Appendix H

Noise Impact Analysis Report

FIRSTCARBON SOLUTIONS™

Noise Impact Analysis
Bayer Development Agreement Extension Project
City of Berkeley, Alameda County, California

Prepared for:
Bayer HealthCare LLC
800 Dwight Way
Berkeley, CA 94710
862.404.3000

Contact: Jessica Hays

Prepared by:
FirstCarbon Solutions
1350 Treat Boulevard, Suite 380
Walnut Creek, CA 94597
925.357.2562

Contact: Mary Bean, Senior Director
Philip Ault, Project Manager, Noise Scientist

Date: November 30, 2020

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ACRONYMS AND ABBREVIATIONS

ADT	Average Daily Traffic
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
dB	decibel
dBA	A-weighted decibel
EPA	United States Environmental Protection Agency
FCS	FirstCarbon Solutions
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
in/sec	inch per second
L_{dn}	day-night average sound level
L_{eq}	equivalent continuous sound level
L_{max}	maximum noise/sound level
OSHA	Occupational Safety and Health Administration
PPV	peak particle velocity
rms	root mean square
VdB	vibration in decibels

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SECTION 1: INTRODUCTION

1.1 - Purpose of Analysis and Study Objectives

This Noise Impact Analysis has been prepared by FirstCarbon Solutions (FCS) to determine and evaluate the off-site and on-site noise impacts associated with the proposed Bayer Development Agreement Extension Project (proposed project). The following is provided in this report:

- A description of the study area, project site, and proposed project.
- Information regarding the fundamentals of noise and vibration.
- A description of the local noise guidelines and standards.
- A description of the existing noise environment.
- An analysis of the potential short-term, construction-related noise and vibration impacts from the proposed project.
- An analysis of long-term, operations-related noise and vibration impacts from the proposed project.

1.2 - Project Summary

1.2.1 - Site Location

The proposed project is located in the City of Berkeley, in Alameda County, California. The 46-acre project site is roughly bounded by the Southern Pacific Railroad right-of-way to the west, Seventh Street to the east, Grayson Street to the south, and Dwight Way to the north together with a separate parking lot, which is located on a portion of the block between Dwight, Seventh, Parker and Sixth streets. There are three contiguous parcels near the corner of Carleton and Seventh Streets which are not owned by Bayer. Surrounding the project site are industrial, commercial, and residential land uses to the north, commercial land uses to the east, and industrial and commercial land uses to the south. A few single-family homes are located southeast of Seventh and Grayson Streets. Adjacent to the western boundary of the project site is the Southern Pacific Railroad right-of-way, a waterfront park, and beyond is Interstate 580 (I-580). Regional access to the project site is provided via the I-580 via the University Avenue exit, located to the north of the project site, and via the Ashby Avenue exit, located to the south of the project site. Local access to the project site is provided via Dwight Way, Parker Street, Carlton Street, Grayson Street, and Seventh Street. The local vicinity map is shown in Exhibit 1.

1.2.2 - Project Description

The project site currently houses biopharmaceutical operations with supporting offices and other ancillary uses and includes two primary areas, the “North Properties” located north of Carlton Street, and the “South Properties” located south of Carlton Street. The Development Agreement (DA) covers only the North Properties. The proposed project would combine the North Properties and South Properties into the 2022 amended Development Agreement. The proposed project would modernize the Bayer Campus and utilize space more efficiently, enabling a reduction from 1,866,000 square feet under baseline conditions to 1,738,000 square feet of administration/office, manufacturing labs, production, warehouse, utility, and maintenance space at buildout under project conditions. The proposed DA site plan is shown in Exhibit 2.

Source: Bing Aerial Imagery.

