

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO.

WASTE DISCHARGE REQUIREMENTS R5-2004-0082
FOR
EQUITY OFFICE MANAGEMENT, L.L.C. AND
M&H PROPERTY MANAGEMENT
ARDEN SQUARE SHOPPING CENTER
POTASSIUM PERMANGANATE INJECTION AND RECIRCULATION SYSTEM
SACRAMENTO COUNTY

The California Regional Water Quality Control Board, Central Valley Region (hereafter Regional Board) finds that:

1. Equity Office Management, L.L.C. (hereafter EOP) submitted a complete Report of Waste Discharge (RWD) on 18 March 2003 for a proposed groundwater recirculation system and focused potassium permanganate injections at 3108 Arden Way, Sacramento. EOP submitted this RWD as the successor by merger to Spieker Properties, the former owner of the property.
2. M&H Property Management (hereafter M&H) is the current owner of the property. EOP is hereafter referred to as the Discharger, and both EOP and M&H are responsible for compliance with this Order. However, since M&H is the property owner and EOP will be operating the groundwater treatment system and discharging treated groundwater, EOP is initially required to comply with this Order. If EOP does not comply, then within 60 days of notification by the Executive Officer, M&H will be required to comply.
3. The property is Assessor's Parcel Number 286-0030-019-0000 (hereafter referred to as Site), at T9N, R5E, S62 in MDB&M, as shown on Attachment A, which is attached hereto and made part of these Waste Discharger Requirements (WDRs), hereafter referred to as Order, by reference.

BACKGROUND

4. In 1992, following an inspection by the Sacramento County Environmental Management Department, Hazardous Materials Division, a dry cleaner tenant at the Site was advised to discontinue the disposal of separator water containing tetrachloroethene (PCE) into the boiler and sanitary sewer and instead handle the material as a hazardous waste. Wastewater from the washing machines at the facility drained into a masonry floor drain, which then entered the sanitary sewer. However, the tenant operator continued to use the transfer type of dry cleaning unit until November 1995, when it switched to a dry-to-dry non-venting dry cleaning machine that is closed-loop, generates less wastewater. The new dry cleaning unit was installed within a secondary containment unit to contain any releases.
5. In 1996, PCE was discovered in soil and groundwater during an environmental assessment for the purpose of a property transfer. Between 1997 and 1998, three phases of remedial investigations were performed to assess the vertical and lateral extent of PCE in soil and groundwater, resulting in the installation of 12 monitoring wells, 11 vapor extraction wells, one air sparging well, and one groundwater extraction well.

6. In 1998, a soil gas survey was performed. Based on the soil gas survey results, soil beneath the floor inside the former dry cleaning facility was excavated. In 1999, a soil vapor extraction (SVE) and treatment system began operation. The SVE system was shut down in August 2002 after testing showed that the treatment system had removed a majority of the volatile organic compound (VOC) contamination from the vadose zone soil.
7. Groundwater monitoring has been conducted at the Site since 1997 as a result of remedial measures completed to date. Groundwater is first encountered at about 85 feet below ground surface (bgs) and flows northward. An aquitard exists at about 98 feet bgs. The primary contaminant of concern at the Site is PCE. The highest concentration of PCE detected in groundwater at the Site was 1,800 micrograms per liter ($\mu\text{g/l}$) in September 1997 in monitoring well MW-1, as shown on Attachment B, which is attached hereto and made part of this Order by reference. MW-1 is immediately downgradient of the source area. The concentration of PCE in MW-1 has steadily declined since 1997. The highest concentrations of PCE in groundwater during 2003 occurred in well MW-9 with concentrations ranging from 180 to 610 $\mu\text{g/l}$. Several VOCs other than PCE, including chloroform, 1,1,1-trichloroethane, and 1,1-dichloroethane have historically been detected infrequently in various wells at low concentrations (1,1,1-trichloroethane on two occasions in June and September 1997 in MW-5 and 1,1-dichloroethane on one occasion in MW-10 in September 1998). Chloroform has been detected periodically in groundwater from both upgradient and downgradient wells. The source of the chloroform has not been identified, but chloroform is not a breakdown product of PCE.
8. On 8 July 1999, Monitoring and Reporting Program (MRP) No. 99-805 was issued to require quarterly monitoring of the monitoring wells. This MRP remains in effect.
9. In January 2001, aquifer slug tests and a bench-scale test were performed to provide additional information for the design and implementation of an in-situ chemical oxidation pilot test using potassium permanganate to oxidize PCE in groundwater.
10. The Discharger performed sampling in November 2001 of the two most upgradient monitoring wells (MW-2 and MW-4) to assess baseline groundwater conditions for VOCs. PCE was not detected in either well. Formaldehyde was detected at 0.77 and 1.9 $\mu\text{g/l}$. For all other parameters detected in the November 2001 sampling, monitoring wells MW-2, MW-4, and MW-14 were used to determine site specific baseline ranges for the pilot test, which are as follows:

Calcium	36 - 40 milligrams per liter (mg/l)
Chloride	34 mg/l
Hexavalent Chromium	5.8 – 8.6 $\mu\text{g/l}$
Potassium	23 - 27 mg/l
Sodium	20 - 22 mg/l
Total Dissolved Solids (TDS)	330 - 390 mg/l
11. In January 2002, the Regional Board issued WDRs Order No. R5-2002-0009 allowing a potassium permanganate injection pilot study. In May 2002, the Discharger injected about 17,500 gallons of potassium permanganate into the groundwater at a concentration of up to 1,500 mg/l at up to 12

gallons per minute (gpm) under only gravitational pressure for about eight hours a day for three consecutive days. The injection occurred through an injection well about 10 feet west of well SP-1A. Overall, the results of the pilot test have been favorable and within the range of what were anticipated. Significant and sustained removal of PCE has been observed in the downgradient pilot study monitoring wells. For example, results of the pilot study showed that PCE was reduced to non-detect levels in pilot test monitoring wells MW-1 and MW-16 and showed a reduction in PCE concentrations in downgradient monitoring well MW-14 from pretest levels of 68 µg/l to 15 µg/l.

12. The Discharger collected baseline concentration data in part to track the byproducts of the oxidation process, which include manganese dioxide, chloride, TDS, and hexavalent chromium. TDS and chloride concentrations remained consistent after the injection, but metals concentrations, such as hexavalent chromium, manganese, and arsenic increased as a result of the injection, as anticipated. Since July 2002, the concentrations of all metals have steadily declined and returned to baseline concentrations except for hexavalent chromium. The concentrations of hexavalent chromium were not anticipated because the bench test results, which used site soil and groundwater samples, resulted in no net increase of hexavalent chromium. Hexavalent chromium concentrations have declined in all but three monitoring wells (MW-1, EX-1, and SP-1A), but it has taken longer to attenuate because of the high oxidation levels in groundwater in the Site vicinity.
13. In November 2003, the Discharger installed three groundwater monitoring wells (MW-17, MW-18, and MW-19) to further delineate the downgradient extent of PCE pollution and to add additional monitoring points to evaluate upcoming full-scale remedial actions. The Discharger also installed two extraction wells (EX-2 and EX-3) on the south side of Arden Way. The two extraction wells will be incorporated into the permanganate and groundwater recirculation treatment system that will operate in the area of the plume located south of Arden Way.

