of releases of hazardous materials. As required under both federal and state regulations, the appropriate response to a PCB release is dictated by the known or assumed PCB classification of the equipment responsible for the release. Concentrations are determined based on the source of the release, not on the spilled concentration. For PCBs and PCB-contaminated materials that are 50 ppm PCBs or greater, federal regulations under TSCA govern spill response and cleanup. TSCA requires spill cleanup for releases from equipment or materials that are classified as low or high PCBs (i.e., ≥ 50 ppm PCBs). California hazardous waste regulations require spill cleanup and reporting for releases of PCB-contaminated liquids that fall below the federal regulations (i.e., ≥ 5 ppm but < 50 ppm). Equipment labels are used to identify PCBs and PCB-containing equipment. However, if equipment labels are not present and/or do not provide full information, assumptions about PCB concentrations are often necessary during the initial spill response. For example, any release of untested mineral oil from electrical equipment is assumed to be PCB-contaminated per federal regulations (i.e., ≥ 50 ppm but < 500 ppm).

The first step when a hazardous material release occurs is notification. Under both federal and state rules, the responsible party is required to immediately notify the California Office of Emergency Services (Cal OES) state warning center hotline, and/or 911 when a hazardous material release occurs. This initial reporting is typically a verbal notification (i.e., by telephone). Materials that are 50 ppm PCBs or greater are considered hazardous per federal regulations and liquids that are 5 ppm PCBs or greater are considered hazardous per state regulations. Therefore, any released liquids that are 5 ppm PCBs or greater should be reported to Cal OES.

TSCA hazardous materials spill cleanup requirements (i.e., for releases of PCBs ≥ 50 ppm) are summarized here:

- Low PCB Concentrations (< 500 ppm): excavate all soil within the spill area and backfill with clean soil. Double wash/rinse solid surfaces.
- High PCB Concentration (≥ 500 ppm): notify National Response Center; cordon off the area with a minimum 3-ft buffer and post warning signs; document and record area of visible contamination; excavate all soil within the spill area and backfill with clean soil. Remove all contaminated porous surfaces (e.g., wood asphalt, cement, concrete, etc.). Double wash/rinse non-porous solid surfaces; properly dispose of all PCB or PCB-contaminated materials from the cleanup site (e.g., soils, solvents, rags, etc.);
- Soils must be remediated to background levels (i.e., detection limits) where practicable.

Federal and state regulations also restrict the allowable concentrations of PCBs remaining in any post-cleanup soils and/or materials, based on the risk categories identified in Table 4.2. For example, in low occupancy areas (i.e., restricted access areas such as electrical substations), PCBs must be below 25 ppm, or the area can have up to 50 ppm PCBs if the appropriate notification is posted at the site. In high occupancy areas (e.g., unrestricted access areas), PCBs must be below 10 ppm. Clean fill used to replace soil removed during the cleanup process must contain less than 1 ppm PCBs. (Note that all of these allowable remaining concentrations are potentially above the thresholds required to meet TMDL goals.)

Table 4.2 Federal and State Regulatory Classifications of PCB Concentrations and Cleanup Levels.

Risk Category	Allowable PCB Concentration
PCB waste remediation required	≥ 50 ppm in original source
Low Human health risk from direct exposure	< 50 ppm
High occupancy areas (i.e., non-restricted access areas)	≤ 10 ppm in remaining material
Low occupancy areas (i.e., restricted access areas, such as electrical substations)	≤ 25 ppm in remaining material
Low occupancy areas IF the area contains a label or other visible notification of the contamination	≤ 50 ppm in remaining material
Low occupancy areas with a cap	25 to < 100 ppm in remaining material
Clean fill	< 1 ppm

4.1.3 Chemical Analysis Methods for PCBs

For compliance purposes, TSCA regulations recommend the use of EPA Method 8082 (i.e., the "Aroclor Method") to determine PCB concentrations with a quantifiable level of detection at 2 ppm. Aroclors are the most common PCB formulations that were produced and used commercially in the US. Aroclors are composed of 1 to 7 primary congeners, plus trace levels of other congeners. EPA Method 8082 identifies and quantifies total PCB concentrations based on comparison with the gas chromatograph patterns (referred to as fingerprints) for known Aroclor formulations. Although widely used for determination of PCB concentrations since the 1970's, this method has a number of limitations.

- First, PCBs in a given sample may not match up well with the Aroclor standards that are used for comparison in the analysis. Typically, a group of five to seven Aroclors are used as technical standards. While these are selected to represent the most commonly used formulations, there were many more Aroclor formulations that were produced and used over the years, including slight variations in the formulations produced from year to year. While Aroclors represent the largest mass of PCBs used commercially in the US, they do not represent all PCB products.
- Second, samples that contain mixed Aroclors or that have undergone weathering are not expected to have the same fingerprint as Aroclor standards. Fitting these samples to a set of standard Aroclor fingerprints may not provide accurate information.
- Third, this method does not detect certain PCB congeners, including some of the most toxic.
- Finally, the Aroclor Method has relatively high method detection limits compared with concentrations of concern for water quality.

TSCA regulations allow the use of an alternative analytical method for PCB determination if it is validated as described in 40 CFR 761, Subpart Q. Alternative analytical methods for PCBs, such as EPA Method 1668, or a revised version of Method 8082 that allows for individual congener analysis provide lower detection and reporting limits, and can be used to detect all 209 individual PCB congeners. However, these methods require more specialized laboratory equipment and expertise to perform, and are therefore considerably more expensive than the "Aroclor" method. Although these improved methods are more appropriate for stormwater control purposes because they are not required, they are unlikely to be used in place of the easier and less expensive "Aroclor" method when responding to mineral oil spills.

4.1.4 Spill Reporting

In addition to the initial verbal notification, both state and federal regulations may also require submission of follow-up written reports for releases of hazardous materials that are at or above the federal reportable quantities (RQs), or for discharges of oil to navigable waters. For PCBs, the federal RQ is 1 pound (0.454 kg), while for oil spills, the federal RQ is 42 gallons. Thus, under federal regulations, a follow-up written report must be submitted for any release of 1 lb or more of PCBs at concentrations ≥ 50 ppm, or for "Non-PCBs" mineral oil spills of 42 gallons or more. In California, state regulations only require submission of follow-up written reports if the amount of the hazardous material released is at or above the federal RQ.

