Action: Mobile monitoring to identify air pollution hotspots and assess the impact of truck emissions on community exposure

Background & Objective

The East Los Angeles, Boyle Heights, and West Commerce (ELABHWC) community is intersected by a multitude of public roads and freeways with high traffic volumes and a high fraction of diesel truck traffic due to the presence of warehouses and railyards. The CSC identified truck emissions (i.e., traffic near warehouses and railyards, truck idling, as well as moving trucks operated on freeways, intersections and major roadways) and their impact on local residents as a major air quality concern in ELABHWC. The CSC concerns due to emissions related to railyards are addressed in separate progress reports. The focus of this report is specifically on truck traffic near warehouses, on major roads and freeways, and in areas identified by the CSC.

The monitoring strategy to study and characterize this air quality priority includes comprehensive mobile measurements with a focus on black carbon (BC), particulate matter (PM), ultrafine particles (UFP), and nitrogen dioxide (NO_2). Mobile monitoring is first conducted near warehouses and in areas identified by the CSC with high density of moving and idling trucks within the local neighborhood streets. These measurements will extend to other areas within the ELABHWC community to support implementation of emission reduction strategies and track their progress; identify air pollution hotspots; and assess the impact of truck emissions on community exposure. These measurements can be used to look at pollution in the areas of traffic concern for a review with traffic information to support the implementation of Automated License Plate Readers (ALPR), which is currently being explored by South Coast AQMD staff in collaboration with California Air Resources Board (CARB). For more information please see CERP Ch. 5b.

Method

Air monitoring was conducted using a mobile platform capable of measuring a wide range of particulate and gaseous pollutants, including PM, BC, UFP, and NO_2. Figure 1 shows the location of truck idling hotspots (yellow circles), truck traffic related air quality concerns (purple stars), and warehouses within ELABHWC. Truck traffic air quality concerns were identified by the CSC through a prioritization activity during the February 2019 CSC meeting, whereas the truck idling hotspots were identified by the CSC through a separate prioritization activity during the October 2019 CSC meeting. The locations of warehouses were obtained from Southern California Association of Governments' (SCAG) 2016 land use dataset. South Coast AQMD is working with SCAG to obtain a more up to date map of warehouses, considering the rapid development of warehouses in this community.

The Long Beach Freeway (i.e., I-710) that passes through the ELABHWC community is one of the most heavily traveled roadways in the Los Angeles Air Basin. The South Coast AQMD maintains a Near Road monitoring network consisting of four sites adjacent to major freeways, including a near-road air monitoring station downwind of the I-710 freeway where some of the major diesel emission tracers (BC, NO_2, PM2.5 and UFP) are measured. Even though the South Coast AQMD I-710 station is located outside of ELABHWC community, pollutant concentrations measured at this monitoring site can provide representative pollutant exposure information for people who live, work, or go to school near freeways or who spend a significant time traveling on some of the busiest roadways in Southern California with a high fraction of diesel truck traffic.

Results

- As of July 2020, a total of 6 days of mobile monitoring has been carried out to study and characterize levels of air pollutants related to diesel exhaust on major roads and freeways, near warehouses, and in and around truck idling hotspots and truck traffic air quality concerns identified by the CSC
- Mobile monitoring results indicated elevated concentrations of NO_2, UFP, and BC on major freeways and roadways (Attachment A)
- Elevated levels of NO_2, UFP, and BC were observed near some of the warehouses, truck traffic air quality concerns, and truck idling locations, while the rest did not show any significant elevations (Attachment A)
- NO_2, UFP, and BC concentrations were found to be generally lower in residential communities as compared to those measured in and around major streets and freeways (Attachment A)
- Data analysis results from the I-710 near road monitoring station can be found in Attachment B of the Truck Traffic progress report for the Wilmington, Carson, West Long Beach (WCWLB) community

Next steps

- Continue mobile monitoring with a focus on truck idling hotspots, truck traffic air quality concerns, and warehouses
- Continue to assess mobile measurements data/results to support implementation of emission reduction strategies and track their progress, and support implementation of ALPR

