

RISK ANALYSIS OF LADWP MARINE TANK FARM

1. PURPOSE OF ANALYSIS

The purpose of this risk analysis is to calculate the size of the hazard footprints created by the Los Angeles Department of Water and Power (LADWP) Marine Tank Farm located at 130 West A Street in Wilmington, California. The risk analysis has been conducted in accordance with the Port's Risk Management Plan (RMP) (Port of Los Angeles 1983) which is part of the Port's Certified Master Plan. All hazard footprint calculations have been done using the Port's Hazard Footprint Program (HFPC) developed in conjunction with the Risk Management Plan. A hazard footprint is defined by the RMP as a diagram indicating the extent of the area within which a specified level of adverse effect is exceeded against a specified vulnerable resource. The overall policy of the RMP is the minimization or elimination of overlaps of hazard footprints and vulnerable resources.

2. PROJECT DESCRIPTION

Information on the LADWP Marine Tank Farm was obtained from a Phase II Environmental Site Assessment (Kleinfelder 2004) of the tank farm and from Google Maps. Figure 1 shows the location of the facility.

Figure 2 shows the layout of the facility. There are a total of three tanks located within two diked areas. Two 450,000 bbl capacity tanks are located in one diked area and one 30,000 gal capacity tank is located in a separate diked area. The capacities of the storage tanks were estimated based on their diameter as estimated from Google Maps and their identification number as presented in the Phase II Environmental Site Assessment. It is quite common to identify and number storage tanks based on their capacity. Hence, the tanks identified in Figure 2 as Fuel Oil Tank 450.001 and Fuel Tank 450.002 most likely have a capacity of 450,000 bbl. This capacity is consistent with tanks that have a diameter or around 225 ft as estimated from Google Maps. Likewise, CS Tank 30.001 is assumed to have a capacity of 30,000 bbl. It is quit obvious from the Google aerial photos that CS Tank 30.001 is an external floating roof tank. Based on the size of the two large tanks, the product listed as being stored in them (fuel oil), and on the Google aerial photo, it is believed that the tanks have internal floating roofs. Because it has not been verified at this time that the two large tanks have internal floating roofs, an excursion case has been analyzed assuming that the two tanks are fixed roof.

The areas encompassed by the two diked areas have been estimated from Google Maps. The area of the dike surrounding CS Tank 30.001 is estimated to be 22,400 sq ft while the area of the dike surrounding the two large tanks is estimated to be 270,000 sq ft.