Spill reporting requirements for releases of 1 lb or more of PCBs ≥ 50 ppm are detailed here:

- Identification of the source
- Spill date and time (actual or estimated)
- Cleanup date and time completed or terminated
- Identification of spill locations and contaminated material/surfaces, including identification of restricted access or non-restricted access location
- Pre-cleanup sampling data used to establish spill boundaries, if required
- Description of solid surfaces cleaned
- Depth of soil excavation and quantity of soil removed
- Post-cleanup sampling data
- Estimated cost of cleanup (not required)

4.1.5 Regulation of Utility Vault Discharges

There are additional regulatory requirements for short-term intermittent discharges from electrical utility vaults to surface waters of the U.S. An electrical utility vault is an underground room that provides access to subterranean electrical equipment, which may include PCB transformers or other PCB-containing equipment. These are commonly found throughout the electrical system across the Bay Area. Water may collect in these vaults, requiring utility companies to dewater subsurface vaults and underground structures to protect equipment, and provide safe worker conditions for installation, maintenance, or repair of equipment. Compliance with a general NPDES permit is required for these discharges. In California, the General NPDES permit is issued by the California State Water Resources Control Board (Order WQ 2014-0174-DWQ). To be covered under the general permit, a utility company must submit an application to both the State Water Board and their Regional Water Quality Control Board.

The permit application includes a Notice of Intent (NOI) and a Pollution Prevention Plan. For vault discharges: PG&E's most recent Pollution Prevention Plan submitted to the San Francisco Bay Regional Water Quality Control Board (Region 2) in compliance with the general permit requirements is available on the State Water Board website (https://www.waterboards.ca.gov/water_issues/programs/npdes/docs/utilityvaults/ppplans/pger2_noi_ppp.pdf). It is estimated that approximately 150 to 200 utility vaults are dewatered in the San Francisco Bay Regional each year.

Regulation of utility vault discharges is included in this section because unplanned spills or releases from PCB equipment within a vault may occur due to equipment failure. However, although utility vault discharges could potentially result in release of PCBs, chemical analysis of the liquid in the vault is only required at vaults discharging > 10,000 gallons. Instead, if the vault contains equipment from prior to January 1, 1985 and there is any noticeable oil or sheen, the water is containerized and hauled offsite for analysis and disposal. At all other vaults, liquid samples are collected in a jar, allowed to sit for 5 minutes, and then the appearance (color/opacity) of the liquid in the jar is compared to pictures of three example sample jars that vary in the levels of contamination from green (low contamination) to red (high contamination). The appropriate disposal method for the liquid from the vault is determined by the appearance of the sample. If the sample collected looks similar to the green zone samples, then the liquid from the vault can be discharged through a filter sock into the storm drain or waterway. If the sample collected looks similar to the red zone sample, then the liquid from the vault must be collected and disposed of off-site. This qualitative evaluation provides no information on PCB concentrations that may be present in the liquid.

During the first year of coverage under the general NPDES permit, in compliance with the Notice of Applicability (dated September 22, 2016), PG&E collected samples at fifteen of their utility vault dewatering projects. Samples were analyzed for PCBs using EOA Method 1668. The monitoring results were summarized in an email from Regional Water Board staff. PCBs were detected in 11 out of 15 samples. In samples with detections, PCBs concentrations ranged from 0.5 ng/L to 3.4 ng/L.

4.2 Regulatory Gaps

SCVURPPP has identified several important regulatory gaps that currently exist which limit control of PCB releases from electrical utility applications that will be needed to meet TMDL goals. There are currently no CWA permit requirements that apply to electrical utility stormwater discharges. Under the CWA, an NPDES permit is required for stormwater discharges associated with industrial activities. This stormwater discharge permit is known as the industrial general permit (IGP). The facilities that are covered by the IGP are identified by Standard Industrial Classification (SIC) codes, or description of the industrial activities. Electrical utility companies fall under the SIC Group 49 (gas and electrical distribution), which is not one of the SIC codes classified as an industrial activity. Thus, PG&E and other electrical utilities in California are exempt from the requirements of the IGP. In addition, although electrical utilities are subject to hazardous waste regulations, releases of PCBs from electrical utility applications that are not classified as hazardous waste (i.e., < 5 ppm liquids or < 50 ppm solids) are not regulated. Other regulatory gaps include the lack of adequate requirements for chemical analysis of spilled materials from electrical utility equipment or utility vault discharges, and lack of adequate spill cleanup oversight and reporting to local jurisdictions.

5.0 Ongoing Release of PCBs from Oil-Filled Electrical Equipment (OFEE)

Although the bulk of PCBs remain contained within OFEE until the equipment is removed from use and transported to proper hazardous waste disposal facilities, releases of PCBs to the environment can and do occur. This section evaluates whether unintended releases of PCBs from OFEE still occur today, and whether it is possible or probable that these releases are a source of PCBs to the MS4. This section also presents an overview of available information on how electrical utilities respond to releases from OFEE. The available data on releases from PG&E OFEE are summarized, based on review of 24 years of spill records contained in the Cal OES spill report database and from internal PG&E records provided to the Regional Water Board in 2000 (PG&E 2000).

5.1 Spill Response Protocols

Electrical utility companies typically address spills or leaks from their OFEE with Standard Operating Procedures (SOPs) that should conform to both TSCA requirements and the more stringent California hazardous waste rules. The SOPs describe the steps to be taken by field crews in the event of an OFEE leak or spill, which should generally include the following:

- Notify compliance Manager
- Stop and contain the leak
- Prevent the release from reaching storm drains and waterways
- Determine the spill area (i.e., the area with visible traces of oil plus 1 foot beyond)
- Document and diagram area of visible contamination, include sewer systems and creeks
- Determine the PCB classification
    - Initiate In-field test[3] to determine if the concentration of PCBs is ≥ 50 ppm
    - Spills are treated as 50-499 ppm until verified by transformer label or lab analysis
    - Obtain an oil sample for testing (oil samples preferred over soil samples)
- Notify property owner
- Notify Cal OES when release exceeds
    - 270 gallons with unknown PCB content
    - 1 lb. of dry weight PCBs
    - PCBs concentration ≥ 500 ppm

According to information supplied to the Regional Water Board (PG&E 2000), PG&E spill response is guided by internal documents, including:

- ***Utility Operations Standard D-2320*** - for PCB spills in the distribution system;
- ***PCB Management at Substations -*** for PCB spills in the transmission system.