PROPOSED REMEDIATION PROJECT

14. Based on the successful results of the pilot study, the Discharger has constructed groundwater fate and transport and reaction models to simulate treatment processes for full-scale remediation. The Discharger proposes two separate remedial actions for full-scale remediation. The first action is to install and operate a potassium permanganate injection and groundwater recirculation treatment system on the Site. The second action is to conduct focused potassium permanganate injections in 10 wells off-Site to clean up lower concentrations of PCE in groundwater near the leading edge of the plume. The Discharger may conduct both actions simultaneously or in phases. The use of two separate groundwater treatment systems is due to the access constraints caused by Arden Way, which is an arterial street that contains numerous buried utilities which prevent extending piping from the Site across to the north side of Arden Way.
15. For the on-Site system, the Discharger proposes to extract groundwater from four extraction wells (EX-2 through EX-5) installed about 160 feet apart downgradient of the source area, as shown on Attachment B. The extracted groundwater will be piped back to the permanganate recirculation treatment compound near monitoring well MW-2 and filtered to remove particulate matter. For the first six months of the system operation, the groundwater will be pumped to a permanganate

mixing tank that will mix in powdered potassium permanganate to result in a mixture with about 250 mg/l of potassium permanganate. The permanganate and groundwater solution will be filtered prior to injection to remove particulate matter, including undissolved permanganate crystals, to minimize the potential for clogging portions of the well screen and/or formation.

16. The four injection wells (RW-1 through RW-4) are also about 160 feet apart and are equidistant from the extraction wells. The groundwater reaction model results predict that injecting water with 250 mg/l of potassium permanganate solution should result in a concentration of 10 mg/l of potassium permanganate in the extracted groundwater. Groundwater reaction model simulations predict that the groundwater amended with potassium permanganate (hereafter referred to as amended groundwater) should reach the extraction wells about 95 days after the startup of the system with steady-state concentrations occurring in about four months.
17. After the initial six months of injecting amended groundwater, the Discharger will stop adding the permanganate and continue to recirculate the groundwater to continue to pull the amended groundwater through the aquifer. Modeling has shown that continuously adding potassium permanganate for more than six months would exceed the soil oxidant demand and the chemical oxidant demand for PCE.
18. The Discharger will discharge small amounts of excess extracted unamended groundwater (if necessary) into IW-1 to keep the recirculation system in balance. In the event that groundwater is discharged to IW-1, any permanganate in the extracted water will be neutralized using a low dosage of sodium bisulfite or citric acid. Using either of these additives will reduce the permanganate to manganese dioxide, which is a solid. The solids will be removed prior to injection using a filter.
19. The treatment area for the potassium permanganate injection and groundwater recirculation system extends from extraction wells EX-2 and EX-3 about 250 feet upgradient (south) to injection wells RW-3 and RW-4. Extracting groundwater from the four extraction wells, along with the natural groundwater flow direction, will pull the amended groundwater through the treatment area and provide hydraulic control for complete containment of the potassium permanganate within the treatment area. Groundwater reaction model simulations predict that extraction wells EX-2 and EX-3 should capture groundwater about 120 feet downgradient of the Site.
20. The volume of amended groundwater injected will vary by season. The recirculation system will run continually for two years with the potassium permanganate only being added to the extracted groundwater for six months of each year. The optimal injection schedule for amended groundwater will be 180 days per year for two years when water levels allow groundwater extraction rates greater than 4.5 gpm from each extraction well or 18 gpm for the treatment system as a whole. At low water levels, injection for the system will be about 8.5 gpm with about 2.1 gpm from each extraction well. At high water levels, injection for the system will be about 33 gpm with about 8.3 gpm from each extraction well.
21. The Discharger has calculated that it will take about 80 days for the potassium permanganate to be consumed after the initial six months of amended groundwater injection has stopped. The

Discharger proposes to continue to recirculate the extracted water for about 100 days longer than the calculated time for the potassium permanganate to be consumed to allow time to monitor the treatment process and assess the permanganate dosage, permanence of PCE removal, and attenuation of byproducts.

22. In addition to the amended groundwater program, the Discharger will conduct focused injections off-Site (north of Arden Way) about 370 feet downgradient of extraction wells EX-2 and EX-3. Focused potassium permanganate injections will occur in 10 injection wells in two rows of five about 60 feet apart, as shown on Attachment B. This will create two 250-foot wide treatment areas perpendicular to the groundwater flow direction. The location of the injection wells is based on the extent of the PCE plume and outside of the influence of the on-Site groundwater recirculation system. Based on calculations of groundwater velocity and the recirculation system modeling, the Discharger proposes four separate focused injection events each six months apart to fully remediate VOC pollution downgradient of the Site. This schedule will help prevent overdosing in the event that the groundwater recirculation system and/or focused injection modeling is conservative and the injections result in a greater reduction in downgradient VOC concentrations than calculated. Each additional round of focused injections, beyond the four proposed in the 1 March 2004 *Final Cleanup Plan* (FCP), will require written approval by the Executive Officer.
23. Based on the results of the pilot study, the Discharger proposes an injection volume of 4,500 gallons at 1,500 mg/l potassium permanganate solution per injection well, which will result in a 15 milligram per kilogram soil dosage rate. The soil dosage rate refers to the mass of soil and groundwater in the aquifer for the treatment area, which is calculated so that the potassium permanganate does not exceed the soil and chemical oxidant demand. The injection volume will result in a treatment radius of about 33 feet for each injection well. The injections will last about 10 days, with injections in one well per day. This dosage is about 70 percent of the dosage used for the pilot study, which should result in minimal byproduct production.
24. As part of the monitoring for the focused injections, the Discharger will install three additional monitoring wells (MW-20 through MW-22) near the 10 focused injection wells. These wells will monitor the treatment area and determine whether the potassium permanganate, pollutant breakdown products, and/or reaction byproducts have migrated beyond the boundary of the calculated treatment area.
25. As part of the overall Site evaluation, the Discharger will collect baseline samples from the monitoring wells associated with the recirculation system and focused injections. As part of the recirculation system monitoring, the Discharger will continue to collect samples from monitoring wells MW-1, MW-3, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11, MW-14, MW-15, MW-16, and MW-19. As part of the focused injection monitoring, the Discharger will continue to collect samples from MW-12, MW-13, MW-20, MW-21, MW-22, and the 10 focused injection wells. The required constituents and monitoring frequency is detailed in attached MRP No. R5-2004-0082. The Discharger will continue the sampling program until the constituents monitored in groundwater have been reduced below cleanup goals, as provided in *A Compilation of Water Quality Goals*, or have returned to baseline concentrations.

26. In the event that hexavalent chromium concentrations exceed 20 percent above baseline concentrations in any well outside the treatment area associated with the recirculation monitoring, as listed under "Recirculation Monitoring Wells," "Outside Treatment Zone Wells" in Table 1 of the attached MRP, the Discharger will install a sulfur modified iron (SMI) filter to remove the hexavalent chromium prior to reinjecting the amended or unamended groundwater. If hexavalent chromium concentrations remain 20 percent above baseline concentrations in any of those monitoring wells three months after the addition of the SMI filter, the Discharger will immediately cease amending the extracted groundwater with potassium permanganate and continue to monitor hexavalent chromium concentrations for an additional six months. Within the six months, the Discharger will conduct bench-scale testing using the groundwater outside the treatment area affected by the potassium permanganate injection to determine the dosage of calcium polysulfate needed to reduce hexavalent chromium concentrations to baseline levels. Within two months of receiving written approval of the calcium polysulfate dosage, the Discharger will inject calcium polysulfate into groundwater at the treatment area boundary.
27. In the event that hexavalent chromium concentrations are 20 percent above baseline concentrations in any monitoring well outside the treatment area associated with the focused injection, as listed under "Focused Injection Monitoring Wells," "Outside Treatment Zone Wells" in Table 1 of the attached MRP for a monitoring period of three months. If hexavalent chromium concentrations do not decrease to baseline concentrations or within 20 percent of baseline within the three months, the Discharger has three months to conduct bench-scale testing to determine the dosage of calcium polysulfate needed to reduce hexavalent chromium concentrations to baseline levels and provide the results to the Regional Board. Within two months of receiving written approval of the calcium polysulfate dosage, the Discharger will inject calcium polysulfate into groundwater at the treatment area boundary.
28. Although the pilot study showed that concentrations of byproducts other than hexavalent chromium remained consistent or reduced to baseline concentrations (as predicted by bench testing), that the potassium permanganate did not extend beyond the calculated radius, and no pollutant breakdown products were observed, contingencies for these events are needed. In the event that potassium permanganate reaches MW-20, the Discharger will not inject any additional potassium permanganate into the focused injection wells until the Executive Officer gives written approval to do so. Although the injections of potassium permanganate have stopped, monitoring as required in MRP No. R5-2004-0082 will continue so compliance with Groundwater Limitations C.4 is met.
29. In the event that concentrations of pollutant breakdown products, chloride, TDS, manganese, and/or arsenic are 20 percent higher than baseline concentrations in MW-18, the Discharger will collect a confirmation sample from MW-18 within 14 days of receiving the analytical results. If the MW-18 confirmation sample confirms the exceedence, the Discharger will not inject any additional potassium permanganate into the focused injection wells until the Executive Officer gives written approval to do so. Although the injections of potassium permanganate have stopped, monitoring as required in MRP No. R5-2004-0082 will continue so compliance with Groundwater Limitations C.4 is met.