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1,000 500 0 1,000 Feet

Exhibit 1
Local Vicinity Map
Aerial Base

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BAYER HEALTHCARE LLC
BAYER DEVELOPMENT AGREEMENT EXTENSION PROJECT
NOISE IMPACT ANALYSIS

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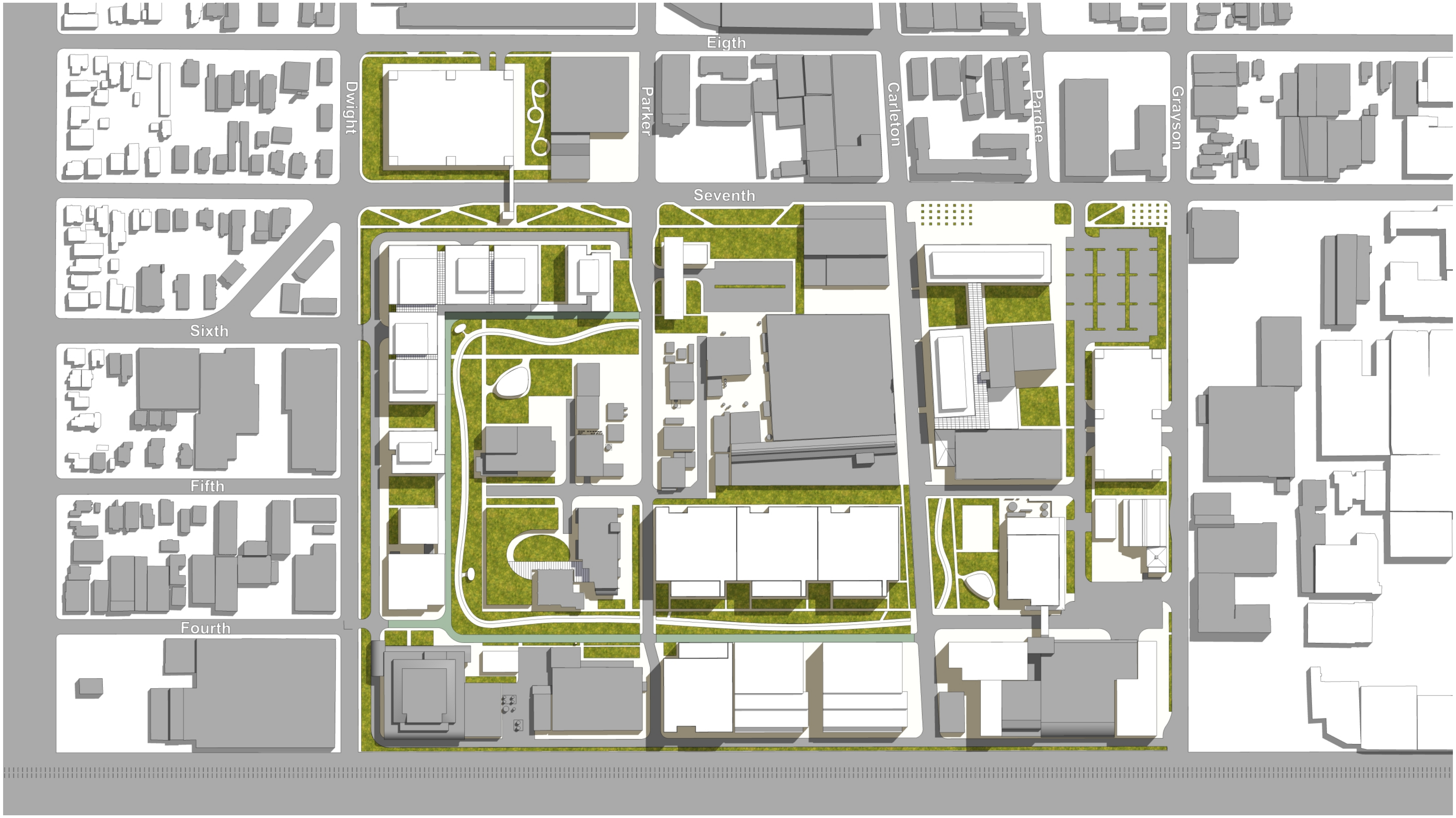

Source: FirstCarbon Solutions, 09/2020.

