Shell Oil Company

One Shell Plaza
P.O. Box 2463
Houston, Texas 77001

July 26, 1982

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. V. R. Mahon
Department Manager
Power and Way Maintenance
Bay Area Rapid Transit District
800 Madison Street
Oakland, CA 94607

Dear Mr. Mahon:

SUBJECT: BART KE TRACK
7TH AND BROADWAY, OAKLAND

This is to report on the status of Shell's recovery well operation discussed in my letter to you of December 14, 1981 and to advise that Shell now plans to terminate this operation.

The recovery well was installed on January 7, 1982 underneath the sidewalk in front of the Oakland Police Department at 7th and Broadway. Drawdown pumping at the approximate rate of 4 to 8 gallons per minute began on March 9, 1982 and has basically continued since that date. The scavenger pump floating atop the watertable and designed to remove hydrocarbons, has recovered no separate phase hydrocarbons.

Shell has concluded that continued operation of the recovery well system serves no useful purpose. It is our geologist's opinion that any remaining separate phase gasoline plume has been attenuated into the surrounding soil such that no separate phase hydrocarbons will be recovered by the operation. This is based upon the fact that there no longer is any indication of mobile hydrocarbons in the ground. Our geologist believes that the hydrocarbons previously collected from inside the BART tube constituted virtually all of the removable gasoline.

Under these circumstances, Shell will terminate the project as follows. If no hydrocarbons are recovered by September 1, 1982, then we will stop pumping the recovery well. The equipment will be left in place pending the results of our post-pumping monitoring. In September, we will continue to monitor observation wells 4, 5, 6 and 7 once a week. In October and November, we will monitor bi-weekly and from December to the end of August 1983, we will monitor once a month. If this monitoring program reveals that pumping should be reinstituted, then we will pump. If not, then we will permanently close the recovery well and the observation wells.

Since we can never be certain as to every aspect of the subsurface soil/groundwater, especially as to changes caused by the BART tube, and the variations in the grouting and sealing of the tunnel, we suggest that you continue to check the tube for hydrocarbons. Please advise us if any more hydrocarbons appear in the tube.

Thank you for your assistance in this matter.

Very truly yours,

Alex S. Karlin
Attorney

ASK:crl

cc: Mr. Frank J. Linville ← THIS COPY FOR
Manager of Construction
Bay Area Rapid Transit District
800 Madison Street
Oakland, CA 94607

Mr. Mark Ng
City of Oakland, City Hall
Office of Public Works
14th and Washington Street
Oakland, CA 94612

Fire Marshall
City of Oakland, City Hall
14th and Washington Street
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Mr. Joseph G. Damas, Jr., Supervisor
Waste Water Control Section
East Bay Municipal Utility District
P. O. Box 24055
Oakland, CA 94623
(re: Account No. 005-90031)

GROUNDWATER
TECHNOLOGY, INC.
CONSULTING GROUNDWATER GEOLOGISTS

BACKGROUND:

In late 1978 early 1979 gasoline type hydrocarbons were discovered infiltrating into Bart's K.E. line below the intersection of 7th and Broadway Streets in Oakland, California.

In early 1979 Shell Oil Company, who operated a service station near the intersection of 8th and Broadway was notified of the problem and subsequently conducted a tank and line testing program that located a pressure leak on the line.

A well is reported to have been drilled on the Shell property to a depth of 25' subsequent to the suspect loss but did not encounter the water table.

Note: Available data indicates the depth to water to be 25'-30' below surface in a silty sand.

Estimated loss at the time of testing is reported at 1800 gallons from a records inventory check. Subsequent activities, post January, 79, have involved drawing off a mixture of gas and water through ports in the K.E. tube amounting to more than 80 (55 gallon) barrels of liquid estimated to contain up to 50% hydrocarbons.