[3] Field tests to determine if the PCB concentration is greater than 50 ppm are chlorine colorimetric tests, total chlorine x-ray fluorescence tests, total chlorine microcoulometric tests, and rapid immunoassay tests.

These documents were not available for review. However, PG&E staff presented the basic elements of their spill response protocol during a public presentation to CCCWP in 2013. PG&E's spill response protocol, as described during this presentation, is summarized here. First, PG&E's spill response is based on the following three guiding principles:

1. Personnel and public safety: isolate or barricade the area from the public; don't do anything to put yourself and others in harm's way.
2. Reporting: report the incident to electric operations
3. Containment: prevent the spill from spreading using diking or applying absorbents.

PG&E's response to a specific release incident is determined by the PCB classification of the responsible equipment. The state response level (5 to <50 ppm PCBs) requires immediate clean-up by next business day. The federal response level requires immediate clean-up until clean for spills of 50 to < 500 ppm, and the additional use of all resources to clean the spill immediately for spills > 500 ppm.

Spill cleanups can involve minor effort such as wiping up small quantities of spilled oil from non-porous surfaces, to excavation of large areas of soil and cleanout of storm drains. The disposal of all materials removed from a cleanup site or used to clean the site are handled according to the TSCA hazardous waste classifications (50 to < 500 ppm; and ≥ 500 ppm in solids or liquids), or the state non-RCRA hazardous waste classification (5 to <50 ppm PCBs in liquids).

In addition, as required by US EPA regulations to prevent oil pollution (40 CFR, Part 112 and 761), PG&E has prepared Spill Prevention Control and Countermeasure (SPCC) Plans for facilities that could potentially discharge oils to navigable waters (including storm drains and drainage ditches). SPCC plans are prepared if the facility also meets one or more of the following criteria: aboveground oil storage > 1,230 gallons; and/or underground oil storage > 42,000 gallons; and/or storage of containerized PCB-contaminated liquid wastes for disposal between 50 and 500 ppm. The purpose of the SPCC Plan is to ensure oil spills are minimized, and if any oil spills do occur, to prevent spilled oils from leaving the property and provide maximum cleanup efficiency.

5.1.1 Response to Utility Vault Discharges

Electrical Utility Companies' response to releases from vaults or underground equipment are guided by the regulatory requirements in the general NPDES permit issued by the State Water Board for all utility vault discharges. Procedures detailed in PG&E's vault discharge guideline address cleanup procedures when combined with water.

5.2 Summary of PG&E OFEE Release Data for the Bay Area

The information provided here is based on a review of publicly available data in the Cal OES spill report database, as well as internal PG&E spill records supplied by PG&E to the Regional Water Board in September 2000 that were provided pursuant to a California Water Code §13267 request for information. The Cal OES database and available PG&E spill records were searched for reports of spill releases related to OFEE in the Bay Area between 1994 and 2017. Over

1,200[4] reported release incidents from PG&E OFEE in the Bay Area were identified. The information provided by these records and a summary of the important issues identified for water quality concerns are summarized in the remainder of this section. It is important to note that current regulations do not require reporting for all releases from OFEE. The information provided below is based only on the reported releases for which records were available, and likely represents an underestimate of actual OFEE releases during the time period of review. However, these reports clearly demonstrate that PCBs may still be present in the electrical transmission and distribution systems in the Bay Area, and that releases from these systems can and do continue to occur.

Generally, the publicly available spill release records provide information about the spill release date, time, location, chemical, quantity released, actions taken, known or anticipated risks posed by the release, and additional comments. Other information that is sometimes reported for OFEE releases includes a description of the causes of the release and the equipment affected, and the concentrations of PCBs in that equipment (if known). Concentration information reported is likely assumed from equipment labels, as ranges are most often provided rather than specific values. Typically, the reports are limited to the information that was available at the time the spill was initially reported. In some cases, follow-up information such as the results of analytical testing of the spilled materials is also provided, but this is not typical.

5.2.1 Number of Reported OFEE Releases

Between 1994 and 2017, over 1,000 spills from PG&E electrical equipment were reported to Cal OES. PG&E records contain information about ~ 200 additional releases that were not reported to Cal OES between 1994 and 2000.

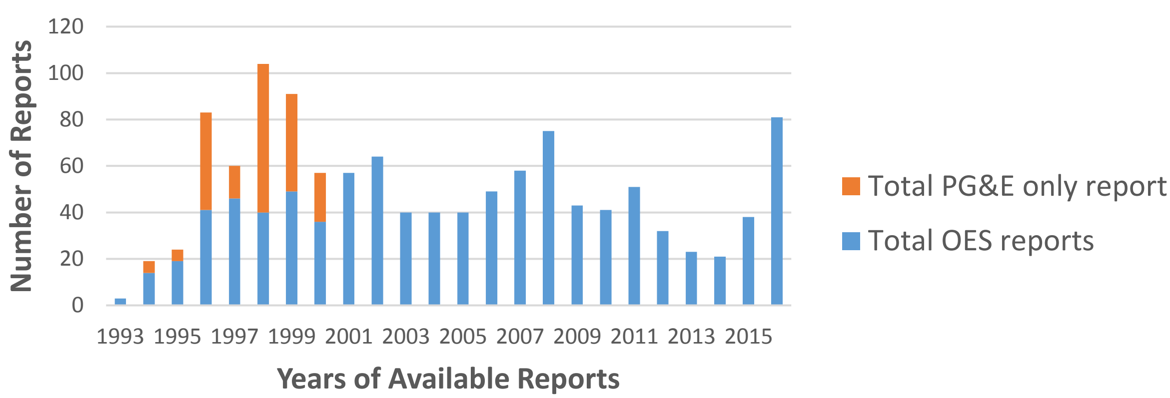

Figure 5.1 Oil-filled electric equipment spills reported to the California Office of Emergency Services (Cal OES) and/or identified through internal Pacific Gas & Electric (PG&E) reports between 1993 and 2017.