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Exhibit 2
Site Plan

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BAYER HEALTHCARE LLC
BAYER DEVELOPMENT AGREEMENT EXTENSION PROJECT
NOISE IMPACT ANALYSIS

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SECTION 2: NOISE AND VIBRATION FUNDAMENTALS

2.1 - Characteristics of Noise

Noise is generally defined as unwanted or objectionable sound. Sound becomes unwanted when it interferes with normal activities, when it causes actual physical harm, or when it has adverse effects on health. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and in the extreme, hearing impairment. Noise effects can be caused by pitch or loudness. *Pitch* is the number of complete vibrations or cycles per second of a wave that result in the range of tone from high to low; higher-pitched sounds are louder to humans than lower-pitched sounds. *Loudness* is the intensity or amplitude of sound.

Sound is produced by the vibration of sound pressure waves in the air. Sound pressure levels are used to measure the intensity of sound and are described in terms of decibels. The decibel (dB) is a logarithmic unit, which expresses the ratio of the sound pressure level being measured to a standard reference level. The 0 point on the dB scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Changes of 3 dB or less are only perceptible in laboratory environments. Audible increases in noise levels generally refer to a change of 3 dB or more, as this level has been found to be barely perceptible to the human ear in outdoor environments. Only audible changes in existing ambient or background noise levels are considered potentially significant.

The human ear is not equally sensitive to all frequencies within the audible sound spectrum, so sound pressure level measurements can be weighted to better represent frequency-based sensitivity of average healthy human hearing. One such specific “filtering” of sound is called “A-weighting.” A-weighted decibels (dBA) approximate the subjective response of the human ear to a broad frequency noise source by discriminating against very low and very high frequencies of the audible spectrum. They are adjusted to reflect only those frequencies that are audible to the human ear. Because decibels are logarithmic units, they cannot be added or subtracted by ordinary arithmetic means. For example, if one noise source produces a noise level of 70 dB, the addition of another noise source with the same noise level would not produce 140 dB; rather, they would combine to produce a noise level of 73 dB.

As noise spreads from a source, it loses energy so that the farther away the noise receiver is from the noise source, the lower the perceived noise level. Noise levels diminish or attenuate as distance from the source increases based on an inverse square rule, depending on how the noise source is physically configured. Noise levels from a single-point source, such as a single piece of construction equipment at ground level, attenuate at a rate of 6 dB for each doubling of distance (between the single-point source of noise and the noise-sensitive receptor of concern). Heavily traveled roads with few gaps in traffic behave as continuous line sources and attenuate roughly at a rate of 3 dB per doubling of distance.

2.1.1 - Noise Descriptors

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. Equivalent continuous sound level (L_{eq}) is the total sound energy of time-varying noise over a sample period. However, the predominant rating scales for human communities in the State of California are the L_{eq} and community noise equivalent level (CNEL) or the day-night average level (L_{dn}) based on dBA. CNEL is the time-varying noise over a 24-hour period, with a 5 dBA weighting factor applied to the hourly L_{eq} for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours) and a 10 dBA weighting factor applied to noise occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). L_{dn} is similar to the CNEL scale but without the adjustment for events occurring during the evening hours. CNEL and L_{dn} are within 1 dBA of each other and are normally exchangeable. The noise adjustments are added to the noise events occurring during the more sensitive hours.

Other noise rating scales of importance when assessing the annoyance factor include the maximum noise level (L_{max}), which is the highest exponential time-averaged sound level that occurs during a stated time period. The noise environments discussed in this analysis are specified in terms of maximum levels denoted by L_{max} for short-term noise impacts. L_{max} reflects peak operating conditions and addresses the annoying aspects of intermittent noise.

2.1.2 - Noise Propagation

From the noise source to the receiver, noise changes both in level and frequency spectrum. The most obvious is the decrease in noise as the distance from the source increases. The manner in which noise reduces with distance depends on whether the source is a point or line source, as well as ground absorption, atmospheric conditions (wind, temperature gradients, and humidity) and refraction, and shielding by natural and manmade features. Sound from point sources, such as an air conditioning condenser, a piece of construction equipment, or an idling truck, radiates uniformly outward as it travels away from the source in a spherical pattern.