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In late 1979 the problem appeared to abate only to reappear in January of 1980 possibly associated with a minor earthquake. At the current time two spigots have been installed in the driven section of the tube, one of which yields raw product and the other an apparent mixture of dissolved gasoline and water. Seepage of the hydrocarbon/water mixture currently enters the tube and collects and inflows into drains that convey the mixture across the active tube to a sump and pump station located on the southeast corner of 7th and Broadway. The liquid is then pumped to the surface and reported to be discharged to the storm sewer system.

combined?

As a result of the ongoing chronic problem, it was determined that a groundwater investigation be undertaken to assess potential sources of the product, determine mode of movement and assess potential recovery methodologies.

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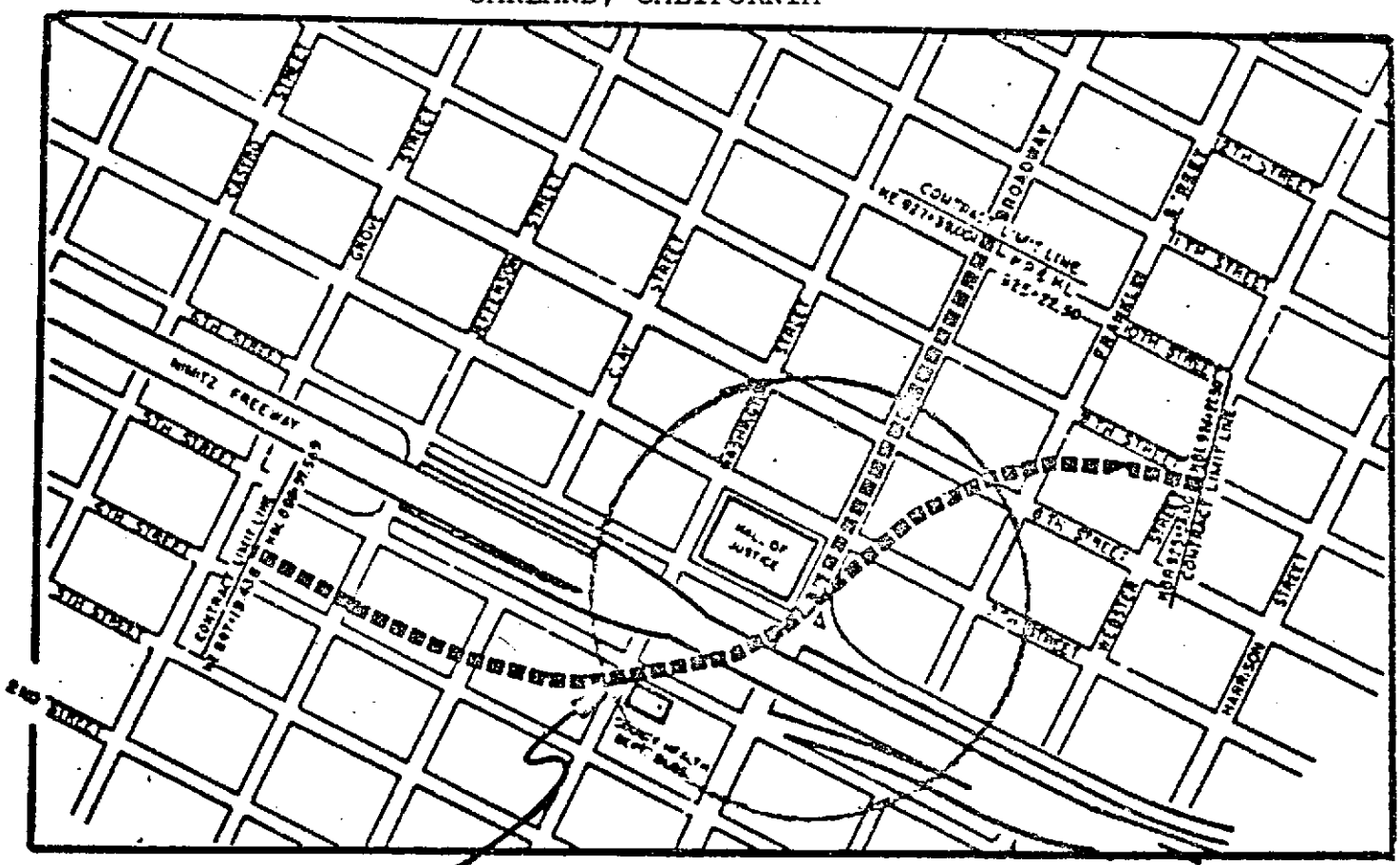
CONSULTING GROUNDWATER GEOLOGISTS