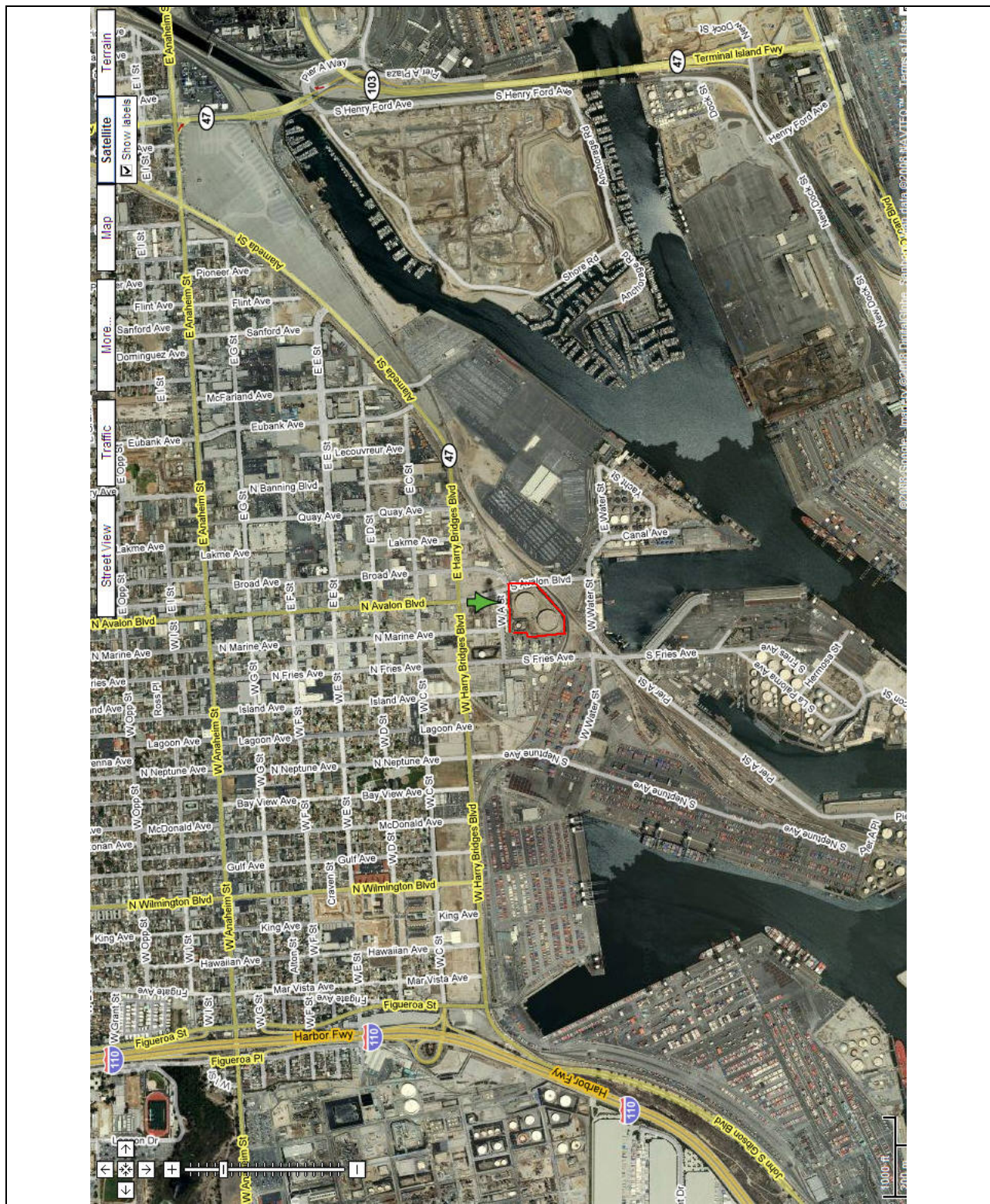
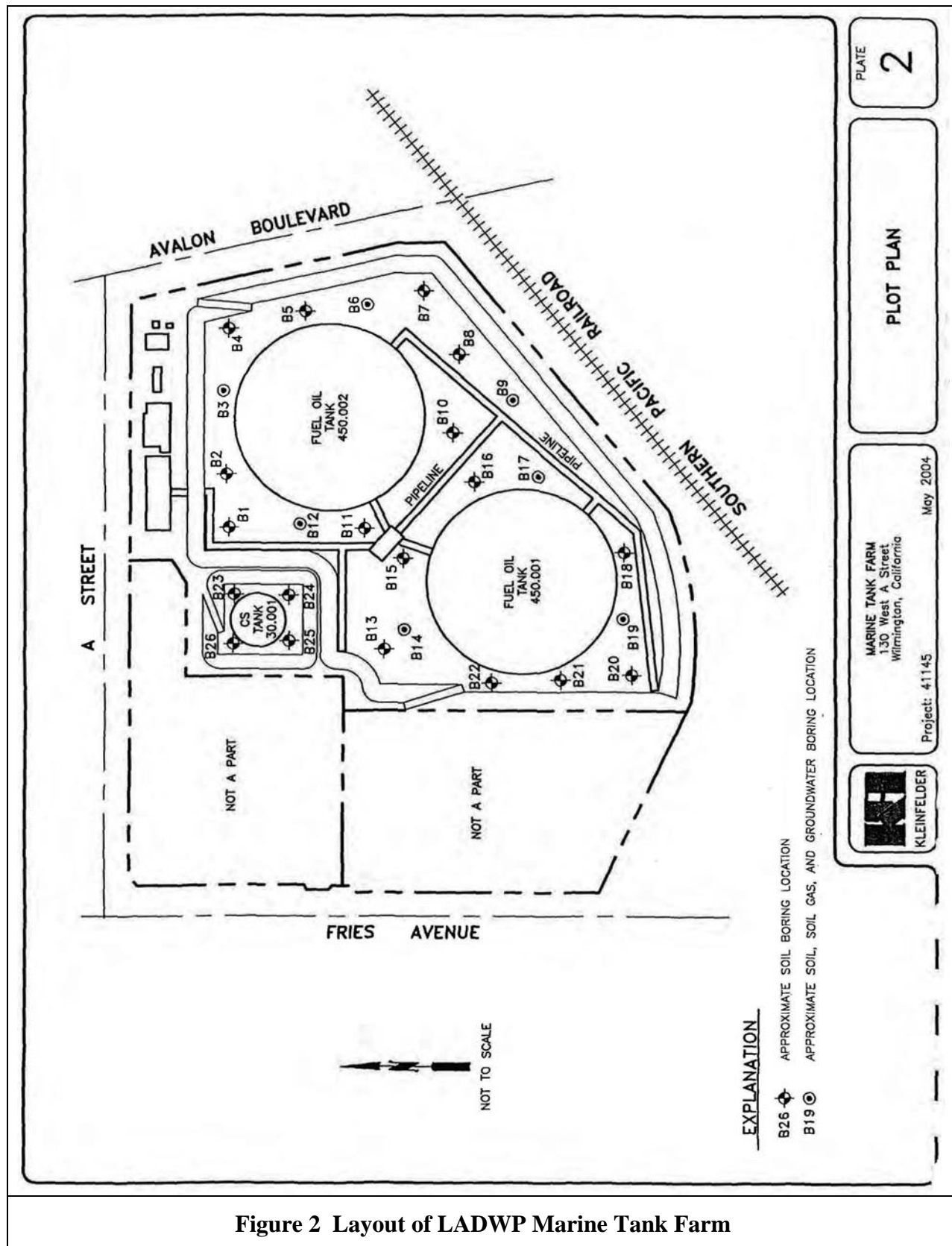