The attenuation or sound drop-off rate is dependent on the conditions of the land between the noise source and receiver. To account for this ground-effect attenuation (absorption), two types of site conditions are commonly used in noise models: soft-site and hard-site conditions. Soft-site conditions account for the sound propagation loss over natural surfaces such as normal earth and ground vegetation. For point sources, a drop-off rate of 7.5 dBA per each doubling of the distance (dBA/DD) is typically observed over soft ground with landscaping, as compared with a 6 dBA/DD drop-off rate over hard ground such as asphalt, concrete, stone and very hard packed earth. For line sources, such as traffic noise on a roadway, a 4.5 dBA/DD is typically observed for soft-site conditions compared to the 3 dBA/DD drop-off rate for hard-site conditions. Table 1 briefly defines these measurement descriptors and other sound terminology used in this section.

Table 1: Sound Terminology

Term	Definition
Sound	A vibratory disturbance created by a vibrating object which, when transmitted by pressure waves through a medium such as air, can be detected by a receiving mechanism such as the human ear or a microphone.
Noise	Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
Ambient Noise	The composite of noise from all sources near and far in a given environment.
Decibel (dB)	A unitless measure of sound on a logarithmic scale, which represents the squared ratio of sound-pressure amplitude to a reference sound pressure. The reference pressure is 20 micropascals, representing the threshold of human hearing (0 dB).
A-Weighted Decibel (dBA)	An overall frequency-weighted sound level that approximates the frequency response of the human ear.
Equivalent Noise Level (L_{eq})	The average sound energy occurring over a specified time period. In effect, L_{eq} is the steady-state sound level that in a stated period would contain the same acoustical energy as the time-varying sound that actually occurs during the same period.
Maximum and Minimum Noise Levels (L_{max} and L_{min})	The maximum or minimum instantaneous sound level measured during a measurement period.
Day-Night Level (DNL or L_{dn})	The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring between 10:00 p.m. and 7:00 a.m. (nighttime).
Community Noise Equivalent Level (CNEL)	The energy average of the A-weighted sound levels occurring during a 24-hour period, with 5 dB added to the A-weighted sound levels occurring between 7:00 p.m. and 10:00 p.m. and 10 dB added to the A-weighted sound levels occurring between 10:00 p.m. and 7:00 a.m.
Source: Data compiled by FCS 2020.	

2.1.3 - Traffic Noise

The level of traffic noise depends on the three primary factors: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, the loudness of traffic noise is increased by heavier traffic volumes, higher speeds, and greater number of trucks. Vehicle noise is a combination of the noise produced by the engine, exhaust, and tires. Because of the logarithmic nature of noise levels, a doubling of the traffic volume (assuming that the speed and truck mix do not change) results in a noise level increase of 3 dBA. Based on the Federal Highway

Administration (FHWA) community noise assessment criteria, this change is "barely perceptible." For reference, a doubling of perceived noise levels would require an increase of approximately 10 dBA. The truck mix on a given roadway also has an effect on community noise levels. As the number of heavy trucks increases and becomes a larger percentage of the vehicle mix, adjacent noise levels increase.

2.1.4 - Stationary Noise

A stationary noise producer is any entity in a fixed location that emits noise. Examples of stationary noise sources include machinery, engines, energy production, and other mechanical or powered equipment and activities such as loading and unloading or public assembly that may occur at commercial, industrial, manufacturing, or institutional facilities. Furthermore, while noise generated by the use of motor vehicles over public roads is preempted from local regulation, the use of these vehicles is considered a stationary noise source when operated on private property such as at a construction site, a truck terminal, or warehousing facility.

The effects of stationary noise depend on factors such as characteristics of the equipment and operations, distance and pathway between the generator and receptor, and weather. Stationary noise sources may be regulated at the point of manufacture (e.g., equipment or engines), with limitations on the hours of operation, or with provision of intervening structures, barriers or topography.