CONSIDERATIONS ON INFILTRATION OF GASOLINE INTO BART K E LINE 7TH AND BROADWAY OAKLAND, CALIFORNIA



Prepared by: Paul M. Yaniga
General Manager

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TOPOGRAPHY:

The study area is within the down town area of the City of Oakland located along Broadway between 5th and 8th Streets. The area is within a zone of the city that is under going some renovation so that localized changes in topography are created daily. Despite local earth moving activities the general topographic feature by which the site would be classified is a very gentle north to south slope to flat lying terrain.

GEOLOGY:

The site as related to the problem being evaluated is underlain by recent unconsolidated sediments. The top few feet within the immediate study consist of manmade land that is basically re-worked building rubble and roadway materials. Immediately beneath the rubble is found an approximate 30' - 40' sequence of fine sands to silty sands. Below the base of the fine sandy sequence the "Bay Muds" are found, a dense plastic clay sequence.

HYDROGEOLOGY:

The aquifer affected by the gasoline and seeping into the tube is under "water table" conditions within the unconsolidated sands. The average depth to water in the immediate study area varies from 14' at the southern end of the work area to a depth of 21' to 23' in the area of 7th and Broadway where the product is infiltrating into the Bart Tube. The gradient of the water table as expected from structural information and review of existing data is from north to south. i.e. Higher numbered streets to lower numbered streets. The rate of groundwater movement in the native silty sands would be expected to be in the range of 10^{-2} to 10^{-4} CM/SEC. The presence of disturbed zones from excavation and back fill with more permeable material would of course accelerate movement.

OBSERVATIONS AND COMMENTS:

- Product entering the Bart tube gains access at the juncture of the cut and cover section of the tube with the driven or tunneled section of the tube.

- Neopreme seals in the driven portion of the tube show evidence of deterioration from the gasoline allowing greater in flow of water and product.

- Remedial measures initiated by Crowley Environmental Services to treat the symptoms of gasoline within the tube have been effective in controlling the impacts but, do not deal with the source.

- Review of available documents and discussions with Bart Personnel and the contractor involved in the construction of the tube indicate that sections of the driven portion of the tube were grouted (back filled) with pea gravel. This method of construction is reported to have been used from 7th street north.

- Logs of auger borings for the construction of the tube along Broadway street indicate the presence of fine sands and silty sands to depths of 25' to 30'.

- Construction documents reviewed with one of the contractors on the Bart tube development provided information that the cut and cover section of the tube is built within a bentonite slurry wall. This method of construction is reported to have been used from 7th street south.

- A pre-drilling "crack survey" was conducted within the area of anticipated drilling with results supplied to Shell. The pre work survey indicated the presence of numerous subsidence and tension related features. The pre-work inventory documented their existnece so as to assure no causal relation to our drilling activities.

- All observation wells were constructed in accordance with the procedures outlined in Appendix 1. Individual drill logs and well construction are shown in Table 1A - 1G

- Sub-surface profiles encountered in the seven wells evidenced somewhat similiar profiles. General conditions encountered were medium to fine sands and clayey sands that were brown to yellow-brown in coloration.

- In wells # 1 - 6 the water table was generally encountered between 20' and 23'. At well #7, field evaluation of retrieved cuttings indicated water at higher levels, approximately 12' to 15' below grade. (well 7 is on other side of 880 freeway)

- Wells # L-1 through L-6 with the exception of L-4 exhibited odors of gasoline type hydrocarbons.