[4] Records span 24 years of spill reports, and includes PG&E's own record of releases from 1994 thru 1999 and a portion of 2000. The number of reports PG&E submitted in 2000 represents less than half the number of reports for that year. Records did not include all the districts in the Bay Area. District documents submitted reported releases prior to June of 2000, with the exception of one district that submitted a June report. As a result, the number of additional reports from PG&E's records are assumed to be less than half the number of incidents for 2000.

5.2.2 Volume of OFEE Releases

The total volume of material released from all reported OFEE spills in a given year in the Bay Area is presented in Figure 5.2. Mineral oil or transformer oil are the substances identified in over 99% of reported releases from OFEE in the Cal OES spill report database. In a phone conference with Regional Water Board staff in 2012, PG&E said they submit written reports to Cal OES for all PCB spills that meet or exceed the mineral oil federal RQ of 42 gallons (personal communication, Jan O'Hara 2012). However, the reports reviewed indicate written reports are sometimes submitted for spills that are much less than 42 gallons.

The reported volumes of oil released during a single incident range from less than one gallon up to 5,000 gallons. Nearly half of all OFEE spill reports identify the volume of oil spilled as 5 gallons or less, and more than 90% of all spill reports identify the volume of fluid spilled as less than 100 gallons. Releases as large as 500 gallons from the distribution system and 5,000 gallons from the transmission system have been reported. Only five incidents reported releases that exceeded 1,000 gallons of oil. Nearly all (~99%) of reports provided information on the volume of oil released.

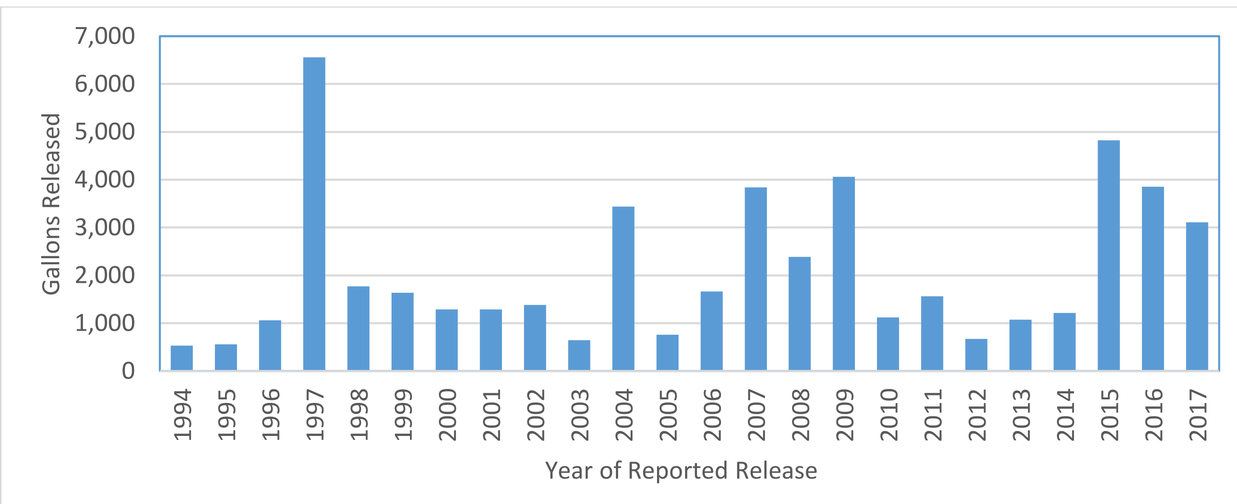

Figure 5.2 Total reported gallons of mineral oil released each year (1994 – 2017) from PG&E electrical utility equipment in the Bay Area.

The reported volumes released do not necessarily equate to the volume of the oil that may have reached storm drains or local creeks. The estimates of those volumes were not available through these reports.

5.2.3 Location of OFEE Releases

Cal OES and PG&E records show releases occurred in all Bay Area counties. Leaks and spills of PCBs from electrical equipment have occurred on roads, sidewalks, pervious areas, vegetation, structures, vehicles, and even people (Cal OES 2016). Most releases occurred in the distribution system, often from equipment installed in public ROWs such as pole-mounted transformers installed along roadways.

A number of reports document direct releases from OFEE to the MS4, and potentially a downstream waterbody (e.g., creek). There are at least 17 incidents identified during the past 15 years that involved direct releases from PG&E OFEE directly to a waterbody or to storm drains that discharge to local creeks (Table 5.1). The majority of these releases were reported as having unknown PCB concentrations, and no reports provide any follow-up information on the concentration of PCBs in the spilled materials based on chemical analysis.

Table 5.1 Examples of Information Reported on Releases of PCB mineral oil to Bay Area Storm Drains and Creeks

Date	Gallons	Reported Concentration	Water Body	Municipality
1/24/16	Unknown	<50 ppm	Coyote Creek	San José
2/17/16	Up to 18	Unknown	Los Gatos Creek	Los Gatos
3/7/16	10	Unknown	Culvert	Concord
8/16/16	Unknown	<50 ppm	Guadalupe River	San José
11/17/15	Unknown	Unknown	Cerrito Creek	Richmond
10/4/2015	5	Unknown	Creek	Los Gatos
5/3/2015	30	<2 ppm	Cerrito Creek	Richmond
3/2/2011	30	Unknown	Unknown Marsh	Menlo Park
6/2/2007	40	Unknown	Pond, Marsh Area	Vallejo
2/28/06	20	<50 ppm	Calara Creek	Pacifica
5/27/2006	1	Unknown	Unknown Creek	Orinda
10/10/2005	Unknown	Unknown	Coyote Creek	San José
7/23/2005	<15	Unknown	Nearby Creek	Walnut Creek
12/8/2004	Small amount	<50 ppm	Moraga Creek	Orinda
3/7/2004	Unknown	Unknown	Blossom Creek	Calistoga
7/14/2003	8	< 50 ppm	Coyote Creek	San José
2/16/2002	15	Unknown	Napa River	Napa

5.2.4 Causes of OFEE Releases

Cal OES release reports and PG&E records document a number of causes of PCB releases from OFEE. Most releases can be attributed to one of the following:

- **Equipment Failure**. This is the cause of the majority of the reported releases. Equipment failure in utility vaults has additional potential as an important source of PCBs because OFEE in these vaults may contain more than 100 gallons of mineral oil. More than 50 release incidents were reported for equipment contained in electrical utility vaults during the time period reviewed. A number of these reports noted the presence of water in the vaults in addition to the PCB oil released. Releases from equipment failure in utility vaults are mostly contained, but Cal OES spill reports document releases of PCB oil that breached containment, including discharges that reached water bodies.
- **Accidents**. Approximately 20% of reported releases resulted from equipment knocked over by accident. In the distribution system, reports document 50 to 500 gallons

released from poles knocked over during car accidents, by construction equipment, and during tree trimming. On rare occasion PCB releases have occurred during accidents while equipment is in transport.