Construction activities are a common source of stationary noise. Construction-period noise levels are higher than background ambient noise levels but eventually cease once construction is complete. Construction is performed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated on each construction site and, therefore, would change the noise levels as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction related noise ranges to be categorized by work phase. Table 2 shows typical noise levels of construction equipment as measured at a distance of 50 feet from the operating equipment.

Table 2: Typical Construction Equipment Maximum Noise Levels, L_{max}

Type of Equipment	Impact Device? (Yes/No)	Specification Maximum Sound Levels for Analysis (dBA at 50 feet)
Impact Pile Driver	Yes	95
Auger Drill Rig	No	85
Vibratory Pile Driver	No	95
Jackhammers	Yes	85
Pneumatic Tools	No	85
Pumps	No	77
Scrapers	No	85
Cranes	No	85
Portable Generators	No	82

Type of Equipment	Impact Device? (Yes/No)	Specification Maximum Sound Levels for Analysis (dBA at 50 feet)
Rollers	No	85
Dozers	No	85
Tractors	No	84
Front-End Loaders	No	80
Backhoe	No	80
Excavators	No	85
Graders	No	85
Air Compressors	No	80
Dump Truck	No	84
Concrete Mixer Truck	No	85
Pickup Truck	No	55
Source: Federal Highway Administration (FHWA). 2006. Highway Construction Noise Handbook. August.		

2.1.5 - Noise from Multiple Sources

Because sound pressure levels in decibels are based on a logarithmic scale, they cannot be added or subtracted in the usual arithmetical way. Therefore, sound pressure levels in decibels are logarithmically added on an energy summation basis. In other words, adding a new noise source to an existing noise source, both producing noise at the same level, will not double the noise level. Instead, if the difference between two noise sources is 10 dBA or more, the louder noise source will dominate, and the resultant noise level will be equal to the noise level of the louder source. In general, if the difference between two noise sources is 0–1 dBA, the resultant noise level will be 3 dBA higher than the louder noise source, or both sources if they are equal. If the difference between two noise sources is 2–3 dBA, the resultant noise level will be 2 dBA above the louder noise source. If the difference between two noise sources is 4–10 dBA, the resultant noise level will be 1 dBA higher than the louder noise source.

2.2 - Characteristics of Groundborne Vibration and Noise

Groundborne vibration consists of rapidly fluctuating motion through a solid medium, specifically the ground, that has an average motion of zero and in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. The effects of groundborne vibration typically only causes a nuisance to people, but in extreme cases, excessive groundborne vibration has the potential to cause structural damage to buildings. Although groundborne vibration can be felt outdoors, it is typically only an annoyance to people indoors where the associated effects of the shaking of a building can be notable. Groundborne noise is an effect of groundborne vibration and only exists indoors, since it is produced from noise radiated from the motion of the walls and floors of a room, and may also consist of the rattling of windows or dishes on shelves.

Several different methods are used to quantify vibration amplitude such as the maximum instantaneous peak in the vibrations velocity, which is known as the peak particle velocity (PPV) or the root mean square (rms) amplitude of the vibration velocity. Because of the typically small amplitudes of vibrations, vibration velocity is often expressed in decibels—denoted as LV—and is based on the reference quantity of 1 micro inch per second. To distinguish these vibration levels referenced in decibels from noise levels referenced in decibels, the unit is written as "VdB."

Although groundborne vibration can be felt outdoors, it is typically only an annoyance to people indoors where the associated effects of the shaking of a building can be notable. When assessing annoyance from groundborne vibration, vibration is typically expressed as rms velocity in units of decibels of 1 micro-inch per second, with the unit written in VdB. Typically, developed areas are continuously affected by vibration velocities of 50 VdB or lower. Human perception to vibration starts at levels as low as 67 VdB. Annoyance due to vibration in residential settings starts at approximately 70 VdB.