- Where gasoline odors were detected they were generally observed to first occur approximately 14'-17' below grade.

- Well #4 although yielding readings of 3-5% on the combustible gas detector did not evidence any gasoline odor or product in the soil. This is not out of line with our understanding of the problem as well #4 is actually located on the other side of the tube from where gasoline is entering.

- Well #7 located along the same side of the tube as the observed seepage, but 2 blocks to the south likewise showed no evidence of gasoline. This well is located adjacent to the "cut and cover" section of the tube.

- Of the wells showing evidence of product wells #2 and #3 located along the Broadway side of the former Shell Station property indicated the greatest apparent concentrations. This is inferred in that during construction of well #2, 100% explosibility readings were noted. It also became necessary to purge well #2 with nitrogen to reduce explosive readings. Well #3 exhibited levels of explosibility at approximately 40% of LEL but also showed a thin (approximately 1 mm) accumulation of product on the well at the time of penetrating the 12' to 14' level (See Table 1B)

- Well L-5 located on the northwest corner of 7th and Broadway, closest to the inflow point of gasoline to the tube, also evidenced strong gasoline odors and explosibility levles at 80% of the LEL. Core samples recovered from 19'-22' showed gasoline saturated sand.

- Well L-6 located on the southwest corner of 7th and Broadway showed some sign of gasoline hydrocarbons but, at lower levels than at wells #1,#2,#3, or #5.

- Well #7 located on the northeast corner of 5th and Washington showed no evidence of any gasoline hydrocarbons.

SUMMARIZED CONCLUSIONS:

- Groundwater within the study area is under "water table" conditions in an unconsolidated sand to silty sand. The gradient or slope of water table trends northwest to southeast in essence moving from the higher numbered streets to the lower numbered streets. Figure # 6

- The depth to the water table in the area of study is 20'-25' below grade, such that it coincides with the depth below grade of the Bart tube.

- The reported pea gravel grout used to fill the void between the driven section of the tube and the native materials would have a significant permeability differential to the native fine grained silty sands i.e. the gravel having a much greater permeability.

- The reported bentonite slurry wall surrounding the cut and cover section of the tube would also exhibit a permeability differential to the native insitu fine sands i.e. the bentonite being much less permeable.

- The combination of pea gravel back fill behind the plates along the driven section of the tube in conjunction with the bentonite slurry wall along the cut and cover section of the fill could produce a "permeability trap" where by product moving through the native sediments adjacent to the tube could be lured to the more permeable pea gravel grout against the tube and then become pocketed where the low permeable bentonite comes in contact with the gravel fill.

- No free product was observed in the wells on 3 (three) sampling surveys conducted subsequent to the monitoring well construction. The presence of strong gasoline odors in cuttings retrieved during well development along with explosibility readings and physical appearance of the retrieved water samples at the time of drilling shows greatest traces of gasoline in the area of wells #1,#2, #3,#5 and #6.

- Greatest apparent concentrations were noted at wells # 2,#3 and #5 respectively suggesting a nearby source of product.

- Wells #2 and #3 located on the corner of 8th and Broadway at the site of the old Shell station provide the most evidence of any past loss from this site.

- It should be noted that there currently exists no data (wells) up gradient from these locations, # 2 & 3, to refute other sources further up water table gradient. It should also be noted, that if other up gradient sources of product existed they too would have the tendency to migrate toward the disturbed pea gravel zone adjacent to the tube and would not likely show up at the location of wells #1, #2, and #3 in the native sediments.

RECOMMENDATIONS:

1. To provide assurance of no outside source of product flowing onto the former Shell station property. Three (3) additional observation well locations could be considered:
   (a) One (1) well should be located on the northwest corner of Broadway and 8th street.
   (b) One (1) well should be located west of well #1 toward the intersection of 8th and Washington.
   (c) One (1) well should be located to the west of well #5 toward the intersection of 7th and Washington.

