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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

SAN FRANCISCO DIVISION

DAN CLARKE,

Plaintiff,

v.

PACIFIC GAS AND ELECTRIC COMPANY; and **PG&E CORPORATION**,

Defendants.

Case No. 14-04393-WHO

PLAINTIFF DAN CLARKE'S SECOND AMENDED COMPLAINT

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Plaintiff Dan Clarke ("Clarke" or "Plaintiff") alleges on information and belief, except as where based on personal knowledge, as follows:

INTRODUCTION

1. This action arises out of terrestrial contamination caused by manufactured gas plants ("MGPs") owned and operated by PG&E in the Marina neighborhood of San Francisco, the Fillmore MGP and the North Beach MGP (collectively, the "Subject MGPs").

2. MGPs were highly polluting, low-tech refineries that were used, in the nineteenth and early twentieth centuries, to create gas from coal, and later oil, and a combination of coal and oil that was then pumped in pipes to (mainly residential) consumers for lighting, cooking, and heating in their vicinity.

3. The soil and groundwater of the historical footprint of these facilities, which as the above map shows encompassed an area equivalent to several city blocks, as well as the soil and groundwater of the areas in their vicinity, are contaminated with a variety of solid and/or hazardous waste from the MGPs that was disposed of by PG&E on or in the vicinity of the Subject MGP Sites (collectively, "MGP Wastes").

4. The MGP Waste contamination from these MGPs may present an imminent and substantial endangerment to human health and the environment.

5. PG&E has known about this endangerment since at least the 1970s. Nonetheless, PG&E did not even begin to do any type of area-wide investigation until 2010.

6. Even then, it took the filing of the instant lawsuit and the joint investigation conducted by Plaintiffs and PG&E under the mediated supervision of Chief Magistrate Judge Joseph C. Spero (the "Court Mediated Investigation" or "CMI") to compel PG&E to take basic investigative actions.

7. Prior to this lawsuit, PG&E refused to test groundwater in the Marina neighborhood and had not conducted any investigations aimed at identifying the location of MGP tar deposits and investigations of MGP Waste contamination in public right-of-ways.

8. Rather, prior to this lawsuit, PG&E limited its investigation solely to the private properties whose owners—despite misleading statements that falsely played down the health risk of the likely MGP Waste contamination made by PG&E representatives and in materials produced by PG&E and distributed by it and the California Department of Toxic Substance Control ("DTSC")—requested that PG&E investigate contamination of their properties.

9. Such investigations were, in almost all cases, limited to the backyards of the properties and, in all cases, was limited to identifying the concentrations of polyaromatic hydrocarbon ("PAH") concentrations in the properties' soils.

10. If PAH contamination was found, PG&E would generally limit its remediation to the removal of a few feet of soils from the backyard and/or covering it with concrete, without ever even examining to what extent MGP Waste contamination affected soils underneath the home on the property, air quality within the home, or groundwater beneath it.

11. This facially deficient (but cheap) strategy of investigation and remediation was conducted by PG&E pursuant to a Voluntary Clean-Up Agreement (the "VCA") between PG&E and the DTSC, which places DTSC in the position of paid-contractor of PG&E, rather than a supervisory regulator.

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12. Under the VCA, which remains in place, DTSC never orders PG&E where or how to investigate the MGP Waste nor does it order PG&E to address the contamination PG&E finds.

13. Rather, DTSC reviews materials provided to it by PG&E and gives those materials the appearance of regulatory approval that PG&E needs for cover. Further, DTSC acts, at PG&E's request, as the counterparty to land use covenants ("LUCs") with property owners, by which contamination is "addressed" by legally limiting what can be done to a property, instead of by removing the contamination. While these LUCs are entered between DTSC and the homeowner, they are drafted by PG&E.

14. As a result of the pressure of this litigation and the CMI, PG&E has been compelled to conduct a substantially more comprehensive investigation of the MGP Waste contaminating the Marina neighborhood and has been less able to conduct inadequate remediations of private properties.

15. However, large gaps still remain that may present an imminent and substantial endangerment to human health or the environment if not addressed. Those gaps will not be addressed without an order by this Court providing the relief requested herein.

16. Specifically, the following three major gaps remain and will not be filled without intervention by this Court:

a. Lead: Despite (or because of) overwhelming evidence that MGP Wastes from the Subject MGPs, containing lead at concentrations that are profoundly toxic to children and pregnant women, were stored, transported, and disposed of by PG&E on the sites of the Subject MGPs (the "Subject MGP Sites") and in their immediate vicinity, PG&E had vigorously fought efforts to compel it to even test for the chemical in its investigation, let alone conduct any associated remediation. It is, thus, almost certain that, unless the Court orders that it be addressed, MGP Wastes containing high concentrations of lead will remain unidentified and unremediated, threatening residents and visitors to the Subject MGP Sites and their immediate vicinity.

b. Public Information: It is now almost 10 years since PG&E first began contacting homeowners in the Marina concerning the potential MGP Waste contamination of their properties. Nonetheless, a large number of likely contaminated properties have not even

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been investigated yet. This is largely because the information that PG&E has provided directly and indirectly to homeowners falsely understates the human health risk presented by the MGP Wastes likely on their properties. Accordingly, unless more accurate information is provided, it is likely that the current occupants and visitors or homes located on or in the immediate vicinity of the Subject MGP Sites will expose themselves to MGP Waste contamination that is dangerous for human health and that such contamination will not ultimately be remediated, resulting in a risk of exposure for subsequent occupants and visitors of the properties.

c. Public Properties and Right-Of-Ways: The CMI confirmed what is obvious—that public properties and right-of-ways in the vicinity of contaminated private properties are themselves also contaminated. As such, construction and utility workers working on these properties, as well as other members of the public, are routinely exposed to hazardous MGP Wastes. However, PG&E is doing nothing to remediate these properties and is under no order to do so, making it highly likely that this contamination will remain in place and threaten human health and the environment, without action by this Court.

17. Given PG&E's consistent and stubborn refusal to address these gaps and the unwillingness or inability of the DTSC or other governmental agencies to force them to do so, it is necessary that the Court order the relief requested below in order to address the remaining threats to human health and the environment that contamination that MGP Wastes may present on the Subject MGP Sites and the vicinities thereof.

PARTIES

I. Plaintiff

18. Plaintiff **DAN CLARKE** ("Clarke") is an individual, residing in San Mateo, California, who formerly resided, with his wife, at 1625 North Point St., San Francisco, California, which is on North Beach MGP site.

19. Clarke habitually visits the areas affected by the contamination alleged in this action for aesthetic and recreational enjoyment, visiting the affected area alone and with family, friends, and guests from out of town, and he intends to do so in the future. Despite having moved 25 miles away two years ago, Clarke still goes into the City often. It is Clarke's custom to drive to

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the Marina Green and leave his car there, while Clarke, or Clarke and his visitors, walk along the shoreline and through the Marina. There are few places on earth that are more peaceful or inspiring. When Clarke is with others, he likes to show off the area he used to call home. When alone, he just thinks about how lucky he is. The Marina neighborhood and shoreline from the Golden Gate Bridge around to the Ferry Building are a source of continuing pleasure for Clarke. Clarke still loves the Marina and San Francisco and that is one of the reasons he keeps going back there.

20. When Clarkes walks the shoreline and through the Marina, his thoughts go to the amazingly interconnected world we live in and how we share this beautiful environment with all God's creatures.

21. Clarke's enjoyment of the affected area is diminished by the harm that the complained of contamination is causing to the environment of the affected area. Clarke believes humans have a responsibility to take care of the environment and it stresses Clarke to think about the way MGP contamination in this area is impacting the environment of his former neighborhood.

22. Clarke is concerned for others. Clarke's enjoyment of the affected area is diminished by the knowledge that the affected area is contaminated by chemicals toxic to human health and the environment. It pains Clarke to think that there are children attending a school on top of contamination and is frustrated and angered by PG&E's unconscionable neglect and failure to have fully informed parents of the possibility of this threat.

23. Clarke intends to visit the affected areas in the future, alone and with guests, for the same types of aesthetic and recreational enjoyment; and such enjoyment would be substantially increased if the contamination alleged in this action is addressed.

24. Before moving in November 2017, Clarke lived in the Marina in the home he sold to PG&E, for eighteen years. During this time, for 10 years, Clarke and his wife routinely handled "black rocks" that they found in the backyard. Clarke later learned that these rocks were a form of MGP Waste and that MGP waste contains high levels of cancer-causing chemicals, particularly PAHs, as well as other toxins such as lead. This has placed Clarke and his wife at an increased

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risk of developing cancer and other health problems, which has caused Clarke significant stress and anxiety.

25. A source of that anxiety is the lack of certainty Clarke has concerning the full nature and extent of the MGP Wastes to which Clarke and his wife were exposed while living in the Marina neighborhood. This lack of certainty also makes it difficult for Clarke to assess the extent of the health risks that Clarke and his wife face as a result of that exposure and thus make intelligent decisions concerning measures to address and mitigate those risks. Accordingly, a complete and comprehensive investigation of the nature and extent of the MGP contamination in the Marina neighborhood would both lessen the stress and anxiety from which Clarke currently suffers and assist him in addressing the health risks Clarke and his wife face.

26. The sale of the Clarke Home to PG&E was not something that Clarke considered voluntary. Rather, Clarke loved living in the Marina neighborhood and planned to do so for the rest of his life. Clarke swore he would never leave. However, as a result of the contamination of the neighborhood and the inability to reach an agreed-upon plan for remediating Clarke's property with PG&E, Clarke was forced to sell it to PG&E, and move to a different home in a different town. If it wasn't for the contamination, Clarke would never have done so. As a result of the move, Clarke not only was dislodged from the neighborhood and severed from his social connections there, but also incurred significant financial costs for such things as moving and storage.

27. Because of Clarke's continued interest in seeing the contamination alleged in this action fully investigated and remediated, after selling his home to PG&E, Clarke continued to spend countless hours pursuing an adequate investigation of the contamination through the CMI, then more hours again pursuing a negotiated resolution of the claims in this action. Clarke now diligently works to have the contamination investigated and remediated.

II. Defendants

28. Defendant **PG&E CORPORATION** is a corporation organized and existing under the laws of the State of California, with its principal place of business in San Francisco, California.

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29. Defendant **PACIFIC GAS AND ELECTRIC COMPANY** is a corporation organized and existing under the laws of the State of California, with its principal place of business in San Francisco, California. Pacific Gas and Electric Company is the wholly owned operating company of PG&E Corporation.

30. Defendants Pacific Gas and Electric Company and PG&E Corporation, with their respective predecessors, successors, subsidiaries, and parents, are referred to collectively herein as "PG&E" or "Defendants."

31. PG&E owned and operated the North Beach MGP and the Fillmore MGP during the relevant period and are responsible for the contamination caused thereby alleged herein.

32. At all relevant times, each of the Defendants was an agent, employee, servant, partner, alter ego, and/or joint venturer of his co-Defendant in the acts and omissions that have caused the injuries to Plaintiff and was at all times, acting within the course and scope of said agency, employment, service, partnership, conspiracy, alter ego status, and/or joint venture.

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JURISDICTION

33. This Court has jurisdiction pursuant to 28 U.S.C. § 1331, as this action arises under the laws of the United States, specifically, 42 U.S.C. §§ 6901 *et seq*.

34. An actual controversy exists between the parties within the meaning of 28 U.S.C. § 2201. This Court may grant declaratory relief, and additional relief, including an injunction, pursuant to 28 U.S.C. §§ 2201 and 2202, and 42 U.S.C. § 6972.

VENUE

35. Venue lies in this judicial district pursuant to 28 U.S.C. § 1391(e), because a substantial part of the events or omissions giving rise to the claims at issue in this action occurred in this judicial district. The MGP waste contamination at issue is located in the City and County of San Francisco ("CCSF"), including without limitation the Marina neighborhood. Furthermore, PG&E is headquartered in the CCSF.

INTRADISTRICT ASSIGNMENT

36. This action substantially arises out of actions in the CCSF. Thus, under Civil L.R. 3-2(d) this action is to be assigned to the San Francisco or Oakland Division.

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FACTUAL BACKGROUND

I. PG&E's Former Operation of MGPs in the Marina Neighborhood of San Francisco

A. Background - MGPs and Toxic and Solid Waste Associated Therewith

37. As the name suggests, manufactured gas plants ("MGPs") were plants that manufactured gas used for lighting, heating, and cooking purposes throughout most of the nineteenth century and the first half of the 20th century. The manufacturing process for "synthetic fuel gases" (also known as "manufactured fuel gas," "manufactured gas" or simply "gas") typically consisted of the gasification of combustible materials, almost always coal, but also wood and oil, and, especially in the later period of their operations, a combination of coal and oil. The coal and/or other fuel stock were gasified by heating it in enclosed ovens with an oxygen-poor atmosphere. The fuel gases generated were mixtures of many chemical substances, including hydrogen, methane, carbon monoxide and ethylene, and could be burnt for heating and lighting purposes. Coal gas, for example, also contains significant quantities of unwanted sulfur and ammonia compounds, as well as heavy hydrocarbons, and so the manufactured fuel gases needed to be purified before they could be used.

38. Once manufactured, the gas would be pumped directly to residential and other users through pipes. Thus, as is the case with the MGPs at issue here, the plants were often situated in close vicinity to residential areas.

39. MGPs commonly (and here) consisted of several component operations/buildings, often colloquially referred to collectively as "gas-works," spread across an area of several city blocks. The heart of an MGP was the "retort bench," which would generally be housed in its own building known as the "retort house." The retort bench was the construction in which the retorts were located. Retorts were where the coal and/or other fuel stock would be heated and the gas evolved. Depending on the sophistication of the retort, a greater or lesser amount of the fuel stock would be carbonized. Within the retort house on top of the retort benches were "hydraulic mains," in which the gas evolved from the fuel stock, as well as MGP tar and ammoniac liquor, would collect through pipes that carried off the gas from the retorts. One of the principal purposes of the

hydraulic mains was to draw off some of the large amounts of MGP tar, with which gas from the retorts was laden.

40. Even with the drawing off of some MGP tar by the hydraulic mains, the gas coming directly from the bench was a noxious soup of chemicals. Components of that soup that needed to be reduced in quantity before the gas was distributed included: MGP tar, which could be sold; ammonia vapors, which could also be sold; naphthalene; and hydrogen sulfide. The main components of an MGP used to accomplish this reduction were the "purifier" and the "scrubber."

41. Chief among the contaminants that operators sought to remove was hydrogen sulfide, which caused the gas to smell like rotten eggs. Thus, the principal purpose of purifiers was the reduction of this chemical from the gas. This was originally done through either a dry or wet lime process, each involving lime through which the gas was passed. The resulting waste from the wet lime process was a material commonly known as "blue billy," which contains cyanides and is recognized as one of the first historical toxic wastes. Blue billy, along with other MGP Wastes like MGP tar, debris from MGP facilities, and waste maintenance materials, was often disposed of by depositing it into a nearby body of water, such a canal or bay. It was also frequently piled into heaps and buried onsite.

42. Scrubbers were used principally to remove ammonia from the gas.

43. Once through the purifier and the scrubber, the gas would then be stored in what was referred to as "gasholders" made of brick, stone, concrete, steel, or wrought iron, until pumped to customers.

44. In addition, gas works often had various other facilities within their footprints, including: MGP tar refineries, tanks, and vats, which were collectively used to collect, store, process through fractional distillation the MGP tar byproduct created in the gas making process, recovering tar, benzole, creosote, phenol, and cresols for sale; a "lampblack separator" used to extract carbon black for sale from coke, the byproduct that would remain in the retort after evolution of the gas; boilers used to generate steam for the powering of MGP operations, often through the burning of coke; a generator house, in which electricity would be generated; and oil tanks.

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45. From their inception, MGPs had the reputation for being dirty and polluting, both as to the smoke and the waste their operations created. The wastes produced by MGPs are persistent in nature, and often still contaminate the site of former MGPs, as well as areas where MGP waste was intentionally deposited and/or to which it has migrated. These wastes come in several forms including coal residue solids, MGP tar, blue billy, "ammoniac liquor," debris from MGP facilities, and waste maintenance materials.

46. Ammoniac liquor, MGP tar that was not further refined and sold, and washes were often allowed to leach into the ground or dumped into waterways. These types of MGP Wastes and others were also often buried on site, including in what were referred to as "wells" or "tar wells."

47. Coal residue solids and MGP tar contain mixed long-chain aromatic and aliphatic hydrocarbons, a byproduct of coal carbonization, types of chemicals that are commonly referred to, in the collective, as polycyclic aromatic hydrocarbons or PAHs. Many of the PAHs associated with MGP Waste are known carcinogens and are identified as "toxic pollutants" by the United States Environmental Protection Agency ("US/EPA") under 40 C.F.R. § 401.15. PAHs, in general, are recognized as extremely hazardous compounds to human health and the environment. Not only are many known carcinogens, they are also lipophilic, meaning they can dissolve into fats, a characteristic that allows them to easily cross biological membranes and accumulate inside organisms. PAHs are also genotoxic, meaning that once accumulated in an organism they damage the genetic information within the organism's cells, causing mutations.

48. Blue billy contains cyanides and lime.

49. MGP Wastes also contain significant amounts of lead. Lead was contained in feedstocks, and lead from this source is associated with purifier box wastes. Lead was also used in paint at MGPs, as caulking for gas holders, in pipework, for roofing, in batteries, and as lead arsenate insecticide in MGP facilities. It was also used in maintenance activities where the common pit-putty was an equal-parts (by weight) mixture of red lead, white lead, and litharge, litharge being another term for lead oxide. Additionally, mortars used in MGP facilities contained

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litharge because of its resistance to the acid environment and coal acid products from coal pyrolysis.

50. The traditional pathways for contact between these wastes and humans and/or the environment include direct contact with contaminated soils, groundwater, and/or aboveground water and contact with toxic vapor off-gassing from contaminated soils and/or groundwater.

B. Overview of Historic MGPs in the Marina

51. PG&E operated two MGPs (the "Subject MGPs") in the Marina neighborhood of San Francisco during the early 20th century (the "Subject MGP Sites"). These facilities processed into gas coal and, especially during the later period of their operation, other hydrocarbons, such as crude oil, often in combination with coal, which was then pumped through pipes to houses and businesses for cooking, heating, and lighting.

1. North Beach MGP

52. The North Beach MGP Site is comprised of at least four city blocks bounded by Marina Boulevard, Buchanan Street, North Point Street, Laguna Street, Bay Street, and Webster Street, designated by the CCSF Office of the Assessor-Recorder as Blocks 0459, 0460A, 0445A, and 0463B. The site also includes a triangular area of vacant land and paved parking (Marina Green) situated northeast of Marina Boulevard. PG&E produced gas at the North Beach MGP near the area north of Bay and Buchanan Streets until at least April 1906, when it was damaged in the Great Earthquake. Following the earthquake, PG&E used the gasholders at the site to store and distribute gas that was manufactured at the Beach St. MGP and piped to the gasholders at the North Beach MGP.

53. A schema prepared by agents of PG&E showing the footprint of the North Beach MGP, with certain of the facilities that made up its gasworks, laid over an area of the modern-day Marina neighborhood is attached hereto as Exhibit A. The schema shows *inter alia* that the gasworks included a large retort house, a purifying house, scrubbers, tar wells, gas holders, deep wells, and crude petroleum tanks, including one near the CCSF owned marina in an inlet of San Francisco Bay ("Gashouse Cove"). The latter crude petroleum tank was built on an artificial

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earthen mole that extended into the Bay. The tar wells were used by PG&E as means of disposing of MGP tar wastes underground in the vicinity of the water table.

54. A map from the years following the Great Earthquake of 1906 shows the partially damaged structures of the North Beach MGP. It further shows that facilities consistent with and in addition to those presented on Exhibit A. These include facilities titled "tar refinery," "tar tanks," and "tar vats." The refinery was located in the middle of present-day Beach St. at a location immediately south of where the schema indicates a "tar well" was located. Other components were located North of this location, including the tar tanks. The map further shows a boiler located north of these tanks.

55. Following the Great Earthquake of 1906, PG&E demolished the structures that were not in continued use and disposed of the MGP Wastes created through their demolish on the North Beach MGP Site or in its immediate vicinity.

56. Investigations thus far conducted within the North Beach MGP Site and areas in its immediate vicinity shows very significant levels of MGP Waste contamination. This includes: large deposits of MGP Waste contamination that has been characterized as MGP tar; large amounts of MGP Waste contamination in the soils, including solid MGP Waste containing high levels of lead and PAHs; and high levels of groundwater MGP Waste contamination. The North Beach MGP Site and areas in its immediate vicinity are now primarily residential with some small commercial buildings including at least one school.

2. Fillmore MGP

57. The Fillmore MGP Site is comprised of at least four city blocks bounded by Fillmore Street, Cervantes Street, Mallorca Way, Pierce Street, and Toledo Way, designated by the CCSF Office of the Assessor-Recorder as Blocks 0462A, 0463A, 0466A, and 0467A. PG&E owned and operated the Fillmore MGP near the area west of Fillmore and Bay Streets until at least April 1906, when it was damaged in the Great Earthquake. The Marina Middle School is located on part of this site.

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58. Following the Great Earthquake of 1906, PG&E demolished the structures that were not in continued use and disposed of the MGP Wastes created thereby on the Fillmore MGP Site or in its immediate vicinity.

59. A schema prepared by PG&E agents showing the footprint of the Fillmore MGP, with certain of the facilities that made up its gasworks, laid over an area of the modern-day Marina neighborhood is attached hereto as Exhibit B. The schema shows *inter alia* that the gasworks included two purifying houses, a tar reservoir, gas holders, a generator, crude oil tanks, and a wharf. One of the gasholders was below the playground of Marin Middle School. The US Geological Survey map below indicates that these gas holders were damaged at some point, presumably in the Great Earthquake

60. Though not explicitly represented on the schema, the gasworks of the Fillmore MGP included 72 retorts and seven generators for manufacturing gas by the Lowe process. The gas was stored in three gas holders; two holders located on the main Fillmore MGP premises and one gas holder located at what is now Marina Middle School. By 1892, the Fillmore MGP had expanded west one block to Pierce Street and was manufacturing both coal and water gas. The layout of the Fillmore MGP is as follows. The two gas holders, each with a capacity of 335,000 cubic ft, stood along Francisco Street on the southern part of the Fillmore MGP. To the east and northeast of the gasholders stood two purifying houses, each with an attached oxide room. To the north of the western gasholder was the generator room, which housed the 72 coal retorts and several Lowe water gas generators. North of the generator room laid the coal and coke shed. West of the generator room stood the coal yard and two crude petroleum tanks. A wharf used to supply coal and other supplies was north of the generator house.

61. The existence of this wharf also highlights another characteristic of this MGP and one that it shared with the North Beach MGP; it was on the immediate shoreline during the time of its operations. The above map also shows this. In the mid-1800s, a seawall, named Fair's Seawall, was constructed on the north edge of what is now Marina Green. Until approximately

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1912, behind this seawall was a "lagoon" in an area now diagonally bisected by Cervantes St., into which the Fillmore MGP's wharf jutted.

62. Investigations thus far conducted indicate significant soil contamination in the historical footprint of the MGP and its vicinity, including highly elevated levels of PAHs and lead, as well as large MGP tar deposits within what was the artificial bay and is now fill on which residents of the Marina live.

II. PG&E Handled, Stored, Treated, Transported and/or Disposed of Solid and/or Hazardous MGP Wastes at the Subject MGP Sites and/or in the Vicinity thereof

63. During the course of its operations of the Subject MGPs and upon its closure of the Subject MGPs, PG&E handled, stored, treated, transported and/or disposed of solid and/or hazardous MGP wastes at the Subject MGP Sites and/or the vicinity thereof.