- **Storms, Fires, Overheating from high summer temperatures**. This is the reported cause of more than 10% of the releases from the distribution system.
- **Field Repairs and Fluid Replacement**. The Cal OES database contains records that indicate draining fluids in the field may have been ongoing as recently as 2007, when a report documented that a valve left open from draining a transformer in the field caused a release. In 2016, Daniel Sanchez, PG&E's Manager HazMat and Water Quality Environmental Management Programs, informed Regional Water Board staff that PG&E does not drain and refill pole mounted PCB transformers in the field any longer; however, it is unclear when this practice ceased, and/or if it still occurs with equipment not mounted on poles.
- **Vandalism**. Between 1997 and 2015, there were at least 25 separate reported incidents of vandalism that resulted in PCB releases, for example:
  - In 1997, gunshot damage caused the release of 5,000 gallons of mineral oil from a substation transformer and regulators in San Mateo County;
  - In 2011, copper theft at a substation released 750 gallons of mineral oil in Contra Costa County;
  - In 2013, vandalism of pad-mounted transformers resulted in the release of possibly 1,000's of gallons of mineral oil before discovery in San José.

5.2.5 PCBs Concentrations in OFEE Releases

Of the more than 1,200 spill reports that were reviewed, approximately one-third identified the PCBs concentration as unknown, or did not provide any information on the PCBs concentration of the spilled material (Figure 5.3). Releases with high PCBs concentrations (> 500 ppm) were infrequently reported, accounting for only 1% of reported spills. Concentrations above 50 ppm represent about 8% of the reported spills. As recently as 2016, failure of a PG&E pole-mounted transformer resulted in release of mineral oil with 280 ppm PCBs to surrounding soils and brick structures. For approximately 44% of the reported releases, the PCBs concentration was identified as less than 50 ppm, based primarily on assumptions associated with a "Non-PCB" label. According to labeling requirements, a "Non-PCB" label indicates the PCB concentrations in the oil are assumed to be less than 50 ppm (federal regulations) or less than 5 ppm (state regulations) (see Section 4.1). However, in most cases, no additional information was provided in the spill reports to indicate how the non-PCB category was arrived at, or whether the federal (> 50 ppm) or state (> 5 ppm) "Non-PCB" category was assumed. For the vast majority of these reports, no follow-up chemical analysis results were provided that confirmed the Non-PCB designations. In limited reports, follow-up PCBs analysis results were provided for materials that were identified as "Non-PCB" during initial reporting. Generally, these results found PCB concentrations between 5 and 49 ppm, suggesting the federal labeling requirements were applied. Although these data fit within the federally defined "Non-PCB" category of < 50 ppm, they are above the state "Non-PCB" category.

More importantly, any concentration above 1 ppm is potentially significant in terms of water quality impacts. These results clearly demonstrate that for stormwater purposes, the "Non-PCB" designation does not guarantee the concentrations are negligible. Rather, it suggests the Non-PCB designation represents a threshold that is far too high to be protective of stormwater quality.