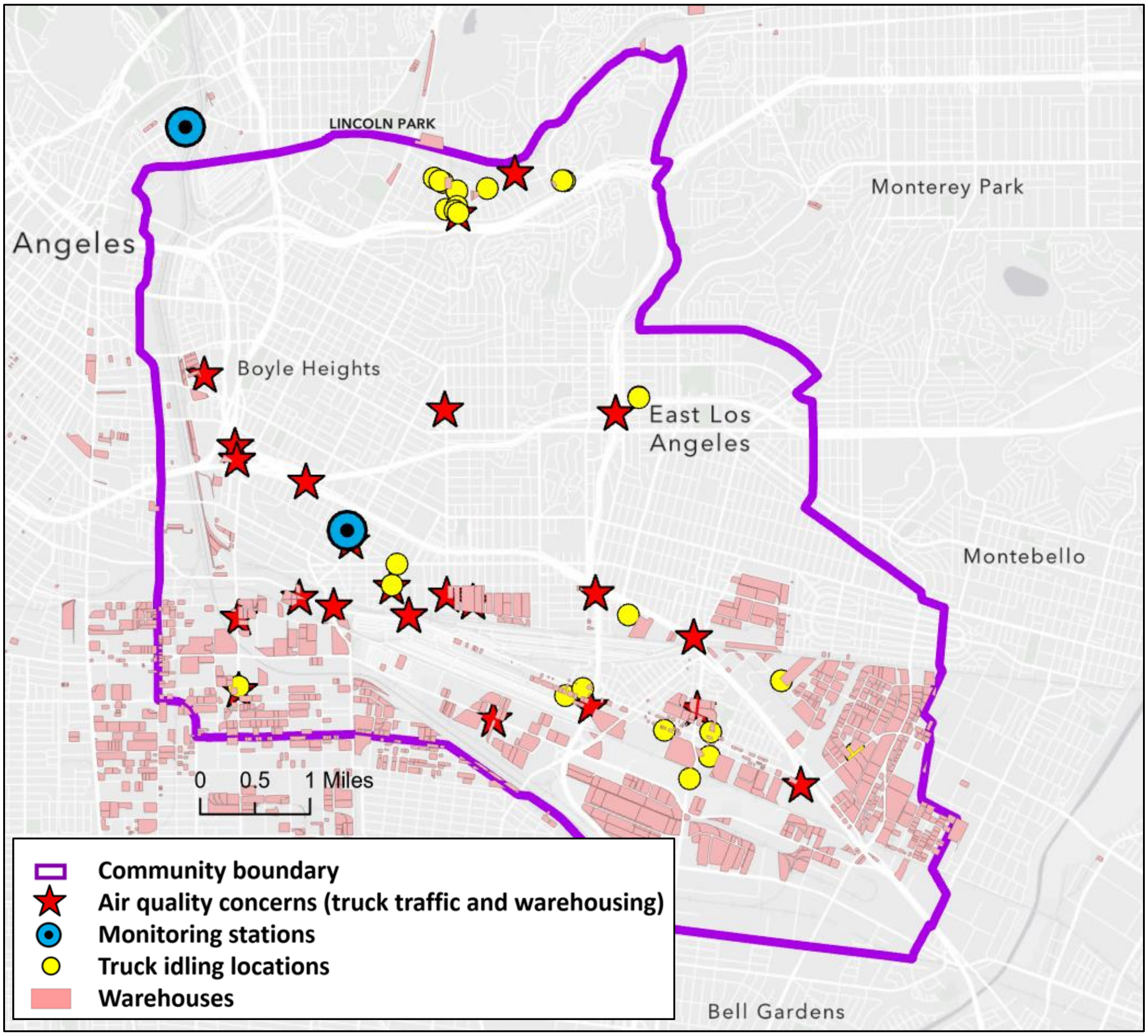

Figure 1. Map showing the location of truck idling hotspots (shown as yellow circles), truck traffic related air quality concerns (shown as purple stars), and warehouses (SCAG's 2016 land use dataset) within ELABHWC, as well as the location of monitoring stations for baseline measurements

Attachment A

As of July 2020, a total of six mobile monitoring surveys have been conducted in the East Los Angeles, Boyle Heights, and West Commerce (ELABHWC) community to measure diesel emissions. Diesel engines emit a complex mixture of air pollutants, including both gaseous and solid material. The solid material in diesel exhaust is known as diesel particulate matter (DPM), which is a component of fine particles (PM2.5 – particulate matter smaller than 2.5 micrometers in diameter). There is no technique to directly measure DPM (a major contributor to health risk); therefore, indirect measurements based on surrogates for components of diesel exhaust are used, specifically black carbon (BC). DPM is typically composed of carbon particles ("soot", also called BC) and numerous organic compounds. Diesel exhaust also contains gaseous pollutants, including volatile organic compounds (VOC) and nitrogen oxides (NOx).