64. The operation of the Subject MGPs centered on the separation of gas from coal and/or oil and then the purification of the gas. During these processes, PG&E created, handled, stored, transported and/or disposed of at various locations within the grounds of the Subject MPG Sites and/or in the vicinity thereof significant amounts of solid and hazardous toxic wastes, including wastes

65. During the course of PG&E's operation of the Subject MGPs, debris from damaged facilities as well as unused maintenance materials, which included high levels of PAHs, lead, and other toxic substances, were stored, transported, and disposed of by PG&E on the Subject MGP Sites and in the immediate vicinity thereof.

66. When portions of the facilities of Subject MGP Sites were decommissioned and demolished, the demolition debris, which included high levels of PAHs, lead, and other toxic substances, were stored, transported, and disposed of by PG&E on the Subject MGP Sites and in the immediate vicinity thereof.

67. Accordingly, soil sampling on the Subject MGP Sites and in the immediate vicinity thereof has revealed high concentrations of brick and other building materials intermixed with lead and PAHs, from the surface to 10 feet below ground surface ("bgs").

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III. The Solid and/or Hazardous MGP Wastes Handled, Stored, Treated, Transported by, and/or Disposed of by PG&E at the Subject MGP Sites and/or in the Vicinity thereof Present, and/or May Present, an Imminent and Substantial Endangerment to Health and/or the Environment

68. PG&E's handling, storage, treatment, disposal and/or transportation of solid and/or hazardous MGP wastes at the Subject MGP Sites and/or the vicinity thereof has resulted in the contamination of the soil and groundwater of the terrestrial portions of those locations. This contamination presents an imminent and substantial endangerment to health and/or the environment and/or may present an imminent and substantial endangerment to health and/or the environment in the future.

69. In locations where sampling has been conducted, contaminants associated with former MGP operations have been detected in soils and groundwater throughout the footprint of the former MGPs and in the vicinity of the Subject MGPs.

70. The concentrations of the MGP Waste contaminants detected to date are significant and pose an imminent and substantial endangerment to both human health and the environment, and/or may present an imminent and substantial endangerment to health and/or the environment in the future.

71. Attached hereto as Exhibit C is an investigation report (with appendices and figures omitted for size) prepared by the environmental consultants of Plaintiffs based on the results of the CMI that details the contamination of the Subject MGP Sites and areas in their vicinity ("Plaintiffs Investigation Report").

72. The full extent of the contamination associated with the former MGP plants has not yet been defined. It is highly probable that additional significant levels of contamination exist in areas not yet evaluated at, and in the vicinity of, the Subject MGPs that would also pose an imminent and substantial endangerment to human health and the environment, and/or may present an imminent and substantial endangerment to health and/or environment in the future.

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A. MGP Wastes in the Soils of the Subject MGP Sites and Their Immediate Vicinity Contain Very Dangerous Levels of Lead that PG&E Refuses to Address

73. PG&E does not dispute the existence of high levels of lead in soils on the Subject MGP Sites; and PG&E's own "Guidance for Disturbing Soil at Former Manufactured Gas Plant Sites" (which is attached as Appendix F to Plaintiffs' Investigation Report) lists lead and arsenic as the "most common" metal byproducts "associated with former MGP sites."

74. Nonetheless, PG&E steadfastly refuses to acknowledge that lead is a contaminant of concern at the Subject MGP Sites or meaningfully investigate lead contamination in the soils of the Subject MGP Sites or their immediate vicinity.

75. In fact, so as to suppress the creation of data supporting the conclusion that lead is a contaminant of concern related to the Subject MGP Sites, after PG&E recognized that testing soils removed from remediated properties for waste disposal purposes was creating data showing high concentrations of lead on properties located on the Subject MGP Sites, PG&E stipulated with its waste disposal contractor that the soils removed from remediated properties constituted toxic waste, thereby avoiding the further creation of such incriminating data.

76. PG&E has also offered a varying set of counter explanations for the very high levels of lead found on properties located on the Subject MGP Sites and their immediate vicinity.

77. These explanations include:

a. The Selby Smelter – PG&E has suggested that the Shelby smelter, which operated, from approximately 1879 to 1884 at the location described as "the foot of Hyde Street, North Beach," is the source of lead found in the soils of properties on the Subject MGP Sites, rather than the Subject MGPs;

b. Lead paint – PG&E has suggested that lead paint used at the Pan Pacific International Exposition ("PPIE") or on current residential structures is the source of lead rather than the Subject MGPs;

c. PPIE exhibits – PG&E has suggested that source of lead is a "lead mill" exhibit that was operated that during the PPIE by W.P. Fuller;

d. Ubiquitous lead – PG&E has also suggested that lead is ubiquitous in San Francisco; and

e. DTSC and CCSF requests – PG&E, finally, has suggested that DTSC and CCSF requested that lead be excluded from the contaminant of concerns that would be investigated as part of PG&E's investigation of the Subject MGP Sites.

78. None of these explanations hold.

79. First, as reported in Appendix E of Plaintiffs Investigation Report, concentrations of lead in soil proximate to the terrestrial footprints of the former Fillmore and North Beach MGP are significantly higher than those outside of the facilities' footprints. This is inconsistent with: (a) an aerial deposition pattern from the Selby Smelter, which would not have concentrated in areas localized in the footprints of the Fillmore and North Beach MGPs; (b) lead paint from the PPIE and current residential structures, which would not have concentrated in areas localized in the footprints of the Fillmore and North Beach MGPs; (c) lead from W.P. Fuller's "lead mill," which would not have concentrated in areas localized in the footprints of the Fillmore and North Beach MGPs; and (d) the proposition that lead is simply ubiquitous, which is inconsistent with higher levels of lead being found in certain locations, specifically the footprints of the Fillmore and North Beach MGPs.

80. Second, elevated lead concentrations were observed throughout the soil column of the Subject MGP Sites, including well below the surface, commingled with brick debris indicative of demolished MGP facilities, and in areas of the North Beach MGP footprint, where remaining MGP building foundations clearly demonstrate the elevated lead concentrations are below fill placed after MGP demolition. This, again, is inconsistent with PG&E's alternative explanations (a) through (d) for reasons, including, without limitation, that lead does not migrate vertically in soils and, if these alternative explanations were correct, it would not be found commingled with MGP building debris.

81. PG&E's counter explanations also fail for reasons specific to each:

a. The prevailing winds place the Selby Smelter downwind of the eastern boundary of the Marina Basin and east of a topographic high; and a historical record of

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complaints related to the Selby smelter exhaust reveals that all are from locations south and east of the smelter – in the direction of the prevailing winds and away from the Marina.

b. The vast majority of exterior surfaces at the PPIE were finished with plaster and were not painted. Instead, the plaster was impregnated with three pigments that did not contain lead, including: burnt sienna (a hydrated oxide of iron, alumina silicate, lime, and barium sulphate), raw umber (containing ferric oxide, manganese dioxide, carbonate of lime, alumina, and silica), and yellow ochre (a natural mineral consisting of silica and clay owing its color to an iron oxyhydroxide mineral, goethite). Lead paint, on the other hand, was used in very limited ways, i.e.: on decorative pools, millwork, exterior and interior woodwork, doors and windows, ironwork, sheet metal, and plaster walls in bathrooms up to a height of 6-feet.

c. The PPIE "lead mill" exhibit was located a significant distance from either the North Beach MGP or the Filmore MGP footprints and, given the relatively small scale and controlled conditions of a public exhibit, this lead mill was unlikely to contribute a significant amount of lead to the environment.

d. The claim of the ubiquity of lead has not been substantiated by data in the Marina and is contradicted by statistical review. For example, PG&E contractor, Jacobson James & Associates ("JJA") refers, in a 2015 report, to "ubiquitous" lead concentrations in shallow soils in the East Marina area, without providing a basis for this statement. The mean and 95% upper confidence limit ("95% UCL") of lead in the 23 samples collected by JJA in 2014 at depths within two feet of ground surface north of the terrestrial footprint of the former North Beach MGP and next to the East Harbor, where JJA considered lead "to be ubiquitous in the marina area," were found to be 61 mg/Kg and 83 mg/Kg, respectively. These levels of lead are substantially below that identified on the footprints of the Subject MGP Sites, disproving the assertion that lead is "ubiquitous."

e. And, on April 8, 2016, as part of the CMI, Plaintiffs and PG&E jointly requested that DTSC verify PG&E's contention that the DTSC and CCSF had requested that lead be excluded from the investigation of the Subject MGP Sites. On October 10, 2017, the DTSC responded that "DTSC contacted prior staff involved in the early stages of the PG&E MGP

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program as well as all records related to this inquiry" and "was unable to determine whether such a decision had been made." In other words, PG&E sought cover for its omission of lead from the list of toxic chemicals for which it tests in a purported affirmative decision by DTSC, but no evidence supports that DTSC made such a decision. Rather, the evidence further supports the conclusion that PG&E has defined for itself the extent of its obligations concerning contamination caused by the MGP Wastes, and the DTSC has not played any active role in that regard.

82. Finally, regulatory guidance and industry references all identify lead as a common contaminant of concern at MGP Sites, a fact that PG&E representatives have acknowledged.

83. Nonetheless, PG&E has refused to include lead among the contaminants of concern for which it investigates soils collected from the Subject MGP Sites or even to inform residents of homes in the area that such contaminations may exist in their soils—soils that their children play in.

B. As a Result of Public Relations by PG&E that Understate the Risk, MGP Wastes in the Soils of Many Private Properties that Contain High Levels of Numerous Toxic Chemicals Have Not Been Remediated or Even Tested

84. PG&E's aforementioned refusal to test properties on the Subject MGP Sites and their immediate vicinity for likely elevated levels of lead from MGP Wastes is part of a broader strategy by PG&E's to misinform private property owners of the health risk presented by MGP Wastes on their properties.

85. During the approximate decade-long life of its program to address MGP Waste contamination in the Marina neighborhood, PG&E has consistently understated the health risk presented by such waste, in order to dissuade private property owners from demanding adequate (and expensive) remediations of their properties.

86. Consistent with PG&E's intentions and as a result of this strategy, a substantial number of private properties on or in the vicinity of the Subject MGP Sites still have not been investigated, almost ten years since the program to address to the contamination began.

87. In the mid-1980s, PG&E tested surface soils at approximately two dozen private properties in the vicinities of the North Beach MGP and Fillmore MGP. PG&E used these tests to (falsely) demonstrate to the US/EPA that the areas are safe for humans and there was no need to

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raise the Subject MGPs to the National Priority List under the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"). In stark contrast to that mid-1980s determination, recent testing has revealed the area unsafe for humans without adequate remediation. In fact, seven out of nine of the exact same private properties that were tested at both times have now required removing large quantities of contaminated soils and restricting access in order to make the residences safe for human habitation. PG&E informed the owners that the mid-1980s tests showed low contamination levels but, "as a courtesy," sent men around with rakes to "clean up" yards.

88. In fact, PG&E knew that such "clean ups" were inadequate and that the levels of contaminants were not low. However, PG&E's management had determined that an adequate remediation of Subject MGP Sites—given their location in San Francisco's Marina neighborhood—would be difficult and expensive. Thus, PG&E set about investigating and remediating dozens of other MGPs in its service area, first, and leaving the Subject MGP Sites till last. In the meantime, PG&E did not inform Marina residents for decades about the health risks of the likely contamination on their properties.

89. During this period, PG&E not only had an increasing body of knowledge from other MGP sites that indicated the likely contamination of those in the Marina, it had specific knowledge of MGP Waste contamination in the Marina based on several events, including without limitation the following:

- 1977, signs of a large plume of MGP Wastes from the Fillmore MGP behind Fair's Seawall;
- 1986, signs of MGP Wastes spread on the surface of yards in the Marina district;
- 1989, another sign of a large plume of MGP Wastes from the Fillmore MGP in the center of the lagoon formed by Fair's Seawall;
- 1991, confirmed MGP Waste contamination in saturated soils and groundwater at the Marina Substation and calls by DTSC, Regional Water Quality Control Board (the "RWQCB"), and PG&E's own consultant to investigate the larger North Beach MGP site;

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- 1994 and subsequent years, confirmed and reconfirmed MGP Waste contamination in Gashouse Cove;
- 1994, confirmed MGP Waste contamination in saturated soils and groundwater at the Gaslight Building;
- 1997, confirmed MGP Waste contamination in soil and groundwater, and signs of MGP Waste on the surface which was later deemed similar to the "black Rocks" at Clarke's residence, at the Gaslight Building which required a remediation; and
- 2006, confirmed MGP Waste contamination on the perimeter of Gashouse Cove suspected to be an upland source continuously contaminating the Bay.

90. However, none of this information nor the health risks that was likely posed by MGP Wastes on their properties was shared with Marina residents.

91. When PG&E finally got around to addressing the MGP Waste contamination in the Marina neighborhood, in 2010, it shifted its public information strategy: it admitted the possibility of MGP Wastes on people's properties, but, in an effort to dissuade residents from demanding an adequate remediation of their properties—particularly removal of contamination from below their homes—PG&E aggressively spread a false narrative that the contamination presented little to no health risk to residents and flatly refused to conduct certain types of investigation activities, including sampling of groundwater contamination, sampling of indoor air vapor, sampling below structures, or testing soil samples for lead.

92. This false narrative has been consistently spread by PG&E in its correspondence with Marina residents, fact sheets prepared by it and distributed under its name and that of DTSC, statements made by it in public and private meetings, and various other communications; and a key component of this false narrative is the assertion that the MGP Waste is only dangerous to human health if there is direct contact with the waste, and that such contact is very unlikely because of the depth of the MGP Wastes in the soil.

93. PG&E supports the false narrative by keeping damaging information effectively hidden from the public and by selectively reporting favorable information while not reporting countervailing information.

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94. The following is an example of PG&E keeping information effectively hidden. Liquid coal tar, a highly concentrated form of MGP contamination, has been discovered within three feet of the surface in, as least two locations, on the North Beach MGP Site, including in the yard of home. These discoveries bely PG&E's repeated assertion that the contamination only exists deep underground, and they directly relate to risk to area residents. Despite the serious implications—including that it is now known that the possibility that similar contamination might be at other locations is no longer remote—PG&E has not informed Marina residents of it. PG&E's only "public disclosure" of one such discovery is a deliberate obfuscation: it was briefly mentioned deep inside an obscure report published on DTSC's website more than two years after the discovery. In addition, the phrase used to describe liquid coal tar, "… considered representative of the tar-like material and not soils …" is obfuscated as techno-speak. PG&E's actions in this matter are clearly designed to give it the ability to claim transparency while effectively keeping the public uninformed of information pertinent to their wellbeing.

95. The following is an example of PG&E selectively reporting some information while not reporting information which might counteract the false narrative. A private elementary school, kindergarten through fourth grade, is located atop the retorts of the North Beach MGP Site in an area where there has been confirmed contamination requiring remediation on every property tested. PG&E tested the school, but not for contamination, as it had for every other property in the vicinity. Instead, PG&E tested the school only for sub-slab vapor and indoor air and delivered a "report" pointing to possible sources other than MGP contamination for the anomalies found in the vapor and air. While all other reports have at least the veneer of objectivity, the report for the school is unambiguously worded in a way that persuades the reader there is nothing to worry about. Most reprehensible is that PG&E decided to leave out certain facts, including the fact that nearby properties have installed vapor management systems either as precaution or because DTSC required such systems. PG&E obviously wants people to feel safe, but it is not entitled to make decisions for others. PG&E's actions in this matter not only dismiss contamination under the school as unimportant, but deprive the building owner, school staff,

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parents, and students of relevant facts related to likely health risks to consider for their decision making.

96. PG&E has, furthermore, in its communications with Marina residents sought to encourage the understanding that residents will be much better off if they simply go along with what PG&E proposes, rather than fight it.

97. For example, at a 2010 public meeting with homeowners likely to be affected because their property is in the vicinity of the Subject MGPs, a veteran PG&E employee knowledgeable of many MGP investigations was brought in to speak. The employee introduced himself, briefly alluded to his knowledge and experience on MGP projects, and proceeded to tell the story of two MGP cleanup projects. These two projects had completely opposite outcomes for the residents triggered by the behavior of the residents. In one project, the residents fought PG&E through legal means and, of course, PG&E defeated them. PG&E was not inclined to be very generous with those residents. In the other project, the residents were naturally inconvenienced by the cleanup but saw that it was inevitable and went along without a fuss. PG&E helped these residents both physically and financially. The message was hard to miss.

98. PG&E has also falsely downplayed the likelihood that homeowners would be required to enter into a land use covenant ("LUC"), which would likely permanently stigmatize the property and reduce its value, if they agree to the sort of minimal remediation for which PG&E has advocated. In fact, virtually every property in the vicinity of the Subject MGPs investigated to date has enough contamination to warrant remediation and, almost always, such remediation includes the requirement of an LUC.

99. PG&E has not corrected or modified the false narrative that MGP Wastes on people's properties presents no health risk.

100. This is particularly disturbing in light of not only the significant amounts of lead-containing MGP Wastes consistently found near the surface of properties on the Subject MGP Sites and their immediate vicinities, but also the ubiquity on the surface of such properties of solid MGP Wastes, sometimes called black rocks, lampblack, clinkers, etc., which are known to contain very high levels of PAHs that are known carcinogens. Moreover, given the significant

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levels of PAH contamination contained in shallow groundwater in many portions of the affected areas, there is a real and substantial risk of indoor air vapor contamination.

101. To save money, PG&E has created a false impression among Marina residents that no health risks are presented by the MGP Wastes on their properties, which has resulted (as PG&E hoped) in a large number of such residents doing nothing about the contamination.

102. The self-serving bias of PG&E's public information campaign has caused a large number of Marina residents and visitors to be needlessly exposed to MGP Wastes and, if not ordered by the Court to be remedied, will allow the continuation of these exposures into the future.

C. MGP Wastes in the Soils of Right of Ways and Other Public Properties on the Subject MGP Sites and Their Immediate Vicinity Contain High Levels of Numerous Toxic Chemicals for which There Is No Plan to Address

103. In addition to private properties, the Subject MGP Sites and immediate vicinities contain large areas consisting of rights-of-way ("ROWs") and other public properties, such as the Marina Green, triangle area, and parking area opposite the Safeway store, all of which are downgradient of probable MGP contamination sources. There are also public properties adjacent to the probable MGP contamination sources that are equal gradient or upgradient of those sources, such as Fort Mason and Moscone park.

104. As part of the CMI, PG&E and Plaintiffs sampled the soils and groundwater in many of the ROWs located on the Subject MGP Sites and their immediate vicinity.

105. This sampling revealed what one would expect: the ROWs and other public properties in the vicinity of contaminated private properties are also contaminated.

106. However, nothing is being done to address this contamination and there are no plans to address it.

107. PG&E, in fact, has recently made its intention to do nothing about the contamination clear. It recently issued "guidance" concerning contamination that—in addition to its inadequacy as guidance—abdicates any responsibility or plan by PG&E to remediate the contamination. Rather, the guidance purports to shift the burden of addressing contamination encountered in ROWs to those who encounter it. The document, moreover, understates the nature

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and extent of the contamination that is likely to be encountered in the ROWs and the risks to human health presented thereby. Together with the way it recommends contaminated soils be handled, this makes it very likely, if followed, that persons who come in contact with soils in the ROWs will be exposed to harmful chemicals and MGP Wastes contained therein will remain there to expose others later.

108. CCSF is not filling this gap. It has taken a passive role with respect to MGP contamination, acting only to facilitate permitting for investigations and private property remediations, and doing nothing to secure the investigation, let alone remediation of MGP contamination of ROWs and other public properties in the terrestrial portions of Marina neighborhood.

109. DTSC has explicitly represented that it has no active role in addressing *any* of the MGP contamination at the Subject Sites or their vicinity—whether on public or private property—and will not order PG&E to do anything in that regard. Rather, DTSC's self-defined role is limited to reviewing and approving investigation and remediation plans proposed and submitted by PG&E.

110. DTSC, thus, has not ordered and will not order PG&E to address the MGP Wastes contaminating ROWs and other public properties.

111. Nor will RWQCB fill this gap. Pursuant to an agreement with DTSC, RWQCB has limited its attention to MGP Waste contamination in the Bay and its shoreline. Accordingly, RWQCB has not issued any orders and will not issue any orders concerning the contaminated ROWs or other public properties.

112. No government agency has indicated even any interest in addressing the MGP Waste contamination in the soils and groundwater of the ROWs and other public properties located on the Subject MGP Sites and their immediate vicinity.

113. As a result, despite the existence for years of data showing substantial MGP contamination in ROWs and other public properties, there have been no ROWs or public property remediations to date; and unless this Court grants Plaintiff the relief he requests herein, the MGP

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Wastes located in ROWs and other public properties will remain unremediated, exposing the public to risks of exposure and the attendant health risks .

IV. PG&E Has Affirmatively and Repeatedly Taken Advantage of Ineffective Local Regulation for More than Two Decades to Avoid Testing and Remediating MGP Wastes at or in the Vicinity of the Subject MGP Sites

114. Since 1991, PG&E has effectively controlled state regulators so as to avoid its responsibility to do comprehensive testing for and remediation of MGP Wastes at the Subject MGP Sites and the vicinity thereof. The relative strengths of California Environmental Protection Agency ("Cal/EPA") and PG&E are such that adequate regulation has systematically been thwarted and is continuing to be bypassed

A. In 1991, PG&E Took Advantage of Divided and Weak State Regulatory Agencies to Affirmatively Avoid Testing and Remediating MGP Wastes in Suspected Locations Around the Marina Substation

115. In 1984, the United States Environmental Protection Agency ("US/EPA") identified a number of former MGP sites across the country that could pose a threat to health or the environment.

116. In 1986, PG&E and the US/EPA met and discussed a plan for investigating and remediating MGP sites in PG&E's service area. PG&E's plan included coordination with the Cal/EPA.

117. US/EPA has a policy to transfer the administration of national programs to state and local governments to the fullest extent possible. Consistent with that policy, US/EPA deferred to Cal/EPA the responsibility for oversight of testing and remediation of the Subject MGP Sites. The US/EPA has not been involved since.

118. Subsequently, two branches of Cal/EPA became involved in these investigations: the DTSC and the RWQCB.

119. PG&E took advantage of ineffective regulation by Cal/EPA when the Marina Substation, a very small part of the North Beach MGP, was tested in 1991.

120. DTSC was the lead agency for oversight and classified the project as a State Response or National Priority List ("NPL").

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121. Testing of the Marina Substation revealed significant PAHs in soil and groundwater.

122. The Preliminary Endangerment Assessment (the "PEA") produced based on the investigation of MGP Waste contamination of the Marina Substation indicated that contamination existed beyond the small 0.25 acre area that was tested. The PEA noted that the Marina Substation was a part of the larger North Beach MGP, which spanned three city blocks. It also indicated that groundwater played a role in the migration of contamination from one site to another. The PEA recommended further investigation over a larger geographic area.

123. RWQCB wrote a memorandum after reviewing the PEA in October 1991 that expressed concern for the high PAHs found in both soil and groundwater. RWQCB's report clearly and unambiguously indicated that PG&E needed to test the wider area for MGP contamination.

124. There was distrust between the Cal/EPA branches at that time. RWQCB's memo stated: "should watch this case. I'm concerned that DTSC will sign off or not push [groundwater and environmental] risk issues. Also 'side' boundry [sic] definition could become an issue (RWQCB vs. DTSC)."