2. As existing wells show no evidence of standing free product but, do indicate strong odors of gasoline, it could be possible to develop an isopleth map of dissolved gasoline concentrations that would aide in defining the source and likely current area of concentrations. This would involve a detailed sampling program for gasoline hydrocarbons. Samples collected would be analysed for gasoline hydrocarbons particularly BTX components by volatile organic analysis via gas chromatography.
   (a) Results obtained would be plotted on the same base map as used for water table gradient in the form of a dissolved product isopach map and be used to determine probable plume configuration.

3. Assuming that our collected information on apparent concentration and area of contamination is correct and that a permeability trap exists adjacent to the tube a retrieval system could be developed to pull the product away from the tube. This would be accomplished via construction of a well with a pumping level lower than the base of the tube. This is a technique that has been applied many times by GTI with good sucess. If free product remains in the area it will be pulled toward the center of the cone of depression created by the pumping well. As free product collects within the cone of depression, a second product pump is used to remove the accumulated hydrocarbon. Considerations that need to be made in employing this process include:

(a) Development of a good sound well of sufficient depth and integrity of construction to allow creation of a cone of depression that will contain further movement of the lost product and re-direct it toward the pumping well. Based upon current data a recovery well located near L-5 would have to lower the water table at least approximately 13'-15' drop, the water level below the base of the K E Line.

(b) Sufficiently sized pump and setting to allow the lowering of the water table below the base of the tube to such elevation as necessary to stop further inflow of product to the subway system.

(c) Location of the well in as close a proximity to the center of the plume as possible, if product is trapped in the pea gravel adjacent to the tube, this luxury will not be available as it would have to be in the center of the intersection of 7th and Broadway. It will therefore,be necessary to locate a recovery well along the northwest corner of 7th and Broadwary. For safety purposes, all plumbing and wiring should be laid below grade in a vault.