Figure 1 Location of LADWP Marine Tank Farm



Based on information shown on the Plot Plan presented in the Phase II Environmental Site Assessment (shown as Figure 2), it has been assumed that Tank 30.001 stores cutter stock while the other two tanks store fuel oil. Cutter stock generally refers petroleum products that are added to other petroleum products to lower their viscosities. A review of a number of Material Safety Data Sheets (MSDSs) found that the lowest flash point for cutter stock was 160° F. Fuel oil, listed for the other two tanks, is generally a product similar to diesel oil no. 1 or 2. These products generally have flash points above 100° F. Characteristics of the two products are provided in Table 1. Flammable materials have a flash point below 100° F while combustible products have a flash point between 100° F and 200° F. Flash point is defined as the lowest temperature at which a liquid can form an ignitable mixture in air near the surface of the liquid. The lower the flash point, the easier it is to ignite the material. The National Fire Protection Association (NFPA) rating is broken into three categories, health, flammability, and reactivity, with ratings of from 0 to 4 in each category with 0 being the lowest hazard and 4 the highest. A rating of 0 or 1 is not considered to be a significant hazard. A combustible liquid is given a flammability rating of 2 while a flammable liquid is given a flammability rating of 3. As can be seen by the table, none of the products assumed to be stored at the LADWP tank farm are classified as flammable or are considered to present a health hazard including a toxic vapor hazard. Because it has not been verified at this time that that the only products presently being stored at the facility are fuel oil and cutter and because there is no information on what products may be stored under the current permits, an excursion case has been analyzed assuming that a flammable material is or can be stored at the facility. Gasoline has been assumed as the flammable product in the excursion analysis. The characteristics of gasoline are also provided in Table 1.

