TECHNICAL REPORT
PETITION OF MR. CURTIS D. QUINONES
SWRCB/OCC FILE A-1740

Prepared by:
Dennis Parfitt, CEG 1223
Division of Water Quality

RE: SWRCB/OCC FILE A-1740, PETITION OF MR. CURTIS D. QUINONES

This report addresses the three issues raised by petitioner and outlined in the March 24, 2006 request for technical evaluation from the Water Board Office of Chief Counsel:

1. Beneficial Uses
2. Biodegradation
3. Environmental Risk

The specific questions posed by OCC are italicized and then followed by my response.

BACKGROUND

The subject site is located about 200 feet from the edge of Monterey Bay (Figure 1) in an area that was historically near the edge of an estuary. Circa 1880 or earlier, a broad dike (to accommodate a railroad and Del Monte Avenue) was constructed across the confluence of the estuary with the bay creating the 20-acre El Estero Lake. Presently, the lake functions to moderate storm water runoff from a 4.5 square mile ephemeral, urbanized watershed and is used as a source of irrigation water in the summer and fall for the adjacent park and cemetery.

A dry cleaning establishment operated at the site continuously for about 80 years. In January 1987, when workers were servicing a water main located on city property immediately adjacent to petitioner's site, a strong chemical odor (later confirmed to be PCE) was discovered in the sandy soil at a depth of about 18 inches. In 2001 five petroleum USTs were removed from the site. Soil borings were drilled and monitor wells were constructed to characterize the extent and magnitude of fugitive petroleum hydrocarbons and PCE. The data generated indicated an apparent second source area of PCE located near the center of the site about 70 feet south of the release discovered in 1987.

The geology at the site is relatively simple; about a 22 to 24 foot thickness of fine-to-coarse sand with minor amounts of silt and clay overlying a wave cut terrace of non-water bearing bedrock. The hydrology however, is complex; over 80% of the aquifer is below mean sea level (msl), the water surface of the lake is maintained at an elevation of about 2 to 3 feet msl, the tidal range in Monterey Bay is about –1.5 feet msl to over 6 feet msl, and the water table at the site varies from about 3 feet msl in the fall to about 4.5 feet msl in the spring. With the available water level elevation and water quality data, it can be inferred that net groundwater flow at the site is to the bay and the lake in the winter and spring (due to groundwater mounding from infiltrating rainfall) and from the bay to the lake in the summer and fall (due in part to the withdrawal of about 13,000,000 gallons [40 acre feet] from the lake for landscape irrigation).

BENEFICIAL USES

The Petitioners argue that the Central Coast Water Board incorrectly identified the groundwater basin and beneficial uses that must be protected for groundwater beneath the Site. Petitioners also argue that groundwater meets the criteria for de-designation pursuant to State Water Board Resolution No. 88-63, which is incorporated as part of the Basin Plan.

What beneficial uses are designated for the groundwater at the Site?

"Groundwater throughout the Central Coastal Basin ... is suitable for agricultural water supply, municipal and domestic supply; and industrial use."[1]

Does groundwater meet the criteria set forth as exemptions in Resolution No. 88-63?

Petitioner asserts that groundwater at the site is non-potable (saline-to-brackish) and meets the 3,000 ppm total dissolved solids (TDS) criteria of Resolution No. 88-63 exempting the groundwater at the site as a source of drinking water[2]. The record shows that the TDS[3] of groundwater sampled from site monitor wells varies spatially, seasonally, and historically and has ranged from a high of about 30,000 ppm[4] for

[1] Chapter 2, Section 1 (at page II-1) of the Central Coast Region Water Quality Control Plan.
[2] The Regional Board's response to the petition is silent on this issue. The record indicates the Regional Board granted an exemption in 1990 to a site located near the western shore of the lake. The site is the location if a former gas and electric plant and is contaminated with TPHg, TPHd, BTEX, PNAs, heavy metals, and oil.
[3] Most of the TDS data are derived from electrical conductivity (EC) measurements collected during well sampling events. TDS ≈ EC x 0.6
[4] Sea water has a TDS of about 34,000 ppm.

groundwater from well MW-3 in 1987 to a low of about 400 ppm for groundwater from well MW-6 in 2004. The variability is caused by a combination of factors that include the geometry, character, and position of the aquifer between the bay and the lake, seasonal precipitation patterns, changing land use, and monitor well construction.

The data show that concentrations of TDS are typically lower in the spring and higher in the fall[5]. This seasonal pattern of fluctuating concentrations is inferred to be a response to the influx of winter rainfall and summer and fall seawater intrusion induced by withdrawals from the lake. The data also show a general decreasing TDS trend for both the maximum fall concentrations and minimum spring concentrations. This declining trend is inferred to be a response to the conversion of the site from commercial land use (with largely impermeable ground cover) to open space (and consequent unimpeded infiltration of rainfall) in 2001.