30. Based on a well survey, the closest water supply well is about 800 feet upgradient from the injection point. The closest downgradient supply well is about 2,000 feet north of the Site boundary.

REGULATORY CONSIDERATIONS

31. The injection of chemicals into waters of the State is subject to regulation under the California Water Code. This Order authorizes the Discharger to discharge potassium permanganate and groundwater amended with potassium permanganate and/or calcium polysulfate into groundwater subject to specific discharge requirements.
32. The *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, Fourth Edition*, (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives (WQOs), contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Water Resources Control Board (State Board). Pursuant to Section 13263(a) of the California Water Code, WDRs must implement the Basin Plan.
33. Surface water drainage is to the American River within the legal boundaries of the Sacramento – San Joaquin Delta. Beneficial uses of the American River between Folsom Dam and the Sacramento River are municipal and domestic supply; agricultural irrigation supply; industrial service supply; power generation; water contact recreation; noncontact water recreation; warm and cold freshwater habitat; migration of warm and cold freshwater species; spawning, reproduction and/or early development of warm and cold freshwater species; and wildlife habitat.
34. The designated beneficial uses of underlying groundwater are municipal and domestic supply, agricultural supply, and industrial service and process supply.
35. Surrounding land uses are residential and commercial.
36. State Board Resolution No. 92-49 requires the Regional Board to require actions for cleanup and abatement of discharges that cause or threaten to cause pollution or nuisance to conform to the provisions of State Board Resolution No. 68-16 (hereafter Resolution 68-16) and the Basin Plan. Pursuant to Resolution No. 92-49, the Regional Board shall ensure that dischargers are required to cleanup and abate the effects of discharges in a manner that promotes attainment of either background water quality, or if background levels of water quality cannot be restored, the best water quality which is reasonable and which complies with the Basin Plan including applicable WQOs.
37. Resolution 68-16 requires the Regional Board in regulating discharges to maintain high quality waters of the State until it is demonstrated that any change in quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and potential beneficial uses, and will not result in water quality less than that described in plans and policies (e.g., quality that exceeds any WQO). Temporal degradation of groundwater at this Site due to the

discharge of potassium permanganate and amended groundwater with potassium permanganate may occur. The temporary degradation allowed by this Order is consistent with Resolution 68-16 since (1) the purpose is to accelerate and enhance remediation of groundwater pollution by PCE and such remediation will benefit the people of the State; (2) the degradation is limited in scope and duration; (3) best practicable treatment and control, including adequate monitoring and contingency plans to assure protection of water quality, are required; and (4) the discharge will not cause WQOs to be exceeded beyond the treatment area or project duration, as defined in Finding Nos. 19, 21, and 22.

38. Section 13267(b) of California Water Code provides that:

In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste outside of its region that could affect the quality of the waters of the state within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the board requires. The burden, including costs of these reports, shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports.

The technical reports required by this Order and the attached MRP No. R5-2004-0082 are necessary to assure compliance with these WDRs. The Discharger is the successor to the former property owner (Spieker Properties) of real property that contains the former tenant's facility that discharged the waste covered by this Order. The Discharger has received access to the Site from the current owners (M&H Property Management) to conduct the groundwater cleanup.

39. The California Department of Water Resources sets standards for the construction and destruction of groundwater wells, as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 74-81* (December 1981). These standards, and any more stringent standards adopted by the State or County pursuant to California Water Code Section 13801, apply to all monitoring wells.

40. Issuance of this Order is an action to assure the restoration of the environment and is, therefore, exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000, et seq.), in accordance with Section 15308 and 15330, Title 14, California Code of Regulations (CCR).

41. This discharge is exempt from the requirements of *Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste*, as set forth in Title 27, CCR, Section 20005, et seq., (hereafter Title 27). The exemption pursuant to Section 20090(b), is based on the following:

- a. The Board is issuing WDRs,
- b. The discharge complies with the Basin Plan, and
- c. The wastewater does not need to be managed according to Title 22 CCR, Division 4.5, and Chapter 11, as a hazardous waste.

In addition, Section 20090(d) allows exemption for a project to clean up a condition of pollution that resulted from an unauthorized release of waste based on the following:

- d. The cleanup and abatement action is under the direction of a public agency;
 - e. Wastes removed from the immediate place of release will be discharged according to the Title 27 regulations; and
 - f. The remedial actions intended to contain wastes at the place of release shall implement the Title 27 regulations to the extent feasible.
42. Pursuant to California Water Code Section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.
 43. All the above and the supplemental data and information and details in the attached Information Sheet, which is incorporated by reference herein, were considered in establishing the following conditions of discharge.
 44. The Discharger and interested agencies and persons were notified of intent to prescribe WDRs for this discharge and provided with an opportunity for a public hearing and an opportunity to submit written views and recommendations.
 45. In a public meeting, all comments pertaining to the discharger were heard and considered.

IT IS HEREBY ORDERED that pursuant to Sections 13263 and 13267 of the California Water Code, Order No. R5-2002-0009 is rescinded and Equity Office Management, L.L.C. and M&H Property Management, their agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following while conducting the above-described potassium permanganate injection and recirculation system:

[Note: Other prohibitions, conditions, definitions, and some methods of determining compliance are contained in the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements" dated 1 March 1991, incorporated herein.]

A. Discharge Prohibitions

1. Discharge of wastes to surface waters or surface water drainage courses is prohibited.
2. The discharge of other than potassium permanganate, calcium polysulfate, or groundwater amended with potassium permanganate or calcium polysulfate into groundwater is prohibited.

3. Discharge of waste classified as 'hazardous' under Section 2521 of Title 23, CCR, or as 'designated' under Section 13173 of California Water Code is prohibited.
4. Discharge of potassium permanganate or amended groundwater at a location or in a manner different from that described in Finding Nos. 15 through 17, 20, 22, and 23 is prohibited.
5. Full system operation is prohibited until the report required in Provision E.4.a has been approved by Regional Board staff.