125. DTSC did attempt to "push" the risk issues initially - but ultimately failed. The Site Evaluation Tracking Sheet written by DTSC in December 1991 was unambiguous. It stated *inter alia*: "chemicals of concern are present in soil and groundwater . . . Additional investigations needed regarding sources and/or transport of chemicals in soil and groundwater . . . PEA high priority . . . Further investigation must include entire 9.5 acres [North Beach MGP site] . . . Confirmed groundwater contamination at the site."

126. Then in June 1992, DTSC wrote a strongly worded letter to PG&E stating that further action across the larger site was necessary. The letter cited the significant levels of PAHs found in both soil and groundwater. It said these were hazardous substances known to cause cancer. The letter emphasized the threat to health and the environment. DTSC wanted PG&E to test both soil and groundwater across the entire 9.5 acre site. The letter was a call to action.

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127. PG&E ignored the request, and no remediation of the substation—let alone even an investigation of the entire North Beach MGP Site—was done by PG&E for twenty years.

128. And when PG&E returned after two decades to begin a broader investigation of the MGP Waste contamination at the site, it limited its investigation to soil sampling, studiously avoiding sampling groundwater until compelled to do so as a result of the instant action.

129. Notwithstanding its strongly worded letter, DTSC did not pursue the matter further. This was despite the fact that DTSC had responsibility for oversight of an investigation that started from a US/EPA initiative in the 1980s and that this investigation was a State Response or NPL, as opposed to a voluntary action.

130. DTSC effectively closed its file on the Marina Substation in 1992. At some point, DTSC changed the status of the project from active to "refer to RWQCB." However, there is no evidence that DTSC actually did anything to refer the Marina Substation investigation to RWQCB. There is no evidence that DTSC referred or initiated an investigation of the larger North Beach MGP with RWQCB either. Accordingly, RWQCB did not open a project or take action of any kind. Indeed, except for the memorandum already mentioned, RWQCB has denied any involvement with this Marina Substation project.

131. These actions (and failures to act) by state regulatory agencies, in 1991, allowed PG&E to affirmatively avoid testing and remediating toxic MGP Wastes in the North Beach MGP Site that have been endangering the health and the environment for over twenty years. As DTSC suspected then, but did nothing about, it is now known that the larger area does, in fact, contain significant contamination from MGP Waste in soil and groundwater. Furthermore, extensive remediation has been necessary at almost every site investigated in the North Beach MGP Site to date.

B. In 1997, PG&E Used Questionable Means to Skirt State Regulatory Agencies and Affirmatively Avoid Testing and Remediating MGP Wastes in Suspected Locations Around the Gaslight Building

132. Adjacent to the Marina Substation and sharing a large border is a property known as the Gaslight Building. The Gaslight Building is private property and ownership was changing

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hands in 1997. An investigation was initiated because one of the lenders was concerned about potential liability from contamination on the property.

133. As noted elsewhere herein, the 1997 testing of the Gaslight Building revealed significant PAHs from MGP Wastes at the site. The report for that investigation is called a Phase II Environmental Site Assessment ("P2ESA").

134. Between the 1991 testing at the Marina Substation and the 1997 testing at the Gaslight Building, there was a little-known testing for MGP contamination at the Gaslight Building. This occurred in 1994. The testing is little known because it was not reported to any regulator at the time and only indirectly reported later by way of inclusion as a reference within a subsequent report. The contractor in 1994, soon after communications with PG&E, warned the owner of "close scrutiny" due to the history of the site and the fact that the North Beach MGP was listed in the CERCLA database. PG&E engaged in misconduct by its failure to report the contamination in 1994 and by conducting the 1997 investigation in a manner designed to avoid the regulators' demand for a wider investigation as had occurred after finding contamination during the 1991 investigation. PG&E's misconduct was an attempt to avoid both its responsibility for MGP contamination in the area and the likelihood that close scrutiny would reveal its nefarious activities.

135. Not surprisingly, the 1997 P2ESA for the Gaslight Building contained findings similar to the 1991 PEA for the Marina Substation: significant PAHs; soil and groundwater contamination; and the suggestion that contamination was migrating through groundwater. In addition, the P2ESA identified high levels of naphthalene in shallow groundwater. The 1997 results reinforced what was known in 1991 – there was contamination throughout the larger North Beach MGP site.

136. Despite these findings, PG&E, in an operation later called "scoop and run" by one regulator, performed a minimal remediation at the Gaslight Building. A narrow landscaping strip along one side of the property was excavated a few feet deep and the area replenished with clean soil and new plants. PG&E's justification for doing so little was: it is a commercial site rather than residential; most of the site is covered by buildings, patios, etc.; gardeners might be the only

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people coming into contact with contaminated soil. Groundwater and its ability to transport known highly toxic PAHs from the site to other locations, including residences, were ignored.

137. Oversight of the 1997 Gaslight Building investigation and remediation was dubious.

138. DTSC does not have the P2ESA or any other information about the 1997 Gaslight Building project in its files. A responsible individual at DTSC denies any knowledge of the 1997 Gaslight Building investigation and remediation.

139. Plaintiff received from PG&E a copy of the P2ESA along with a cover letter addressed to RWQCB. The letter asked for a review of the P2ESA relative to RWQCB standards. The letter also asked if RWQCB concurs with the proposed remediation. The letter had the proper address for an RWQCB office at the time.

140. RWQCB also did not have any information about the 1997 Gaslight Building project in its files. Responsible individuals at the RWQCB, as well, said they had no prior knowledge of the cover letter or P2ESA, until those documents were brought to their attention by Clarke in 2014. Similar to the Marina Substation in 1991, the RWQCB did not believe it had nor has oversight responsibility for the Gaslight Building investigation or remediation.

141. Indeed, there are questions about the cover letter and P2ESA and the way they were given to RWQCB. The cover letter was addressed to a "Mr. Vic Powell" at the RWQCB. However, there was nobody by the name of Vic Powell employed by the RWQCB in 1997 or at any other time.

142. In 1997, there existed at the RWQCB a department which dealt with underground storage tanks and which had no expertise in MGPs or personnel who worked on, or connection in any way with, the prior 1991 investigation of MGP contamination at the Marina Substation. A man named Vic Pal, an inexperienced new hire, worked in the department. PG&E concocted and executed a scheme to use the P2ESA to obtain RWQCB "approval" for the 1997 investigation and remediation of the Gaslight Building by passing the report through inexperienced personnel, specifically not Mr. Vic Pal, but another agent, while simultaneously avoiding any scrutiny by experienced personnel familiar with the prior findings at the Marina Substation.

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143. It is clearly evident that in connection with the 1997 Gaslight Building activity, PG&E once again actively ignored signs of contamination in the larger North Beach MGP area and thereby allowed the endangerment to health and the environment to persist for many years. There could be no question that, by 1997, PG&E knew that soil contamination, groundwater contamination, and the spreading of contamination via groundwater existed on a site that contained residences, schools, parks, etc. and bordered on the San Francisco Bay. PG&E also, again, exhibited a careless attitude—at the very least—toward state regulators in order to further its agenda.

144. It is an unmistakable example of PG&E's irresponsible behavior that it remediated the Gaslight Building in 1997 to protect gardeners, while at the same time deliberately ignoring that conditions similar to those at the Gaslight building were likely to exist at other locations and thereby pose a threat to other members of the public. Indeed, the "black rocks" found in Clarke's home were later, in 2010, confirmed by PG&E to be the same material as found at the Gaslight Building. Thus, it is PG&E's own twin actions – protecting one group of people from a known threat (for which PG&E is responsible) while simultaneously using devious means to avoid knowing if that same threat exists nearby (as is likely in the circumstances) – demonstrate a reckless disregard for the safety of the public.

C. Since 1977, PG&E Has Purposefully Ignored Indications of a Large Plume of MGP Waste from the Fillmore MGP and Failed to Report It to Regulatory Agencies or Initiate an Investigation of It

145. In 1977, test borings for a box sewer along Marina Boulevard found the area between Scott and Webster extensively contaminated with what was characterized as a "creosote" residue, but which would now be described as "MGP tar." The report said the contamination probably resulted from previous MGP activities in the area. PG&E, as the owner-operator of those MGPs, would have been informed at that time.

146. CCSF discovered the deposits in 1977 but did little more than record the findings in their report. The box sewer along Marina Boulevard got built, and no department in CCSF apparently saw the health and environmental endangerment caused by this contamination as part of their mission to address.

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147. The MGP Waste deposits along Marina Boulevard are located in what was historically a lagoon confined by Fair's Seawall when the North Beach and Fillmore MGPs were in operation. The Fillmore MGP fronted onto this lagoon in the same way the North Beach MGP fronted onto Gashouse Cove. The sediments in Gashouse Cove today are heavily contaminated with MGP Wastes. The area inland from Fair's Seawall was filled after the MGP ceased operations, in approximately 1912. That filling created a sizable part of the Marina district. Today, the lagoon and whatever contamination it contains is covered over by the Marina Green and perhaps 50 acres of San Francisco residential property.

148. In 2010, PG&E was asked about their plans for investigation of the likely contamination behind Fair's Seawall. PG&E's initial response was that the soil and soil-gas investigation they initiated in 2010 would eventually include groundwater and that that testing would define any impacts in the subject area. Later, PG&E settled into the position that no investigation is needed because all the contamination is below the water table, i.e. in the groundwater. PG&E maintains that contamination in the groundwater cannot harm humans because no one comes in contact with it and no one drinks it. PG&E maintains that MGP contamination that is capped and left in place cannot harm the environment because PAHs are insoluble and immobile.

149. As a result of the CMI, testing for MGP contamination in the lagoon was begun. However, as a result of the ending of the CMI before it fulfilled its purpose, that work is far from complete. There remains, at this writing, more that is unknown than what is known about contamination in this area.

150. Indeed, despite the US/EPA's initiative in the 1980s to investigate MGP sites that might pose a threat to health or the environment, neither DTSC nor RWQCB have any information in their files about the 1977 creosote discovery or any projects to investigate the area.

151. Nor do DTSC and RWQCB show any signs that they will order PG&E to investigate ROWs and other public spaces in the area. That leaves PG&E as the sole decision-maker, a fox guarding the henhouse. Unless the Court orders it, contamination in the area will remain unknown, as will threats to people and the environment.

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D. PG&E Has Grossly Misled Plaintiff and the Public About Oversight on Past Investigations of MGP Waste

152. Since the beginning, PG&E has been using fact sheets to shape the public perception of the MGP Waste situation at the Subject MGP Sites. It contains very carefully worded but nonetheless false and misleading statements about earlier investigations. For example:

a. Concerning the Gaslight Building remediation in the 1990s, PG&E says: "We worked with one of these owners to remove soil from a portion of their property – no further work was requested by the owner. This work was completed under the oversight of the Regional Water Quality Control Board." This is referring to the "scoop and run" at the Gaslight Building in 1997 discussed above.

b. Concerning Marina Substation testing in the 1990s, PG&E says: "The other owner was satisfied with the test results and made no request for further work." This is referring to the Marina Substation testing in 1991 discussed above.

153. In the first quote, PG&E uses the word "oversight" to imply something significantly more than what actually took place. As discussed, RWQCB had no knowledge of this work and PG&E skirted the oversight through dubious means.

154. In the second quote, PG&E speaks of an "other owner" who was apparently satisfied with the test results and makes no request for further work. But the property is the Marina Substation, so PG&E is committing a deception of omission by failing to mention that ***PG&E itself*** is the "other owner." The fact that the entity liable for any remediation costs made the decision that no remediation was necessary is a much different reality that is intentionally and falsely suggested by the quote: to whit, that an independent third party gave the property a passing grade. This is made further misleading by the fact that, while PG&E was satisfied and made no request for further work, DTSC, RWQCB, and its own consultant were not at all satisfied; and all three requested further work. Indeed, that the lead agency overseeing this investigation, DTSC demanded (but was ignored) further work across the whole 9.5 acre North Beach MGP Site and that both soil and groundwater be tested.

V. Plaintiff Has Complied with the Notice Requirements under RCRA

155. On April 29, 2014, Plaintiff sent, via certified mail return receipt requested, PG&E, DTSC, US/EPA, CAL/EPA, the State Water Resources Control Board, and the San Francisco RWQCB, with written notice of PG&E's violations of RCRA.

CLAIM FOR RELIEF

Violations of the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 *et seq*.

156. Plaintiff incorporates by reference all the allegations contained in the previous paragraphs as though fully set forth herein.

157. PG&E has contributed to the handling, storage, treatment, transportation, and disposal of MGP Waste on the Subject MGP Sites and the vicinity thereof.

158. PG&E dumped, leaked, discharged, spilled, injected, and/or placed MGP Waste on the Subject MGP Sites and the vicinity thereof.

159. Such MGP Waste may present an imminent and substantial threat to health and/or the environment.

WHEREFORE, Plaintiff prays for relief as hereinafter set forth.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff prays for judgment and further relief as follows:

1. This Court declare PG&E in violation of RCRA.

2. This Court order the establishment of an independent environmental remediation trust (the "ERT") that will be responsible for remediating the MGP Waste contamination of the Subject Sites and their vicinity as alleged herein.

3. This Court declare PG&E responsible for funding the ERT.

4. This Court order and restrain PG&E to pay into the ERT, over time, funds sufficient to affect the remediation of the MGP Waste contamination of the Subject Sites and their vicinity as alleged herein.

5. This Court award Plaintiffs the costs of suit herein, including attorneys' fees and expert witness fees, including without limitation pursuant to 42 U.S.C. § 6972(e); and

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6. This Court grant such other and further equitable or legal relief as the Court deems just and proper.

Dated: March 18, 2020

GROSS & KLEIN LLP

By: */s/Stuart G. Gross*
STUART G. GROSS
Counsel for Plaintiff

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EXHIBIT A

North Beach MGP

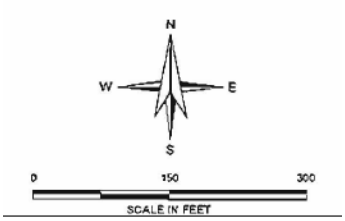

EXHIBIT B

Fillmore MGP

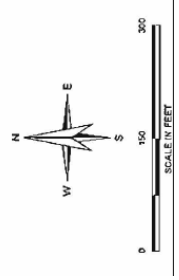

EXHIBIT C

INVESTIGATION REPORT

Former PG&E Manufactured Gas Plants in the San Francisco Marina District
DTSC Project 60001239: PG&E Former North Beach Manufactured Gas Plant
DTSC Project 60001254: PG&E Former Fillmore Manufactured Gas Plant

October 24, 2017

Prepared For:

San Francisco Herring Association ("SFHA") and Dan Clarke

Prepared By:

EnviroAssets, Inc.
www.EnviroAssets.com
(888) 748-8820
Oakland, California

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Oakland, California

Michael Harrison, P.E.

EXECUTIVE SUMMARY

In October 2015, the San Francisco Herring Association ("SFHA") and Dan Clarke ("Clarke," collectively with SFHA, "Plaintiffs"), and the Pacific Gas and Electric Company and PG&E Corporation (collectively, "PG&E," in combination with Plaintiffs, the "Parties") executed an agreement, the Mediated Investigation Agreement or "MIA," to jointly determine the nature and extent of waste produced as a result of, and/or in connection with, the operation, of a manufactured gas plant or "MGP" ("MGP Residue"[1]) in the "Marina Neighborhood, the Fisherman's Wharf Neighborhood, the Marina Adjacent Offshore Areas, and the Fisherman's Wharf Adjacent Offshore Areas"[2] (Figure 1). The MIA is comprehensive of work conducted jointly, as well as independently, by the Parties.[3] Investigations have demonstrated that soil, soil vapor, and groundwater within right-of-way ("ROW") areas, private properties, the former PG&E substation, and the shoreline proximate to and sediment within the East and West Harbors have been impacted with MGP Residue by former MGP operations. Two former MGPs operated within the Marina District from approximately 1882 (Fillmore MGP) and 1886 (North Beach MGP) until the 1906 earthquake (Figure 2). Until the 1920s (it is unclear when the Fillmore MGP gas holder was demolished), portions of the two Marina MGPs not destroyed by the earthquake were used to store and transport manufactured gas produced elsewhere.

The MIA stipulates that the Parties shall endeavor to jointly prepare an investigation report based on their respective analyses of the provided data, which shall be signed by both parties. However, it also provides that in the event that PG&E and Plaintiffs are unable to agree as to the conclusions to be drawn from their respective analyses, each shall issue a separate report, which has been done it this case. In response to a request from the California Department of Toxic Substances Control ("DTSC") and the San Francisco Bay Regional Water Quality Control Board ("Water Board," together with DTSC, the "Regulatory Agencies"), common sections that present investigation data without interpretation have been prepared for inclusion in both Parties' submittals. Common information presented in PG&E's and the Plaintiffs' reports is included in sections 2 and 7 of this report. The DTSC also requested that individual reports be provided for the former Fillmore and North Beach MGPs, as the DTSC currently maintains individual project numbers for each plant, but that the reports explore if the projects should be merged. The interpretative sections of this report reflect and substantiate Plaintiffs' conclusion that these sites should be evaluated as a single site, incorporating the entire Marina District and neighboring off-shore areas.

The joint investigation was conducted, with oversight by the DTSC and in consultation with the Water Board, to "further assess the extent of MGP-related impacts from ground surface in soil

[1] Parties, *Mediated Investigation Agreement*, October 2015.
[2] Ibid.
[3] Capitalized terms not defined herein, shall have the meanings assigned to the in the MIA.

and groundwater until a hydrogeologic boundary (aquitard or aquiclude) is reached"[4], and included samples collected beneath the aquitard/aquiclude formed by Young Bay Mud. The investigation included using Cone Penetrometer Test ("CPT") soundings to profile soil conditions, while using the Tar-specific Green Optical Screening Tool ("TarGOST®") to collect data for high resolution profiling of possible MGP-related non-aqueous phase liquids ("NAPL"), synonymously referred to hereafter as "tar." A hydropunch-type sampling device was then used to collect depth-discrete groundwater samples to delineate dissolved phase MGP-related impacts. A CPT rig was used to advance the borings to a maximum depth of 68 feet below ground surface ("bgs"). Groundwater samples were collected from 18 of the 27 locations, and a total of 54 groundwater samples were collected, including quality control ("QC") samples, from varying depths within the borings. Soil samples were collected from five adjacent comparison borings "to allow hydrogeologic logging including color, odor, fill characteristics, and collection of soil samples for chemical analysis."[5] The following conclusions are based on review of these recent data with other available data in the Marina District:

Marina District MGPs Projects Should Be Combined

Plaintiffs believe that data from investigation of the two Marina District MGPs and Related Investigations[6] of private and public properties and the near shore areas must be compiled and synthesized in order to evaluate the nature and extent of MGP Residue in the Marina District. Reasons in favor of doing so include: (i) the North Beach and Fillmore MGPs share common location and history; (ii) both MGPs shared common processes with common raw materials and wastes; (iii) groundwater and contamination distributions in the Marina District share a common groundwater basin (the Marina Basin) and can only be understood with a comprehensive evaluation; and (iv) both MGPs share PG&E as a common responsible party.

Shallow Soil Sampling Impacts

Visualization of polyaromatic hydrocarbons ("PAHs") and cyanide in shallow soil are provided herein (Figures 3 and 4) and supports the following observations:

- Significantly elevated concentrations of PAHs have been identified in shallow soil – from the ground surface to the groundwater interface.
- The highest concentrations of summed PAHs are found in the vicinity of the former MGP operations and approximate property boundaries.

[4] MIA Parties, *Former North Beach Manufactured Gas Plant Site Right-Of-Way Areas Work Plan Addendum*, June 15, 2016.
[5] Ibid.
[6] "'Related Investigations' means any completed, ongoing, or planned projects within the Investigation Area, the results of which may contain information consequential to the nature and extent of MGP Residue in the Investigation Area." MIA, § I(L).

- In the vicinity of the former Fillmore and North Beach MGPs, the highest concentrations of summed PAHs in shallow soil are located on the terrestrial side of, or boundary between, the upland and former San Francisco Bay border. However, significant concentrations of summed PAHs, potentially related to the post-Panama-Pacific International Exposition ("PPIE") fill demolition of the MGPs, emanate from the MGPs in all directions.
- The concentrations in the vicinity of the former MGPs exhibit concentrations that are several magnitudes higher than concentrations of PAHs in shallow soil across the investigation area, which exhibit significant variability.
- The boundaries of the most impacted areas are poorly defined, with large data gaps in sample locations apparent.
- Relatively lower, but still elevated concentrations of PAHs exist in areas spatially removed and non-contiguous with former MGP footprints that are more difficult to harmonize with conceptual site model sources of waste releases, and may be associated with non-MGP sources of PAHs.
- Concentrations of cyanide (total) have been observed in soil primarily within the western portion of the former Fillmore MGP, and near the scrubbers and tar refinery/tar well at the former North Beach MGP.
- The Parties are currently disputing whether lead in soil should be investigated as a component of the joint investigation. Consequently, soil samples from the Joint Investigation were archived for potential future lead analysis. As further discussed in Section 8.5, Plaintiffs evaluated existing lead in soil data in the *Iteration R0 - Conceptual Site Model*[7] and concluded that concentrations of lead in soil on the terrestrial footprints of the former Fillmore and North Beach MGP are significantly higher than those outside of the facilities' footprints and should be investigated as MGP Residues.

Groundwater Impacts – MGP Tars/Separate Phase Residuals

A visualization of MGP Tars or separate phase residuals ("MGP Tars/SPR"),[8] is provided herein (Figure 6 and Table 10) and supports the following observations:

- MGP Tars/SPR is observed emanating from gas production areas, gas holders, tar wells, and oil storage tank areas where leaks and discharges would be anticipated and have been demonstrated at other similar historical MGP facilities.
- MGP Tars/SPR is observed emanating along the pre-1891 and 1899 shorelines – including within the former SF Bay channel immediately east of Webster Street – where

[7] Plaintiffs, *Iteration R0 Conceptual Site Model (CSM) Former Fillmore and North Beach MGP Sites*, December 14, 2016.

[8] MGP Tars/SPR include NAPL (both discontinuous and continuous), observations of sheen, groundwater samples above estimated solubility, and summed 16-PAH concentrations in sediment samples where a linear regression with paired groundwater samples was conducted.

discharges of refinery wastes were likely to have occurred. In particular, carbureted water gas MGPs would have been confronted with large volumes of tars and tar emulsions that were routinely discharged as waste due to the difficulty of recovering tar economically from the process.

- MGP Tars/SPR deposits are continuous across terrestrial and San Francisco Bay areas.
- The complete extents of MGP Tars/SPR deposits have not been identified.

Groundwater Impacts – Vapor Intrusion Concerns

Visualization of volatile indicator compounds in shallow groundwater, naphthalene and benzene, are provided herein (Figures 6 and 7, associated tables 1110 and 1211) and support the following observations. Concentrations of naphthalene and benzene exceed guidance concentrations for vapor intrusion human health risk levels for shallow groundwater in residential areas in large areas of the Marina District. Vapor intrusion risk in the Marina District is of particular concern due to factors including: the elevated concentrations of MGP-related volatile indicator compounds identified in shallow soil and shallow groundwater in the Marina District; the fact that much of the residential building stock in the Marina District is built on sand; the fact that differential settlement of older construction typical of the Marina District lends itself to cracks in foundation slabs; and the fact that such construction also generally lacks significant integrated vapor barriers. Furthermore, both contaminant source and sub-slab attenuation factors used to evaluate potential concerns from shallow soil vapor and groundwater threat to vapor intrusion assume attenuation over an existing building slab – therefore neither of those factors are sufficiently protective in the case of buildings with perimeter foundations and crawl spaces. Such buildings are known to exist, but have not been specifically investigated and inventoried in the Marina District as haven't buildings with residential space at or below grade, which are also of particular interest for vapor intrusion concerns.