Monitor well construction, i.e., the portion of the aquifer screened by a well, is also a factor in the measured TDS concentrations. It has long been known that coastal aquifers exhibit strong salinity gradients due in large part to the difference in the densities of salt water and fresh water[6]. This phenomenon is apparent when evaluating data obtained from wells MW-4, MW-5, and MW-6 (see Figure 1). Wells MW-4 and MW-5 are screened from the bedrock contact to about four to five feet below the water table. Well MW-6 is screened from about five feet above the contact to near the water table. While these wells are equidistant from the bay, the TDS concentrations of groundwater samples from well MW-6 have consistently been less than 3,000 ppm (400 ppm to 2,600 ppm, mean = 1,300 ppm, n=15) while the TDS concentrations of groundwater samples from wells MW-4 and MW-5 have typically been three to five times greater (1,800 ppm to 12,000, mean = 4,700 ppm, n=27). These data indicate that the saltwater/fresh water transition zone is about eight to ten feet above the bedrock contact. Thus, at the location of these wells, groundwater in the upper half of the aquifer (about 4 to 12 feet bgs) qualifies as a source of drinking water per Resolution No. 88-63 while the groundwater below about 12 feet bgs does not.

Resolution No. 88-63 specifies that water sources which do not produce an average sustained yield of 200 gallons per day are exceptions to "Sources of Drinking Water." In this particular case, a domestic supply well (with a 20 foot sanitary seal) constructed at the site would likely be capable of producing greater than 500 gallons per day. However, the water produced would likely have a TDS concentration of 5,000 to 10,000 ppm.

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[5] About 40 percent of the TDS measurements obtained in March, April, and May exceed 3,000 ppm (mean concentration ≈3,200 ppm) while about 60 percent of the measurements obtained between July and December exceed that concentration (mean concentration ≈3,300 ppm).

[6] eg. Walton, W.C., *Groundwater Resource Evaluation*, McGraw-Hill, San Francisco, pp. 194-200, 1970. Todd, D. K., *Groundwater Hydrology*, 2nd ed., John Wiley and Sons, New York, pp. 496-502, 1980.

BIODEGRADATION

The petitioners contend that the water quality objectives at the Site will be met within a reasonable period of time and specifically that applicable maximum contaminant levels will be met within approximately a decade due to biodegradation.

If no active remediation is undertaken, how soon will biodegradation or natural attenuation result in achievement of water quality objectives and other applicable water quality standards?

Petitioners' estimate of the time that it will take to meet WQOs is based on water quality data obtained from the analyses of groundwater samples from wells MW-6 (the replacement well for MW-1) and MW-7. These wells, due to their overly long screen intervals (15 feet for MW-6 and MW-7 and 20 feet for MW-1), produce groundwater samples that are negatively biased, i.e., a vertical composite sample of groundwater. With regard to dissolved-phase PCE and degradation by-products (TCE, 1,2-DCE, and vinyl chloride) detected in groundwater samples from these wells, the reported concentrations are analogous to the above discussion of TDS concentrations in site groundwater. It can be reasonably inferred from the record that DNAPL PCE is present in the interval from the aquifer/bed rock contact to about five to six feet above the contact in the vicinity of these wells and that shallow groundwater present in the upper half of the aquifer likely meets WQOs[7]. While the data suggest that the DNAPL is not wide spread and of limited mass, moving groundwater that comes in contact with the DNAPL will contain concentrations of PCE greater than WQOs for decades if not a century or more.

Are active remediation methods feasible at the Site?

Soil excavation and removal of the upper foot or two of the bedrock surface in the areas around monitor wells MW-6 and MW-7 is the only feasible, short term, active remedial alternative.

Would natural attenuation rather than active remediation comply with the requirements of Resolution No. 92-49?

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[7] Reported PCE concentrations in groundwater samples from well MW-1 (completed to bedrock with a 20 foot screen) before it was destroyed in 1991 and replaced with well MW-6, ranged from 23.5 mg/l to 85 mg/l (17% to 60% of PCE's solubility - about 140 mg/l); concentrations in samples from well MW-7 (completed to bedrock with a 15 foot screen) have ranged from 16 mg/l to 170 mg/l (14% to 120% of the PCE solubility). These samples are composites of clean shallow groundwater and deeper contaminated groundwater flowing through the DNAPL source zone. This dilution effect is particularly evident when one compares the reported PCE concentrations (<0.01 mg/l to 2 mg/l) in samples from well MW-6 (screened to 5 feet above the bedrock contact) with those for samples from MW-1. A groundwater sample obtained in November 2001 from a temporary well installation (SB-8, screened from about 5 feet to 15 feet bgs – about 5 feet above the bedrock contact) located about 40 feet north of MW-7, had a reported "very strong HVOC odor," a "sheen ... indicative of the presence of non-aqueous phase PCE," and a PCE concentration of 240 mg/l (Soil and Groundwater Investigation Report, RTD, June 5, 2002). Reported concentrations in excess of a chemical's solubility is an indication that a non-aqueous phase of the chemical was present in the sample.