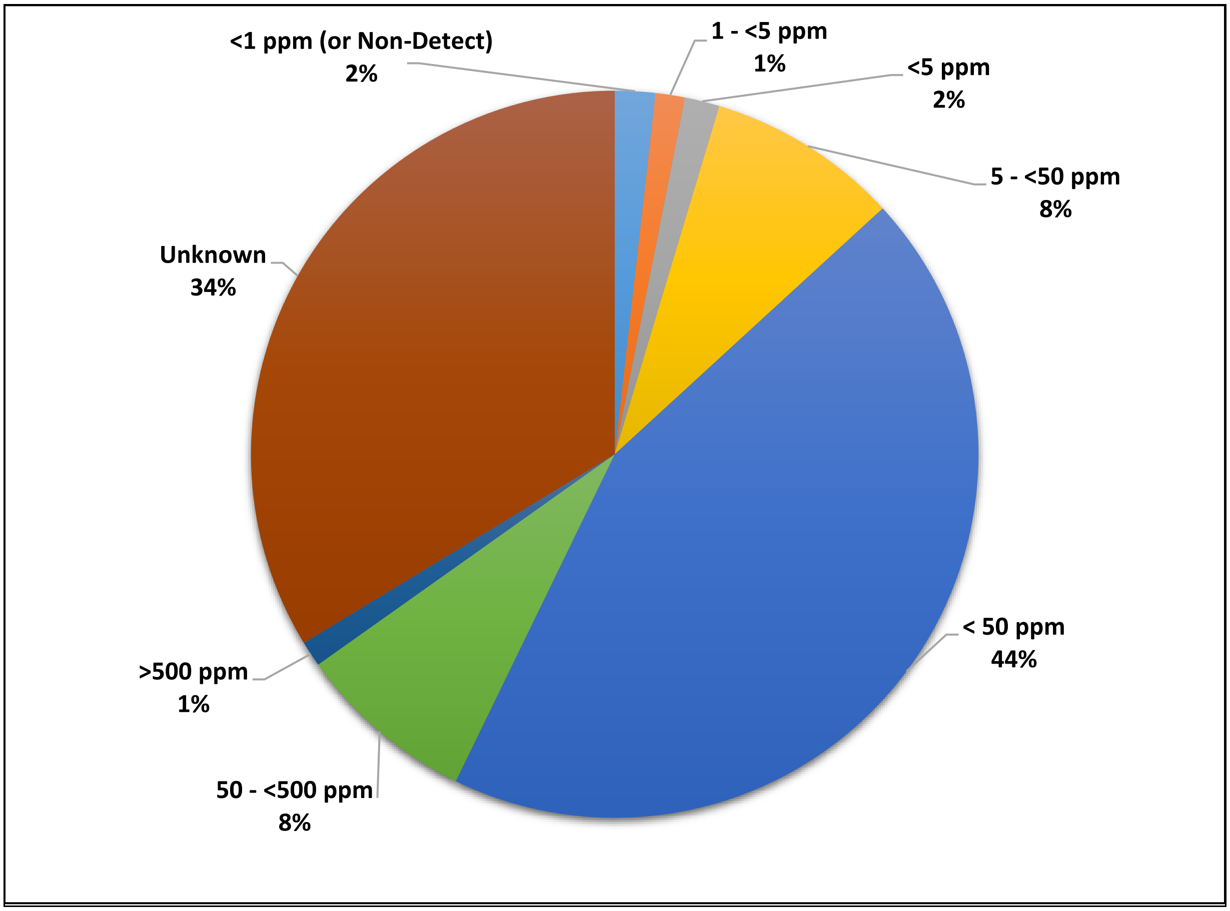

Figure 5.3 PCB Concentration data reported for releases from PG&E Electrical Equipment between 1993 and 2016.

Only 1% of the reported releases identified the PCB concentrations as either below 1 ppm, or below detection limits. Although the quality of the PCB concentration data in the release reports varied widely, these results clearly demonstrate that PG&E's electrical equipment in the Bay Area can still contain PCBs at concentrations of concern for stormwater programs.

5.2.6 Cleanup Methods and Actions Taken in Response to OFEE Releases

The Cal OES reports provide almost no information on actions taken to stop active spills, or the methods used to cleanup spilled materials from surrounding surfaces, storm drain infrastructure, or creeks. Local agencies need this type of information to better understand the potential risks that remain following initial clean-up. Because of the extremely low cleanup standards that are needed to achieve the urban stormwater runoff TMDL waste load allocation, additional remedial actions may be warranted.

6.0 Current Constraints to Controlling PCBs from Electrical Utility Applications – A Stormwater Perspective

This section draws from the information presented in previous sections to identify the most pressing issues faced by Bay Area MS4s trying to control PCB releases from electrical utility applications. This section summarizes the regulatory and information gaps that constrain local agencies' abilities to control the release of PCBs from this source to Bay Area MS4's. This section identifies options to address these gaps, including the need for a region-wide approach to address best management practices, spill cleanup and reporting procedures from the Bay Area's primary electrical utility, PG&E.

The major constraints on Bay Area MS4s' current ability to manage PCBs from PG&E equipment and facilities include the following:

1. Regulatory Gaps
2. Jurisdictional Control Gaps/Lack of Regional Approach
3. Spill Response, Notification and Reporting Gaps
4. Other Information Gaps

Each of these constraints and options for addressing them are described in more detail below.

6.1 Regulatory Gaps

Existing federal and state regulations are primarily focused on controlling the management and handling of in-use PCBs and PCB-containing equipment when the concentrations are above the thresholds for hazardous waste. Under federal regulations, the hazardous waste threshold for PCBs is ≥ 50 ppm. Under California regulations, the hazardous waste threshold for PCBs is ≥ 5 ppm in liquids, and ≥ 50 ppm in solids. As described in Section 3, the allowable post-cleanup concentrations of remaining soils and other surface materials ranges from 10 to 25 ppm, depending on the risk category of the site. As a result, current efforts to control and cleanup PCB releases from OFEE are focused on these thresholds.

By comparison, Bay Area MS4s are concerned with much lower concentrations of PCBs. For example, Bay Area MS4s identify *potential* PCBs sources to stormwater if soil or sediment concentrations are ≥ 0.5 ppm, and *confirm* identification of a PCBs source to stormwater if soil or sediment concentrations are ≥ 1.0 ppm. Cleanup of PCBs at these substantially lower concentrations is necessary to meet the stringent urban stormwater runoff waste load allocations called for in the PCBs TMDL.

In addition, current regulation of electrical utility vault discharges allows the release of discharges that potentially contain PCBs. These discharges may be released directly to a storm drain or creek (albeit through a filter sock) based only on a qualitative evaluation of the color and turbidity of the discharge. Additional analysis should be required prior to discharge of liquids from utility vaults that contain OFEE to determine if PCBs are present at concentrations of concern for water quality.

A recent factsheet developed by the Regional Water Board for PCB remediation sites and spill cleanups provides recommendations that would help address some of these regulatory gaps, including the following (SFBRWQCB 2016):

- Cleanup sites should not allow PCBs to remain available for transport to stormwater runoff at any concentration;
- Soil sample minimum reporting levels at cleanup and spill sites is 0.01 ppm (compared with the current federal minimum detection limit of < 2 ppm); and
- Analytical methods should be selected to ensure a high likelihood that all PCBs present in the sample will be detected.

6.2 Jurisdictional Control Gaps

PG&E equipment and facilities are distributed across all Bay Area Counties. Local agencies lack regulatory authority to control PG&E's practices and procedures across neighboring jurisdictions. Actions by any one local agency are not easily enforced. Even if PG&E complies in one location, this may have no impact on PG&E actions in other local jurisdictions. Furthermore, this situation presents compliance difficulties for PG&E if each jurisdiction has different or even incompatible requirements. The variable quality of release reports in the Cal OES database further demonstrates the current inconsistency of PG&Es spill response and reporting across different Bay Area locations and over time. Dependence on the reliability and general understanding of PG&E staff at any one location, especially without a standardized approach across PG&E properties and equipment is problematic. As discussed above, current state and federal regulations are not adequate, and should be improved to address this issue. Development of a regional approach under a single regulatory authority would greatly improve the consistency and quality of efforts to reduce PCBs from PG&E OFEE.