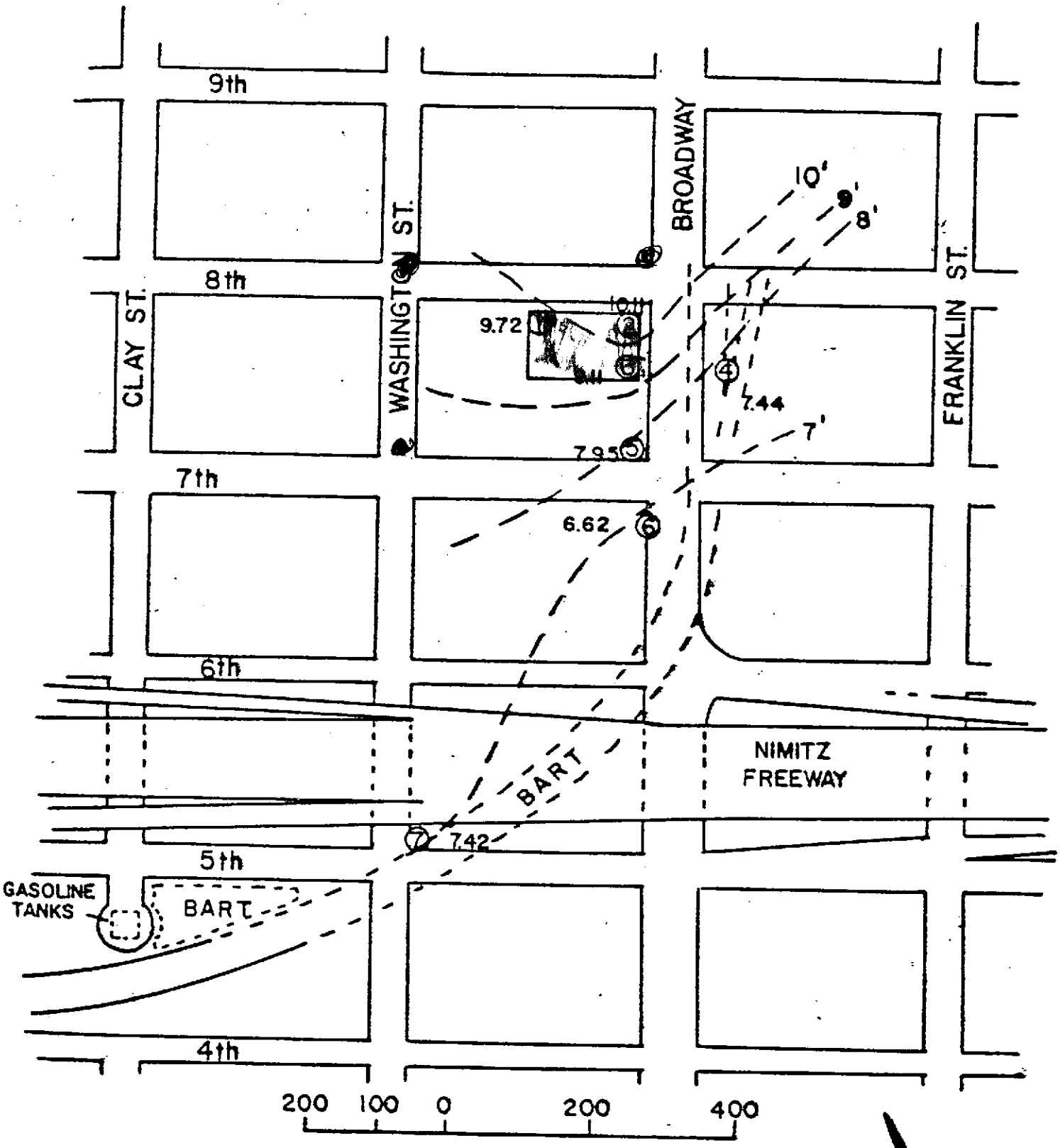
(d) Water discharge considerations will have to be made. In the area there will likely be concerns of subsidence related to pumping activities which may dictate re-circulation of the water at a point outside the plume of contamination, but within the influence of the pumping well. If subsidence concerns are appeased and surface discharge of the water is chosen, it will likely require some form of permit or approval.

(e) Recovered product will have to be stored in the area of the recovery well until sufficient volume is retrieved to warrent removal. This storage tank should be located within a protected area or buried below ground.

Note: A schematic of the type of system described is attached as Figure # 3 and 3A for your further reference, a literature package on Oil Recovery Systems hadrware for physical recovery of hydrocarbons is also included.

Should surface discharge of the produced water be chosen it may be required to treat the discharge for dissolved gasoline prior to release. Success has been achieved in this area with the use of air stripping towers and granular activated carbon.

4. Should the amount of free gasoline remaining be small (this is not indicated by the product entering the tube) or the problem be more of a dissolved gasoline nature bio-degradation can be employed and be effective in resolution of the problem. The principle employed is one of accelerated biologic breakdown of the gasoline by increasing the numbers of gasoline utilizing bacteria through a program of nutrient and oxygen addition to the groundwater system. This is normally employed, once the majority of free product has been removed,which does not appear to be the situation at this location. A schematic of the process is attached as Figure # 8.



WATER-TABLE GRADIANT MAP from 9/14/81

Figure # 6

- Well Locations

(2.)