Groundwater Impacts – Cyanide and Lead

In the vicinity of the former Fillmore MGP, cyanide (total) in groundwater occurs beneath and north of the former MGP with a slightly elevated area downgradient of the former generator house. We note that free cyanide, the most toxic form of cyanide, has been detected in groundwater at only three relatively divided locations and at low concentrations: (FF-ROW-TG11 and FF-ROW-MW06) in the vicinity of the former Fillmore MGP, and at NB-ROW-CMT15 well cluster in the vicinity of the former North Beach MGP. We note that the distribution of cyanide (total) in groundwater appears to be associated with occurrence of MGP Tars/SRP, which have been identified across the East Harbor – where cyanide has not been analyzed for. Therefore, we believe that cyanide should be added to the chemical analysis suite for offshore areas.

Distributions of lead in groundwater are disjointed and do not present a clear picture of release and migration. Additionally, the anomalously high concentrations of lead of 2400 µg/L and

3900 µg/L in borings near the former Fillmore MGP (FF-TG-53) and former North Beach MGP (NB-ROW-TG70), require additional investigation.

Interim Remedial Action – Shallow Tar Reservoir

During installation of NB-ROW-MW11 on March 1, 2017, a PG&E contractor encountered "Continuous NAPL present at 9.67', pooled on concrete refusal surface."[9] That concrete refusal surface is understood to be the bottom of the former North Beach MGP Tars well along Beach Street, as the boring is within the footprint of the historical tar well. Due to the discovery of free product within a shallow former underground storage tank, this area should be considered for an Interim Remedial Action.

[9] Boring log, JJ&A, Well Number MW-11.

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1.0 INTRODUCTION AND PURPOSE

In October 2015, Plaintiffs and PG&E executed an agreement, the Mediated Investigation Agreement or "MIA," to jointly determine the nature and extent of MGP Residue[10] in the "Marina Neighborhood, the Fisherman's Wharf Neighborhood, the Marina Adjacent Offshore Areas, and the Fisherman's Wharf Adjacent Offshore Areas."[11] The MIA is comprehensive of work conducted jointly, as well as independently, by the Parties. Investigations under the MIA have demonstrated that soil, soil vapor, and groundwater within ROW areas, private properties, the former PG&E substation, and sediment within the East and West Harbors has been impacted by the former MGP operations.

Two former MGPs operated within the Marina District from approximately 1882 (Former Fillmore MGP) and 1886 (North Beach MGP) until the 1906 earthquake, with the North Beach MGP continuing to be used into the 1930's, as a storage facility for manufactured gas produced elsewhere. These refineries produced gas from water, coal, and crude oil. The gas was used for lighting, cooking, heating, and driving industrial processes in San Francisco. This fuel served as a bridge from a whale-oil-based economy to the network of high-pressured interstate natural gas pipelines and electric lighting that would supplant manufactured gas by the 1950's. These relics of our society's industrialization "created waste products which are resistant to natural decay and often result in potential effects on public health and the environment."[12] In the Marina District, impacts from MGP Residue have been observed since at least 1977 when Dames and Moore identified creosote and oil contamination while conducting a subsurface investigation associated with the North Shore Outfalls Consolidation Project. Investigations by PG&E date back to at least 1986, and continue today. Further details regarding the history and setting of the former North Beach and Fillmore MGPs is provided in the *Iteration R0 - Conceptual Site Model*[13] submitted by Plaintiffs to the DTSC and Water Board on December 14, 2016.

The MIA stipulates that the Parties shall endeavor to jointly prepare an investigation report based on their respective analyses of the provided data, which shall be signed by both parties. However, it also provides that in the event that PG&E and Plaintiffs are unable to agree on the conclusions to be drawn from their respective analyses, each shall issue a separate report, which has been done in this case. In response to a request from the Regulatory Agencies, common sections that present investigation data without interpretation have been prepared for inclusion in both Parties' submittals. Common information presented in PG&E's and the Plaintiff's reports is included in sections 2 and 7 of this report. The DTSC also requested that individual reports be provided for the former Fillmore and North Beach MGPs, as the DTSC currently maintains

[10] Op. Cit., Parties, MIA 2015.
[11] Ibid.
[12] NY Department of Environmental Conservation, *New York State's Approach to the Remediation of Former Manufactured Gas Plant Sites*, January 2008.
[13] *Iteration R0 - Conceptual Site Model*, Former Fillmore and North Beach MGP Sites, Court Mediated Investigation, San Francisco, California, December 14, 2016.

individual project numbers for each plant, but that the reports explore if the projects should be merged. The interpretative sections of this report reflect and substantiate Plaintiffs' conclusion that these sites should be evaluated as a single site, incorporating the entire Marina District and off-shore areas; to do otherwise would severely limit the ability of the analyst to understand the nature and extent of MGP Residue in the Marina District and Offshore Areas.

2.0 JOINT INVESTIGATION SCOPE

The joint investigation was conducted with oversight by the DTSC, and in consultation with the Water Board, to "further assess the extent of MGP-related impacts from ground surface in soil and groundwater until a hydrogeologic boundary (aquitard or aquiclude) is reached."[14] The investigation included using CPT soundings to profile soil conditions, while using TarGOST® to collect data for high resolution profiling of possible MGP-related tar. A hydropunch-type sampling device was then used to collect depth-discrete groundwater samples to delineate dissolved phase MGP-related impacts. A CPT rig was used to advance the borings to a maximum depth of 68 feet bgs. Groundwater samples were collected from 18 of the 27 locations, and a total of 54 groundwater samples were collected, including QC samples, from varying depths within the borings. Soil samples were collected from five adjacent comparison borings "to allow hydrogeologic logging including color, odor, fill characteristics, and collection of soil samples for chemical analysis."[15]

The investigation was conducted in general accordance with the following documents prepared by Haley & Aldrich, on behalf of PG&E, and approved by the DTSC:

- Right-of-way Areas Investigation Work Plan dated 24 March 2014 (Haley & Aldrich, 2014);
- Right-of-way Areas Investigation Work Plan Addendum dated 26 January 2016 (Haley & Aldrich, 2016a);
- Sampling and Analysis Plan ("SAP") revision 5 dated 15 January 2015 (Haley & Aldrich, 2015a);
- Quality Assurance Project Plan ("QAPP") revision 4 dated 15 January 2015 (Haley & Aldrich, 2015b); and
- Former North Beach Manufactured Gas Plant Site Right-Of-Way Areas Work Plan Addendum, Mediated Investigation Agreement Joint Investigation dated 15 June 2016 (Haley & Aldrich, 2016b).

During the joint Investigation Event,[16] the following work was conducted:

[14] MIA Parties, *Former North Beach Manufactured Gas Plant Site Right-Of-Way Areas Work Plan Addendum*, June 15, 2016.
[15] Ibid.
[16] "Investigation Event" means one of several projects to determine the nature and extent MGP Residue in the Investigation Area that together constitute the Mediated Investigation (MIA, October 2015).

- Prior to advancing each Cone Penetrometer Test / TarGOST® ("CPT-TG") boring, the location was cleared by a private utility locating services followed by manual excavation to depths between five and ten feet bgs as a final check for subsurface utilities. The target depth for the CPT-TG borings was until bay mud was encountered, refusal, or the maximum depth of the sampling equipment was reached (68 feet bgs).
- At nine locations, continuously cored soil borings were advanced until a hydrogeologic boundary (aquitard or aquiclude) was reached, or refusal was encountered, to allow hydrogeologic logging including color, odor, fill characteristics, and collection of soil samples for chemical analysis. These borings were advanced with direct-push or sonic drilling techniques.
- Multiple depth-discrete groundwater samples were collected at most CPT-TG locations using a hydropunch-type sampling device to delineate dissolved phase MGP-related impacts.

3.0 RATIONALE FOR COMBINED NORTH BEACH AND FILLMORE MGP APPROACH

During a June 29, 2017, meeting between the Parties and Regulatory Agencies, the participants discussed Plaintiffs' opinion that the North Beach and Fillmore MGP projects should be combined and PG&E's contrary opinion. As the DTSC currently maintains individual project numbers for each plant, the DTSC requested that a report be provided for each project, and that the reports should provide an evaluation of whether separate or joint treatment is appropriate for the Marina District MGPs – and as a result, whether the two DTSC projects should be combined into a single project. For the reasons discussed in the following section, it has been confirmed that data from investigation of the two Marina District MGPs and Related Investigations of private and public properties and the near shore areas must be compiled and synthesized in order properly evaluate the nature and extent of MGP Residue in the Marina District.

3.1 Common Location and History

The former Fillmore and North Beach MGPs sit on the boundary between the natural coastline and San Francisco Bay, in the Marina District. They share a similar hydrogeology, history of artificial filling, and common groundwater aquifers. Their boundaries lie within approximately 440 feet of each other.

Both MGPs commenced operation in the 1880's: the former Fillmore MGP commenced operations in 1882 and the North Beach MGP commenced operations in 1886. Until 1898, when the sea wall envisioned by James G. Fair was finally completed, both MGPs discharged to the same section of San Francisco Bay – 12 years of similar refinery discharges to a common waterway, without the physical barrier of the sea wall, which was only later erected.

3.2 Common Processes, Raw Materials, and Wastes

Both MGPs utilized coal and carbureted water gas processes. Consequently, they handled the same raw materials, operated with similar practices common to contemporary MGPs, and produced similar waste streams. It is evident to Plaintiffs that MGP Residue from the two MGPs is commingled in the Marina District, as the patterns of contamination in the visualization of data provided herein indicate.

3.3 Groundwater and Contaminant Interpretation Requires a Basin Perspective

The hydrogeology in the vicinity of both MGPs is interrelated, and consequently cannot be understood in the Investigation Area without a comprehensive, area-wide approach. This is evident on the Groundwater Elevation and Flow Direction figure presented as Figure 3, *First Quarter 2017 Groundwater Monitoring Report, Former Fillmore MGP*.[17] Furthermore, combining the two projects would end the type of contorted and inconsistent reporting evident in H&A 2017, where wells, data, and site features in the Investigation Area, including the entire North Beach MGP, variously appear and disappear on figures 1-4 (Appendix A).

Both MGPs operated as the Marina District underwent significant changes, and impacted large areas with waste discharges and demolition debris. Existing data suggests that contamination from the MGPs is comingled, although additional investigation is required to confirm this hypothesis. The depositional patterns of the identified wastes must be viewed comprehensively to evaluate the patterns of waste deposition and migration. As an example, data at and emanating from the former North Beach MGP is separated into four main projects plus a myriad of individual private property investigations – an arbitrary segregation of data into multiple projects that has hindered data evaluation and understanding in prior reports. A review of contaminant distributions that allow consideration of a variety of release mechanism and fate and transport outcomes combined with shoreline evolutionary stages, such as those provided herein, is not possible if arbitrary limits prevent harmonization of data in the site vicinity – preventing the clear relationship between MGP Tar release facilities, former tidal channels, and current distributions that span contiguous terrestrial and marine areas from being depicted.

3.4 Shared Responsible Party

PG&E is the responsible party for both the Fillmore and North Beach MGPs. This common responsible party simplifies combining the regulatory projects into a single, rationalized project.

4.0 PHYSICAL SETTING

This section presents an abbreviated discussion of the physical setting, including the geology and hydrogeology of the Marina District. A more comprehensive treatment of the subject is provided

[17] Haley & Aldrich, *First Quarter 2017 Groundwater Monitoring Report, Former Fillmore MGP*, July 21, 2017 (H&A 2017).

in the *Iteration R0 - Conceptual Site Model*. The approximate locations of the former MGP plants are presented on Figure 2, along with their historical features.

4.1 Geology and Fill

Generally, the Marina District is a bedrock basin, with outcrops exposed at Fort Mason to the east, and the Presidio to the west and to the south. Within the Marina District, bedrock elevation was interpreted by Bonilla (1992) to form a northwest trending trough in the center of the area, with the greatest depth of top of bedrock at approximately 300 feet below mean sea level ("MSL"). The northwest-trending valley in the bedrock surface is buried by firm Pleistocene bay clay, a dense Pleistocene sand layer, soft Holocene bay sediments, loose to dense Holocene beach and dune sands, and artificial fill (Bonilla, 1992). Portions of the Marina District have been subject to extensive artificial filling, beginning in approximately 1851, and continuing through approximately 1917 (Bonilla, 1991). These filling activities have incrementally extended the natural coastline visible in the 1869 U.S. Coast Survey (Figure 9) to create the land that now comprises a significant portion of the Marina District.

Extension of the Marina District coastline began with locally derived sand (from sand dunes) along the shoreline in 1869, and by 1893 involved concerted efforts by James G. Fair to fill and flatten the Marina marshlands with sand excavated from sand dunes in the Black Point Military Reservation (Fort Mason),[18] which were completed in 1895. The large wharf, extending 1000 feet north of Bay Street into the Bay on the grounds of the former North Beach MGP, which is commonly referred to as the "earthen mole" or "mole," was constructed by the San Francisco Gas Light Company in 1891. (San Francisco Gas Light Company later changed its name to San Francisco Gas and Electric Company and then, in 1905, merged with California Gas and Electric Corporation to form PG&E). Mr. Fair also began construction of a seawall in 1892, which was formed of driven piles, and was not completed or filled in. However, in 1896, two years after Mr. Fair's death, construction of a new seawall along a slightly different course began. This new seawall was constructed of piles and imported rock. Construction of this revised design seawall began in 1896, and was completed in 1898.[19] Significant filling behind the seawall was not conducted until 1912, when large hydraulic fills comprised of dredged fill from the San Francisco Bay were placed in the central part of the Marina and held in place by the sea wall in preparation for the 1915 PPIE. Based on photographic evidence from 1912, the former Fillmore and North Beach MGPs were not demolished until the hydraulic filling project was largely completed. Following the PPIE, additional filling of the Marina was conducted to bring it to its current grade, including additional hydraulic fill, public dumping, and potentially imported fill in concert with residential development and street construction.

[18] Bardell, Robert, *What Lies Beneath the Marina*, The Argonaut, Journal of the San Francisco Museum and Historical Society, Vol. 14, No. 2, Winter 2003 and Vol. 15, No. 1, Summer 2004.
[19] Ibid.

The following stratigraphy exists within the Marina District where the former MGPs were constructed along the boundary between the natural pre-1869 shoreline, and artificial post-1869 Marina District shoreline.

- Artificial (emplaced) fill (including sandy hydraulic fill and post-development sediments relocated dune sands and building debris);
- Dune sand and beach deposits (Holocene sand) (poorly graded sand);
- Bay mud (Holocene mud) (plastic gray silty clay);
- Older native coarse and fine-grained sediments (Pleistocene sand and alluvium) (fine-grained sand, silty sand, and fine-grained layers);
- Older Bay mud (Pleistocene Old Bay Clay) (plastic silty and sandy clay); and
- Franciscan Complex (consolidated sandstone, shale, chert, greenstone and serpentinite).

Fine-grained deposits (*e.g.*, Bay mud and fine-grained alluvium) are generally encountered at approximately 30 to 50 feet bgs. The southernmost extent of recent Bay mud has been mapped in the vicinity of the two MGPs and is overlain primarily by sandy hydraulic fill (Bonilla, 1992).

4.2 Groundwater Flow

On March 20, 2017, PG&E contractors collected groundwater elevation data from Marina District monitoring wells. These depth to water measurements "were coordinated with the timing of the lower low tide on 20 March 2017 to the extent practicable."[20] Shallow groundwater flow directions are generally north to northwest, as would be anticipated based on topography and lithology of the northwest trending trough that forms the Marina Basin (Figure 3, excerpted from H&A 2017 and included as Appendix A). Groundwater flow in the deeper Pleistocene sands has not been investigated.

5.0 MANUFACTURED GAS PLANT HISTORY

In the early 1800's, MGPs using industrial processes to produce gas from coal, oil, and other feedstocks began to expand across the United States. The manufactured gas was used for lighting, cooking, heating, and driving industrial processes and was a bridge from a whale-oil-based economy to the network of high-pressured interstate natural gas pipelines that would supplant manufactured gas by the 1950's. "Gas from MGPs was used for all the same purposes that natural gas is used for today. In addition, in the late 1800s, gas was used for lighting prior to the introduction of electricity." (NYDEC, undated). "Manufactured gas was one of the great industrial enterprises of the nineteenth century. Its active history, worldwide, spanned about 170 years, extending past the halfway mark of the twentieth century. In the United States alone, [it is] estimate[d] [that] there have been from 32,860 to 50,108 sites where coal or other organic materials were pyrolytically converted to gas or coke and tar-chemical by-products" (Hatheway,

[20] H&A 2017.

2012). Key elements of the following historical discussion, including investigation milestones discussed in Section 6.0, are included on the attached timeline as Figure 10.

5.1 Former North Beach Manufactured Gas Plant

The former North Beach MGP (Figure 2) operated in what is now known as the Marina District of San Francisco, comprised of at least four city blocks bounded by Marina Boulevard, Buchanan Street, North Point Street, Laguna Street, Bay Street, and Webster Street, and including a triangular area of vacant land and paved parking (Marina Green) situated northeast of Marina Boulevard. Information regarding the site history of the former North Beach MGP and historical structures was obtained from PG&E files, historical San Francisco information available on-line, Sanborn maps, and historical topographical maps. The Sanborn maps for the Site and surrounding areas are included in Appendix C.

Operations began in 1886 at the former North Beach MGP when a large gas holder was constructed by the San Francisco Gas Light Company to hold gas produced at its Howard Street gas works. Production of manufactured gas at the plant began in 1891 and continued on a full-time basis until the April 1906 earthquake and fire destroyed much of the plant. Between 1892 and 1893, a 2,000,000 cf capacity gas holder was constructed in the block bounded by Bay, Laguna, North Point, and Buchanan Streets. Although gas was not manufactured at the former North Beach MGP after the earthquake, the gas holders located at the current Marina Substation were not dismantled after the earthquake and fire and continued to be used to store gas manufactured at other PG&E gas plants until the 1920s and then natural gas until it was dismantled in the 1950s.

Two processes were used to manufacture gas at the former North Beach MGP: carbureted water gasification and coal gasification. Carbureted water gasification ("CWG") was used from the initiation of operations in 1891 until the destruction of manufacturing capability in 1906. Coal gasification was introduced in 1894 and was used in addition to carbureted water gasification until 1899 (Ecology & Environment, Inc., 1991).

Based on information from the Sanborn map from 1893, a second relief gas holder of 250,000 cf had also been constructed on the same block (Block 0459). "Almost universally, and unlike the basic coal-gas plant, CWG plants required two gasholders, a small one known as the relief holder (to absorb the gas pressure differentials inherent in the 'blow-run' nature of that gas-manufacturing process), and a larger storage holder." (Hatheway 2012). The 1893 Sanborn map also depicts a "Coal Pile 15' high" immediately north of the relief gas holder. Across Buchanan Street to the west was the gas generating and purification equipment, including a purifying house along Bay Street, the condenser, generator, and boiler rooms along Buchanan, and the scrubber and exhauster building in the middle of the block (Block 0460A). North across North Point Street, on the block bounded by Buchanan, Webster, and Beach Streets (Block 0445A) was a 14-ft high brick crude oil tank, presumably containing the feedstock for the carbureted water-gas

generators. Also on this block was the coal-gas retort house, located in the northwestern corner of Buchanan and North Point Streets. Other MGP structures on this block included a "tar kettle," "hand pump," a tar well, and coal and coke pile located about 20 ft south of San Francisco Bay and reported to be 12 ft high in the 1889 Sanborn Map (Appendix C). Further to the north on the North Beach MGP mole, a 27,000 barrel (1,134,000 gallon) above ground "crude petroleum [storage] tank" or "AST" is depicted on an 1899 Sanborn map "on a platform 4' high" (Sanborn 1899). As seen in historical photographs (Appendix C), MGP structures were constructed predominantly of fire resistant brick and steel.

The North Beach MGP plant area is shown on the 1898 Coast and Geodetic Survey map (Appendix C) of San Francisco's wharf and bulkhead lines, in addition to a wharf immediately west of the north terminus of Buchanan Street. The area of this wharf, which now forms the western side of the Gashouse Cove Marina, was associated with oil unloading, tanking, and pipelines for the MGP until operations ceased in April 1906. In December 1900, the former North Beach MGP relief gas holder was struck by lightning and destroyed; and rebuilt "at once" (The San Francisco Call, 1900). The April 1906 earthquake severely damaged the former North Beach MGP and the adjacent Sierra and San Francisco Power Company steam-electric plant. The oil wharf used for unloading fuel also collapsed, and the crude petroleum AST was reported as "destroyed" (SF Rec & Parks, 2015). The 1906 earthquake destroyed most other wooden buildings in the area; the ground settled considerably, by as much as two to three feet, and the settlement ruptured the outlet connections of the gas holder (O'Rourke et al., 1992).

5.2 Former Fillmore Manufactured Gas Plant

The former Fillmore MGP (Figure 2) operated in what is now known as the Marina District in San Francisco, near the area west of Fillmore and Bay Streets. The former Fillmore MGP initially occupied the block now bounded by Fillmore, Steiner, Bay, and Francisco Streets, but eventually also included one block further to the West, now bounded by Pierce Street. A portion of this facility was located on an area now covered by asphalt at the southeast corner of the Marina Middle School property.

Information regarding the site history and historical structures was obtained from PG&E files, historical San Francisco information available on-line, Sanborn maps, and historical topographical maps. The Sanborn maps for the plant and surrounding areas are included as Appendix C.

The former Fillmore MGP appears to have been built in 1882 or 1883. In 1886, the former Fillmore MGP consisted of 12 benches of sixes, 72 retorts, and 7 generators for manufacturing water gas by the Lowe process. The gas was stored in three gas holders: two holders located on the former Fillmore MGP premises and one gas holder located at what is now 3500 Fillmore Street. By 1892, the former Fillmore MGP had expanded west one block to Pierce Street and was manufacturing both coal and water gas.

The layout of the former Fillmore MGP is shown on the 1893 Sanborn map. The two gas holders, each with a capacity of 335,000 cf, stood along Francisco Street on the southern part of the former Fillmore MGP. To the east and northeast of the gas holders stood two purifying houses, each with an attached oxide room. To the north of the western gas holder was the generator room, which housed the 72 coal retorts and several Lowe water gas generators. North of the generator room lay the coal and coke shed. West of the generator room stood the coal yard and two crude petroleum tanks. As with the former North Beach MGP, former Fillmore MGP structures were likely constructed predominantly of fire resistant brick and steel and were severely damaged by the 1906 earthquake. As described in the Report of the State Earthquake Investigation Commission:

> Along the north shore water-front, between Fillmore and Steiner Streets, from Bay Street to the water's edge, was a plot of made ground occupied by a gas producing plant. Here brick walls were cracked and partly thrown down; part of the wooden framework was wretched out of position, and the chimney stack was broken. One of the large gas containers was badly wrecked, but whether its destruction was caused directly or in some secondary way, as by rapid leakage, is not known.

5.3 Gas Production Methods

Two processes were used to produce gas at the former North Beach and Fillmore MGPs: Coal Carbonization ("CC") and CWG.

Gas manufacturing using the CC process included the following (NYDEC, undated):

- The coal was heated in closed retorts or beehive ovens that minimized combustion of the coal by limiting air (oxygen) entering the retort (pyrolyzation);
- Volatile aromatic hydrocarbons were evolved as a gas;
- The gas was then collected, cooled, and purified; and
- The resulting gas was stored in gas holders before being piped to the surrounding area.