6.3 Spill Response, Notification and Reporting Gaps

Based on review of reports in the Cal OES database, PG&E's current spill response, notification, and reporting procedures are not adequate to address TMDL goals, and do not provide the Regional Water Board or Bay Area MS4s with the information needed to better quantify and control releases to the MS4. Although PG&E contends they report all required releases to Cal OES, the records vary greatly in the amount and quality of the information provided. Specific gaps in the current requirements for spill response, notification, and reporting include the following:

1. Because written reports are only required for spills or releases that have concentrations above state and federal hazardous waste levels, and for amounts spilled that are above federal RQs (1 lb of PCBs, or 42 gallons of mineral oil), there is currently no information on spills/releases that likely occur at lower concentrations (< 5 ppm). Although reported releases of less than 42 gallons of PCB-containing oil were found in the Cal OES database, it is unknown how many spills were not reported for small volumes that were less than the federal RQ. Lack of complete reporting limits quantification and control of all PCBs releases. More stringent requirements to address TMDL goals should include spill response and reporting for ***all*** spills/releases from PG&E OFEE ***unless*** there is clear and sufficient evidence available when the spill is initially discovered that unequivocally

identifies the equipment involved as having been installed *after 1985*. This more stringent requirement will ensure that all releases from equipment that could potentially contain PCBs will be reported.

2. Bay Area MS4s do not receive timely notification of releases from PG&E OFEE. Even for releases that must be reported to Cal OES, PG&E does not typically notify local agencies directly. Instead, Bay Area MS4s are responsible for reviewing Cal OES reports in order to identify spills or releases that have occurred in their jurisdictions. This delay is problematic because clean-up actions have likely been completed by the time reports are submitted to Cal OES. Bay Area MS4s should be notified of releases within their jurisdiction as soon as possible so they can provide oversight during initial cleanup efforts, as well as any follow-up that is needed to ensure cleanup was completed to the desired levels. The appropriate local agency staff understand their municipal storm drain systems and how storm drain inlets connect to creeks and water bodies in their jurisdictions. Better communication between PG&E crews and municipalities can result in more efficient responses and less impact to waterways.
3. Bay Area MS4s do not currently have access to the SOPs and other documentation that PG&E and PG&E contractors use to guide spill response and cleanup actions when releases from OFEE occur. Bay Area MS4s need to review these documents and may want to suggest revisions to ensure all necessary measures and precautions are included to achieve consistency across spill cleanups.
4. Current reporting does not provide all the information needed by Bay Area MS4s to quantify PCBs from OFEE releases, or to track where PCBs remain in use in the system. The information available is limited to the information reported in the Cal OES database, which typically captures only the data that were available at the time the spill occurred. Although these reports may provide some preliminary information on the mass of PCBs released (i.e., volume and concentration spilled), these reports rarely provide any corroborating measurement data or any follow-up information on the effectiveness of cleanup activities.
5. The concentrations of PCBs reported are not usually based on advanced chemical analysis methods. Often, the PCB concentrations are simply reported as "unknown." When concentrations are reported, they are likely based on equipment labels, which may not be precise or up-to-date, rather than chemical analysis. In addition, even when chemical analysis is used to determine PCBs concentration, the preferred analytical method (i.e., the "Aroclor" method) does not have sufficiently low detection limits or the ability to quantify all relevant PCB congener concentrations. As discussed in Section 4.1, chemical analysis methods should follow the recommendations of the Regional Water Board for congener analysis at sufficiently low reporting levels to capture all concentrations of concern and congeners of concern to address water quality issues (SFBRWQCB 2016).

6.4 Other Information Gaps

Sections 2.0 through 5.0 summarize SCVURPPP's current state of knowledge about PCBs and electrical utility applications in the Bay Area. However, the information currently available is not adequate to fully quantify the scope and magnitude of electrical utility applications as a source of PCBs to stormwater in the Bay Area. In particular, there is a significant lack of information available to identify specific equipment that currently contains PCBs, or that historically contained PCBs, especially at the low concentrations that are of concern for water quality. The data reported on PCB concentrations focuses on equipment that contains higher PCBs (e.g., > 500 ppm, and rarely < 50 ppm). However, for water quality protection, PCBs concentrations in soil or stormwater as low as 0.5 ppm are a concern. Information on the existence of these low level PCBs in electrical utility equipment is not currently available. Given the widespread and dispersed nature of electrical utility equipment, and the lack of information that can be used to identify which equipment contains (or historically contained PCBs), it would be difficult for any single local agency to identify and control these potential PCBs sources. Bay Area MS4s need PG&E to provide the following information:

1. An inventory of the mass of PCBs in electrical utility applications across the Bay Area. Although McKee et al. (2006) estimated that electrical utility equipment releases 1.2 to 4.3 kg/year of PCBs to the MS4s in the Bay Area, this estimate is highly uncertain. This estimate was based on multiple assumptions because there is a lack of data available to accurately quantify the historic or current PCBs mass from this source. As a first step, improved data on the number, type, and location of OFEE that were installed in the Bay Area prior to 1985 would help establish an accurate baseline mass of PCBs in the system.
2. Information to establish the mass of PCBs that have already been removed from OFEE in the Bay Area due to PG&E voluntary removal actions. PG&E implemented programs in the past to remove PCBs from electrical equipment, but has not provided documentation that spells out what was done, where it was done, and how much PCB-containing equipment (or associated PCBs mass) was removed through these programs.
3. Information on the mass of PCBs that have been removed and continue to be removed each year due to ongoing, routine maintenance programs that remove older OFEE from service. Through these efforts, the total mass of PCBs remaining in the system continues to drop each year. Accurate inventories of the number, type, location, and PCBs mass removed each year would provide Bay Area MS4s insight into how quickly this source is being reduced through these efforts, and the likely PCBs mass remaining in the system.
4. Information to establish the locations and masses of PCBs that may still be present in soils or surfaces where legacy releases occurred. Historically, large OFEE that contained PCBs were frequently found at electrical substations. These substations often housed their own maintenance shops with above and/or underground vaults to drain, repair, and maintain transformers and other OFEE. The onsite repair shops were phased out during the 1960s at small substations (< 100 acres), and OFEE are no longer drained at these locations. Large substations (100 acres or more) have continued to maintain full time staff, but it is unclear what types of maintenance activities continue to occur at these large substations. It is also unclear how many of the 302 substations in the Bay Area are large, or where these large substations are located. In addition, historic leaks or other accidental releases of PCBs from OFEE on substation properties and in public ROW areas across the Bay Area may also contribute to current PCB-contamination of soils or other surfaces adjacent to these locations. However, PG&E contends they did not

maintain records of spills that occurred prior to regulatory requirements for site cleanup/containment (PG&E 2000). This leaves municipalities with little information on where historic PCB releases may have occurred within their jurisdictions.