B. Discharge Specifications

1. The Discharger shall provide hydraulic control that provides full and complete containment within the treatment area of any groundwater pollutants, pollutant breakdown products, amendments, and byproducts of the in situ treatment process during and after discharge of any amended groundwater. The Discharger shall continue to provide hydraulic control while discharge and cleanup are ongoing.
2. No waste constituent shall be released or discharged, or placed where it will be released or discharged, in a concentration or in a mass that causes violation of the Effluent or Groundwater Limitations.
3. Prior to beginning full scale operation of the groundwater recirculation system, consisting of groundwater extraction from four wells, the Discharger shall comply as follows:
 - a. System Check

Prior to operating the groundwater recirculation system with amended water, a system check shall be conducted to confirm the proper construction and operation of the recirculation system. The following requirements apply to this system check phase:

- i. A conformance inspection shall be conducted to confirm that all equipment, piping, instrumentation, and control system of the groundwater recirculation system have been installed according to the approved design. Any deficiencies shall be corrected.
 - ii. To confirm piping integrity, piping of the extraction and injections wells shall be pressure tested at 150 percent of the design pressure with potable water. Any leaks shall be repaired.
 - iii. All instrumentation, control systems, and equipment shall be inspected for malfunctions. Instrumentation shall be calibrated and operational. All automatic controls, such as shutdown or alarm switches, shall be certified operational. Mechanical equipment such as the transfer pump and air blower will be cycled on and off. Any functional deficiencies shall be corrected.
- b. Prove-out of System

The following requirements apply to this prove-out of system phase.

- i. The prove-out of system phase shall last a minimum of two weeks.
- ii. Each of the four extraction wells shall be pumped for at least one hour to confirm that the pumps operate properly.
- iii. All extracted groundwater shall either be properly disposed of at a disposal facility, or held for amendment and reinjection once the recirculation system is operating in full-scale status.
- iv. All equipment, instrumentation, and alarm/notification systems shall be inspected throughout the duration of the prove-out and certified operational.
- v. All treatment, transport, and disposal components (including pumping valves, liquid level controllers, pipelines, blowers, flow meters, pressure gauges, etc.) shall be inspected daily for the initial two weeks after start-up of the system, followed by twice weekly inspections for two weeks, weekly inspections for the next two months, and monthly inspections thereafter.
- vi. The operation of the groundwater recirculation system shall cease at the end of the prove-out period. The Discharger shall not resume operation of the system until the Regional Board staff has reviewed the prove-out of system report (Provision E.4.a) and has authorized operation in writing.

c. Full-Scale Operation

The Discharger shall not initiate the full-scale operation of the groundwater recirculation system until Regional Board staff has reviewed the prove-out of system report and has approved the full-scale operation of the system. The following requirements apply to this full-scale operations phase.

- i. The discharge of amended or unamended groundwater to the injection wells shall not exceed their respective capacities.
 - ii. The Discharger shall operate the recirculation system to maximize VOC removal.
 - iii. All treatment, transport, and disposal components (including pumping valves, liquid level controllers, pipelines, blowers, flow meters, pressure gauges, etc.) shall be inspected monthly.
 - iv. The system's automatic controls, including the alarm/notification and shutdown systems, shall be tested and certified operational on an annual basis.
4. Prior to injecting amended groundwater into the injection wells, potable water shall be injected into each well proposed for use as an injection well to establish the well's capacity. The Discharger shall inject potable water into each well at 50, 100, and 150 percent of the estimated well capacity. The injection at each flow rate must continue for a minimum of one hour. All leaks and/or malfunctions observed during the potable water test shall be corrected. The Discharger shall not begin injecting amended groundwater to these wells until the Regional Board staff has reviewed the potable-water start up summary report (Provision E.4.a) and approved the injection in writing.

5. The Discharger shall only inject potassium permanganate into the focused injection wells off-site in accordance with Finding Nos. 22 and 23.

C. Groundwater Limitations

1. The Discharger shall not cause the groundwater outside the treatment areas to contain waste constituents greater than 20 percent above baseline ranges as determined in the Baseline Summary Report (Provision E.4.b).
2. The Discharger shall not cause the groundwater outside the treatment areas to contain pollutant breakdown products, amendments, or byproducts in concentrations that equal or exceed WQOs or background concentration. For the following constituents, the limits presented below shall be used to apply applicable WQOs:

Chloroethane	16	ug/L
1,1-Dichloroethane	3	ug/L
1,2-Dichloroethane	0.4	ug/L
1,1-Dichloroethylene	6	ug/L
cis-1,2-Dichloroethylene	6	ug/L
trans-1,2-Dichloroethylene	10	ug/L
1,1,1-Trichloroethane	200	ug/L
Trichloroethylene	0.8	ug/L
Vinyl chloride	0.05	ug/L
Hexavalent Chromium	21	ug/L
Manganese	50	ug/L
Chloride	106	mg/L
Sulfate	250	mg/L
Total Dissolved Solids	450	mg/L

3. The Discharger shall not cause the groundwater outside the treatment areas to contain taste and odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses.
4. When the remedial activities are completed, the pollutants, pollutant breakdown products, amendments and byproducts shall not exceed baseline levels, within or outside the treatment areas.

D. Effluent Limitations

The following limitations apply to the discharge of unamended groundwater to injection well IW-1.

1. The effluent shall not have a pH of less than 6.5 or greater than 8.4.
2. The discharge of effluent in excess of the following limits is prohibited:

<u>Constituent</u>	<u>Units</u>	<u>30-Day Average</u>	<u>Daily Maximum</u>	<u>Quantitation Limit¹</u>
tetrachloroethene	µg/l	0.5	1.0	0.5
chloroform	µg/l	0.5	1.0	0.5
trichloroethene	µg/l	0.5	1.0	0.5
cis-1,2-dichloroethene	µg/l	0.5	1.0	0.5
hexavalent chromium	µg/l	1.0	2.0	1.0
manganese	mg/l	0.05	0.1	0.02

¹ For nondetectable detection results

3. If the target constituents are detected above the 30-day average concentration limits in IW-1, the Discharger shall obtain a confirmation sample within 24 hours of receiving the results and cease discharging until the analytical results of confirmation samples are below the limits above. If the exceedance is confirmed, the Discharger shall install a granular activated carbon vessel as part of the recirculation system to treat unamended groundwater prior to injection into the upgradient injection well IW-1. The Discharger shall conduct a retest within 72 hours of restarting the system, which shall occur within 60 days of receipt of the confirmed exceedance.

E. Provisions

1. The Discharger shall notify Regional Board staff a minimum of two weeks prior to the startup of the recirculation system and any injection of potassium permanganate.
2. The Discharger shall comply with the attached MRP No. R5-2004-0082, which is part of this Order, and any revisions thereto as ordered by the Executive Officer.
3. The Discharger shall comply with the “Standard Provisions and Reporting Requirements for Waste Discharge Requirements,” dated 1 March 1991, which are attached hereto and by reference a part of this Order. This attachment and its individual paragraphs are commonly referenced as “Standard Provision(s).”
4. All of the following reports shall be submitted pursuant to Section 13267 of the California Water Code. All technical reports required herein that involve planning, investigation, evaluation, or design, or other work requiring interpretation and proper application of engineering or geologic sciences, shall be prepared by or under the direction of persons registered to practice in California pursuant to California Business and Professions Code sections 6735, 7835, and 7835.1. To demonstrate compliance with sections 415 and 3065 of Title 16, CCR, all technical reports must contain a statement of the qualifications of the responsible registered professional(s). As required by these laws, completed technical reports must bear the signature(s) and seal(s) of the registered professional(s) in a manner such that all work can be clearly attributed to the professional responsible for the work.