Gas manufacturing using the CWG process, first introduced in the 1870's, became the preferred process as it "produced a gas mixture that burned hotter and brighter" (NYDEC, undated). The CWG process involved:

- Heating coke or coal in the presence of steam in a closed retort to produce a flammable gas mixture of methane, hydrogen, and carbon monoxide;

- Petroleum products were then sprayed into the hot gas mixture, cracking the petroleum at high temperatures and creating more methane, which increased the heating and lighting value of the gas.

5.4 Anticipated Residuals and Wastes

A variety of types of wastes from a variety of sources are associated with former manufactured gas plants. The following tables provides a summary of waste types and sources, respectively (GRI 1996; Hatheway 2012; Integrys 2007). This summary is general to MGPs and serves as a guide for investigating the nature and extent of potential MGP residues at the Site.

Table 1: MGP Waste Types

Residual	Coal Carbonization	Carbureted Water Gas
Coal Tar	X	X
Oil Tar	-	X
Tar/Oil/Water Emulsion	-	X
Tar Decanter Sludge	X	-
Ammonia Saturator Sludge	X	-
Acid/Caustic Hydrocarbon Treatment Sludges	X	-
Wastewater Treatment Sludges	X	X
Coke	X	-
Ash	X	X
Spent Oxide/Lime	X	X
Sulfur Scrubber Blowdowns	X	X
Ammonium Sulfate	X	-
Plant demolition debris	X	X

The following table, summarized from *Remediation of Former Manufactured Gas Plants and Other Coal-Tar Sites* (Hatheway, 2012) is excerpted from *Multi-Site Conceptual Site Model Former Manufactured Gas Plant Sites* (Integrys, 2007) with minor edits.

Table 2: MGP Wastes Sources

Component	MGP Use	Waste Source Location & Potential
Transportation Spur	Delivery point of feedstocks; exit point of salable residuals.	Human labor was a significant cost to gas making. Feedstocks were brought as close as possible to the retorts and generator houses.
Coal Yard	Storage area which kept coal dry for optimal use in firing boilers or as retort feedstock.	Kept as close as feasible to the retorts and generators. Many plants chose to place coal in sheds so as to optimize gasification in the presence of minimal water content.

Table 2: MGP Wastes Sources		
Component	**MGP Use**	**Waste Source Location & Potential**
Coke Yard	By-product coke from coal-gas plants.	Used symbiotically as feedstock for various water gas plants, especially as co-located.
Retort House	Coal-gas retorts housed internally in benches; groups of benches known as stacks.	The central building of the gas-making process; generally located at the corner of the plant with highest elevation and near the gate, from which the processed gas left the plant through the station meter. Origin of coke quench water = ammoniacal liquor.
Generator House	Location of generator sets for carbureted water gas and oil gas processes.	Generation capacity such that vastly smaller space required for commensurate production over that required for coal-gas process.
Condenser House	Building or addition immediately adjacent to retort house or generator house.	After 1910, tended to be out-of-doors. Same configuration used for all gas generating processes; a wet process that concentrated and/or precipitated tars for further management.
Scrubber	Tall (5-10 m) right-circular cylinders with slanted trays holding contaminant-absorbing wood fiber/chips.	Usually employed a water shower to remove tar and other process residuals from the gas. Residuals captured in scrubber sump for further management.
Washer	Gas immersed in agitated water bath to cool gas and drop tar particles into its sump.	With carbureted water gas and enhanced oil-gas. When designed as a water-seal/wash box, placed first in the clarification sequence as a seal against back-flow of gas.
Combined Washer-Scrubber	When employed, generally post-1895.	Enhanced the recovery of tar from gas. Trapped tar held on sorbant and in sump.
Sumps of Clarification Devices	Condensers, scrubbers and washers, and their combinations had bottom sumps to trap and yield tar and tar sludges.	Tar generally removed manually for recovery, reuse or dumping. Spills and leaks assumed in a generic sense. Tar sludges contained refractory geologic impurities such as quartz and feldspar, entering the system mainly from feedstocks.
Exhauster	Steam-driven gas evacuator employed to reduce gas pressure and promote flow through system.	Position of exhauster chosen by the plant gas engineer to achieve optimal flow of gas through the tar-removal clarification process; most plants had a backup exhauster in parallel.

Table 2: MGP Wastes Sources		
Component	**MGP Use**	**Waste Source Location & Potential**
Purifiers (Purifier Boxes)	Gas was passed through "boxes" containing layers of lime, wood chips, iron impregnated wood chips, oxide of iron (particles) and/or strips of iron as various forms of sorbants, often in conjunction with each other.	Purifier Wastes, Purifier Box Wastes, Oxide Box Wastes. Generally employed minimally as a pair of "boxes" in series, with at least a spare pair in parallel. The boxes trapped some tar, but were designed to trap sulfur, cyanide, arsenic and other heavy metals all of which originated in or from the organic gas feedstock materials. If wood chips were used, they typically decompose beyond recognition. The residual from the chips is typically recognizable from the blue staining resulting from the presence of ferrocyanides, if present (also identified as "Prussian Blue").
Relief Holder	With coal gas, the oldest of the gas holders, serving as a raw gas exposure to tar-dropping seal water before clarification/purification. With carbureted or oil enhanced water gas a usually necessary presence to buffer gas-pressure variations on blow-run cycles. Under some circumstances it was possible for small CWG plants to operate without a relief holder.	Relief holders of the first variety can be expected to have subsurface "tanks" (pits basins) commonly abandoned and virtually full of unrecovered tar. Second variety holder tanks tend to be less commonly abandoned with large volumes of water-gas tar, unless dumped at time of plant decommissioning.
Gas Holders (Gasometers)	As many as needed; ever more and larger as the gas business expanded. Generally predicated on the largest holder being equivalent to one day's make.	Prime concern for subsurface tanks most common to pre- 1900 varieties. Base of gas holders may also have been constructed at surface grade. Pre-1900 varieties typically have a subsurface water-seal tank likely to have leaked considerable amounts of precipitated and trapped PAH through various fractures related to brick, masonry and/or concrete or composite construction materials. Valve pits commonly exhibit hotspot concentrations of PAH contamination.

Table 2: MGP Wastes Sources		
Component	**MGP Use**	**Waste Source Location & Potential**
Tar Wells and Tar Cisterns Aka ammonia wells	Subsurface tanks, right-circular cylinders and rectangular or square-sided; brick, masonry or concrete or composite.	Commonly designed with a self-functioning gas-liquor (process water) discharge system to carry off lightest fraction of gas liquor while retaining the gravity-separated tar fraction; all subject to through-fracture flow leakage to the surrounding earth during the operational period.
Tar Extractor	Typically an above-ground mechanical device for separating tar particles from the passing gas.	Most common and best known were the "P & E" devices of French manufacture.
Tar Separator	Both as above-ground devices housed in structures and as subsurface rectangular-form concrete or wood "tanks," the latter often made of wood planks subject to between plank leakage.	Above-ground devices were machines built to physically separate tar particles from gas liquor; below-ground devices contained flow baffles functioning to slow in-out flow of gas liquor carrying suspended tar, the latter dropped to the sump of the tar separator.
Boiler House	Necessary to power the extractor and a variety of small steam engines and fluid pumps.	Generally consumed coal or by-product coke; could be rigged for burning tar, under close supervision of temperatures. Ash not expected to be toxic unless later so exposed.
Oil Storage Tanks (AST & UST)	Illuminating or enriching oil for non-coal-gas production.	Generally petroleum oils susceptible to biodegradation if leaked or spilled; generally no incentive or rationale to dump.
Plant Plumbing	Below-ground piping, often in trenches or pipe chases.	Virtually all process piping was subject to corrosion and release of PAHs, or release through joints and seams. Well known to the gas industry since 1860s.
Yard Drips (Drip Pots)	Light-oil (drip oil) collection sumps placed along gas-flow pipes in the gas yard.	Used to collect naphthalene and other light oils; these were of value and were recycled, usually as carburetion oils for water gas, or as industrial solvents. Sometimes disposed as herbicide or by dumping.
Furnaces	The fire box located below gas benches and all boilers.	Source of operational heat; residue was only ash, cinder, clinker or slag; not expected to be hazardous by nature of its formation.

Table 2: MGP Wastes Sources		
Component	**MGP Use**	**Waste Source Location & Potential**
Station Meter	Plant production measuring device housed in a building at the gas-outlet from the plant.	Generally co-located with the plant office and in the upgradient end of the property, near the plant gate. Not a source of contamination.
Governor	Gas flow control device adjusting distributed gas to main distribution pressure.	Should not be a source of contamination.
Transportation Spills	Operational-era spills of tars and other fluid residuals (light oils and ammonia) being transferred off-property as byproducts.	Naturally most prominent at larger plants and those plants engaged in by-product recovery operations.
Purification Box Media Spreading Ground	Wood-chip and some forms of iron oxide media could be revivified on this pad and returned for re-use short of ultimate "spent" condition	Action implies shaking and mass-expansion via pitch forks. Sulfur and Prussian blue (cyanide) could be raked up and sold as by-products in many instances.
Spent Wood-Chip Box Waste Burning Ground	A corner or side area of the gas yard where dry chips could be torched and destroyed by fire.	Required dry climate or dry season; ashes carried to a plant dump.
Plant Dump	Primary disposal area on the gas yard; broken, fractured, slagged retort bricks; generator lining bricks, all manner of scurf or other carbon-slag wastes, ash, clinker, slag, off specification tar, tar sludge, lampblack, box wastes, bottles, purifier shelf slats, broken window glass, corroded pipe, scrap iron, wagon and vehicle parts, and broken gas-plant equipment.	Expect a toxic character in general. Plant dump likely will be found in or at the furthest down-slope corner or extension of the gas yard, along the adjacent creek, stream, or river, or filling any original topographic declivity of the ground on the property. In almost all cases, the plant dump was filled early and supplemented with multiple dumps around the periphery of the gas plant, to within a several-block wagon haul distance.

Additionally, "[m]uch general debris from site clearance is found at" MGPs where "material may simply have been spread over the whole site" (Environmental Resources Limited, 1987). Additionally, subsurface structures and demolition debris from MGPs remain on site as "it was industry gasworks demolition practice, through the 1960s, to remove all aboveground structures and piping and to carry the demolition to about 30 cm below existing ground[,] [where] [a]t this final demolition grade, piping was severed, leaving the subsurface remainder in place." (Hatheway, 2012).

5.5 Families of Chemicals of Potential Concern Associated with MGP Waste

Wastes resulting from former manufactured gas operations include families of chemicals that may pose a current or future potential risk to human health and the environment, including:

- Total petroleum hydrocarbons ("TPH"): Petroleum hydrocarbons are mixtures of chemicals found in MGP feedstock and waste products. Waste product TPH from MGPs are differentiable from feedstock TPH due to the impacts of pyrolysis processes on the materials.
- Volatile organic compounds including benzene, toluene, ethylbenzene, and xylenes ("BTEX"): "Created from volatile content of feedstock coal or from enrichment and carburation oils as released and formed under heating in absence of oxygen and reformed in condensation cooling" (Hatheway, 2012).
- Semivolatile organic compounds, primarily polycyclic aromatic hydrocarbons or PAHs: as with aromatic volatile organic compounds ("VOCs"), PAHs are formed from the incomplete combustion of fossil fuels and are "[c]reated from volatile content of feedstock coal or from enrichment and carburation oils as released and formed under heating in absence of oxygen and reformed in condensation cooling" (Hatheway, 2012).
- Cyanide group compounds ("Cyanogens"): A process waste formed from nitrogen taken in with air and carbon present in the process and related to retort air leaks or the use of coal rather than coke for reactor beds. Cyanogens have been associated with oil and carbureted water gas since at least 1908.[21]
- Metals, specifically Arsenic and Lead: As trace elements from feedstocks and associated with purifier box wastes (Hatheway, 2012). Additionally, "lead was used in paint, as caulking for gas holders, in pipework, for roofing, in batteries, and as lead arsenate insecticide" (Environmental Resources Limited, 1987) and in maintenance activities where "the common pit-putty was an equal-parts (by weight) mixture of red lead, white lead, and litharge," litharge being another term for lead oxide (Hatheway, 2012). Additionally, mortars used in MGP facilities may have contained litharge. As discussed in a publication of the period, "[l]itharge-glycerine mixtures have long been used for cements, for they form a workable, quick-setting mortar which sets with slight expansion into a hard, strong, chemically resistant material" including resistance to the acid environment and coal acid products from coal pyrolysis (McKinnon, 1933).

5.6 Potential Sources of Chemicals of Potential Concern other than Former MGPs

Other sources of the chemicals of potential concern associated with MGP Residue also exist in the environment, including:

[21] Hatheway, Allen W., *Remediation of Former Manufactured Gas Plants and Other Coal-Tar Sites*, July 27, 2011.

- Background lead from sources other than MGP operations, which may include;
    - Lead from painted structures of the PPIE and post-PPIE development
    - Lead from leaded gasoline,
- Ambient PAHs in soil;
- Arsenic in soil from pesticides or natural sources;
- TPH used for vehicle fueling and heating; and
- Background metals in soil and/or groundwater.

6.0 Summary of Prior Site Investigations and Milestones

All investigations within the Investigation Area, other than joint investigations, that may yield, or have yielded, information consequential to the nature and extent of MGP Residue in the Investigation Area are referred to as "Related Investigations" per the MIA as follows:

> "Related Investigations" means any completed, ongoing, or planned projects within the Investigation Area, the results of which may contain information consequential to the nature and extent of MGP Residue in the Investigation Area.

A list of Related Investigations has been complied and included as Appendix D. This list will be updated as necessary.

6.1 Former North Beach Manufactured Gas Plant

In 1986, PG&E collected "surface soil" from what appear to be ten properties in the former North Beach MGP area. These results are found in various letters addressed to individuals in November 1986 and identified elevated concentrations of PAHs and lead. The data are provided without specific sample location or sampling methodology and are not discussed further herein.

In 1991, Ecology and the Environment, Inc. ("E&E") prepared a Preliminary Endangerment Assessment ("PEA") at the Marina Substation. The Marina Substation is located at 1575 North Point Street, in the block bounded by Buchanan, North Point, Laguna, and Bay Streets. A portion of the relief holder and a coal pile (identified in Sanborn Maps) associated with the former North Beach MGP were formerly located on this property. During its investigation, E&E completed five borings, with three of them converted to monitoring wells. The investigation identified concentrations of total PAHs in soil samples from 0.12 to 1,160 mg/Kg, with the highest concentrations identified from sample MW-NOB-2-S collected from "stained soil in the saturated zone at approximately 20 feet below ground surface" where field crews upgraded to level C personal protective equipment (which connotes respirator use) due to the strong odor of naphthalene (E&E, 1991). The groundwater sample collected from the converted well MW-NOB-2 included fuel oil range hydrocarbons reported at 7.5 mg/L which is above solubility for

fuel oil range hydrocarbons. The report concluded that "[a]dditional investigations are recommended to determine the source(s) of the COPCs measured in on-site saturated soils and groundwater (PNAs, BTXE, and TPH)."

In response to the E&E PEA, the DTSC[22] concluded: that "[b]oth groundwater and soil are contaminated with polynuclear aromatic hydrocarbons (PNA), consisting of hazardous substances known to cause cancer," that "the site poses a potential threat to the public health and the environment and site remediation may be required," and that "the site needs to be characterized to determine the full extent of hazardous waste release." Similarly, the Water Board[23] concluded the site was a "high priority" and noted that PEA report "focuses on 0.24 acres" of a 9.5 acre site. Despite the regulatory concerns, almost twenty years elapsed before PG&E began investigating the Marina District, and then only above the water table. Investigations below the water table did not begin until after Plaintiffs filed their complaint on September 30, 2014.

In 1994, TMC Environmental collected soil samples from six locations at the former gas metering building of the former North Beach MGP and associated property at 3640 Buchanan Street using hand augers. Eighteen total soil samples were collected from depths ranging from one to 12-feet below ground surface; however thirteen samples were analyzed after the one foot and three foot bgs samples from three locations (B2, B3 and B4) were composited by the laboratory. The sample results "revealed the presence of Polynuclear Aromatic Hydrocarbons and Polychlorinated biphenyls" (TMC, 1994).

In 1997, Woodward-Clyde prepared Phase II Environmental Site Assessment for the 3640 Buchanan Street property. Woodward-Clyde collected 33 soil samples ranging from 6-inches to 14.5-feet bgs from nine locations and collected groundwater samples from three shallow temporary monitoring wells installed to 17 (W3) and 19-feet bgs (W1 and W2). Woodward-Clyde identified "significant levels of numerous polycyclic aromatic hydrocarbons in the shallow soil" with "low concentrations of various PAH compounds in the shallow groundwater" and petroleum hydrocarbons that were "probably not site related" (Woodward-Clyde 1997). The report also identified tar and lampblack in exposed surface soils, and recommended remediation "designed to minimalize the potential for human contact with site soils that contain residual PAHs in excess of the PRGs for a commercial site" (Woodward-Clyde 1997).

Starting in 2008, samples have been collected along parts of the perimeter of Gashouse Cove (aka, the San Francisco East Marina) located at the northern portion of the former North Beach MGP footprint to investigate the "presence of near-shore upland residues from petroleum hydrocarbons including polycyclic aromatic hydrocarbons (PAH)" (Jacobson James & Associates, 2014) and including NAPL/MGP tars. The ongoing investigations, beginning with

[22] DTSC, PEA Review letter, June 29, 1992 (Appendix C).
[23] Water Board, Site Evaluation Tracking Sheet, July 1, 1992 (Appendix C).

eight borings at depths ranging to 54 feet bgs in 2008, now involves 117 soil borings, 11 temporary piezometers, and 18 individual monitoring wells in nine clusters (Jacobson James & Associates, 2016).

Since 2010, investigations have been conducted on private properties on or proximate to the former North Beach MGP footprint. The majority of sampling work has focused on collecting soil and soil vapor samples from the upper 10 feet of the subsurface, and testing of the samples has, in most cases, been limited to PAHs. Soil excavation has been performed to remediate shallow soil impacts at certain properties.

In May and June of 2014, and April and June of 2015, soil and soil vapor samples were collected by Haley & Aldrich in public ROW areas in the vicinity of and within the North Beach MGP Site footprint. The objective of these investigations was to assess the presence of MGP-related impacts in public ROW areas in the vicinity of and within the Site in the shallow soils (0.5 to 10 feet bgs). A total of 220 soil samples and 103 soil vapor samples, including quality control samples, were collected from 38 locations in the public ROW areas.

Additional investigations in 2016 were completed for site characterization purposes. The objective of the additional investigation was to assess the extent of MGP-related impacts below the water table within the ROW areas. The investigation methodology included the following:

- CPT soundings were used to profile soil conditions while using TarGOST® to collect data for high resolution profiling of MGP-related NAPL or MGP tars. A hydropunch-type sampling device was then used to collect depth-discrete groundwater samples to delineate dissolved phase MGP-related impacts. A CPT or direct push drill rig was used to advance 13 borings to a maximum depth of 57 feet bgs.
- Twenty-eight groundwater samples were collected from 11 of the 13 locations, including quality control samples, from varying depths within the 11 borings.
- Soil samples from three adjacent comparison borings were collected to verify the TarGOST® responses.

This investigation identified separate phase MGP tars (i.e., NAPL) at eight (8) of 13 borings completed in the vicinity of the former North Beach MGP at depths ranging from 8.75 feet bgs (TG19) to 45 feet bgs (TG30). A report on the ROW characterization work was submitted to DTSC by Haley & Aldrich on behalf of PG&E on July 29, 2016. On June 15, 2016, a joint investigation workplan addendum was submitted to the DTSC on behalf of the Parties to further define the lateral and vertical extent of MGP impacts in the vicinity of the former North Beach MGP, and was approved on September 21, 2016. The results of the investigation called for under that workplan addendum are reported herein.

6.1.1 East Harbor

In 1994, Advanced Biological Testing (ABT) tested sediments in the East Harbor. "A sample composited from five sediment cores was tested and found unacceptable for in-bay disposal based on high (i.e. >5 ppm) concentrations of total PAH."[24]

From 1994 to 2000 and again from 2015 to today, at least nine investigations of sediment in the San Francisco East Harbor Marina, aka Gashouse Cove, were conducted on behalf of the City and County of San Francisco and PG&E. "The primary contaminants of concern in marina sediments are polycyclic aromatic hydrocarbons (PAHs) that are present at elevated concentrations, relative to background levels for San Francisco Bay sediments, due to presence of, and activities related to, the former North Beach Manufactured Gas Plant (NB MGP) proximal to the location of the current East Harbor marina." (Leidos, 2016 October). Cyanide and volatile organic compounds have not been included in sample analyses. We note that PAHs were detected in every sample collected from the East Harbor, from the sediment surface to depths of over 25-feet, including widely distributed MGP Tars, and that a hydrocarbon seep was photographed in the East Harbor in 2012. Investigation data evidences that:

- Contamination is actively migrating from shallow sediment to Bay waters, as separate phase product, despite prior attempts to prevent it through Interim Remedial Actions;[25]
- PAHs were detected in every sample collected from the East Harbor; and
- Grossly contaminated sediments and/or separate phase product have been identified within 6-feet of the top of sediment (mudline) widely across the harbor, including at five feet deep proximate to the shoreline at location BS15, and out in the channel within 3 feet of sediment surface at C42.
- Grossly contaminated soil and sediments have been identified at depth within and proximate to the East Harbor, including: summed PAH concentrations of 14,537,300 µg/Kg at 20.5 feet below mudline within the East Harbor (L-11-20.5-21); and summed PAH concentrations of 26,500,000 µg/Kg at 32-feet bgs (SB-JJA-33-31-32-A) and 276,000 µg/Kg at 43-feet bgs (SB-JJA-21-42-43-A) beneath the Marina Green.

Furthermore, data demonstrate that contamination is migrating in sediment—including data showing elevated concentrations *above* the1962/1963 marina design dredge elevations—and a variety of research and industry knowledge confirm the potential for deeper contamination to migrate under seismic forces and under potential future scenarios that result in sediment disturbance deeper than 3.5-feet. Concerning seismic events, in particular, those events may well alter sediment stratigraphy and pore pressures, which can mobilize subsurface hydrocarbons, alter groundwater flow and groundwater/surface water discharges, and additionally disturb

[24] Arthur D. Little, Inc., *Sediment Evaluation at East Harbor*, March 2000

[25] SF Recreation & Parks, *Request for Permit Amendment from San Francisco Recreation and Park Department East Harbor Marina: Interim Remedial Repair Measure Corrective Action*, May 5, 2017.

sediment lithology. New surficial seeps of subsurface hydrocarbons have been observed following earthquakes that altered the subsurface pressure regimes and lithological conditions that previously held them in check.[26] Seismic disturbance of soil is well documented in the area of the San Francisco Marina District where a significant amount of soil from sand boils was brought to the ground surface during the Loma Prieta Earthquake in 1989. At least 74 sand boils were recorded in the Marina District, and a cumulative volume of the observed sand boils deposits exceeded 37 cubic meters.[27] It is also assumed that sediment disturbances occurred at depth that did not emerge at the ground surface where they were observable. Furthermore, a lacustrine sediment study suggested that seismic activity had caused in situ mobilization of sediment on relatively gentle slopes, with minimal horizontal displacement and this may have been a product of liquefaction induced by coseismic shaking or displacement.[28] Given the seismic setting of the area, its history of sediment disturbances as uses of the shoreline have changed, and the existing consideration of seismic reinforcement of the sea wall, the potential for this occurring is high.