Table 1 Description of Hazardous Materials

Name	NFPA Classification Health-Flammability-Reactivity	Flash point (deg F)
Fuel oil	0-2-0	> 100
Cutter stock	0-2-0 or 0-1-0	> 160
Gasoline	1-3-0	< 0
Source: U.S. Coast Guard 2001		

3. HAZARD FOOTPRINT ANALYSIS

The RMP presents methodologies for calculating five types of hazard footprints, radiant heat from a fire, flammable gas from a release without a fire, blast overpressure from an explosion, flying debris from an explosion, and toxic gas from a release. The RMP methodology also determines when each of the hazard footprints must be calculated. According to the RMP, toxic gas hazard footprints are not required for products that NFPA health ratings of less than 2. Since both fuel oil and cutter stock have NFPA ratings of 0, toxic gas hazard footprints are not required to be calculated. Also, since gasoline has an NFPA health rating of 1, no toxic gas cloud is required.

Also according to the RMP, flammable gas cloud hazard footprints are only required for products with NFPA flammability ratings of 3 or 4. Both fuel oil and cutter stock have NFPA flammability ratings of 2 (some cutter stocks have an NFPA flammability rating of 1). Hence, flammable gas cloud hazard footprints are not required to be calculated for the facility. For the excursion case where gasoline is assumed, the calculation of a flammable gas cloud hazard footprint is required.

Each of the hazard footprints is described below.

Radiant Heat – Thermal radiation or radiant heat generated by a fire is the primary cause of damage resulting from a fire. The danger presented to any animate or inanimate object depends on the nature of the object as well as the intensity of the heat flux and the time of exposure. The danger to people is the primary concern. The border of the footprint showing hazard to people from radiant heat is drawn at the farthest distance from the place of the potential fire where a heat flux of 1,600 Btu per hour per square foot will occur. Exposed personnel within this distance will feel extreme pain within 15 to 30 seconds and will suffer second degree burns after 30 seconds. Radiant heat hazard footprints are required for products with flash points less than 140° F and hence, radiant heat hazard footprints are required to be calculated for fuel oil but not for cutter stock. Radiant heat hazard footprints are also required for gasoline.

Blast Overpressure – Blast overpressure is the term used to describe the blast waves generated by an explosion. The overpressure decreases as it travels away from the explosion. Blast overpressure is measured in pounds per square inch (psi). The boundary of a blast overpressure hazard footprint is drawn at the distance where 2.5 psi can be felt. This is the level where eardrums can begin to rupture. Blast overpressure hazard footprints are not required to be calculated for floating roof tanks since the floating roof sits directly on the liquid in the tank thereby minimizing the potential for flammable vapors building up inside the tank. Blast overpressure hazard footprints are required to be calculated for non-floating roof tanks storing products with flash points less than 140° F. Hence, no blast overpressure hazard footprints are required for the base case where all three tanks are assumed to be floating roof including the excursion case where gasoline is stored. For the excursion case where the two large tanks are assumed to be fixed roof, blast overpressure hazard footprints are required for fuel oil and gasoline (excursion case) but not for cutter stock.

Flying Debris – Explosions and the resulting air blast are generally accompanied by flying fragments or debris. These “missiles” have the potential to severely injure or kill people. Flying debris hazard footprints are not required to be calculated for floating roof tanks since the floating roof sits directly on the liquid in the tank thereby minimizing the potential for flammable vapors building up inside the tank. Flying debris hazard footprints are required to be calculated for non-floating roof tanks storing products with flash points less than 140° F. Hence, no flying debris hazard footprints are required for the base case where all three tanks are assumed to be floating roof including the excursion case where gasoline is stored. For the excursion case where the two large tanks are assumed to be fixed roof, flying debris hazard footprints are required for fuel oil and gasoline (excursion case) but not for cutter stock.

Flammable Gas – A gas cloud from a release of a flammable material will move at the speed of the wind and mix with the air as it does so. Such a gas cloud can become ignited when the gas to air mixture is above the lower flammability limit (LFL) of the gas and the cloud encounters an ignition source. The border of the flammable gas cloud hazard footprint is drawn where the gas to air mixture falls below the LFL. Flammable gas cloud hazard footprints are not required for the base case since neither fuel oil nor cutter stock is classified as flammable. The calculation of a flammable gas cloud hazard footprint is required for the excursion case where it is assumed that gasoline can be stored.

The following summarizes the hazard footprints required for the base case and excursions.