- a. The Discharger shall submit a groundwater recirculation system prove-out of system, system check, and potable water start up summary report for approval at least two weeks prior to the proposed commencement of full-scale operation of the groundwater recirculation system. This report shall document compliance with the Discharge Specifications B.3.a, B.3.b and B.4. In addition, this report shall include a performance evaluation of the system and discussion of each test with calculated flow rates and hydrostatic tests.
- b. The Discharger shall submit a Baseline Summary Report due prior to injection of potassium permanganate or startup of the recirculation system to evaluate the natural variation and propose baseline numbers for pollutants, pollutant breakdown products, amendments, and byproducts. The Discharger shall not begin injection until receiving written Executive Officer approval of baseline concentrations.
- c. The Discharger shall submit a Startup Report due no later than **60 days** after startup of the potassium permanganate recirculation system. The Startup Report shall include a description of well and system installation and results of the first month of operation.
- d. The Discharger shall submit a focused potassium permanganate Investigation Report due no later than **60 days** after the initial round of focused injections. The Investigation Report shall discuss the field activities and describe the injections including rates, volume, and time, and results of the first two weekly sampling events.
- e. The Discharger shall submit a groundwater recirculation system Status Report due no later than **1 year** after the startup of the system. The Status Report shall include a summary of the six months of amended groundwater injection and five months or recirculation of extracted groundwater operation, sampling results, calculations of the extracted and injected volumes, amount injected into IW-1, if applicable, and a discussion of rates of potassium permanganate consumed, permanganate dosage, permanence of PCE and PCE breakdown product removal, and attenuation of byproducts. If the Discharger proposes injection of amended groundwater other than described in Finding Nos. 15, 16, and 20 based on the results presented in the Status Report, the Discharger shall not begin the next injection of amended groundwater until new WDRs are issued. If the amended groundwater injection is consistent with Finding Nos. 15, 16, and 18, Regional Board staff will provide written concurrence prior to the next round of amended groundwater injection.
- f. Prior to any additional focused potassium permanganate injections, beyond the four proposed in the FCP and as described in Finding Nos. 22 and 23, the Discharger shall submit a work plan for additional injections that includes sampling results from the most recent focused injections, rationale for the additional injections, and time schedule for Executive Officer approval.

5. In the event that hexavalent chromium concentrations are 20 percent above baseline in any well outside the recirculation treatment area, the Discharger shall immediately notify Regional Board staff of the exceedance(s) and obtain a confirmation sample within **14 days** of receiving the results. Within **48 hours** of receiving the confirmation sample results, the Discharger shall notify Regional Board staff of the results followed by written notification within **7 days**. If the exceedance is confirmed, within **30 days** the Discharger shall implement the contingency plan as described in Finding No. 26.
6. In the event that hexavalent chromium concentrations are 20 percent above baseline in monitoring wells associated with the focused injections outside of the extraction well capture zone for a monitoring period of three months, within **30 days** the Discharger shall implement the contingency plan as described in Finding No. 27.
7. In the event that potassium permanganate reaches MW-20, the Discharger shall implement the contingency plan as described in Finding No. 28.
8. In the event that concentrations of pollutant breakdown products, chloride, TDS, manganese, and/or arsenic are 20 percent higher than baseline concentrations in MW-18 or potassium permanganate reaches MW-18, the Discharger shall immediately notify Regional Board staff of the exceedance(s) and obtain a confirmation sample within **14 days** of receiving the results. Within **48 hours** of receiving the confirmation sample results, the Discharger shall notify Regional Board staff of the results followed by written notification within **7 days**. If the exceedance is confirmed, within **30 days** the Discharger shall implement the contingency plan as described in Finding No. 29.
9. The Discharger shall comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Regional Board or court order requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.
10. The Discharger shall maintain records of all monitoring information including all calibration and maintenance records, copies of all reports required by this Order, and records of all data used to complete the application for this Order. Records shall be maintained for a minimum of three years from the date of the sample, measurement, or report. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Executive Officer.
11. The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control that are installed or used by the Discharger to achieve compliance with this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems, which are to be installed by the Discharger only when necessary to achieve compliance with the conditions of this Order.

12. The Discharger shall report any non-compliance, system shutdown, and/or accidental spill or release of liquid or material verbally to the Regional Board within 24 hours of the spill or release, and follow-up the verbal notification with written documentation of the spill or release within 14 calendar days of the incident.
13. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.
14. As described in the Standard Provisions, the Discharger shall report promptly to the Regional Board any material change or proposed change in the character, location, or volume of the discharge.
15. While this Order is in effect, and prior to any change in ownership of the Site or management of this operation, the Discharger shall transmit a copy of this Order to the succeeding Owner/Operator, and forward a copy of the transmittal letter and proof of transmittal to the Board.
16. The Regional Board will review this Order periodically and will revise requirements when necessary.

I, THOMAS R. PINKOS, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 4 June 2004.

THOMAS R. PINKOS, Executive Officer

Attachments

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
MONITORING AND REPORTING PROGRAM NO. R5-2004-0082
FOR
EQUITY OFFICE MANAGEMENT, L.L.C. AND
M&H PROPERTY MANAGEMENT
ARDEN SQUARE SHOPPING CENTER
POTASSIUM PERMANGANATE INJECTION AND RECIRCULATION SYSTEM
SACRAMENTO COUNTY

This Monitoring and Reporting Program (MRP) incorporates requirements for monitoring the progress of the potassium permanganate injection and recirculation system. This MRP is issued pursuant to California Water Code Section 13267. Equity Office Management L.L.C. (Discharger), the successor to the former owner of the site, Spieker Properties, and is required to comply with this MRP. If Equity Office Management L.L.C. fails to perform as directed by this MRP, then upon notification by the Executive Officer, the current site owner, M&H Property Management, will be required to comply. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer. In addition to this MRP, groundwater sampling and reporting outlined in MRP No. 99-805 is still required.

All samples shall be representative of the volume and the nature of the discharge and matrix of the sampled medium. The time, date, and location of each grab sample shall be recorded on the sample chain of custody form.

REMEDIATION MONITORING

As shown on Attachment B, there are 17 shallow zone monitoring wells, three proposed shallow zone monitoring wells, two deep monitoring wells, three extraction wells, two proposed extraction wells, one proposed injection well, four proposed recirculation injection wells, 10 proposed focused permanganate injection wells, and one sparge well. The Discharger shall follow the groundwater monitoring program for the wells listed on Table 1, which lists the sampling frequency and the analytical testing requirements. Sample collection and analysis shall follow standard EPA protocol and sample analyses shall be completed by a California State certified laboratory.

Field measured parameters shall be recorded every time these wells are sampled. The field measured parameters to be recorded are:

<u>Constituents</u>	<u>Units</u>
Electrical conductivity	µmhos/cm
pH	pH units
Oxidation-reduction potential	millivolts
Dissolved oxygen	mg/l
Temperature	°F/°C
Groundwater elevation	Feet and hundredths, mean sea level

All field testing instruments (such as those used to measure the constituents listed above) may be used provided that:

1. The operator is trained in proper use and maintenance of the instruments;
2. The instruments are field calibrated prior to each monitoring event;
3. Instruments are serviced and/or calibrated by the manufacturer at the recommended frequency; and
4. Field calibration reports are provided with the appropriate monitoring report.

REPORTING

In reporting monitoring data, the Discharger shall arrange the data in tabular form so that the date, sample type, and reported analytical result for each sample are readily discernible. The data shall be summarized in such a manner to clearly illustrate compliance with waste discharge requirements and spatial or temporal trends, as applicable. The results of any monitoring done more frequently than required at the locations specified in the MRP shall also be reported to the Regional Board. In addition, the Discharger shall notify the Board within 24 hours of any unscheduled shutdown of the potassium permanganate injection and recirculation system.

As required by the California Business and Professions Code Sections 6735, 7835, and 7835.1, all reports shall be prepared by a registered professional or their subordinate and signed by the registered professional.

A. Monthly Operation Reports

The Discharger shall submit to the Regional Board monthly operation reports by the 1st day of the second month following sampling (i.e., the January Report is due by 1 March). These operation reports shall contain a summary of the results of monitoring, including effluent and injection well flow rates, volume of treated water, pressure readings, and water levels, operation and maintenance activities for that month, and a summary of any shutdown and/or spill events that occur that month.