6.2 Former Fillmore Manufactured Gas Plant

In 1986, 1987, and 1998, PG&E collected "surface soil" from at least 13 properties in the former Fillmore MGP area and analyzed them for lead and PAHs. These results are found in various letters addressed to individuals in November 1986 and identified elevated concentrations of PAHs and lead. The data in the letters were provided without specific sample location or sampling methodology and are not discussed further herein.

In 1990, USGS completed an investigation of soil conditions following the 1989 Loma Prieta earthquake. The log from a boring at the five corner intersection of Cervantes Blvd, Beach Street, and Mallorca Way, immediately down gradient of the Fillmore MGP, noted a creosote smell (Bennett, 1990).

Since 2010, investigations have been conducted on private properties and within the ROW areas on or proximate to the former Fillmore MGP footprint. The majority of sampling work has focused on collecting soil and soil vapor samples from the upper 10 feet of the subsurface. Soil excavation has been performed to remediate shallow soil impacts at certain properties.

In December 2010, soil samples were collected by Haley & Aldrich in ROW areas in the vicinity of and within the former Fillmore MGP plant "to evaluate subsurface conditions which may be related to the operations of the former Fillmore Manufactured Gas Plant (MGP) site and the

[26] Sneed, Michelle et. al., *Earthquakes—Rattling The Earth's Plumbing System*, Water Encyclopedia, Ground Water, Wiley-Interscience, 2005, pp. 111-115.
[27] Bardet, J. P. and Kapuskar, M., *The Liquefaction Sand Boils in the San Francisco Marina District During the 1989 Loma Prieta Earthquake*, 1991.
[28] Shilts, W. W., and Clague, John J., *Documentation Of Earthquake-Induced Disturbance Of Lake Sediments Using Subbottom Acoustic Profiling*, January 11, 1992.

demolition of the Pan-Pacific International Exposition (PPIE) area in San Francisco" (Haley & Aldrich, 2011). A total of 46 samples were collected from 12 locations and analyzed for free and total cyanide, volatile fuel hydrocarbons (BTEX) and PAHs at depths from 0.3 to 9-feet bgs. In its conclusions, Haley and Aldrich stated that the investigation "did not generate conclusive evidence of PPIE demolition and burn material within the upper 10 ft of fill from these specific locations within the Study Area" and that "with the exception of three boring locations, two of which were located within the footprint area of the former Fillmore MGP, PAH concentrations in surface and subsurface soils were generally low, and well within typical soil concentrations in urban areas".

In July, September, and October 2014, and in April and June 2015, soil and soil vapor samples were collected by Haley & Aldrich in ROW areas in the vicinity of and within the former Fillmore MGP plant. The objective of these investigations was to assess the presence of MGP-related impacts in public ROW areas in the vicinity of and within the Site in the shallow soils (0.5 to 10 feet below ground surface; ft bgs). A total of 165 soil samples and 76 soil vapor samples, including quality control samples, were collected from the public ROW areas.

Based upon the data collected during the investigation activities in 2014 and 2015, an additional investigation was completed in 2016 for site characterization purposes. The objective of the additional investigation was to further assess the extent of MGP-related impacts below the water table within the ROW areas. The investigation included using CPT soundings to profile soil conditions while using the TarGOST® to collect data for high resolution profiling of MGP-related NAPL. A hydropunch-type sampling device was then used to collect depth-discrete groundwater samples to delineate dissolved phase MGP-related impacts. A CPT rig was used to advance the borings to a maximum depth of 59 ft bgs. Groundwater samples were collected from 16 of the 17 locations and a total of 39 samples were collected, including quality control samples, from varying depths within the 16 borings. Soil samples were collected from two adjacent comparison borings to verify the TarGOST® responses. Separate phase MGP tars (NAPL) were found at 11 of 17 locations completed in the vicinity of the former Fillmore MGP plant at depths from 4.8 feet bgs (TG01) to 30.6 feet bgs (also at TG01). A report on the ROW characterization work was submitted to DTSC by Haley & Aldrich on behalf of PG&E on October 5, 2016. On June 15, 2016, a joint investigation workplan addendum was submitted to the DTSC on behalf of the Parties to further define the lateral and vertical extent of MGP impacts in the vicinity of the Fillmore MGP, and was approved on September 21, 2016. The results of the investigation called for under that workplan addendum are reported herein.

6.3 Non-MGP Specific Marina District Area Investigations

Marina District Investigations that have been conducted in the Marina portion of the Investigation Area, not associated with a specific former MGP, are described below.

6.3.1 Dames and Moore 1977

In 1977, Dames and Moore reported on its boring program designed to "provide the Department of Public Works with additional information on specific subsurface conditions for use in finalizing the revised design of the North Shore Outfalls Consolidation Project" (Dames and Moore, 1977) involving construction of a large capacity gravity main for wet weather stormwater. Borings conducted along the proposed alignment from Scott Street to Webster Street were reported as "extensively contaminated with creosote residue, probably resulting from previous gas plant activities in the area." Additional contamination described as "creosote and some oil contamination" were observed in borings between Webster Street and Laguna Street. These observations were observed between approximately 15 to 24 feet below the San Francisco Datum; or from 3 to 13 feet below NAVD 88.

6.3.2 Haley and Aldrich 2010 Junction Box Investigation

In 2010, Haley and Aldrich investigated soil vapor at depths of 5-feet beneath nine PG&E electrical junction boxes: seven located on the former North Beach MGP plant footprint and two located on the former Fillmore MGP plant footprint. Naphthalene was detected at 120 and 32 µg/m3 at locations on the former North Beach MGP along with detection of chlorinated solvents not associated with MGP operations. Visual observations of potential MGP contamination at additional locations within the North Beach MGP footprint were reported in the field notes.

6.3.3 SAIC 2011

In 2011, SAIC reported on its characterization of "sediments within the West Basin at a higher resolution to further delineate the extent of contamination within two areas previously characterized as 'not suitable for unconfined aquatic disposal' NUAD Area B2-4 and Area B2-1" (SAIC 2011). Composite samples collected from these areas contained total PAH concentrations from 1,191 µg/Kg to 22,587 µg/Kg. A source analysis attributing the contamination to MGPs or other sources was not conducted; however these areas are notable as they lie outside of the seawall constructed prior to the PPIE.

6.3.4 USACE 2011

In 2011, an investigation was conducted for the Army Corps of Engineers at roughly two-dozen sites on upper and lower Fort Mason. The sites were the locations of former Army facilities that could have released hazardous chemicals. High levels of PAHs were detected in soil near an Oil House (Bldg 39), an Oil Shed (Bldg 73), and a Paint Shop (Bldg 40). While previous military use is suspect, two of these sites are in the corner of the original Gashouse Cove shoreline.

7.0 JOINT INVESTIGATION SUMMARY

The scope and sampling methods for the ROW investigation followed the Right-of-Way Areas Investigation Work Plan Addendum and the Mediated Investigation Agreement Joint Investigation (Haley & Aldrich, 2016b) are referred to collectively herein as the "Joint

Investigation" and are summarized herein. Figures depicting hydrogeology and chemistry in plan and cross section view prepared by Haley & Aldrich and jointly submitted by Plaintiffs and PG&E are presented in Appendix B: Joint Figures. Data interpretations and summary data tables submitted by Plaintiffs are provided in attached tables 1-16[29] and Figures 1-11.

7.1 Soil and Groundwater Investigation Summary

The objective of the proposed additional investigation was to further assess the extent of MGP-related impacts from ground surface in soil and groundwater until a hydrogeologic boundary (aquitard or aquiclude) is reached. To achieve this, hand auguring and observation of surface soils were followed by CPT soundings conducted to profile soil conditions concurrently with a TarGOST® for high resolution profiling of possible MGP-related tar. Soil and groundwater samples were also collected as described below. The investigation locations were selected within the City and County of San Francisco ("CCSF") public ROW areas, with a focus on sampling areas near the approximate locations of former MGP structures, where accessible. This investigation was conducted in October through December of 2016 and January, 2017.

7.1.1 Technical Approach and Scope

A step-wise approach was adopted for the Joint Investigation, as follows:

- Prior to advancing CPT soundings at each boring location, the location was cleared by manual excavation to a depth five feet bgs as a final check for subsurface utilities and to allow visual observation and screening of surface soils. Hand auguring was extended to approximately 10-feet bgs, or first encountered groundwater, in 9 locations in the vicinity of the former Fillmore MGP to further permit observation of the shallow vadose zone. The borings were logged for soil descriptions and at least one soil sample was collected and analyzed for certain MGP-related chemicals of potential concern ("COPCs") agreed upon for the joint Investigation Event.
- CPT soundings were obtained to profile soil conditions (i.e., sands, silts, and clays), to a maximum depth of 68 feet bgs;
- The TarGOST® was deployed concurrently with the CPT for high-resolution profiling of MGP-related tar, if present;
- Multiple depth-discrete groundwater samples were collected using a hydropunch-type sampling device to delineate dissolved phase MGP-related COPCs; and
- Continuously cored soil borings were advanced to allow direct observation and logging of the subsurface, provide chemical data for low-permeability intervals not sampled by discrete groundwater methods, to compare with the TarGOST® response, and to provide vertical delineation with dual tube direct push or sonic drilling methods where single tube

[29] Analytical tables produced from MIA data tables maintained by Haley & Aldrich. Plaintiffs note data validation actions that include changing positive detections of chemicals that are not considered common lab contaminants to non-detections when detected concentrations exceed 5-times the method blank detections are under review.

advancement of hydropunch sampling devices through tar deposits was recommended against. The borings included five paired locations in the former North Beach MGP area (NB-ROW-HA42/NB-ROW-TG64, NB-ROW-HA43/NB-ROW-TG66, NB-ROW-HA44/NB-ROW-TG74, NB-ROW-HA45/NB-ROW-TG80, and NB-ROW-HA46/NB-ROW-TG71) and at four locations in the vicinity of the former Fillmore MGP (FF-ROW-HA30/FF-ROW-TG37, FF-ROW-HA31/FF-ROW-TG41, FF-ROW-HA32/FF-ROW-TG56, and FF-ROW-HA33/FF-ROW-TG60).

7.1.2 Soil and Groundwater Analytical Methods

Soil samples were delivered by courier under chain-of-custody protocol to TestAmerica in Pleasanton, California for analysis of the following:

- BTEX using USEPA Method 8260B;
- PAHs (34) using USEPA Method 8270D with selected ion monitoring (SIM);
- PAHs (75) USEPA Method 8270D with selected ion monitoring (SIM);
- Total extractable petroleum hydrocarbons ("TEPH") using USEPA Method 8015D;
- Total cyanide using USEPA Method 9012B; and
- Free cyanide using USEPA Method 9016.

Groundwater samples were delivered by courier under chain-of-custody protocol to TestAmerica in Pleasanton, California for analysis of the following:

- VOCs using United States Environmental Protection Agency (USEPA) Method 8260B;
- PAHs (34) using USEPA Method 8270D with selected ion monitoring (SIM);
- Total and dissolved metals using USEPA Method 6010B, including boron;
- Total extractable petroleum hydrocarbons (TEPH) using USEPA Method 8015D;
- Total cyanide using USEPA Method 9012B; and
- Free cyanide using USEPA Method 9016.

Sample bottles were filled sequentially starting with VOCs, then PAHs, metals, cyanide, and finally TEPH, if sufficient sample volume was available.

7.1.3 Pre-Field Activities

Before the Joint Investigation began, the following permits were obtained for the CPT-TG locations (permits are provided by PG&E in its submittal):

- A permit for environmental borings, from the CCSF Department of Public Health, Environmental Health Section;
- A boring and well permit from the CCSF Department of Public Works, Bureau of Street Use and Mapping;

- Temporary occupancy permits from the CCSF Department of Public Works, Bureau of Street Use and Mapping; and
- A special traffic permit, for select locations, from San Francisco Municipal Transit Authority.

A utility survey was conducted at each location to identify any subsurface utilities at the boring locations, in an effort to prevent utility damage and ensure worker safety. Underground Service Alert ("USA") was notified at least 48 hours before intrusive subsurface work began. Locations were hand cleared, and logged to 5 feet bgs. An investigation- and Site-specific Health and Safety Plan ("HASP") was developed and implemented for the work. A professional traffic control company was hired to produce traffic control plans and provide traffic control during the Joint Investigation. The DTSC was notified at least 5 business days before the investigation began.

7.1.4 Former North Beach MGP Workplan Borings

As proposed in the workplan for the former North Beach MGP portion of the investigation, twenty-seven locations were selected to conduct CPT-TG profiles: NB-ROW-TG64 (TG64) through TG90. The profiling and sample collection occurred between 17 October 2016 and 6 January 2017. Before the CPT-TG borings were advanced, each location was hand augered to a depth of 5 feet bgs. A total of 34 soil samples were collected from the shallow hand augered borings, including QC samples, from depths ranging from 0.7 to 4.5 feet bgs. After logging and sampling was complete in the hand auger borings, each boring was backfilled with bentonite chips, hydrated in place, and patched at the surface to match existing conditions, until the borings were accessed a second time for CPT-TG profiling. To complete the CPT-TG borings, the hydraulic press of a 20-ton CPT truck was used to advance the CPT-TG soundings to a maximum depth of 68 feet bgs.

Groundwater samples were collected adjacent to the CPT-TG borings at 18 of the 27 locations and a total of 54 groundwater samples were collected, including QC samples, from varying depths within the borings. One to five soil samples were collected from paired borings NB-ROW-HA42/NB-ROW-TG64, NB-ROW-HA43/NB-ROW-TG66, NB-ROW-HA44/NB-ROW-TG74, NB-ROW-HA45/NB-ROW-TG80, and NB-ROW-HA46/NB-ROW-TG71 at depths ranging from approximately 5.5 feet bgs to 42.5 feet bgs. The boring locations were surveyed with a Trimble® hand-held global positioning system ("GPS") unit to determine location coordinates. The sections below describe the pre-field activities and methods for CPT-TG, groundwater sampling, soil sampling, and chemical analysis.

7.1.4.1 CPT-TarGOST® Overview - Former North Beach MGP Workplan

Twenty-four of the twenty-seven selected CPT-TG locations were advanced and completed for the Joint Investigation in the ROW areas of the Site footprint and vicinity. Total exploration

depths ranged from approximately 13 to 68 feet bgs. The CPT-TG was advanced until the boring reached approximately 3 feet into a fine-grained layer (e.g., Bay mud) or refusal. CPT-TG logs are provided in Appendix B.

Nine of the 24 borings were advanced to refusal. Refusal was encountered at depths ranging from approximately 13 to 60 feet bgs. The remaining 15 borings were advanced approximately 3 feet into a geologic unit interpreted to be Bay mud or fine-grained alluvium based on the CPT readings, or to the maximum extension of the downhole cables (approximately 68 feet bgs).

Upon completion of the CPT-TG borings, the CPT was removed from the boring and a hollow casing with a disposable tip was pushed back down to depth. Once at depth, the tip was removed and the casing was used to fill the boring with Portland Type II-V cement as the casing was slowly removed from the boring. The upper 6 inches of each borehole was filled with concrete and was completed to match the existing surface.

7.1.4.2 Soil Sampling Overview - Former North Beach MGP Workplan

Haley & Aldrich collected up to two shallow soil samples (< 5 feet bgs) from each of the 24 boring locations during hand augering between 17 October and 15 November 2016. A total of 34 samples were collected. The soil was logged using the Unified Soil Classification System ("USCS") under the oversight of a California Professional Geologist. Soil was periodically collected in re-sealable plastic bags to test the headspace for presence of VOCs using a photoionization detector ("PID"). Soil characteristics, specific sample depths, and headspace VOC results were recorded in the boring logs, which are included in Haley & Aldrich submittals.

At each sample depth, soil samples for analysis of benzene, toluene, ethylbenzene, and xylenes (commonly referred to as "BTEX") were collected directly from the bottom of the hand auger bucket, upon extraction from the boring, using a TerraCore™ field preservation kit (United States Environmental Protection Agency ("USEPA") Method 5035). For each sample, 5-gram aliquots of soil were collected using a Teflon® TerraCore™ sampler and placed in three 40-milliliter ("mL") volatile organic analysis ("VOA") vials, two preserved with 5 mL of ultra-pure deionized water and one preserved with 5 mL of methanol. Glass jars with Teflon®-lined lids were used to collect samples for analyses of semi- and non-volatile compounds (e.g., PAHs and cyanide). After sample collection was complete, the sample containers were placed in ice-filled coolers for shipment to the laboratory. The breathing zone of the work area was periodically screened with a PID and a FROG-4000™ as specified in the HASP.

Cascade Drilling, L.P. ("Cascade") was retained to obtain deep soil samples (> 5 feet bgs) at HA42 through HA46 between 12 December 2016 and 6 January 2017. Thirteen deep soil samples were collected from the five borings, including QC samples, in laboratory supplied containers ranging in depth from approximately 6.5 to 42.5 feet bgs. These soil samples were collected near CPT-TG borings TG64, TG66, TG74, TG80, and TG71, respectively, to compare

chemical analyses with the TarGOST® response. The concrete sidewalk or asphalt in the street was cored and the boring was advanced by hand auger to a depth of 5 feet bgs as a final check for subsurface utilities. After reaching that depth, either a Geoprobe 8040DT direct-push drill rig, or a Terra Sonic International ("TSI")) 150 limited access sonic rig was used to advance the borings to depths ranging from 27.5 feet to 50 feet bgs. For borings HA43 through HA46, a 4.5-inch (direct-push) or 6.2-inch (sonic) outer-diameter drill casing was driven into the soil to collect continuous soil cores from either a nominal 3-inch (direct-push) or 4-inch (sonic) diameter core barrel; HA42 used a 4.90-inch outer-diameter drill casing and a nominal 3-inch diameter core barrel to collect the continuous soil cores. Upon retrieval of the soil core, the acetate liner (direct-push) or plastic sample bag (sonic) was slit open and the soil was logged using the USCS under the oversight of a California Professional Geologist. Soil was handled, screened, and sampled as described above. Reusable sampling equipment, such as the hand auger, were decontaminated using a wash of Alconox® detergent and distilled water, and a final distilled water rinse, between each sample collection. Analytical results are summarized in Tables 3 through 8.

The PAH analysis using USEPA Method 8270D included a list of 34 PAHs, and those analytical results are included in Table 3. Three soil samples were selected for analysis using an extended list of 75 PAHS. These soil samples were selected from NAPL impacted soil in HA43 from depths between 31 feet bgs and 35.5 feet bgs, and from HA44 from depths between 10.5 and 11 feet bgs. The analytical results of those samples, for analytes beyond the list of 34 PAHs, are included in Table 15.

Upon completion of the soil sample collection, the boring was grouted to the surface by pumping Portland Type II-V cement through the casing as it was removed from the borings. The uppermost 6 inches of the borings were completed with concrete to match existing grade.

7.1.4.3 Groundwater Sampling Overview - Former North Beach MGP Workplan

Upon completion of most CPT-TG borings, depth-discrete groundwater samples were collected using a hydropunch-type sampling device from up to four depths adjacent to each CPT-TG location. Prior to advancing the borings for groundwater collection, each location was cleared by manual excavation to a depth of 5 feet bgs as a final check for subsurface utilities. The CPT data were used to target coarse-grained intervals conducive to groundwater sampling. Groundwater samples were not collected from coarse-grained intervals where the TarGOST® indicated the presence of tar and instead samples were collected at locations and depths with little or no TarGOST® response.

A total of 54 groundwater samples, including QC samples, were collected from 18 locations. Groundwater samples were collected from depths ranging from approximately 8 to 62 feet bgs. To collect these samples, a hydropunch-type sampling device was advanced to the bottom of the desired depth interval, which was typically 2 to 4 feet long. Once the depth was reached, a water-

level sounder was lowered inside the drill rods to total depth to confirm that no water had entered the sampler from leaks in the rod string. If the sampler was dry, the disposable tip was detached and the casing retracted to expose the desired sampling interval (i.e., 24 to 28 feet bgs). Water was allowed to enter the sampler for approximately 4 minutes, then a water-level measurement was collected to gauge how quickly water was entering the sampling device. Where targeted sample depth was below the physical limit of peristaltic pumps (approximately 26-feet), groundwater samples were then collected using a combination of a stainless-steel bailer and a peristaltic pump. The stainless-steel bailer was used to collect water for VOC analysis,[30] and the peristaltic pump was used to collect samples for the remainder of the analytes. For samples deeper than ~26-feet, only bailers were used to collect groundwater samples.

In addition to primary groundwater samples, QC samples including field duplicates, equipment blanks and matrix spike/matrix spike duplicate ("MS/MSD") samples were collected. A lab-provided trip blank sample was also submitted with each sample shipment. Field duplicates and MS/MSD samples were collected concurrently with the primary samples using the methods described above. Equipment blank samples were collected by pumping laboratory-prepared deionized water through the pump and tubing into appropriately preserved laboratory-provided sample containers.

Groundwater samples were submitted to TestAmerica for the following analyses:

- VOCs using USEPA Method 8260B;
- PAHs (34) using USEPA Method 8270D with SIM;
- Total and dissolved metals using USEPA Method 6010B, including boron;
- TEPH using USEPA Method 8015D;
- Total cyanide using USEPA Method 9012B; and
- Free cyanide using USEPA Method 9016.

Sample bottles were filled sequentially starting with VOCs, then PAHs, metals, cyanide, and finally TEPH if possible sample volume was available.

Upon collection of the groundwater samples, borings were grouted to the surface by pumping Portland Type II-V cement through the casing as it was removed from the boring. The upper 6 inches of the borings were filled with concrete. Analytical results for VOCs, PAHs, metals (total and dissolved), TEPH, and cyanide (total and free) are summarized in Tables 3 through 8 and 15.

[30] "[P]eristaltic and other suction-lift pumps should be avoided because they may cause loss of VOCs, degassing and redox and pH changes" (source: ASTM, Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations, ASTM Designation: D 6771 – 02).

PAH samples were filtered in the laboratory prior to analysis for groundwater samples collected at TG77. Therefore, dissolved PAH concentrations were only reported at that location. PAH concentrations are reported in Table 4 are from filtered and unfiltered samples, as indicated.

7.1.4.4 Work Plan Deviations - Former North Beach MGP Workplan

The following deviations from the work plan were made for the investigation during field work.

- Groundwater samples were not collected from TG66, TG79, TG83, and TG90, due to shallow refusal.
- A CPT-TG boring was not advanced at TG78 due to concerns from a resident regarding restricted access to their driveway during sampling.
- A CPT-TG boring was not advanced at locations TG86 through TG88 because utilities limited access in those areas.
- Groundwater samples were not collected at TG80 because NAPL was encountered at approximately 6 feet bgs, and it was decided not to collect groundwater samples from below that depth.
- VOCs were analyzed for every groundwater sample collected, but in some instances, there was insufficient volume to analyze the full suite of analytes.

7.1.5 Former Fillmore MGP Workplan Borings

As proposed in the workplan for the former Fillmore MGP portion of the investigation, twenty-nine locations were selected to conduct CPT-TG profiles: FF-ROW-TG35 (TG35) through TG63. The profiling and sample collection occurred between 12 October 2016 and 9 November 2016. Prior to advancement of the CPT-TG borings, each location was hand augured to a depth of either 5 or 10 feet bgs. A total of 44 soil samples were collected from the hand augured borings, including QC samples, from depths ranging from 1.0 to 9.8 feet bgs. After logging and sampling was complete in the hand auger borings, each boring was backfilled with bentonite chips, hydrated in place, and patched at the surface to match existing conditions, until the locations were accessed a second time for CPT-TG profiling. To complete the CPT-TG borings, the hydraulic press of a 20-ton CPT truck was used to advance the CPT-TG soundings to a maximum depth of 68 feet bgs.