- Base case – Assumes all floating roof tanks and storage of only combustible products (e.g., fuel oil and cutter stock)
 - Radiant heat
- Excursion case 1 – Same as base case except that flammable materials (e.g., gasoline) can also be stored
 - Radiant heat
 - Flammable gas cloud
- Excursion case 2 – Assumes two largest tanks do not have floating roofs and only combustible products can be stored
 - Radiant heat
 - Blast overpressure
 - Flying debris
- Excursion case 3 – Same as Excursion case 2 except that flammable materials (e.g., gasoline) can also be stored
 - Radiant heat
 - Flammable gas cloud
 - Blast overpressure
 - Flying debris

The results of the hazard footprint analysis for each of the cases are presented below.

It is noted here that no hazard footprints have been calculated for the diked area containing the cutter stock tank for two reasons. First, because the flash point of cutter stock is greater than 140° F no hazard footprints are required. However, if that tank was used to store a combustible or flammable product, then the calculation of hazard footprints would be required. However, since the size of the cutter stock tank is considerably smaller than the size of the two fuel oil tanks and the area of the diked area containing the cutter stock tank is considerably less than that of the diked area containing the two fuel oil tanks, the hazard footprints for the cutter stock tank and associated diked area would fall well within those of the fuel tanks and associated diked area and therefore would not increase the overall size of the facility hazard footprint.

3.1 Base Case

The Base Case assumes that all the tanks are floating roof and that no flammable products are stored at the facility. Based on the data available at this time, this appears to best reflect the current situation at the facility. The only hazard footprint required for the Base Case is radiant heat from a release of fuel oil from one of the two 450,000 bbl tanks into the diked area followed by a fire. This hazard footprint was calculated to extend to 1,100 ft from the edge of the diked area. The Base Case hazard footprint is plotted on Figure 3.

3.2 Excursion Case 1

Excursion case 1 assumes that the facility currently does or has the right to store flammable petroleum products at the facility. All tanks are still assumed to floating roof. This case adds the potential for a flammable gas cloud hazard footprint. The flammable gas cloud hazard footprint was calculated to extend 160 ft from the edge of the diked area. The radiant heat hazard footprint was calculated to extend 1,280 ft from the edge of the diked area which is slightly greater than the radiant heat hazard footprint for fuel oil. The hazard footprints for Excursion Case 1 are plotted on Figure 4.

3.3 Excursion Case 2

Excursion Case 2 is the same as the Base Case (no flammable products stored) except that the two 450,000 bbl tanks are assumed to be fixed roof. The radiant heat hazard footprint would still be the same (1,100 ft) however the fixed roof tanks require the calculation of blast overpressure and flying debris hazard footprints. These were calculated to be 590 ft and 800 ft respectively. The blast overpressure and flying debris hazard footprints extend from the center of the tanks. The hazard footprints for Excursion Case 2 are plotted on Figure 5.

3.4 Excursion Case 3

Excursion Case 3 is a combination of Excursion Case 1 where flammable products may be stored and Excursion Case 2 where the two 450,000 bbl tanks are assumed to be fixed roof. Hence, the radiant heat hazard footprint (1,280 ft) and flammable gas cloud hazard footprint (160 ft) would be the same as for Excursion Case 1. The blast overpressure and flying debris hazard footprints for the storage of gasoline in a 450,000 bbl fixed roof tank were calculated to be 650 ft and 800 ft respectively. The hazard footprints for Excursion Case 3 are plotted on Figure 6.