B. Quarterly Monitoring Reports

Quarterly reports shall be submitted to the Regional Board on the **1st day of the second month following the end of each calendar quarter (i.e., by 1 February, 1 May, 1 August, and 1 November)**. The reports may be submitted with the quarterly monitoring reports required by MRP No. 99-805. At a minimum, the reports shall include:

1. Results of monitoring, including a narrative description of all preparatory, monitoring, sampling, and analytical testing activities for the groundwater monitoring. The narrative shall be sufficiently detailed to verify compliance with the WDR, this MRP, and the Standard Provisions and Reporting Requirements. The narrative shall be supported by field logs for

each well documenting depth to groundwater; parameters measured before, during, and after purging; calculation of casing volume; total volume of water purged, etc.;

2. A comparison of the monitoring data to the groundwater limitations and an explanation of any violation of those requirements; A table showing well construction details such as well number, groundwater zone being monitored, coordinates (longitude and latitude), ground surface elevation, reference elevation, elevation of screen, elevation of bentonite seal, elevation of filter pack, and elevation of well bottom;

2.3. A narrative discussion of the analytical results for all groundwater locations monitored, including spatial and temporal trends, with reference to summary data tables, graphs, and appended analytical reports (as applicable);

2.4. Copies of all laboratory analytical report(s);

5. Cumulative data tables containing the water quality analytical results and depth to groundwater;

5.6. An evaluation of the performance of the potassium permanganate injection and recirculation system including an analysis of its effectiveness in destroying the pollutants and pollutant breakdown products;

5.7. A scaled map showing relevant structures and features of the facility, the injection grid, the locations of monitoring wells and any other sampling stations, and groundwater elevation contours referenced to mean sea level datum;

5.8. A discussion of compliance and the corrective action taken, if any, as well as any planned or proposed actions needed to bring the discharge into full compliance with the waste discharge requirements; and

5.9. A discussion of any data gaps, potential deficiencies/redundancies in the monitoring system or reporting program.

C. Annual Report

An Annual Report shall be submitted to the Regional Board by **1 February** of each year. This report shall contain an evaluation of the effectiveness and progress of the remediation, and may be submitted with the fourth quarter monitoring report. The Annual Report shall contain the following minimum information:

1. Tabular and graphical summaries of all data collected during the previous year;
2. Groundwater contour maps and contaminant concentration maps containing all data obtained during the previous year;

2.3. Graphical presentation of concentrations of groundwater pollutants, pollutant breakdown products, amendments, and byproducts of the in situ treatment process;

4. Data for monitoring and analysis performed on an annual basis;
5. A discussion of compliance and the corrective action taken, if any, as well as any planned or proposed actions needed to bring the discharge into full compliance with the waste discharge requirements;
6. A discussion of the long-term trends in the concentrations of the pollutants, pollutant breakdown products, amendments and byproducts in the groundwater monitoring wells;
7. An evaluation of the performance of the groundwater treatment system, including a description of all remedial activities conducted during the year, an analysis of their effectiveness in removing the pollutants and pollutant breakdown products and whether the plume of pollutants and pollutant breakdown products is being captured by the extraction system or is continuing to spread, as well as a forecast of the flows anticipated in the next year;
8. A discussion of compliance and the corrective action taken, as well as any planned or proposed actions needed to bring the discharge into full compliance with the waste discharge requirements; and
9. A discussion of any data gaps, potential deficiencies/redundancies in the monitoring system or reporting program and the anticipated date for completion of cleanup activities.

A letter transmitting the self-monitoring reports shall accompany each report. Such a letter shall include a discussion of requirement violations found during the reporting period, and actions taken or planned for correcting noted violations, such as operation or facility modifications. If the Discharger has previously submitted a report describing corrective actions and/or a time schedule for implementing the corrective actions, reference to the previous correspondence will be satisfactory. The transmittal letter shall contain the penalty of perjury statement by the Discharger, or the Discharger's authorized agent, as described in the Standard Provisions General Reporting Requirements Section B.3.

The Discharger shall implement the above monitoring program as of the date of the Order.

Ordered by: _____
THOMAS R. PINKOS, Executive Officer

(Date)

INFORMATION SHEET

ORDER NO. R5-2004-0082
EQUITY OFFICE MANAGEMENT, L.L.C.
M&H PROPERTY MANAGEMENT
ARDEN SQUARE SHOPPING CENTER
POTASSIUM PERMANGANATE INJECTION AND RECIRCULATION SYSTEM
SACRAMENTO COUNTY

M&H Property Management is the current owner of the site located at 3108 Arden Way (Site). Equity Office Management, L.L.C. (Discharger) is the successor by merger to Spieker Properties, the former owner of the Site. The Site has had several property owners since the first set of buildings were built in 1953. The building that housed a former dry cleaning business was built in 1961. In 1992, following an inspection by the Sacramento County Environmental Management Department Hazardous Material Division, the dry cleaner was advised to discontinue the disposal of separator water containing tetrachloroethene (PCE) into the boiler and sanitary sewer and instead handle the material as a hazardous waste. Wastewater from the washing machines at the facility drained into a masonry floor drain, which then entered the sanitary sewer. The facility operator continued to use the transfer type of dry cleaning unit until November 1995 when he switched to a dry-to-dry non-venting dry cleaning machine that is closed-loop, generates less wastewater and is generally self-contained. The new dry cleaning unit was installed within a secondary containment unit to prevent possible releases.

In 1996, PCE contaminated soil and groundwater was discovered during an environmental assessment for the purpose of a property transfer. Between 1997 and 1998, investigations performed to assess the vertical and lateral extent of PCE contamination resulting in the installation of 12 monitoring wells, 11 vapor extraction wells, one air sparging well, and one groundwater extraction well. In 1998, a soil gas survey was performed. Based on the soil gas survey results, soil beneath the floor inside the former dry cleaning facility was excavated. In 1999, a soil vapor extraction and treatment system was put into operation and ran until August 2002. The Regional Board granted approval to cease operating the vadose zone treatment system in 2002 following the review of rebound test and confirmation study results that confirmed that the soil vapor extraction and treatment system had removed a majority of the volatile organic compounds in vadose zone soils in the source area. In January 2001, two additional monitoring wells were installed, and aquifer slug tests and bench-scale testing were performed to provide additional information to design and implement an in-situ chemical oxidation remediation pilot test utilizing potassium permanganate.

Groundwater monitoring has been conducted at the Site since 1997. Groundwater is first encountered at about 85 feet below ground surface and flows northward. The highest concentration of PCE detected in groundwater at the Site was 1,800 micrograms per liter ($\mu\text{g/l}$) in September 1997 in monitoring well MW-1. MW-1 is immediately downgradient of the source area. The concentration of PCE in MW-1 has steadily declined since 1997 as a result of remediation actions undertaken at the Site. The highest concentrations of PCE in groundwater during 2003 occurred in well MW-9 with concentrations ranging from 180 to 610 $\mu\text{g/l}$.

In May 2002, the Discharger conducted a potassium permanganate injection pilot study by injecting about 17,500 gallons of potassium permanganate into the groundwater at a concentration of up to 1,500 milligrams per liter (mg/l) at up to 12 gallons per minute under only gravitational pressure for about eight hours a day for three consecutive days in the source area. Results of the pilot study showed a reduction in PCE concentrations in downgradient monitoring well MW-14 from 220 $\mu\text{g/l}$ to 15 $\mu\text{g/l}$.

Based on the successful results of the pilot study, the Discharger completed groundwater modeling for full-scale remediation. The Discharger proposes two separate remedial actions for full-scale remediation. The

ORDER NO. R5-2004-0082

EQUITY OFFICE MANAGEMENT, L.L.C. AND M&H PROPERTY MANAGEMENT
ARDEN SQUARE SHOPPING CENTER
POTASSIUM PERMANGANATE INJECTION AND RECIRCULATION SYSTEM
SACRAMENTO COUNTY

first action is to install and operate a potassium permanganate amended groundwater recirculation system on Site. The second action is to conduct focused potassium permanganate injections in 10 wells off-Site to cleanup PCE-polluted groundwater. These actions may be conducted simultaneously or in phases.