Measurements were conducted using a mobile platform capable of monitoring a wide range of particulate and gaseous pollutants, including DPM markers, such as PM, BC, ultrafine particles (UFP), and nitrogen dioxide (NO_2), as part of the area-wide surveys. The routes traversed by the mobile platform were defined in a way to perform monitoring in and around major roadways and freeways, warehouses, as well as truck traffic and idling locations identified by the community steering committee (CSC) within the ELABHWC community. The location of truck idling hotspots (shown as yellow circles) and truck traffic related air quality concerns (shown as purple stars) within ELABHWC were identified by the community steering committee (CSC) through a prioritization activity during the February 2019 CSC meeting, whereas the truck idling hotspots were identified by the CSC through a separate prioritization activity during the October 2019 CSC meeting. The locations of warehouses were obtained from Southern California Association of Governments' (SCAG) 2016 land use dataset. South Coast AQMD is working with SCAG to obtain a more up to date map of warehouses, considering the rapid development of warehouses in this community. Based on CSC input regarding development of new warehouses in the northeast areas of the ELABHWC, mobile monitoring was conducted in those areas in addition to the warehouse clusters identified through SCAG's land use dataset.

Typically, measurements from a mobile platform at a given location are relatively short, ranging from seconds to a few minutes when the platform is moving. Therefore, given the high temporal variability of most air pollutants, mobile survey measurements do not necessarily capture the typical air quality conditions of a specific location. One way to address this limitation is to increase the number of passes or transects to obtain a more representative and consistent map of the spatial and temporal variability of the measured air pollutants through repeated measurements. Figure A-1 shows the routes traversed by the mobile platform in and around major roadways and freeways, warehouses, as well as truck traffic and idling locations identified by the community steering committee (CSC) within the ELABHWC community. In this figure, number of passes, that is a measure of representativeness of the measured concentrations, is shown as a white-to-green color gradient, with darker green representing areas where more passes were taken.