Off-site sources that may produce perceptible vibrations are usually caused by construction equipment, steel-wheeled trains, and traffic on rough roads, while smooth roads rarely produce perceptible groundborne noise or vibration. Construction activities, such as blasting, pile driving and operating heavy earthmoving equipment, are common sources of groundborne vibration. Construction vibration impacts on building structures are generally assessed in terms of PPV. Typical vibration source levels from construction equipment are shown in Table 3.

Table 3: Vibration Levels of Construction Equipment

Construction Equipment	PPV at 25 Feet (inches/second)	rms Velocity in Decibels (VdB) at 25 Feet
Water Trucks	0.001	57
Scraper	0.002	58
Bulldozer—small	0.003	58
Jackhammer	0.035	79
Concrete Mixer	0.046	81
Concrete Pump	0.046	81
Paver	0.046	81
Pickup Truck	0.046	81
Auger Drill Rig	0.051	82
Backhoe	0.051	82
Crane (Mobile)	0.051	82
Excavator	0.051	82
Grader	0.051	82
Loader	0.051	82
Loaded Trucks	0.076	86

Construction Equipment	PPV at 25 Feet (inches/second)	rms Velocity in Decibels (VdB) at 25 Feet
Bulldozer—Large	0.089	87
Caisson drilling	0.089	87
Vibratory Roller (small)	0.101	88
Compactor	0.138	90
Clam shovel drop	0.202	94
Vibratory Roller (large)	0.210	94
Pile Driver (impact-typical)	0.644	104
Pile Driver (impact-upper range)	1.518	112
Sources: Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual. September. Federal Highway Administration (FHWA). 2006. Highway Construction Noise Handbook. August.		

The propagation of groundborne vibration is not as simple to model as airborne noise. This is because noise in the air travels through a relatively uniform medium, while groundborne vibrations travel through the earth, which may contain significant geological differences. Factors that influence groundborne vibration include:

- **Vibration source:** Type of activity or equipment, such as impact or mobile, and depth of vibration source;
- **Vibration path:** Soil type, rock layers, soil layering, depth to water table, and frost depth; and
- **Vibration receiver:** Foundation type, building construction, and acoustical absorption.

Among these factors that influence groundborne vibration, there are significant differences in the vibration characteristics when the source is underground compared to at the ground surface. In addition, soil conditions are known to have a strong influence on the levels of groundborne vibration. Among the most important factors are the stiffness and internal damping of the soil and the depth to bedrock. Vibration propagation is more efficient in stiff clay soils than in loose sandy soils, and shallow rock seems to concentrate the vibration energy close to the surface, and can result in groundborne vibration problems at large distance from the source. Factors such as layering of the soil and depth to the water table can have significant effects on the propagation of groundborne vibration. Soft, loose, sandy soils tend to attenuate more vibration energy than hard, rocky materials. Vibration propagation through groundwater is more efficient than through sandy soils. There are three main types of vibration propagation: surface, compression, and shear waves. Surface waves, or Rayleigh waves, travel along the ground's surface. These waves carry most of their energy along an expanding circular wave front, similar to ripples produced by throwing a rock into a pool of water. P-waves, or compression waves, are body waves that carry their energy along an expanding spherical wave front. The particle motion in these waves is longitudinal (i.e., in a "push-pull" fashion). P-waves are analogous to airborne sound waves. S-waves, or shear waves, are also body waves that carry energy along an expanding spherical wave front. However, unlike P-waves, the particle motion is transverse, or side-to-side and perpendicular to the direction of propagation.

As vibration waves propagate from a source, the vibration energy decreases in a logarithmic nature and the vibration levels typically decrease by 6 VdB per doubling of the distance from the vibration source. As stated above, this drop-off rate can vary greatly depending on the soil type, but it has been shown to be effective enough for screening purposes, in order to identify potential vibration impacts that may need to be studied through actual field tests. The vibration level (calculated below as PPV) at a distance from a point source can generally be calculated using the vibration reference equation:

$$PPV=PPV_{ref} * (25/D)^\wedge n \text{ (in/sec)}$$

Where:

> PPV_{ref}=reference measurement at 25 feet from vibration source
> D=distance from equipment to property line
> n=vibration attenuation rate through ground

According to Section 7 of the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual, an "n" value of 1.5 is recommended to calculate vibration propagation through typical soil conditions.[1]

[1] Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual. September.