For the recirculation system, the Discharger proposes to extract groundwater from four extraction wells installed about 160 feet apart downgradient of the source area, which will be piped back to the permanganate recirculation treatment compound near monitoring well MW-2 and put through a filter to remove particulate matter. For the first six months of the system operation, the groundwater will be pumped to a permanganate mixing tank that will mix in powdered potassium permanganate to result in a mixture with about 250 mg/l of potassium permanganate. The mixture will be pumped through a filter to remove particulate matter and undissolved permanganate crystals, and then piped to four injection wells, which are equidistant from the extraction wells. Injected water with 250 mg/l of potassium permanganate should result in a concentration of 10 mg/l of potassium permanganate in the extracted groundwater. Calculations show that the groundwater amended with potassium should reach the extraction wells about 95 days after the startup of the system with steady-state concentrations occurring in about four months.

After the initial six months of injecting amended groundwater, the Discharger will stop adding the permanganate and continue to recirculate the groundwater to continue to pull the amended groundwater through the aquifer. The volume of amended groundwater injection will vary by season. The optimal injection schedule for amended groundwater will be 180 days per year for two years when water levels allow groundwater extraction rates greater than 4.5 gpm from each extraction well or 18 gpm for the treatment system as a whole. At low water levels, injection for the system will be about 8.5 gpm with about 2.1 gpm from each extraction well. At high water levels, injection for the system will be about 33 gpm with about 8.3 gpm from each extraction well. The Discharger will install an injection well near the recirculation treatment compound to discharge small amounts of excess extracted unamended groundwater to keep the recirculation system in balance. Extracting groundwater from the four extraction wells, along with the natural groundwater flow direction, will pull the amended groundwater through the treatment area and provide hydraulic control for complete containment of the potassium permanganate within the groundwater recirculation treatment area. The treatment area for the potassium permanganate injection and groundwater recirculation system extends from extraction wells EX-2 and EX-3 about 250 feet upgradient (south) to injection wells RW-3 and RW-4.

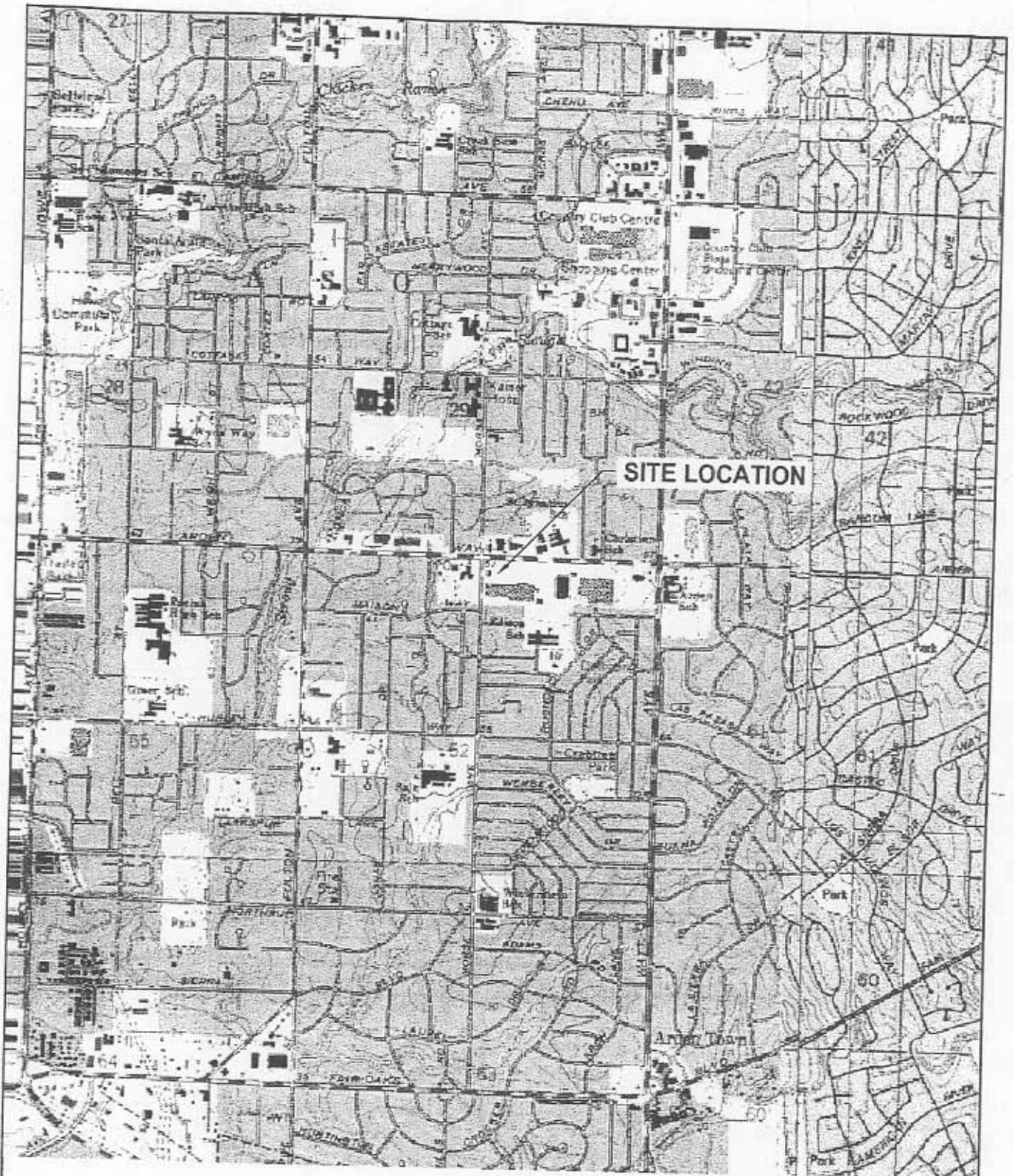
In addition to the recirculation system, about 370 feet downgradient of the furthest downgradient extraction wells, the Discharger proposes 10 injection wells in two rows of five about 60 feet apart, which will create two 250-foot wide treatment area perpendicular to the groundwater flow direction. The location of the injection wells is based on the extent of the PCE plume and outside of the influence of the groundwater extraction system. The Discharger proposes four separate focused injection events each six months apart to fully remediate PCE pollution downgradient of the Site. Based on the results of the pilot study, the Discharger proposes an injection volume of 4,500 gallons at 1,500 mg/l potassium permanganate solution per injection well, which will result in a 15 mg/kg dosage. The injection volume will result in a treatment radius of about 33 feet for each injection well. This dosage is about 70 percent of the dosage used for the pilot study, which should result in minimal byproduct production. The Discharger will install three additional monitoring wells near the 10 focused injection wells to monitor the extent of the permanganate.