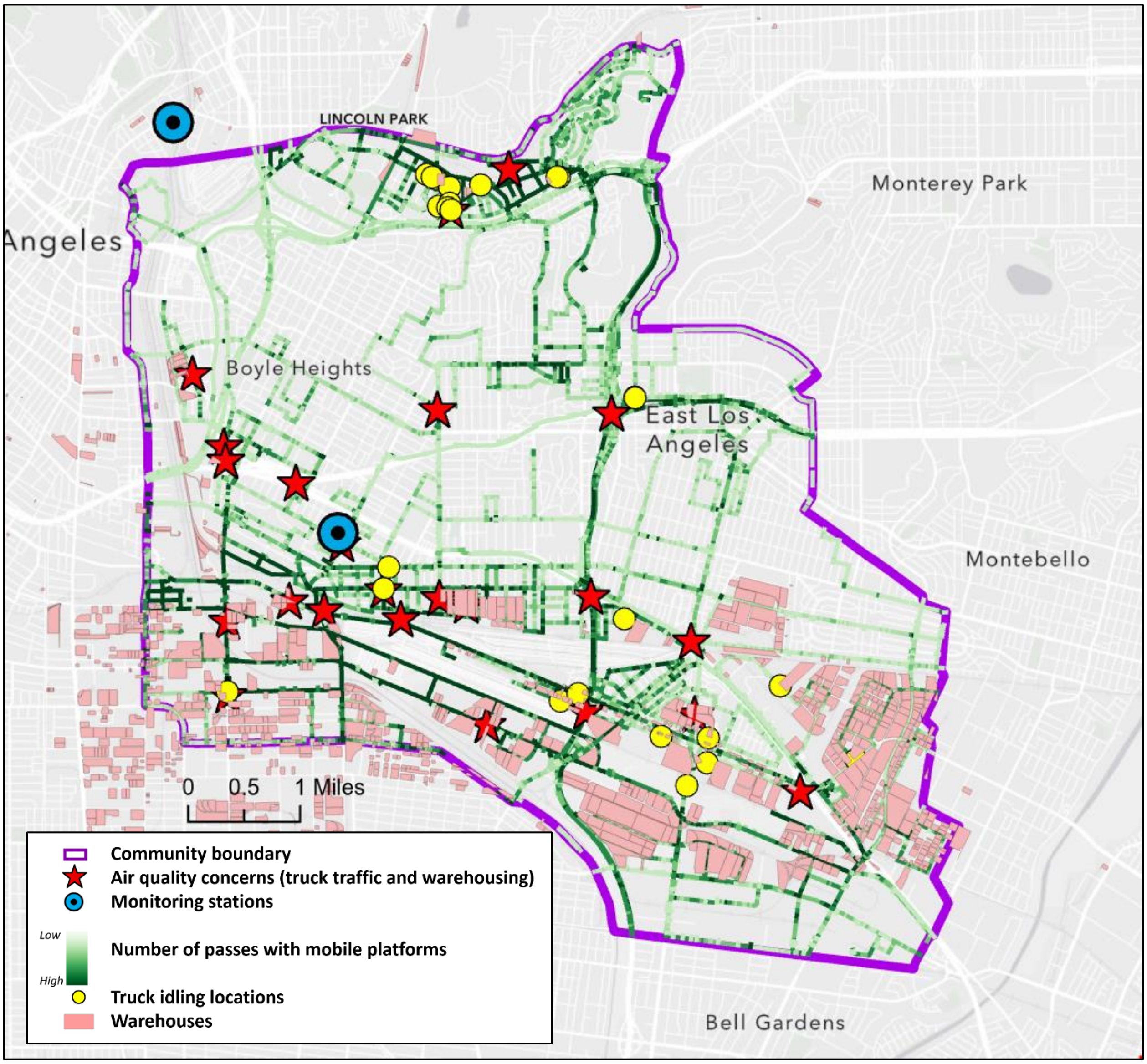

Figure A-1. Map illustrating the routes traversed by the mobile platform used to monitor potential truck emissions from truck idling hotspots, truck traffic-related air quality concerns, and warehouses, as well as the location of monitoring stations for baseline measurements. As of July 2020, a total of 6 days of mobile monitoring was conducted near warehouses, as well as around truck idling hotspots and traffic air quality concerns identified by the CSC

Figure A-2 shows the duration and time window for the area-wide mobile measurements performed within the ELABHWC community in and around freeways, major roadways, warehouses, truck idling hotspots, and truck traffic-related air quality concerns. As shown in this figure, mobile monitoring was performed in different times of day during the six survey days. The starting time of the mobile monitoring surveys varied between 7:30 and 11:30 am PST (Pacific Standard Time), whereas the ending time ranged from 11:30 am to 4 pm PST.

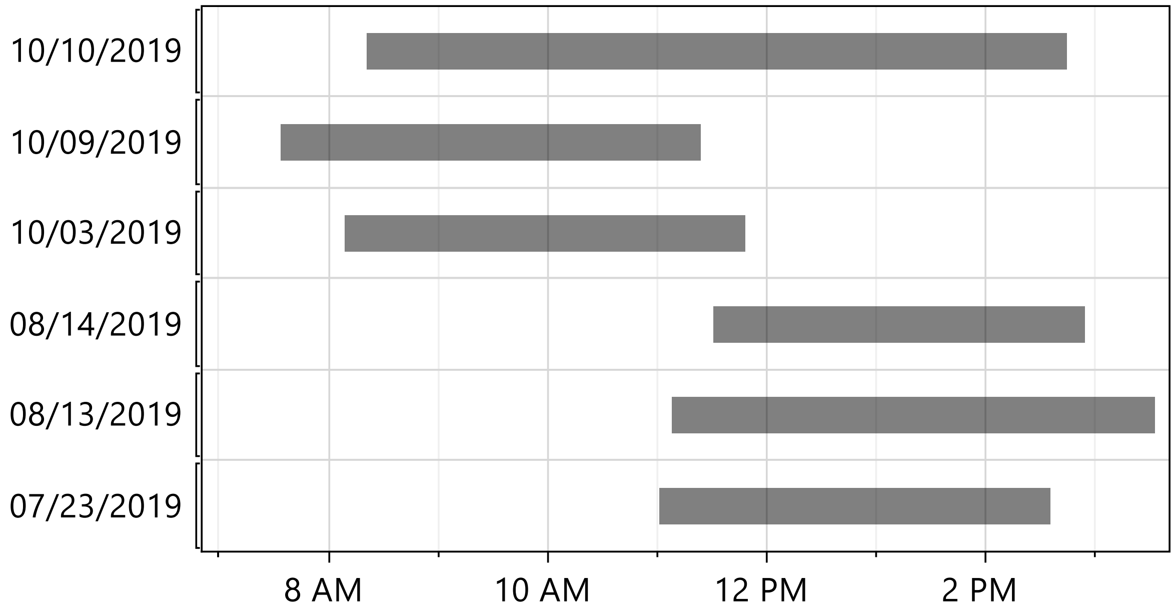

Figure A-2. Plot showing the duration and time window for the area-wide mobile measurements conducted within the ELABHWC community in and around freeways, major roadways, warehouses, truck idling hotspots, and truck traffic-related air quality concerns. The time windows only include hours of active mobile measurements within this community,