Note: Water level contours are tied into verticle datum B.M.# KB 64748 at 5th & Broadway, Oakland

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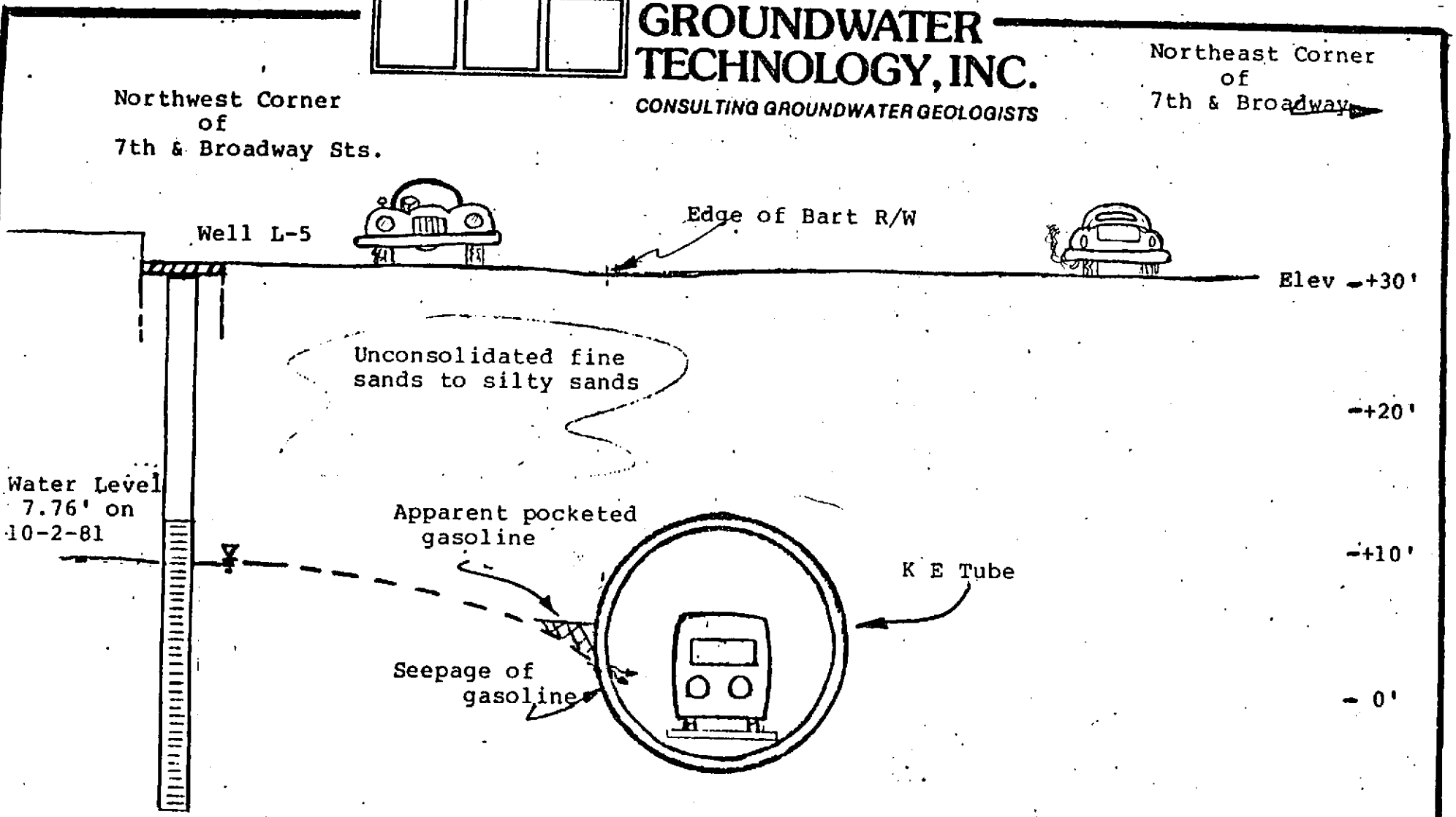