Table 1
 Summary of Analytical Methods Sampling Frequency
 EOP Operating Limited Partnership and M Property Management
 Arden Square Shopping Center
 Potassium Permanganate Injection and Recirculation System
 Sacramento County

Type of Well	Well Identification	Baseline Sample	SAMPLING FREQUENCY		
			Weekly for First Month ¹	Monthly for First Three Months ¹	Quarterly
Upgradient Wells	MW-2	A & C	NS	NS	C
	MW-4	A & C	NS	NS	C
Downgradient Wells	MW-17	A & C	C ²	A & C	A & C
	MW-18 ^{2,3}	A & C	C ²	A & C	A & C
Recirculation Monitoring Wells					
Treatment Zone Wells	MW-5	A & C	B & C	A & C	A & C
	MW-9	A & C	B & C	A & C	A & C
	MW-10	A & C	B & C	A & C	A & C
	MW-14	A & C	B & C	A & C	A & C
	MW-15	A & C	B & C	A & C	A & C
Outside Treatment Zone Wells	MW-1	A & C	C ²	B & C ²	B & C ²
	MW-3	A & C	C ²	B & C ²	B & C ²
	MW-6	A & C	C ²	B & C ²	B & C ²
	MW-7	A & C	C ²	B & C ²	B & C ²
	MW-8	A & C	C ²	B & C ²	B & C ²
	MW-11 ^{2,3}	A & C	C ²	B & C ²	B & C ²
	MW-16	A & C	C ²	B & C ²	B & C ²
	MW-19	A & C	C ²	B & C ²	B & C ²
Focused Injection Monitoring Wells					
Treatment Zone Wells	MW-12	A & C	B & C	A & C	A & C
	MW-13	A & C	B & C	A & C	A & C
Outside Treatment Zone Wells	MW-20 ^{2,3}	A & C	C ²	B & C ²	B & C ²
	MW-21	A & C	C ²	B & C ²	B & C ²
	MW-22	A & C	C ²	B & C ²	B & C ²
Injection Wells	F-1	C	C	C	B & C
	F-2	C	C	C	B & C
	F-3	C	C	C	B & C
	F-4	C	C	C	B & C
	F-5	C	C	C	B & C
	F-6	C	C	C	B & C
	F-7	C	C	C	B & C
	F-8	C	C	C	B & C
	F-9	C	C	C	B & C
	F-10	C	C	C	B & C

Key:

- A Suite A includes the water quality laboratory analyses 8260B (volatile organic compounds), 7199 (hexavalent chromium), 6000/7000 series (arsenic, chromium, manganese, mercury, potassium, and vanadium), 160.1 (total dissolved solids), 300 (cations), 200.7 (anions)
- B Suite B includes the water quality laboratory analyses 8260B (volatile organic compounds) and 7199 (hexavalent chromium)
- C Suite C includes the field measured parameters of permanganate, water level, oxidation-reduction potential, pH, temperature, electrical conductivity, dissolved oxygen, and turbidity
- NS No sampling required
- 1 Sampling schedule begins after the initial injection of potassium permanganate or after the injection into the last (or 10th) focused permanganate injection well for each round of injections
- 2 If any of the field measured parameters indicate potassium permanganate is close to the well, such as a significant increase in ORP or slight purple color in purge water, the Discharger shall analyze for Suite A
- 3 The Discharger shall monitor Suite C for these wells monthly



SITE LOCATION

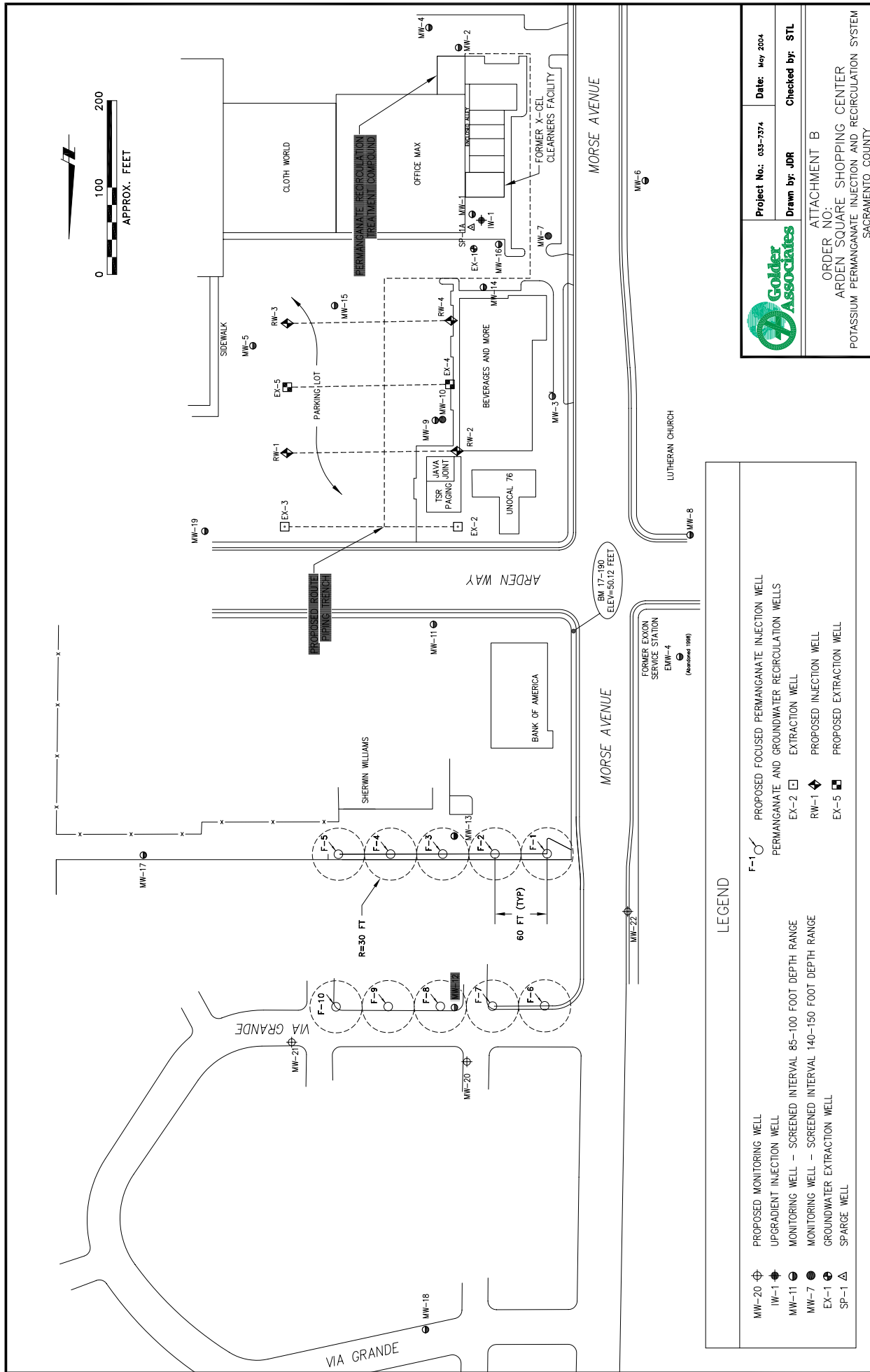


APPROXIMATE SCALE

**ATTACHMENT A
ORDER NO.
ARDEN SQUARE SHOPPING CENTER
POTASSIUM PERMANGANATE INJECTION
AND RECIRCULATION SYSTEM
SACRAMENTO COUNTY**

PROJECT NO: 023-7268 DRAWN BY: BH CHECKED BY: KR DATE: 041902

Golder Associates



Project No.: 035-7374 **Date:** May 2004
Drawn by: JDR **Checked by:** STL
ATTACHMENT B
ORDER NO.:
 ARDEN SQUARE SHOPPING CENTER
 POTASSIUM PERMANGANATE INJECTION AND RECIRCULATION SYSTEM
 SACRAMENTO COUNTY

LEGEND

MW-20 ⊕	PROPOSED MONITORING WELL	F-1 ○	PROPOSED FOCUSED PERMANGANATE INJECTION WELL
IW-1 ⊕	UPGRADIENT INJECTION WELL	EX-2 □	PERMANGANATE AND GROUNDWATER RECIRCULATION WELLS
MW-11 ⊕	MONITORING WELL - SCREENED INTERVAL 85-100 FOOT DEPTH RANGE	RW-1 ◇	EXTRACTION WELL
MW-7 ⊕	MONITORING WELL - SCREENED INTERVAL 140-150 FOOT DEPTH RANGE	EX-5 □	PROPOSED EXTRACTION WELL
EX-1 ⊕	GROUNDWATER EXTRACTION WELL		
SP-1 △	SPARGE WELL		