Upon extensive screening and pre-processing of the data, NO_2 measurements were found to be the most robust and reliable set of diesel exhaust markers measured, with 6 (out of 6) valid days of measurements and minimum instrument down time, followed by UFP and BC measurements, with 3 valid days of measurements, respectively. Figures A-3, A-4, and A-5 illustrate "aggregated" maps of the spatial pattern (or concentration gradient) of NO_2, UFP, and BC concentrations in and around freeways, major roadways, warehouses, truck idling hotspots, and truck traffic-related air quality concerns within the ELABHWC community, as measured by the mobile monitoring platform during those six days. To ensure that the concentration gradient map is representative of the variations in the pollutant concentrations, individual measurements taken within a 50-meter radius in different passes and on different days were "aggregated", by calculating their arithmetic average, and shown as colored hexagonal bins on the map. Therefore, each hexagon on the map represents multiple measurements taken at different passes. In addition, it should be noted that mobile measurements taken on different days and hours cannot be directly compared, mainly because of the day-by-day and diurnal (i.e., hour-of-the-day) variability in pollutant concentrations as a result of changes in meteorology and source emissions strengths. Therefore, in order to account for the day-by-day, as well as diurnal variability in the pollutant concentrations, the mobile monitoring data need to be normalized with stationary data from a fixed site monitoring station, according to a commonly used method in the literature. To achieve this, we collected minutely data from the Resurrection Church monitoring station and computed hourly averages of pollutant concentrations for the time period corresponding to our mobile monitoring period (Figure A-2). For example, on October 3rd, 2019, mobile monitoring was performed from 8 am PST to 12 pm PST, therefore, a total of 4 hourly averages were calculated for each pollutant from the Resurrection Church monitoring station (Figure A-1). Subsequently, the mobile monitoring data with 1-second time resolution was divided by the hourly averaged stationary data that corresponded to the hour in which that measurement was taken. It should also be noted that for a few hours on some of the mobile measurement days, data from the Resurrection Church monitoring station was not available; on these occasions, data from the next closest monitoring station (i.e., Central Los Angeles (CELA) Monitoring Station – Figure A-1) was used instead for day-by-day and hour-of-the-day correction.

As shown in Figure A-3, the mobile monitoring results indicate elevated NO_2 concentrations on freeways, including transects of the I-710, I-5, and 60, as well as major roadways, including Bandini Blvd., Washington Blvd., Santa Fe Ave., and Soto St. It can also be observed from the map that NO_2 concentrations were lower in residential communities as compared to those measured in and around freeways and major roadways within the ELABHWC community. Additionally, as shown in the map, while relatively high NO_2 concentrations were observed in some of the truck traffic air quality concerns and truck idling locations identified by the CSC, no significant elevations in NO_2 levels were observed for many other truck traffic air quality concerns and truck idling locations, especially for the ones located to the north of the community. Similarly, mobile measurements showed elevated NO_2 levels around some of the warehouse clusters, especially near the warehouses located to the south of the community boundary, while no drastic elevations were observed near other warehouse clusters (e.g., near the warehouse clusters located to the southeast of the community).

For UFP (Figure A-4), the most elevated concentrations were observed on I-710, I-10, and 60 freeways, or on some of the major roadways such as Santa Fe Ave. and Soto St. Expectedly, and similarly to NO_2, UFP concentrations were generally lower in residential communities compared to those measured in and around freeways and major roadways within the ELABHWC community. As with NO_2, some of the truck traffic air quality concerns and truck idling locations exhibited somewhat elevated UFP levels, while the rest did not show any significant elevations. In addition, elevated UFP levels were observed near some of the warehouse clusters, whereas measurements near other warehouse clusters did not show significant elevations in the levels.