If more of the information gaps identified above were closed, Bay Area MS4s could develop more accurate estimates of the historic and current loads of PCBs from electrical utility applications in the Bay Area. In addition, with more clarity on locations where PCBs have been removed from the system, or where PCBs were released historically, Bay Area MS4s could more easily identify areas where equipment or soils containing PCBs may still be located. These are the areas where control measures would be the most effective at reducing releases of PCBs to stormwater.

7.0 Recommendations

Based on the information compiled and reviewed, SCVURPPP recommends that BASMAA member agencies and the SF Bay Water Board work cooperatively to ensure that a comprehensive, regional control measures plan is developed and implemented to address the release of PCBs from equipment and facilities in the Bay Area that are associated with electrical utilities. The control measures plan should include prescribed methods and procedures for unplanned releases from OFEE, as well as a plan for proactive reduction of PCBs from in-use OFEE, and further identification and cleanup of historic release sites. Specifically, the following next steps are recommended:

1. **Create a regional work plan to further evaluate the extent and magnitude that electrical utilities are a categorical source of PCBs to urban stormwater runoff**. Due to the regional nature of the source, it is recommended that the work plan be developed via a BASMAA regional project and include the following tasks:
   - Develop preliminary conceptual estimates of current PCBs loadings from electrical utility equipment.
   - Develop a draft letter to SF Bay Water Board requesting that they compel electrical utilities in the Bay Area to provide specific information about PCBs spills, equipment replacement programs, and clean-up protocols.
   - Conduct a preliminary evaluation of the information received from electrical utilities via the SF Bay Water Board request for information to help scope the regional project.
   - Identify the approach and analyses that will be conducted via implementation of the regional project.
   - If warranted, submit a referral to the SF Bay Water Board that identifies electrical utilities as a *Categorical Source* of PCBs to MS4s that require additional controls. The *Categorical Source* designation will facilitate development of a regional approach to abate this source under the regulatory authority of the SF Bay Water Board. Although local agencies may still identify and refer individual electrical utility to the Water Board for abatement properties based on investigations, addressing these properties and equipment as a categorical source may prove to be a more effective and efficient way to reduce PCBs loads this source category.
2. **Implement regional work plan.** Additional information is needed to fully understand the extent and magnitude of PCB releases from OFEE, identify the most appropriate actions to prevent or reduce releases from this source, and develop and implement an effective regional control measure plan. A letter to the SF Bay Water Board that identifies the current data gaps and information needs, and that requests for Water Board assistance in compelling PG&E to provide this information should be developed as part of the implementation of the work plan. A preliminary list of current data gaps is identified in Section 6.0 and should be reviewed during the development of the request. The letter

should also identify additional data gaps that would need to be filled prior to implementing the remaining tasks in the work plan.

3. **<u>Following the completion of the work plan, work with the SF Bay Water Board to develop a regional framework that electrical utilities should use to develop and implement a control measures plan to effectively control the release of PCBs from electrical utility applications</u>**. The framework should include prescribed methods and procedures for unplanned releases from OFEE, as well as a plan for proactive reduction of PCBs from in-use OFEE, and further identification and cleanup of historic release sites. Development of the framework will should include the following elements:
    - An analysis of information provided by electrical utility companies as a result of the SF Bay Water Board's request for information from electrical utilities.
    - Improved estimates of current PCBs loadings from electrical utility equipment based on information received.
    - PCBs spill and clean-up reporting requirement language that the SF Bay Water Board could impose on electrical utilities.
    - Recommended improvements to PCBs clean-up protocol(s) that would reduce the discharge of PCBs to MS4s.
    - Recommended methodologies to account for PCB load reductions from this source via new reporting and clean-up protocols.

4. **<u>Compel PG&E and other electrical utilities to develop and implement control measures outlined in the framework.</u>** This step is critical to the success of the regional approach for controlling PCBs from electrical utility applications. Current state and federal regulations do not adequately control PCBs from this source, yet local agencies lack authority to compel cooperation from PG&E, by far the largest electrical utility in the Bay Area. Using their broad regulatory authority via Porter-Cologne, the SF Water Board should require that PG&E develop and implement measures to effectively control PCBs from entering MS4s and the SF Bay.

8.0 References

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Appendix A: Bay Area Electrical Utility Companies

Source: **State Energy Commission's Website**
http://www.energy.ca.gov/almanac/electricity_data/utilities.html
(list complete as of February 2015)

Investor-Owned Utilities (IOUs)

Pacific Gas and Electric Company (PG&E)
77 Beale Street
San Francisco, CA 94105
(415) 973-7000 (tel)
www.pge.com

Publicly Owned Utilities (POUs)

Alameda Municipal Power
2000 Grand Street
Alameda, CA 94501-0263
510.748.3905 (tel)
http://www.alamedamp.com/

City of Palo Alto, Utilities Department
P.O. Box 10250
Palo Alto, CA 94303
650.329.2161 (tel)
http://www.cityofpaloalto.org/depts/utl/default.asp

Silicon Valley Power (SVP) - City of Santa Clara
1500 Warburton Avenue
Santa Clara, CA 95050
408.615.2300 (tel)
http://www.siliconvalleypower.com/

Publicly Owned Load Serving Entities (LSEs)

CCSF (also called the Power Enterprise of the San Francisco Public Utilities Commission)
1155 Market Street, 4th Floor
San Francisco, CA 94103
209.989.2063 (tel)
http://sfwater.org/index.aspx

Pittsburg Power Company Island Energy - City of Pittsburg,
65 Civic Drive
Pittsburg, CA 94565-3814
925.252.4180 (tel)
http://www.islandenergy.com/

Port of Oakland
530 Water Street, Ste 3
Oakland, CA 94607-3814
510.627.1100 (tel)
http://www.portofoakland.com/

Community Choice Aggregators

Marin Clean Energy (MCE)
781 Lincoln Ave Ste 320
San Rafael, CA 94901-3379
888.632.3674 (tel)
https://www.mcecleanenergy.org/