SECTION 3: REGULATORY SETTING

3.1 - Federal Regulations

3.1.1 - United States Environmental Protection Agency

In 1972, Congress enacted the Noise Control Act. This act authorized the United States Environmental Protection Agency (EPA) to publish descriptive data on the effects of noise and establish levels of sound "requisite to protect the public welfare with an adequate margin of safety." These levels are separated into health (hearing loss levels) and welfare (annoyance levels) categories, as shown in Table 4. The EPA cautions that these identified levels are not standards because they do not take into account the cost or feasibility of the levels.

For protection against hearing loss, 96 percent of the population would be protected if sound levels are less than or equal to an $L_{eq(24)}$ of 70 dBA. The EPA activity and interference guidelines are designed to ensure reliable speech communication at about 5 feet in the outdoor environment. For outdoor and indoor environments, interference with activity and annoyance should not occur if levels are below 55 dBA and 45 dBA, respectively.

Table 4: Summary of EPA Recommended Noise Levels to Protect Public Welfare

Effect	Level	Area
Hearing loss	$L_{eq}(24) \leq 70$ dB	All areas
Outdoor activity interference and annoyance	$L_{dn} \leq 55$ dB	Outdoors in residential areas, farms, and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	$L_{eq}(24) \leq 55$ dB	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	$L_{eq} \leq 45$ dB	Indoor residential areas.
	$L_{eq}(24) \leq 45$ dB	Other indoor areas with human activities such as schools, etc.

Note:
(24) signifies an L_{eq} duration of 24 hours.
Source: United States Environmental Protection Agency (EPA). 1978. Protective Noise Levels, EPA 550/9-79-100. November.

3.1.2 - Federal Transit Administration

The FTA has established industry accepted standards for vibration impact criteria and impact assessment. These guidelines are published in its Transit Noise and Vibration Impact Assessment

Manual.[2] The FTA guidelines include thresholds for construction vibration impacts for various structural categories as shown in Table 5.

Table 5: Federal Transit Administration Construction Vibration Impact Criteria

Building Category	PPV (in/sec)	Approximate VdB
I. Reinforced—Concrete, Steel or Timber (no plaster)	0.5	102
II. Engineered Concrete and Masonry (no plaster)	0.3	98
III. Non Engineer Timber and Masonry Buildings	0.2	94
IV. Buildings Extremely Susceptible to Vibration Damage	0.12	90

Note:
VdB=vibration measured as rms velocity in decibels of 1 micro-inch per second.
Source: Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual. September.

3.2 - State Regulations

California has established regulations that help prevent adverse impacts to occupants of buildings located near noise sources. The "State Noise Insulation Standard" requires buildings to meet performance standards through design and/or building materials that would offset any noise source in the vicinity of the receptor. State regulations include requirements for the construction of new hotels, motels, apartment houses, and dwellings other than detached single-family dwellings that are intended to limit the extent of noise transmitted into habitable spaces. These requirements are provided in the 2016 California Building Standards Code (CBC) (California Code of Regulations [CCR], Title 24).[3] As provided in the CBC, the noise insulation standards set forth an interior standard of 45 dBA CNEL as measured from within the structure's interior. When such structures are located within a 65-dBA CNEL (or greater) exterior noise contour associated with a traffic noise along a roadway, an acoustical analysis is required to ensure that interior levels do not exceed the 45-dBA CNEL threshold. Title 24 standards are typically enforced by local jurisdictions through the building permit application process.

However, the proposed project does not include any type of residential development. Therefore, these standards are not applicable to the proposed project.