As shown in Figure A-5, BC concentrations also showed the highest elevations on freeways (e.g., I-710 and 60 freeways), freeway off-ramps and major roadways (e.g., Bandini Blvd., Washington Blvd., Soto St., Santa Fe Ave). Similarly, to NO_2 and UFP, BC concentrations were generally lower in residential areas compared to those measured in and around freeways and major roadways within the ELABHWC community. In addition, again, similarly to NO2 and UFP, elevated BC levels were observed near some of the warehouses, truck traffic air quality concerns, and truck idling locations, while the rest did not show any significant elevations. It is also noteworthy that even though the spatial patterns of these DPM tracers did not exactly match, the general trends were consistent with expectations, showing elevated levels near and on major freeways and streets. This is an important observation since a large fraction of personal exposure to DPM occurs during travel on roadways. According to California Air Resource Board[1], although Californians spend a relatively small proportion of their time in enclosed vehicles (about 7% for adults and teenagers, and 4% for children under 12), 30 to 55% of daily DPM exposure typically occurs during the time people spend in motor vehicles.

[1] https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health

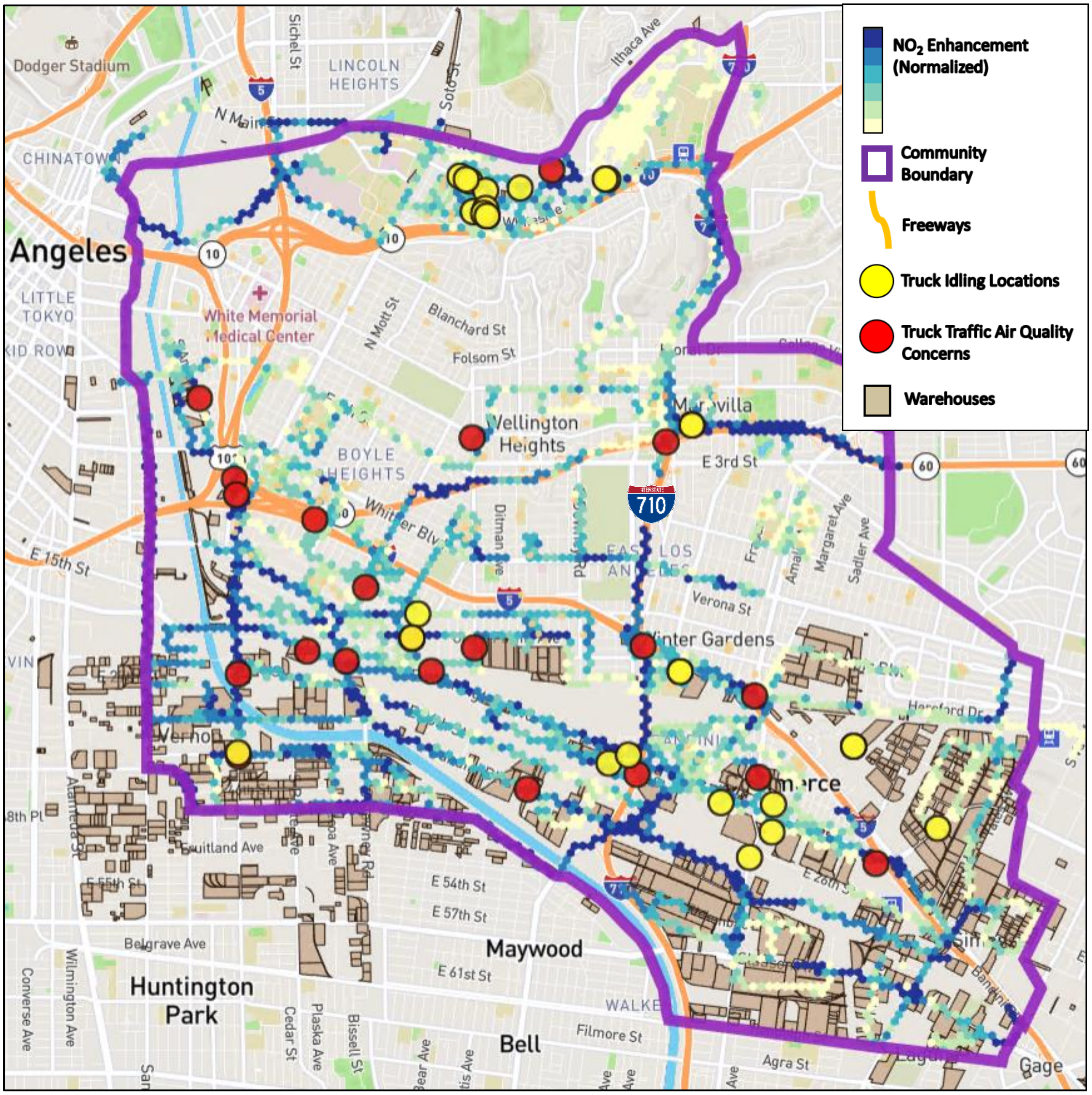

Figure A-3. Aggregated map of the spatial pattern of NO_2 concentrations in and around freeways, major roadways, warehouses, truck idling hotspots, and truck traffic-related air quality concerns within the ELABHWC community, as measured by the mobile monitoring platform on 07/23/2019, 08/13/2019, 08/14/2019, 10/03/2019, 10/09/2019, and 10/10/2019