Groundwater samples were collected adjacent to the CPT-TG borings at 27 of the 29 locations and a total of 78 groundwater samples were collected, including QC samples, from varying depths within the borings. One to five soil samples were collected from paired locations FF-ROW-HA30/FF-ROW-TG37, FF-ROW-HA31/FF-ROW-TG41, FF-ROW-HA32/FF-ROW-TG56, and FF-ROW-HA33/FF-ROW-TG60, at depths ranging from approximately 13 to 55 feet bgs. These borings were advanced with continuous coring to allow field screening for potential MGP Residue and visual observations of lithologic changes and sampling of lower permeability layers not characterized by groundwater sampling targeting coarser intervals. The boring

locations were surveyed with a Trimble® hand-held GPS unit to determine location coordinates. The sections below describe the pre-field activities and methods for CPT-TG, groundwater sampling, soil sampling, and chemical analysis.

7.1.5.1 CPT-TarGOST® Overview – Former Fillmore MGP Workplan

Twenty-seven CPT-TG locations were advanced for the Joint Investigation in the ROW areas of the Site footprint and vicinity. Exploration depths ranged from approximately 30 to 68 feet bgs. CPT-TG logs are provided in Appendix B.

Five of the 27 borings were advanced to refusal. Refusal was encountered at depths ranging from approximately 30 to 48 feet bgs. The remaining 22 borings were advanced to approximately 3 feet into a geologic unit interpreted to be Bay mud or fine-grained alluvium based on the CPT readings, or to the maximum extension of the downhole cables (approximately 68 feet bgs).

Upon completion of the CPT-TG borings, the CPT was removed from the boring and a hollow casing with a disposable tip was pushed back down to depth. Once at depth, the tip was removed and the casing was used to fill the boring with Portland Type II-V cement as the casing was slowly removed from the boring. The upper 6 inches of the borehole was filled with concrete and was completed to match the existing surface.

7.1.5.2 Soil Sampling Overview – Former Fillmore MGP Workplan

Up to three shallow soil samples (< 10 feet bgs) were collected from the 29 boring locations during hand augering between 27 September and 17 October 2016. A total of 44 samples were collected. The soil was logged using the USCS under the oversight of a California Professional Geologist. Soil was periodically collected in re-sealable plastic bags to test the headspace for presence of VOCs using a PID. Soil characteristics, specific sample depths, and headspace VOC results were recorded in the boring logs, which are included in Haley & Aldrich submittals.

Soil samples for analysis of BTEX were collected directly from the bottom of the hand auger bucket, upon extraction from the boring, using a TerraCore™ field preservation kit USEPA Method 5035. Glass jars with Teflon®-lined lids were used to collect samples for analyses of semi- and non-volatile compounds (e.g., PAHs and cyanide). After sample collection was complete, the sample containers were placed in ice-filled coolers for shipment to the laboratory. The breathing zone of the work area was periodically screened with a PID and a FROG-4000™ as specified in the HASP.

Cascade was retained to obtain deep soil samples (> 10 feet bgs) at HA30 through HA33 between 12 December 2016 and 6 January 2017. Twelve deep soil samples were collected from the four borings, including QC samples, in laboratory supplied containers ranging in depth from approximately 13 to 55 feet bgs. These soil samples were collected near CPT-TG borings TG37, TG41, TG56, and TG60, to compare chemical analyses with the TarGOST® response. The

concrete sidewalk or asphalt in the street was cored and the boring was advanced by hand auger to a depth of 5 feet bgs as a final check for subsurface utilities. After reaching that depth, either a Geoprobe 8040DT direct-push drill rig, or a TSI 150 limited-access sonic rig was used to advance the borings to depths ranging from 24.5 feet to 70 feet bgs. A 4.5-inch (direct-push) or 6.2-inch (sonic) outer-diameter drill casing was driven into the soil to collect continuous soil cores from either a nominal 3-inch (direct-push) or 4-inch (sonic) diameter core barrel. Upon retrieval of the soil core, the acetate liner (direct-push) or plastic sample bag (sonic) was slit open and the soil was logged using the USCS under the oversight of a California Professional Geologist. Soil was handled, screened, and sampled as described above. Reusable sampling equipment, such as the hand auger, was decontaminated using a wash of Alconox® detergent and distilled water and a final distilled water rinse. Analytical results are summarized in Tables 3 through 8 and 15.

Upon completion of the soil sample collection, the borings were grouted to the surface by pumping Portland Type II-V cement through the casing as it was removed from the borings. The uppermost 6 inches of the borings were completed with concrete to match existing grade.

7.1.5.3 Groundwater Sampling Overview – Former Fillmore MGP Workplan

Upon completion of most CPT-TG borings, depth-discrete groundwater samples were collected using a hydropunch-type sampling device from up to four depths adjacent to each CPT-TG location. Prior to advancing the borings for groundwater collection, locations were cleared by manual excavation as a final check for subsurface utilities. The CPT data were used to target coarse-grained intervals conducive for groundwater sampling. Groundwater samples were not collected from coarse-grained intervals where the TarGOST® indicated the presence of possible tar and instead samples were collected at locations and depths with little or no TarGOST® response.

A total of 78 groundwater samples, including QC samples, were collected from 27 locations. Groundwater samples were collected from depths ranging from approximately 6 to 48 feet bgs. To collect these samples, a hydropunch-type sampling device was advanced to the bottom of the desired depth interval, which was typically 2 to 4 feet long. Once the depth was reached, an electric water level sounder was lowered inside the drill rods to total depth to confirm that no water had entered the sampler from leaks in the rod string. If the sampler was dry, then the disposable tip was detached and the casing retracted to expose the desired sampling interval (i.e., 24 to 28 feet bgs). Water was allowed to enter the sampler for approximately 4 minutes, then a water-level measurement was collected to gauge how quickly water was entering the sampling device. Groundwater samples were then collected using a combination of a stainless-steel bailer and a peristaltic pump. The stainless-steel bailer was used to collect water for VOA, because it does not expose sample water to a vacuum which can lead to volatile loss during collection of the sample. The peristaltic pump was the preferred method to collect samples for the remainder

of the analytes where samples were collected from depths more shallow than the limit of peristaltic pump functionality (~26-feet).

In addition to primary groundwater samples, QC samples, including field duplicates, equipment blanks, and MS/MSD samples were collected. A lab-provided trip blank sample was also submitted with each sample shipment. Field duplicates and MS/MSD samples were collected concurrently with the primary samples using the same methods described above. Equipment blank samples were collected by pumping laboratory-prepared deionized water through the pump and tubing into appropriately-preserved laboratory-provided sample containers.

Upon collection of the groundwater samples, borings were grouted to the surface by pumping Portland Type II-V cement through the casing as it was removed from the boring. The upper 6 inches of the borings were filled with concrete.

Analytical results are summarized in Tables 3 through 8 and 15. In addition to unfiltered sample results, PAH samples were filtered in the laboratory prior to analysis for the following locations: TG45, TG46, TG47, TG56, TG59, and TG60. Filtered and unfiltered PAH concentrations are reported in Table 4.

7.1.5.4 Work Plan Deviations – Former Fillmore MGP Workplan

The following deviations from the work plan were made for the investigation during field work.

- Due to the limited space requirements and uneven terrain (i.e., concrete and soft soils) at the desired location for TG54, the limited access rig was unable to reach the desired depths for groundwater sampling; therefore, groundwater samples were not collected at this location.
- A CPT-TG boring was not advanced at TG55 because an underground structure or utility was encountered during hand auguring.
- VOCs were analyzed for all groundwater samples collected, but in some instances, there was insufficient volume to analyze the full suite of analytes.

7.1.6 Investigation-Derived Waste Disposal

Decontamination water, purged groundwater, and soil cuttings were containerized separately in DOT rated, 55-gallon drums. The water and soil were classified as hazardous waste and transported by PSC Industrial Services at the end of each day, under standard manifest protocol to an approved storage facility located in Fremont, California. The drums were stored and then transported for disposal at an appropriate facility.

8.0 INVESTIGATION RESULTS

Results from the joint investigation were reviewed along with data derived from Related Investigations, and information from the Conceptual Site Model, to synthesize concentrations distributions with historical setting (such as coastline changes) and hazardous material handling practices. Taken together, the review assists identification of sources of contamination, types of contaminants and affected media, known and potential routes of migration, and existing data gaps that serve to determine the nature and extent of MGP Residue in the environment that have the potential to contribute to risks to human health and ecological receptors.

8.1 Polycyclic Aromatic Hydrocarbons (PAHs) in Shallow Soil

PAHs are formed from the incomplete combustion of fossil fuels and, in the case of MGPs, are "[c]reated from volatile content of feedstock coal or from enrichment and carburation oils as released and formed under heating in absence of oxygen and reformed in condensation cooling" (Hatheway, 2012).

Soil contamination is generally evaluated as "shallow" or "deep" soil, as described in the following paragraphs excerpted from "User's Guide: Derivation and Application of Environmental Screening Levels ("ESLs")" (Water Board, 2016).

> Shallow Soil Contamination (at or above 10 feet bgs): There is potential for residents, commercial/industrial workers, and construction workers to be exposed to contaminated soil at or above 10 feet bgs. This means that, for most screening evaluations, two potentially exposed receptors need to be considered: 1) residential or commercial/industrial; and 2) construction workers.

Soil contamination with MGP Residue can result from releases and disposal of solid materials such as clinker, slag, building debris, and purification box wastes, or can be residual contamination from wastes released as liquids, such as coal or oil tars. These wastes can remain at the original point of discharge or be distributed by site demolition and grading activities. Shallow soil contamination can result in a variety of direct exposure scenarios and can be mobilized as fugitive dust or entrained bed load in surface water flow where not capped. Shallow and deep soil contamination also present a threat to construction workers, and groundwater via the leaching pathway and can present a source of soil gas.

In order to present a representation of PAH concentrations in shallow soil that can be compared to a single human exposure guidance concentration, PAHs in shallow soil samples were converted to a single benzo(a)pyrene equivalent[31] in the top ten feet of soil within the Marina

[31] Department of Toxic Substances Control, Human and Ecological Risk Office (HERO) Human Health Risk Assessment Note 1: Screening Level Human Health Risk Assessments, June 9, 2011

District, with maximum concentrations per location presented on the contaminant contour provided as Figure 3 and associated Table 9. We note that benzo(a)pyrene equivalents are only a proxy for PAH risk and are calculated using a small subset of PAHs found in MGP residue.[32] Additionally, naphthalene, a significant contaminant of concern in the Investigation Area and a PAH, is not included in the benzo(a)pyrene equivalent calculation as applicable guidance recommends that risk from naphthalene be considered based on its individual concentration. Therefore, risk evaluation based solely on benzo(a)pyrene does not adequately address PAH risk. Soil concentrations from private properties that have been remediated were not removed from the visualization so they could add to developing an understanding of release and transport patterns. Therefore, with respect to completed shallow soil private property remediation, the contaminant contour does not necessarily reflect current conditions in all locations. Based on the visualization:

- Significantly elevated concentrations of PAHs have been identified in shallow soil.
- The highest concentrations of summed PAHs are found in the vicinity of the former MGP operations and approximate property boundaries.
- In the vicinity of the former Fillmore and North Beach MGPs, the highest concentrations of summed PAHs in shallow soil are located on the terrestrial side of, or boundary between, the upland and former San Francisco Bay border. However, significant concentrations of summed PAHs, potentially related to the demolition of the MGPs post-PPIE fill, emanate from the MGPs in all directions.
- The boundaries of the most impacted areas, that present a risk to construction workers within the ROW and are elevated significantly above lower residential risk numbers, are poorly defined, with large gaps in sample locations apparent.

8.2 Indicator Volatile Organic Compounds in Groundwater – Vapor Intrusion Threats

The concentration of naphthalene and benzene in the most shallow/first grab groundwater sample collected, and from shallow monitoring wells within the Marina District, are represented on the contaminant contour provided as figures 7Figures 6 and 8, respectively – with the maximum naphthalene concentration selected where both 8260 and 8270 analyses were utilized. Shallow groundwater is impacted at elevated concentrations on the former terrestrial footprint of the MGPs and downgradient (north to northwest). Naphthalene and benzene were selected as indicator compounds for the shallow groundwater representations because they have relatively higher solubilities in groundwater than heavier PAHs, both exhibit toxicity and carcinogenic concerns, and both have the potential to cause vapor intrusion concerns due to their volatility. Reference vapor intrusion guidance concentrations for shallow groundwater are provided on the figures, including: the Water Board ESL guidance concentrations for vapor intrusion human

[32] The standard PAH analysis includes only 7 of the 22 PAHs for which DTSC provides benzo(a)pyrene potency equivalency factors used to calculate benzo(a)pyrene equivalents

health risk levels for shallow groundwater in residential areas (20 µg/L for naphthalene and 1.1 µg/L for benzene); and guidance concentrations calculated with the EPA-OLEM Vapor Intrusion Assessment Groundwater Concentration to Indoor Air Concentration ("GWC-IAC") Calculator Version 3.5.1 (May 2016 RSLs) for groundwater to vapor intrusion human health risk levels (4.6 µg/L for naphthalene and 1.6 µg/L for benzene).

Concentrations of naphthalene and benzene exceed guidance concentrations for vapor intrusion human health risk levels for shallow groundwater in residential areas in large areas of the Marina District. We note that indoor vapor intrusion risk in the Marina District is of particular concern due to factors including: the elevated concentrations of MGP-related volatile indicator compounds identified in shallow soil and shallow groundwater in the Marina District; the fact that much of the residential building stock in the Marina District is built on sand; the fact that differential settlement of older construction typical of the Marina District lends itself to cracks in foundation slabs; and the fact that such construction also generally lacks significant integrated vapor barriers. Furthermore, both contaminant source and sub-slab attenuation factors used to evaluate potential concerns from shallow soil vapor and groundwater threat to vapor intrusion assume attenuation over an existing building slab – therefore neither factors are sufficiently protective in the case of buildings with perimeter foundations and crawl spaces. Such structures are known to exist in the Marina District, but have not been specifically investigated and inventoried, nor have buildings with residential space at or below grade, which are also of particular interest for vapor intrusion concerns.

Prior evaluations of potential indoor air concentrations resulting from vapor intrusion of subsurface contamination prepared for investigations of MGP contamination conducted within the Marina District by H&A, on behalf of PG&E, have consistently applied an attenuation factor of 0.002 to all soil vapor sample concentrations to estimate potential indoor air vapor threats. Plaintiffs have observed this factor, which is referred to by H&A as a "shallow soil vapor attenuation factor"[33] and "DTSC default attenuation factor,"[34] is described as a "Contaminant Source" attenuation factor by DTSC 2011.[35] Plaintiffs, accordingly, believe this 0.002 attenuation factor is being used inappropriately. Plaintiffs note that the Contaminant Source attenuation factor provides for 25 times more attenuation than the Subslab attenuation factor of 0.05 that is provided in DTSC 2011 (the EPA default residential attenuation factor is 0.03[36]); and there is no technical justification for such significant attenuation in coarse sands over such a limited distance between sample depths and bottom of building slabs. Rather, spatial separation of source contamination from potential receptors is required to permit diffusion and advection to

[33] Gina Plantz, Haley & Aldrich, MIA Parties and Regulatory Agencies Meeting, June 29, 2017.
[34] Haley & Aldrich, footnotes of Soil Vapor Analytical Results summary tables, various reports.
[35] DTSC, *Final Guidance For The Evaluation And Mitigation Of Subsurface Vapor Intrusion To Indoor Air*, October 2011.
[36] USEPA, *EPA's Vapor Intrusion Database: Evaluation and Characterization of Attenuation Factors for Chlorinated Volatile Organic Compounds and Residential Buildings*, March 16, 2002.

achieve the reduction in Contaminant Source vapor contamination required to justify using the 0.002 attenuation factor (per the Johnson & Ettinger model that the DTSC guidance is based upon). In contrast with this guidance, H&A, on behalf of PG&E, have applied the 0.002 Contaminant Source attenuation factor to samples collected as shallowly as 1.5-feet bgs in coarse sand beneath residential buildings.

We also note that MGP sites, such as those that are the subject of this investigation, have important differences that limit the applicability of vapor intrusion guidance intended for use on underground storage tank sites. MGP sites are former industrial facilities that involve very large release volumes in contrast to typical gas stations.[37] Here, MGP-related contaminants, including separate phase tars, have been detected in soil and groundwater widely across the Marina District and are continuous below right-of-way and residential areas, with elevated concentrations of contaminants directly below residential buildings. This indicates that in the Investigation Area there is "insufficient separation distance"[38] for biodegradation to limit the potential for vapor intrusion. The shallow contamination also demonstrates that there is not a "sufficiently thick layer of biologically active soil [that] is needed between the building foundation and the contamination to allow biodegradation to occur."[39] No vertical profiling has been conducted to demonstrate a pattern characteristic of active biodegradation zones[40] in these areas, as UST vapor intrusion guidance recommend. These factors further indicate the inappropriateness of using a 0.002 attenuation factor here.

Soil vapor sampling results were also reviewed for vapor intrusion potential to inform future investigations.[41] This review notes that a variety of vapor sample locations exceeded residential guidance when initially sampled, but did not exceed guidance concentrations when resampled – generally within no more than two months of the first sample (Table 16). However, the high levels of contamination in conjunction with evidence that untreated sources of continuing impact to groundwater exist throughout the Investigation Area indicate that ongoing seasonal sampling should be conducted to verify the continuing absence of vapor threat where groundwater is a continuing source to soil vapor and account for seasonal variability. The results also indicate that additional sampling should be focused on unsampled areas where shallow groundwater contamination presents a continuous source of contamination to soil vapor. Additionally, as highlighted in Table 16, detection limits for soil vapor samples were not consistently below residential soil vapor guidance concentrations derived using a 0.05 attenuation factor and leak

[37] USEPA, *Technical Guide For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage*, June 2015 (USEPA 2015).
[38] USEPA, *Petroleum Hydrocarbons And Chlorinated Solvents Differ In Their Potential For Vapor Intrusion,* March 2012.
[39] Ibid.
[40] Op. cit. USEPA 2015.
[41] Indoor air sampling results were not included in this analysis as these are indicative of individual building use, construction, and air exchange rates rather than the vapor intrusion potential addressed herein.

check compounds were not used for each sample collected as vapor sampling guidance requires.[42]

8.2.1 Comparison of Analytical Methods – 8260/8270

Joint investigation groundwater samples were analyzed by US EPA Hazardous Waste Test Methods SW8260B and SW8270C. Naphthalene, a PAH contaminant of interest in the investigation due to its association with MGP Residue and its relatively high toxicity, solubility in groundwater, potential indoor air vapor intrusion threat, and concentration in the Investigation Area, is resolved by both methods. Consequently, we reviewed concentrations of naphthalene identified in paired samples from both methods. Based on a review of these data, there is a significant and systematic negative bias for naphthalene in SW8270C results compared to SW8260B results (8260 results are significantly higher) as demonstrated on the attached graphical analyses provided as Figure 11. We note that this bias occurs for deeper samples,[43] where only bailer sampling was conducted, as well as for shallow samples where different sampling methods, metal bailer and peristaltic pump, were used to collect samples for SW8260B and SW8270C, respectively. Additionally, in order further account for potential sampling methodology, SW8270C results were compared to SW8260B results for monitoring well data where sampling artifacts are minimized compared to grab sampling activities, where a similar bias was identified (Figure 11). Therefore, the bias is not an artifact of sampling methodology.

8.3 MGP Tars/Separate Phase Residuals

A representation of the extents of separate phase MGP Tars/SPR is provided as Figure 6. This figure is derived from visual observations of MGP Tars/SPR in boring cores, direct detection of MGP Tars/SPR by down-hole investigation tools (i.e., TarGOST), and identification of MGP Tars/SPR through maximum groundwater concentrations of naphthalene in groundwater where no visual indication of SPR was noted, and summed 16-PAH concentrations in sediment samples where a linear regression with paired groundwater samples was conducted. This approach provides a comprehensive view of the areas with MGP Tars/SPR, which is missing when the results are reported piecemeal. Additionally, it provides important insights by compensating for the negative bias inherent in Marina District sampling methodologies and limitations in TarGOST's ability to identify discontinuous NAPL. The representation synthesizes off-shore sediment data in the East Harbor with on-shore groundwater and visual observations to provide a current iterative view of areas with separate phase residuals in the Marina District, but does not include data from the West Harbor that has not been compiled and included within the MIA database at the time of writing.

The visualization shows:

[42] DTSC, *Advisory Active Soil Gas Investigations*, July 2015.
[43] The practical limit of a peristaltic sampling pump is approximately 26-feet in depth.

- MGP Tars/SPR is observed emanating from gas production areas, gas holders, tar wells, and oil storage tank areas where leaks and discharges would be anticipated, and have been demonstrated, at other similar historical MGP facilities.
- MGP Tars/SPR is observed emanating along the pre-1891 and 1899 shorelines – including within the former SF Bay channel immediately east of Webster Street – where discharges of refinery wastes were likely to have occurred. In particular, carbureted water gas MGPs would have been confronted with large volumes of tars and tar emulsions that were routinely discharged as waste due to the difficulty of recovering tar economically from the process.

  > *Tars from the water gas process were far less valuable and were much more difficult to recover and process. Separating the tar from the water emulsion in which it was produced was slow and difficult. Most of the "coal tar" we encounter at MGPs today is actually water gas tar, which was actually derived from liquid petroleum products, not coal. Water gas tar is less viscous than true coal tar and is therefore more likely to move as a liquid through subsurface soils.*[44]

- MGP Tars/SPR deposits are continuous from terrestrial and San Francisco Bay areas.
- The identification of the extents of MGP Tars/SPR deposits in the following areas has not been completed:
  - North and northeast of the former Fillmore MGP and north and northwest of the former North Beach MGP – in particular along Fillmore Street.
  - Offshore of the Marina District – in particular outside of the East and West Harbors.
- We note that significant amounts of MGP Tars/SPR have been observed in the West Harbor, but the potential source deposits and migration pathways between the release points of MGP Tars/SPR at the former Fillmore and North Beach MGP have not yet been identified and is an existing data gap that requires additional investigation.

8.3.1 Contamination Beneath Aquitard/Aquiclude Materials

Several areas have been identified where MGP Tars/SPR has penetrated into, or beneath, lower permeability Pleistocene deposits and Bay mud – deposits anticipated to be aquitard/aquicludes that resist the downward mobility of MGP Residue. These areas indicate that a significant mass of contamination, enough to overcome entry pressures into low permeability sediments, exist in the vicinity. Additionally, concentrations of dissolved MGP Residuals have been identified beneath overlying aquitards/aquicludes. The following discussion presents several of the more notable areas and locations.

In the area of the former tar refineries located on the North Beach MGP mole, summed PAHs were identified at 36,820,000 µg/Kg at 30.5 feet bgs in paired borings NB-ROW-HA41/NB-

[44] NY DEC, *New York State's Approach to the Remediation of Former Manufactured Gas Plant Sites*, January 2008.

ROW-TG20. NAPL sheen was identified in paired boring NB-ROW-HA43/ NB-ROW-TG66 at depths of 31.3 to 31.5 feet bgs in the Holocene mud. Significant contamination was identified penetrating four feet into the Holocene mud, with high concentrations of MGP Residuals found at 35 to 35.5 feet bgs in the Holocene mud. Napthalene was identified at concentrations of 293 mg/kg at 31.5 feet bgs and 488 mg/kg at 35.5 feet bgs. TEPH was identified at concentrations of 8,000 mg/kg at 31.5 feet bgs and 4,400 mg/kg at 35.5 feet bgs. At the borings terminus of 42.5 feet, seven feet deeper and two feet into a sandy lean clay layer, relatively low concentrations of MGP Residue continued to be detected, with summed PAHs at 158 µg/Kg, a total penetration of 11-feet.