With regard to the drinking water beneficial use, yes. There is no reasonable expectation that groundwater beneath the site will ever be used as a source of drinking water[8]. The natural remediation alternative, regardless of the length of time needed to achieve drinking water standards, is the *preferred* option.

ENVIRONMENTAL RISK

The petitioners claim that waste remaining at the Site poses no environmental risk because, among other things, the waste is not migrating to adjacent water bodies.

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Could the remaining waste affect the beneficial uses of other waters?

In April 1987, a soil gas survey was conducted to aid in directing future investigations relating to the discharge discovered in January[9]. The survey showed that detectable concentrations of PCE were present in soil gas from Monterey State Beach to the north to near the edge of the lake to the south. In December 1987, monitor well MW-2 was installed near the beach and well MW-3 was installed across Del Monte Avenue near the lake (see Figure 1). Analyses of groundwater samples obtained from MW-2 in September 1988 and in January and July 1990, had reported concentrations (0.6 ppb to less then 10 ppb) of PCE and/or its degradation products, TCE and 1,2-DCA. Analyses of eight groundwater samples obtained from MW-3 between December 1987 and February 1991 reported non-detect for all constituents. The two wells were abandoned in August 1991[10].

The beneficial uses of El Estero Lake identified in the Central Coast Basin Plan are:

- Municipal[11]
- Groundwater recharge[11]
- Water contact recreation[11]
- Non-contact water recreation
- Cold freshwater habitat
- Warm freshwater habitat
- Spawning and reproduction and/or early habitat
- Commercial and sport fishing

[8] California Water Well Standards (Department of Water Resources Bulletin No.94-90) would restrict a domestic water supply well (with a minimum 20 foot sanitary seal) constructed at the site to producing the saline groundwater present in the lower two to four feet of the aquifer. A municipal supply well (with a minimum 50 foot sanitary seal) would be restricted to production from the non-water bearing bedrock.

[9] *Soil Gas Survey, Vapor Cleaners Property, Monterey, California.* Terratech, Inc. May 19, 1987.

[10] The record indicates that all involved in the investigation at that time agreed the wells served no useful purpose.

[11] The lake water was tested for total coliform and fecal coliform in November 1997. The analyses showed a total coliform value of 10,462 colonies per 100ml and that for fecal coliform at 823 colonies per 100ml. The drinking water standard for fecal coliform is less than one colony per 100ml. The source of the coliform is likely a combination of urban runoff and the local shore bird population. The City has posted signs adjacent to the lake banning water contact recreation – "No Swimming or Wading Allowed".

The beneficial uses of the bay identified in the California Ocean Plan are:

- Industrial
- Water contact recreation
- Non-contact water recreation
- Aesthetic enjoyment
- Navigation
- Commercial and sport fishing
- Mariculture (the cultivation of marine organisms for food)
- Rare and endangered species
- Marine habitat
- Fish migration
- Fish spawning
- Shellfish harvesting

Of these beneficial uses, water contact recreation, commercial and sport fishing, mariculture, marine habitat, and shellfish harvesting in the bay could potentially be affected by the wastes remaining at the site. The USEPA National Ambient Water Quality Criteria, Saltwater Aquatic Life Protection, lowest observed effect levels for the constituents of concern are:

	ACUTE	CHRONIC
PCE	10,200 ppb	450 ppb
TCE	2,000 ppb	----
1,2-DCE	24,000 ppb	----
Vinyl chloride	----	----

---- level not listed.

Is monitoring needed to ensure that the discharge does not affect other waters?

As a part of the initial investigation in 1987, two monitoring wells were installed adjacent to the bay and the lake (MW 2 and MW 3 respectively). A 1991 quarterly report to the Regional Board stated that contaminant levels in MW 3 were non-detect and low levels (less than 10 ppb) were periodically detected in MW 2 after over three years of monitoring. Per the 1991 quarterly report recommendation, MW 2 and MW 3 were subsequently destroyed without objection by the Regional Board.

The findings of low and non-detect contaminant levels away from the immediate source area are not surprising. The inherent hydraulic dynamic caused by the unending ebb and flow of the tide creates a condition where groundwater flow to either the bay or the lake can be viewed as being metered, episodic pulses at those times of the cycle when the hydraulic gradient at the site outweighs the last high tide. Considering the site's history

and hydrology, current site conditions are likely at or near stasis and will remain so for the foreseeable future.

The rainfall that yearly percolates to the water table at the site creates a barrier to the vapor inhalation and dermal contact exposure pathway; the ingestion exposure pathway is non-existent. Any contaminant transport in the pulse groundwater discharges to either the bay or the lake can be inferred to occur over a diffuse area in the sublittoral zone at elevations less than about –5 feet msl thus negating any potential exposure of the beach-going public. Considering the absence of any plausible human exposure scenario, continued monitoring of the site would serve no useful purpose.