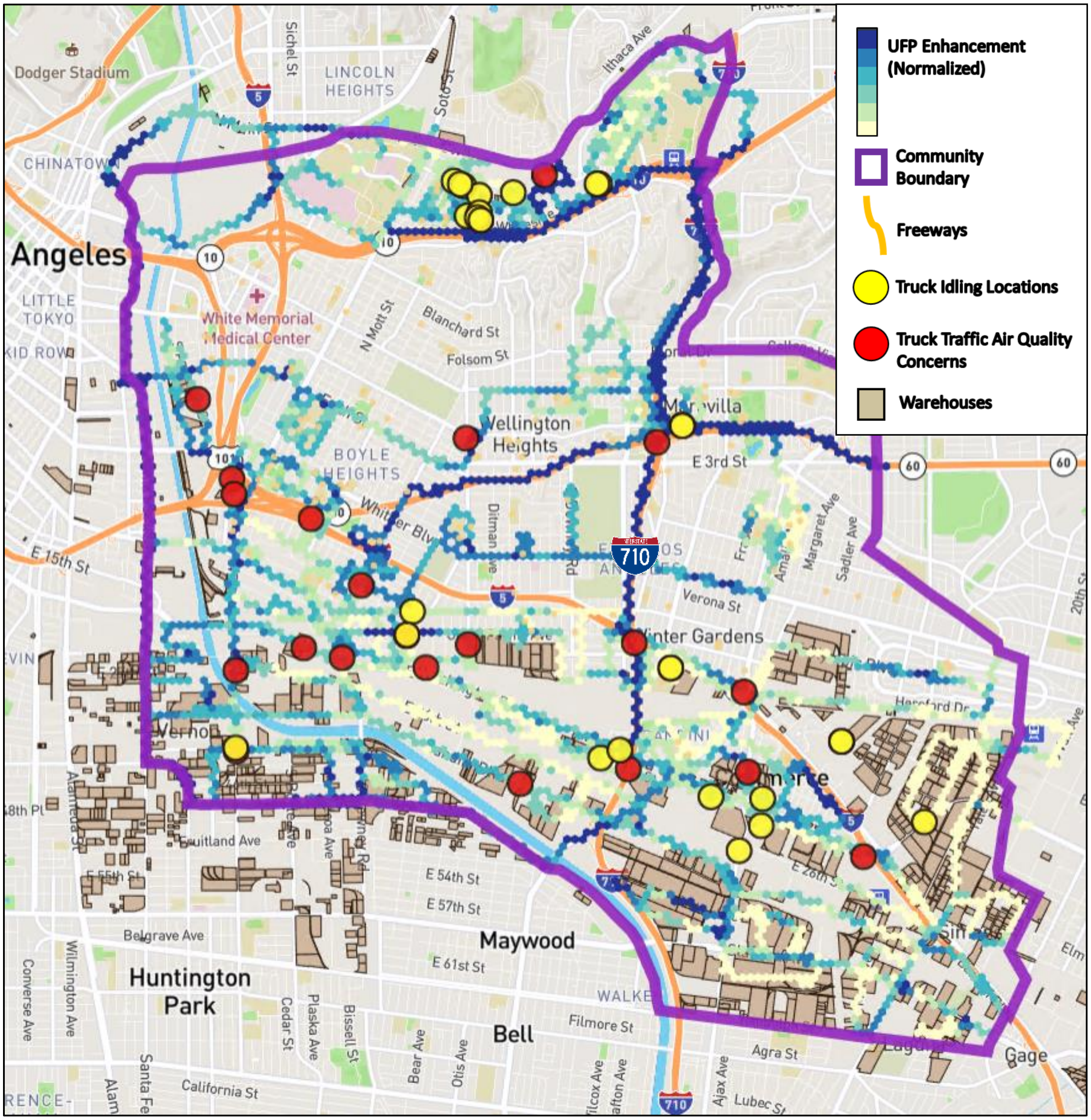

Figure A-4. Aggregated map of the spatial pattern of UFP concentrations in and around freeways, major roadways, warehouses, truck idling hotspots, and truck traffic-related air quality concerns within the ELABHWC community, as measured by the mobile monitoring platform on 07/23/2019, 08/13/2019, 08/14/2019, 10/03/2019, 10/09/2019, and 10/10/2019