Down gradient of the former North Beach relief holder at location NB-ROW-TG30, MGP Tars/SPR are observed penetrating at least six feet into the low permeability Pleistocene sand – to 52 feet bgs. Naphthalene was detected at 16,000 µg/L at 38 feet bgs from this location. North northwest of this location, at NB-ROW-TG82, naphthalene was still detectable at in groundwater at 2.6 µg/L (15 times the drinking water priority ESL of 0.17 µg/L for naphthalene) at depth of 64-68 feet bgs, and was detected at downgradient well NB-ROW-CMT10C at 3,500 µg/L in a sandy unit at 55 feet bgs below approximately ten feet of silt. For context, this concentration is 20,600 times the drinking water priority ESL of 0.17 µg/L for naphthalene.

South of the historical shoreline and within the former Fillmore MGP boundary, location FF-ROW-TG56 contained 5,900 µg/L of naphthalene in the Pleistocene sand beneath approximately eight feet of native silts at a depth of 38 feet bgs. No significant TarGOST response was noted on this boring, however elevated concentrations of MGP Residue were noted in groundwater at depths of 12 and 26 feet bgs in dune sands. This suggests that a significant source of MGP Residue may exist upgradient of this location.

North of the former Fillmore, near the corner of Cervantes and Alhambra Streets, naphthalene was detected in Pleistocene sands at FF-ROW-TG52 at 11 µg/L a depth of 40-44 feet bgs. MGP Tars/SPR were identified in several borings advancing north down Cervantes Street towards Beach Street, where FF-ROW-TG38 contained 5.3 µg/L of naphthalene in Pleistocene sands at 36-40 feet bgs.

North of the former Fillmore MGP on Mallorca Way, MGP Tars/SPR occurs in what appears to be a native sand channel feature beneath Bay mud at FF-ROW-TG11 from approximately 25-27 feet bgs. Nearby, at downgradient location FF-ROW-TG44, MGP Residue was detected in groundwater from 36-38 feet (naphthalene at 4.0 µg/L, again above the drinking water priority ESL of 0.17 µg/L for naphthalene) within Pleistocene sand beneath at least 10 feet of native Holocene bay mud.

The vicinity of the former Fillmore MGP Tars reservoir on Alhambra Street is a source area for MGP Tars/SPR. However, borings have not reached a depth sufficient to investigation the

downward migration of MGP Residuals in this area or downgradient. Because of the potential for a significant mass of MGP Tars/SPR in this area, it should be a focus of additional investigation going forward.

Recent geotechnical borings installed by H&A in August to November 2016 in the East Marina[45] identified permeable sandy layers beneath Holocene mud in several borings in the vicinity of the North Beach MGP mole along the northwest edge of the East Marina and downgradient of the areas described in the prior paragraphs. In boring HA-16-GT-01, Holocene mud was encountered from 46 to 59.5 feet bgs underlain with multiple clayey sand and silty sand layers until a fat clay was encountered at 96.5 feet bgs at the terminus of the boring. In boring HA-16-GT-02, Holocene mud was encountered from 33 to 50 feet bgs underlain with sand and interbedded sands, silts, and clays until the terminus of the boring at 92.5 feet bgs. In boring HA-16-GT-03, Holocene mud was encountered from 35 to 55 feet bgs underlain with interbedded sands, silts, and clays until the terminus of the boring at 92.5 feet bgs. This demonstrates that permeable layers vulnerable to the migration of MGP Residue are present beneath the Holocene mud in the East Marina area, downgradient of MGP Tars/SPR and dissolved phase MGP Residue impacted areas that have not been fully characterized downgradient of the North Beach MGP. Given the commonality of the hydrogeology in the Marina District, it is anticipated that similar layers of interbedded sand exist immediately beneath and downgradient of the Fillmore MGP.

8.3.2 Negative Sampling Bias

A negative sample bias exists in the project analytical record as an artifact of sample selection and methodology. As described in various H&A documents and the joint investigation workplans, groundwater samples collected during independent investigations, and during the recently completed joint Investigation Event, were collected from "coarse grained intervals conducive for groundwater sampling"[46] which were selected for "little or no TarGOST® response."[47] This agreed upon procedure for the joint investigation necessitates that intervals with observed impacts from MGP Tars/SPR be considered when reviewing investigation data to identify sources of contamination, types of contaminants and affected media, known and potential routes of migration, and existing data gaps, that serve to determine the nature and extent of MGP Residue in the environment that have the potential to contribute to unacceptable risks to human health and ecological receptors.

Groundwater wells installed by H&A and its subcontractors have followed this strategy by installing screens in intervals above and/or below intervals where MGP Tars/SPR has been identified and sealing the intervals impacted with visible MGP Tars/SPR. Additionally, soil

[45] H&A, *Geotechnical Data Report, East Harbor Marina*, July 2017 (H&A 2017).
[46] Haley and Aldrich, *Right-of-Way areas Investigation Report*, Former Fillmore, October 5, 2016.
[47] Ibid.

samples were generally not collected for laboratory analysis when field screening identified MGP Residue during boring advancement. Examples of this practice include:

- FF-ROW-CMT06A where a well bottom seal was placed across an interval observed with a "strong odor, oil-like sheen" and the lowest selected screened interval was approximately 7-feet higher;
- FF-ROW-CMT09A where a seal was placed across the interval described with discontinuous NAPL at 14-16 feet bgs with screens selected above and below the unit;
- NB-ROW-CMT11 where a seal was placed across the interval described with "oil-like sheen and strong hydrocarbon odor" with screens selected above and below the unit; and
- NB-ROW-MW02B, where the bottom of screen was set six inches above where "discontinuous dense nonaqueous phase liquids (DNAPL): black, strong odor" was noted below 28 feet.

We note that the monitoring well installation workplans prepared by PG&E contractors prior to installation of these wells do not explicitly discuss this strategy of excluding MGP Tar contaminated intervals from well screens, nor is it discussed in the well installation reports with discussion of MGP Tar occurrence. Because MGP Tar impacted intervals were not screened, these well cannot support NAPL mass estimate and source depletion estimation, mobility and thickness observations, product sampling and/or chemical signature investigation and monitoring, and NAPL degradation monitoring that are integral elements of environmental monitoring at NAPL impacted sites.

In each of these cases, no soil samples of the observed MGP Residue were collected for laboratory analysis. The unfortunate consequence of failing to collect samples from intervals where field screening identifies MGP Residue—a break in common environmental investigation practice—is that the data are likely to be lost, as no analytical records are created for inclusion in the analytical database and GIS tools that are required to interpret the huge amount of investigation data that is developed on large and complex projects such as this. Instead, the observations tend to be lost as they exist only in voluminous field notes that are not easily recalled and incorporated into interpretations of site data.

8.4 Cyanide in Soil and Groundwater

Concentrations of cyanide (total) have been observed in soil primarily within the western portion of the former Fillmore MGP, and near the scrubbers and tar refinery/tar well at the former North Beach MGP (Figure 4 and associated Table 10).

In the vicinity of the former Fillmore MGP, cyanide (total) in groundwater (Figure 5 and associated Table 11) occurs beneath and north of the former MGP with a slightly elevated area downgradient of the former generator house. We note that free cyanide, the most toxic form of cyanide, has been detected in groundwater at two relatively divided locations (FF-ROW-TG11

and FF-ROW-MW06) and relatively low concentrations. In the vicinity of the former North Beach MGP, free cyanide has been detected at only one location, the NB-ROW-CMT15 well cluster, again at a relatively low concentration (Figure 4 and associated Table 10).

8.5 Lead in Soil

The Parties are currently disputing whether lead in soil should be investigated as a component of the Joint Investigation despite PG&E's "Guidance for Disturbing Soil at Former Manufactured Gas Plant Sites" (Appendix F) listing lead and arsenic as the "most common" metal byproducts "associated with former MGP sites". On April 8, 2016, the parties jointly requested that DTSC verify PG&E's contention that the DTSC and the City and County of San Francisco had requested that lead be excluded from the MGP investigation, placing the dispute on hiatus. Consequently, soil samples collected during the investigation were archived for potential future analysis. On October 10, 2017, the DTSC responded that "DTSC contacted prior staff involved in the early stages of the PG&E MGP program as well as all records related to this inquiry" and "was unable to determine whether such a decision had been made."

Plaintiffs have evaluated existing lead in soil data, historical information regarding potential use of lead in MGP facility maintenance and construction and/or generation of lead in MGP operations, and existing regulatory guidance. Based on the review, Plaintiffs have concluded that lead in soil should be investigated as a contaminant of concern because:

1. Concentrations of lead in soil proximate to the terrestrial footprints of the former Fillmore and North Beach MGP are significantly higher than those outside of the facilities' footprints (Appendix E);
2. Elevated lead concentrations were observed well below the surface, commingled with brick debris indicative of demolished MGP facilities, and in areas of the North Beach MGP footprint, where remaining MGP building foundations clearly demonstrate the elevated lead concentrations are below fill placed after MGP demolition; and
3. Lead is a common contaminant of concern in MGP regulatory guidance, industry references, and at MGP sites. A cursory list of guidance documents, industry references, and MGP sites where lead is listed as a COC is included as Appendix F.

PG&E does not dispute the existence of high levels of lead in soils on the footprints of the Fillmore or North Beach MGP facilities, but have offered a variety of alternative explanations for the lead, which have been reviewed by plaintiffs. None of these alternative explanations provide a plausible alternative to the lead contamination observed in the Marina Basin. The offered alternative explanations including:

- The Selby Smelter: PG&E has suggested that the Shelby smelter is the source of lead rather than the MGPs. The smelter operated, from approximately 1879 to 1884 at the location described as "the foot of Hyde Street, North Beach", the prevailing winds place

the Selby Smelter downwind of the eastern boundary of the Marina Basin and east of a topographic high. A list of historical complaints related to the Selby smelter exhaust were reviewed and each were found to be south and east of the smelter – in the direction of the prevailing winds. Additionally, the smelter would have created an aerial deposition pattern that would not explain the lead found at depth and concentrated in areas localized in the footprints of the Fillmore and North Beach MGPs.

- Lead paint: PG&E has suggested that lead paint used at the PPIE or on current residential structures is the source of lead rather than the MGP. However, the vast majority of exterior surfaces at the PPIE were finished with plaster ("staff") and were not painted. Instead, the plaster was impregnated with three pigments that did not contain lead, including: burt sienna (a hydrated oxide of iron, alumina silicate, lime, and barium sulphate[48]), raw umber (containing ferric oxide, manganese dioxide, carbonate of lime, alumina, and silica[49]), and yellow ochre (a natural mineral consisting of silica and clay owing its color to an iron oxyhydroxide mineral, goethite[50]). Lead paint was described in much more limited uses at the PPIE by Markwart 1915 and Todd 1921. These resources are quite specific, and describe the use of lead paint on decorative pools, millwork, exterior and interior woodwork, doors and windows, iron work, sheet metal, and plaster walls in bathrooms up to a height of 6-feet. PPIE debris would also not explain the occurrence of lead at depth in layers that predate the PPIE and are intermixed with MGP Residue. Lead paint used in buildings developed after the PPIE would also be expected to concentrate close to the soil surface and next to buildings, as lead is not known to readily move vertically through soil without a carrier or acidic conditions. Therefore, lead paint does not explain the concentrations of lead identified at depth and away from residential structures perimeters.
- PPIE Exhibits: PG&E has also noted that during the PPIE, W.P. Fuller exhibited a "lead mill". However this exhibit was located a significant distance from either MGP footprint (at PPIE Avenue C and Third Street[51] - now north of Beach Street and west of Fillmore Street), and therefore cannot explain concentrations of lead on the MGP footprints. Additionally, given the relatively small scale and controlled conditions of a public exhibit, this lead mill was unlikely to contribute a significant amount of lead to the environment.
- Ubiquitous lead: PG&E and its contractors have suggested that lead is ubiquitous in San Francisco, but this claim has not been substantiated by data in the Marina Basin, and is contradicted by our statistical review. For example, within Jacobson James & Associates

[48] Hurst, George H., *The Painters Laboratory Guide*, 1902
[49] Uebele, Charles L., *Paint Making And Color Grinding, A Practical Treatise For Paint Manufacturers And Factory Managers*, 1913
[50] Douma, M., curator. (2008). Yellow ochre. In Pigments through the Ages. Retrieved October 16, 2017, from http://www.webexhibits.org/pigments/indiv/overview/yellowochre.html
[51] The Wahlgreen Company, *Official Catalogue of Exhibitors*, 1915

("JJA") 2015[52], PG&E contactor JJA refers to "ubiquitous" lead concentrations in shallow soils in the East Marina area, without providing a basis for this statement. The mean and 95% upper confidence limit ("95% UCL") of lead in the 23 samples collected by JJA in 2014 at depths within two feet of ground surface north of the terrestrial footprint of the former North Beach MGP and next to the East Harbor where JJA considered lead "to be ubiquitous in the marina area," were found to be 61 mg/Kg and 83 mg/Kg, respectively. These statistics are substantially below that of the dataset comprehensive of terrestrial former MGP manufacturing areas provided by Plaintiffs to the Water Board and DTSC in April 2016, and within Section 5.4.6 of the Iteration R0 - Conceptual Site Model, Former Fillmore and North Beach MGP Sites

PG&E representatives have stated in the presence of Plaintiffs and Regulatory Agencies that lead is "minor" contaminant at MGPs, which supports its inclusion in analysis of soil samples. However, PG&E does not analyze for lead in soil samples collected on private properties or the ROW investigations, limiting the effectiveness of the investigation. We note that lead is currently included in groundwater analyses.

8.6 Lead in Groundwater

Distributions of lead in groundwater are disjointed and do not present a clear picture of release and migration. Additionally, the anomalously high concentrations of lead of 2400 µg/L and 3900 µg/L in borings near the former Fillmore MGP (FF-TG-53) and former North Beach MGP (NB-ROW-TG70), require additional investigation.

8.7 MGP Residue Descriptions

Based on our review of shallow soil observations collected during the joint Investigation Event and prior Independent Investigations, boring log descriptions associated with sample intervals containing very high levels of contamination indicative of product contain a variety of terms related to degree of contamination, and may not accurately indicated whether product was encountered. Therefore, boring log descriptions should be standardized with common descriptions of product level contamination such as "staining," "heavy staining," and "product."

Solid waste materials encountered during upland investigations are commonly described with inconclusive language including "clinker-like" and "asphalt-like" material, such as boring TG-57 which notes "clinker-like material up to 1 inch in size." However, solid MGP Residue can be an important source of contamination and an indicator for impacted areas if properly identified. Therefore, we recommend that briefing materials of a variety of solid MGP Residue be prepared such that field personnel can conclusively identify solid MGP waste material in the field, and differentiate solid MGP Residue from non-MGP residue (such as degraded asphalt and coal on boring log descriptions). If so done, solid MGP residue could be consistently described as "MGP

[52] Jacobson James, *Near-Shore Upland Soil Investigation Report*, August 5, 2015 (JJA 2015)

clinker" or similar conclusive term on project boring logs. Mineralogical analysis of specific types of solid waste material is also recommended to support briefing materials for field personnel to support standardization of field observations.

8.8 Continuous Pooled MGP Tars/SPR

During installation of NB-ROW-MW11 on March 1, 2017, H&A subcontractor Jacobson James & Associates (JJA) encountered "Continuous NAPL present at 9.67', pooled on concrete refusal surface."[53] That concrete refusal surface is understood to be the bottom of the former North Beach MGP Tars well along Beach Street, as the boring is within the footprint of the historical tar well. Due to the discovery of free product within a shallow former underground storage tank, this area should be considered for an Interim Remedial Action.

9.0 CONCLUSIONS

As presented in the body of this document, Plaintiffs have evaluated available data in the Marina District and its immediate off-shore areas to identify the nature and extent of MGP Residues, as well as the relationship between the former MGP refineries and important fate and transport features such as the channel between the former mole and the sea wall that eventually enclosed the Marina cove, in the Marina District.

9.1 Shallow Soil

Shallow soil is impacted with significantly elevated concentrations of PAHs, concentrations that greatly exceed risk based standards, from the ground surface to the groundwater interface. Large differences of several magnitudes in concentrations of PAHs in shallow soil occur across the Investigation Area with the highest concentrations of summed PAHs found in the vicinity of the former MGP operations and approximate property boundaries of the MGPs – on the terrestrial side of, or boundary between, the upland and former San Francisco Bay border. Additionally, significant concentrations of summed PAHs, potentially related to the post-PPIE fill demolition of the MGPs, emanate from the MGPs in all directions. The boundaries of the most impacted areas are poorly defined, with large gaps in sample locations apparent that must be further investigated in order to: prioritize remediation plans; refine risk management activities; and advance identification of the nature and extents of contamination in the Marina District. Concentrations of cyanide (total) have also been observed in soil primarily within the western portion of the former Fillmore MGP, and near the scrubbers and tar refinery/tar well at the former North Beach MGP.

As discussed in Section 8.5, the Parties are currently disputing whether lead in soil should be investigated as a component of the joint investigation. However, for the variety of reasons discussed in Section 8.5, Plaintiffs believe that lead is a contaminant of concern at the Marina

[53] Boring log, JJA, Well Number MW-11.

Basin MGPs and should be investigated as such. Additionally, as a variety of metals are associated with MGPs, soils samples should be analyzed for the standard suite of California Title 22 metals during future investigations.

9.2 MGP Tars/Separate Phase Residuals ("SPR")

MGP Tars/SPR that serve as long term sources of contamination to soil vapor, groundwater, sediment, and the San Francisco Bay have been identified widely across the portion of the Marina District that has been investigated and at widely varying depths – from approximately 3-feet bgs to over 50-feet bgs. MGP Tars/SPR are observed emanating from gas production areas, gas holders, tar wells, and oil storage tank areas where leaks and discharges would be anticipated and have been demonstrated at other similar historical MGP facilities. The MGP Tars/SPR are observed emanating along the pre-1891 and 1899 shorelines – including within the former SF Bay channel immediately east of Webster Street – where discharges of refinery wastes were likely to have occurred. These MGP Tars/SPR are continuous across terrestrial and San Francisco Bay areas, including the former North Beach MGP mole and the East Harbor where interim remedial actions have failed to prevent visible migration of MGP Tars/SPR into the water column. MGP Residue has penetrated beneath low permeability aquitard/aquiclude materials, which were anticipated to limit their vertical migration into more sandy layers below. Further investigation of the extents of MGP Tars/SPR deposits are required in order to prioritize remediation plans, refine risk management activities, and advance identification of the nature and extents of contamination in the Marina District. Furthermore, investigation methods and activities have resulted in a negative sampling bias in the analytical record that requires incorporation of qualitative visual and down-hole profiling data to provide a full accounting of MGP Tar nature and extents.

9.3 Groundwater Impacts – Vapor Intrusion Concerns

Concentrations of the VOCs naphthalene and benzene exceed guidance concentrations for vapor intrusion human health risk levels for shallow groundwater in residential areas in large areas of the Marina District. Vapor intrusion risk in the Marina District is of particular concern due to factors including: the elevated concentrations of MGP-related VOCs identified in shallow soil and shallow groundwater in the Marina District; the fact that much of the residential building stock in the Marina District is built on sand; the fact that differential settlement of older construction typical of the Marina District lends itself to cracks in foundation slabs; and the fact that such construction lacks vapor barriers.

Furthermore, both contaminant source and sub-slab attenuation factors used to evaluate potential concerns from shallow soil vapor and groundwater threat to vapor intrusion, respectively 0.002 and 0.05, assume attenuation over an existing building slab; therefore, neither factor is sufficiently protective in the case of buildings with perimeter foundations and crawl spaces. Such buildings are known to exist in the Marina District, but have not been specifically investigated and inventoried. Nor have buildings with residential space at or below grade, which are also of

particular interest for vapor intrusion concerns. Therefore, buildings with perimeter foundations and all buildings with ground floor living spaces should be inventoried in the areas of the Marina District where MGP Tars/SPR and shallow groundwater contamination is indicated. Further investigation of the extents of MGP Tars/SPR deposits, including seasonal sampling of vapor probes in areas with vapor intrusion concerns and lower detections limits the prior investigation samples, are required in order to prioritize remediation plans, refine risk management activities, and advance identification of the nature and extent of contamination in the Marina District.

9.4 Groundwater Impacts – Cyanide and Lead

In the vicinity of the former Fillmore MGP, cyanide (total) in groundwater occurs beneath and north of the former MGP with a slightly elevated area downgradient of the former generator house. We note that free cyanide, the most toxic form of cyanide, has been detected in groundwater at only three relatively divided locations and at relatively low concentrations: (FF-ROW-TG11 and FF-ROW-MW06) in the vicinity of the former Fillmore MGP, and at NB-ROW-CMT15 well cluster in the vicinity of the former North Beach MGP. We note that the distribution of cyanide (total) in groundwater appears to be associated with occurrence of MGP Tars/SRP, which have been identified across the East Harbor – where cyanide has not been analyzed for. Therefore, we believe that cyanide should be added to the chemical analysis suite for offshore areas.

Distributions of lead in groundwater are disjointed and do not present a clear picture of release and migration. Additionally, the anomalously high concentrations of lead of 2400 µg/L and 3900 µg/L in borings near the former Fillmore MGP (FF-TG-53) and former North Beach MGP (NB-ROW-TG70), require additional investigation.

9.5 Interim Remedial Action – Shallow Tar Reservoir

During installation of NB-ROW-MW11 on March 1, 2017, a PG&E contractor encountered "Continuous NAPL present at 9.67,' pooled on concrete refusal surface."[54] That concrete refusal surface is understood to be the bottom of the former North Beach MGP Tars well along Beach Street, as the boring is within the footprint of the historical tar well. Due to the discovery of free product within a shallow former underground storage tank, this area should be considered for an Interim Remedial Action.

9.6 Ongoing Investigation of the Marina District

This report is based on data from all Investigation Events and some Related Investigations through August, 2017. It must be noted that data from other Related Investigations, including the West Harbor, has not been integrated into the project database and was not reviewed during preparation of this report. The investigation of the Marina District is ongoing and additional

[54] Boring log, JJA, Well Number MW-11.

investigations are required to advance the process of determining the nature and extent of MGP residue in the Marina District by investigating MGP Residues in shallow soil, groundwater, and sediment, including the extent of MGP Tars/SPR and occurrence of MGP Residue in aquifer units beneath aquitard/aquiclude materials. Additionally, the potential for vapor intrusion in the Marina District should be investigated, including inventorying structures without building slabs and with residential units at or below grade. Furthermore, samples should be collected for fingerprinting from terrestrial locations from areas of continuous non-aqueous phase liquid (NAPL) MGP Tars – targeting locations where product was historically released into a terrestrial environment and where product was historically released into an aquatic environment (now terrestrial due to subsequent filling). Those samples should be analyzed for a comprehensive suite of chemicals, including PAHs and biomarkers, as the current state of practice recognizes that biomarker review is often required to differentiate between hydrocarbons with phytogenic, petrogenic, or pyrogenic origins. Similarly, mineralogical analysis with macro and microscopic photographs should be performed of solid waste material identified in the field in order to provide briefing materials for field personnel that will support standardization of field observations of solid waste material and the ongoing dispute regarding adding lead in soil to the joint investigation should be resolved.

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