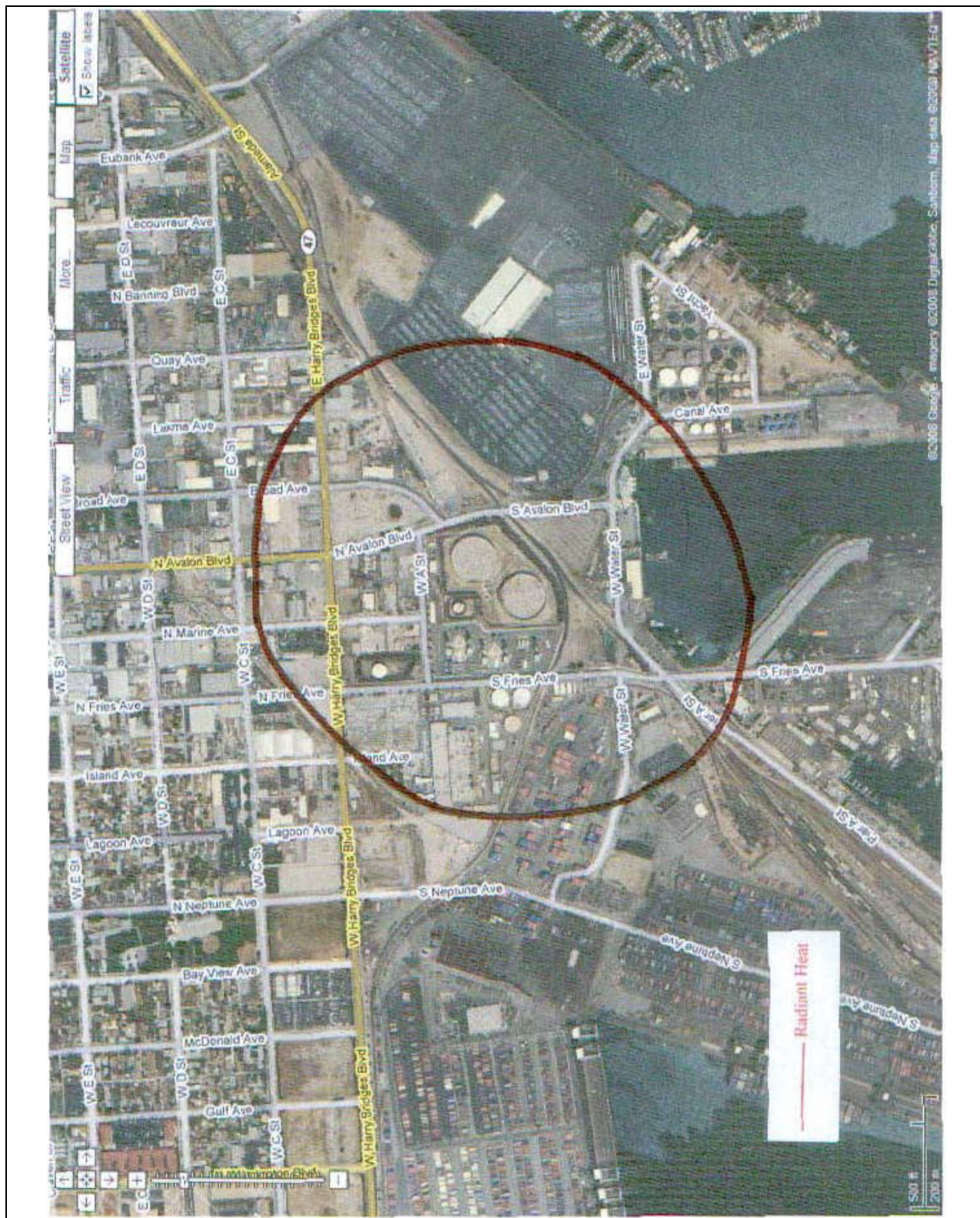


Figure 3 Base Case Hazard Footprint



Figure 4 Excursion Case 1 Hazard Footprints

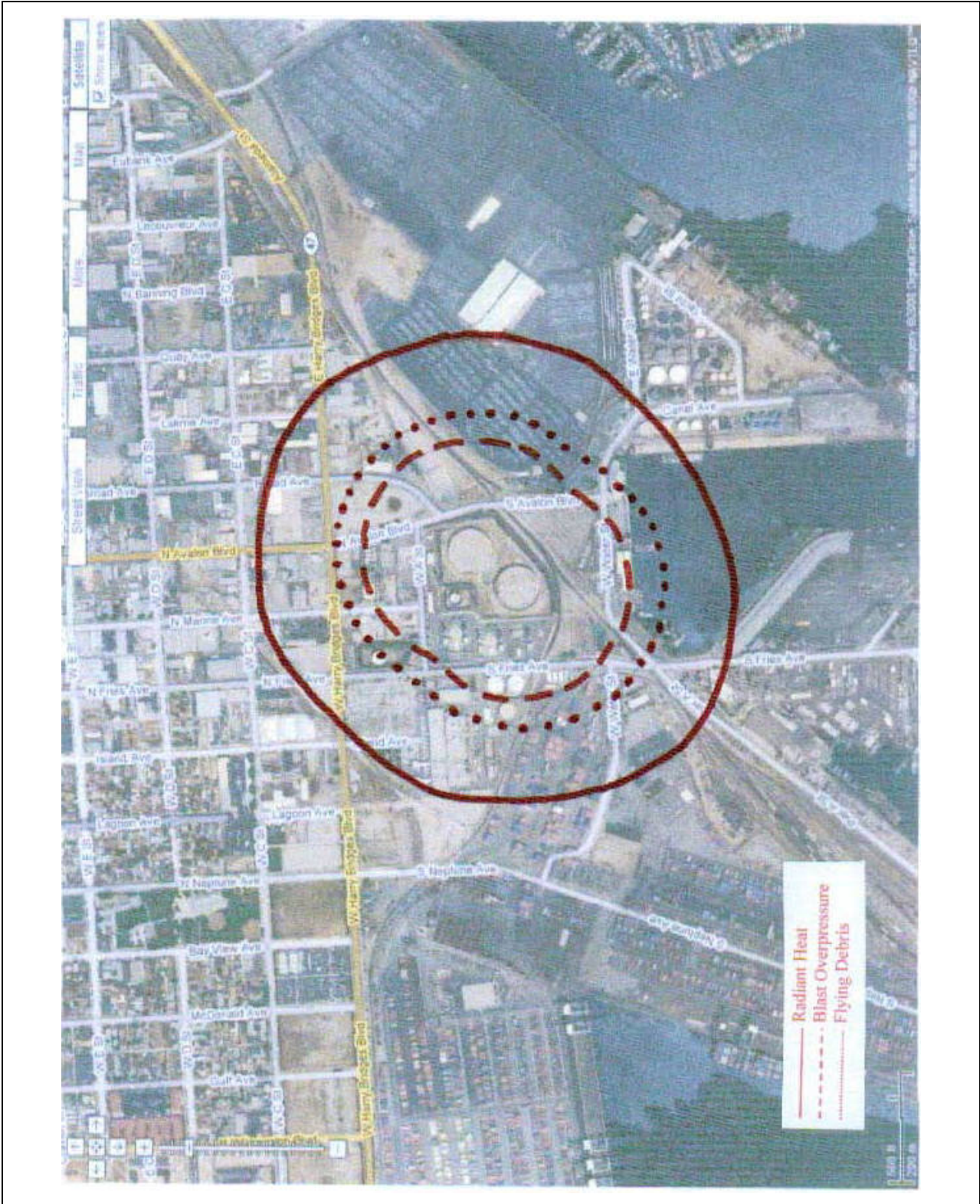


Figure 5 Excursion Case 2 Hazard Footprints

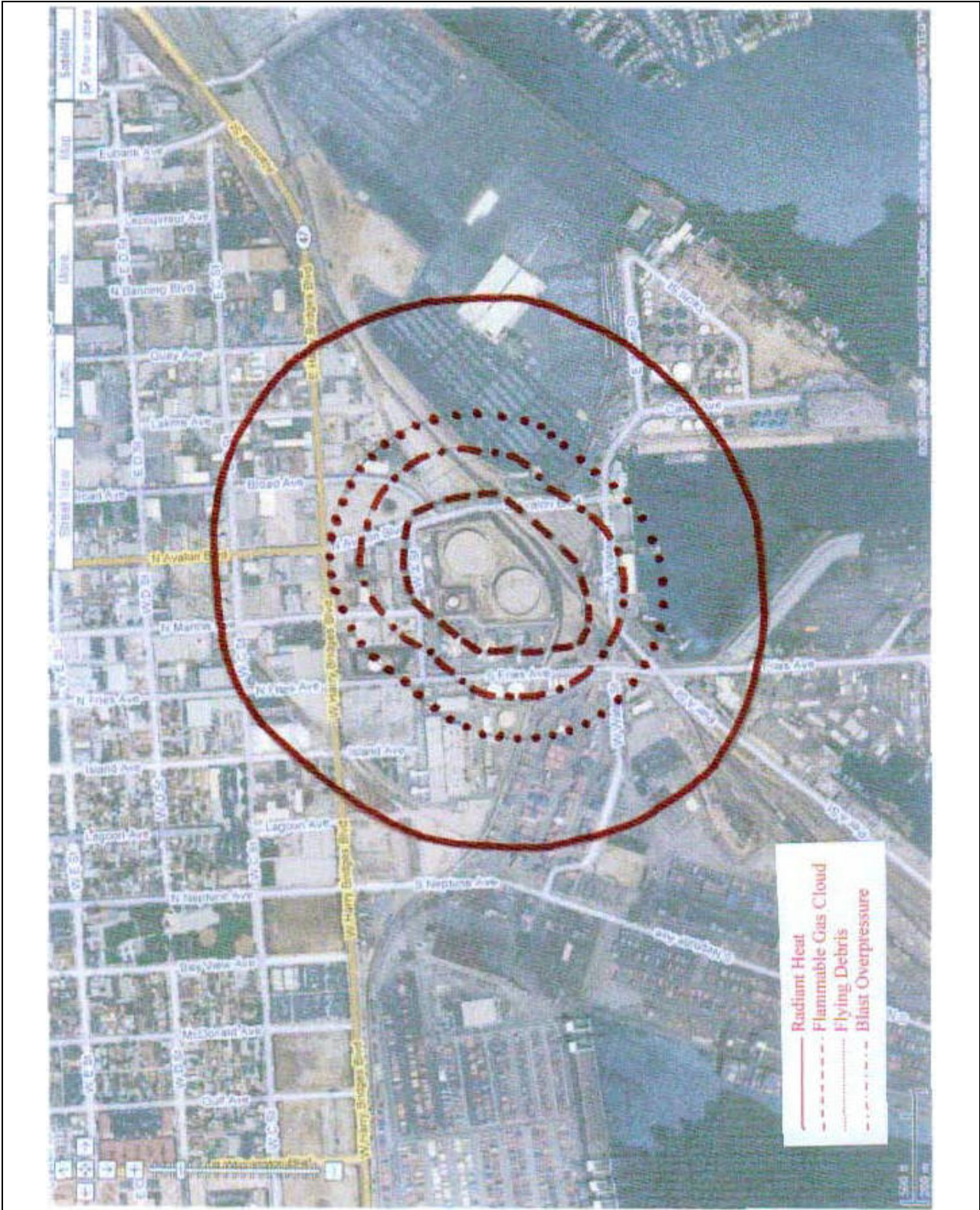


Figure 6 Excursion Case 3 Hazard Footprints

4. SUMMARY

A summary of the hazard footprints for the Base Case and three excursion cases is presented in Table 2. As can be seen by the table, the largest hazard footprint for the Base Case is 1,100 ft. This increases to 1,280 ft if flammable products are stored at the facility (see Excursion Cases 1 and 3). Assuming that the tanks are fixed roof adds in a 800 ft flying debris hazard footprint but does not increase the overall size of the hazard footprint.

Table 2 Summary of Hazard Footprint Analysis

Scenario	Hazard Footprint Distance (ft)			
	Radiant Heat	Flammable Gas	Blast OP	Flying Debris
Base Case	1,100	NR	NR	NR
Excursion 1	1,280	160	NR	NR
Excursion 2	1,100	NR	590	800
Excursion 3	1,280	160	650	800

NR – Hazard footprint not required for this scenario.

REFERENCES

Kleinfelder. 2004. Phase II Environmental Site Assessment Marine Tank Farm, 130 West A Street, Wilmington, California. May.

Port of Los Angeles. 1983. Risk Management Plan an Amendment to the Port Master Plan.

U.S. Coast Guard. 2001. Website: <http://www.chrismanual.com>. Accessed May, 2007.