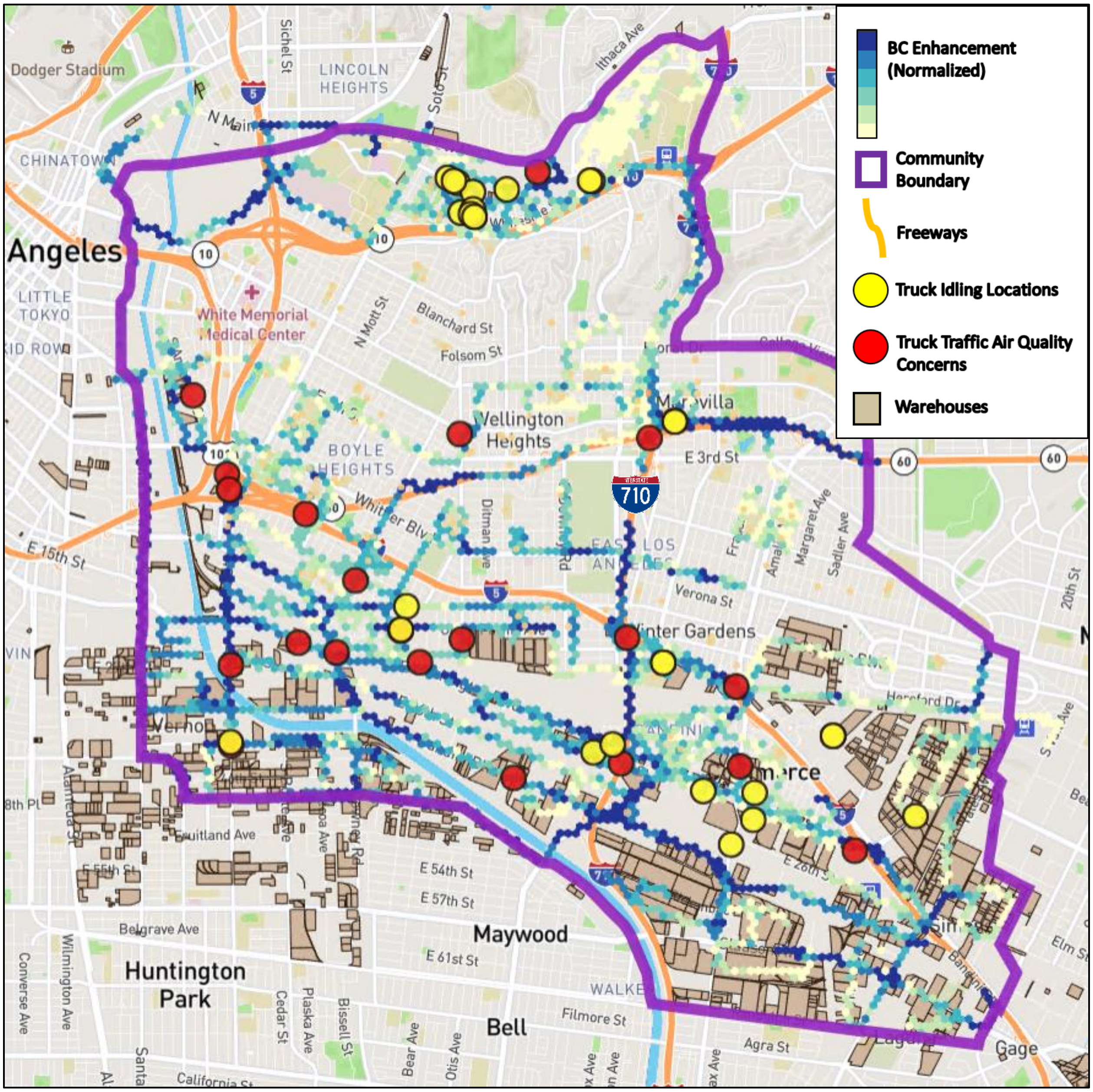

Figure A-5. Aggregated map of the spatial pattern of BC concentrations in and around freeways, major roadways, warehouses, truck idling hotspots, and truck traffic-related air quality concerns within the ELABHWC community, as measured by the mobile monitoring platform on 07/23/2019, 08/13/2019, 08/14/2019, 10/03/2019, 10/09/2019, and 10/10/2019