SCHEMATIC

CROSS SECTION SHOWING INFERRED

RELATIONSHIP OF GROUNDWATER TO

BART K E LINE

Figure # 9

10-22-81 PMY

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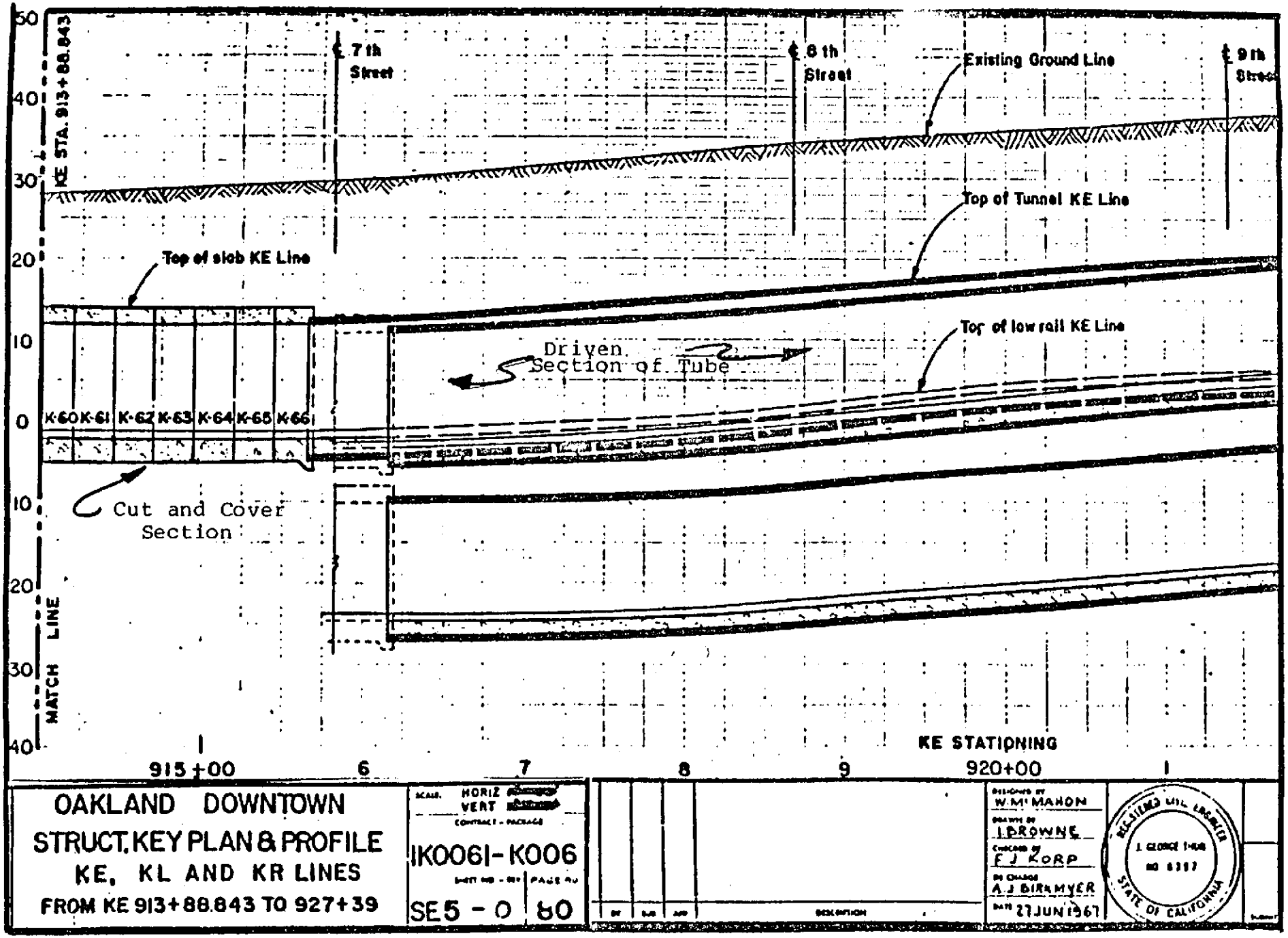

Figure # 10

Copy of portion of plans for Bart K.E. line
showing contact between cut & cover section of the tube
and driven section of the tube at 7th and Broadway in Oakland, California