3.3 - Local Regulations

The project site is located in the City of Berkeley, California. The City addresses noise in the Environmental Management Element of the City of Berkeley General Plan,[4] in the Community Noise Chapter of the Berkeley Municipal Code,[5] and in the Environmental Quality Element of the West Berkeley Plan.[6]

2 Federal Transit Administration (FTA). 2018. Transit Noise and Vibration Impact Assessment Manual. September.
3 California Building Standards Commission. 2017. California Building Standards Code (CCR Title 24), January 1.
4 City of Berkeley. 2003. City of Berkeley General Plan. Website: https://www.cityofberkeley.info/Planning_and_Development/Home/General_Plan__A_Guide_for_Public_Decision-Making.aspx. Accessed April 24, 2020.
5 City of Berkeley. 2020. Berkeley Municipal Code. Website: https://www.codepublishing.com/CA/Berkeley/. Accessed April 24, 2020.
6 City of Berkeley. 1993. West Berkeley Plan. Website:

3.3.1 - City of Berkeley General Plan

The Environmental Management Element of the City of Berkeley General Plan addresses excessive noise. Major noise sources in Berkeley include transportation, industrial plant noise, and activities associated with neighborhoods. The City's Noise Ordinance sets limits for permissible daytime noise levels, it however does not recognize residents living in non-residential zones, such as West Berkeley. The Environmental Management Element provides policies and actions to protect the community from excessive noise levels. Policies and actions applicable to the proposed Project are as follows:

- **Policy EM-43: Noise Reduction.** Reduce significant noise levels and minimize sources of noise.
- **Policy EM-44: Noise Prevention and Elimination.** Protect public health and welfare by eliminating existing noise problems where feasible and by preventing significant future degradation of the acoustic environment.
- **Policy EM-45: Traffic Noise.** Work with local and regional agencies to reduce local and regional traffic, which is the single largest source of unacceptable noise in the city.
- **Policy EM-46: Noise Mitigation.** Require operational limitations and all feasible noise buffering for new uses that generate significant noise impacts near residential, institutional, or recreational uses.
- **Policy EM-47: Land Use Compatibility.** Ensure that noise-sensitive uses, including, but not limited, to residences, child-care centers, hospitals, and nursing homes, are protected from detrimental noise levels.
- **Action EM-47-A:** Noise-sensitive development proposals should be reviewed with respect to the Land Use Compatibility Guidelines shown in Table 6.

  If the noise level is within the "normally acceptable" level, noise exposure would be acceptable for the intended land use. Development may occur without requiring an evaluation of the noise environment unless the use could generate noise impacts on adjacent uses.

  If the noise level is within the "conditionally acceptable" level, noise exposure would be conditionally acceptable; a specified land use may be permitted only after detailed analysis of the noise environment and the project characteristics to determine whether noise insulation or protection features are required. Such noise insulation features may include measures to protect noise-sensitive outdoor activity areas (e.g., at residences, schools, or parks) or may include building sound insulation treatments such as sound-rated windows to protect interior spaces in sensitive receptors.

  If the noise level is within the "unacceptable" level, new construction or development should not be undertaken unless all feasible noise mitigation options have been analyzed and appropriate mitigations incorporated into the project to reduce exposure of people to unacceptable noise levels.

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https://www.cityofberkeley.info/Planning_and_Development/Redevelopment_Agency/West_Berkeley_Plan_(The).aspx. Accessed May 15, 2020.

Table 6: Noise and Land Use Compatibility Guidelines

Land Use Category	Exterior Noise Exposure (dBA, L_{dn})					
	55	60	65	70	75	80
Residential, Hotels, and Motels						
Outdoor Sports and Recreation, Neighborhood Parks and Playgrounds						
Schools, Libraries, Museums, Hospitals, Personal Care, Meeting Halls, Churches						
Office Buildings, Business Commercial and Professional						
Auditoriums, Concert Halls, Amphitheaters						

	NORMALLY ACCEPTABLE: Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
	CONDITIONALLY ACCEPTABLE: Specified land use may be permitted only after detailed analysis of the noise reduction requirements and needed noise insulation features have been incorporated.
	UNACCEPTABLE: New construction or development should generally not be undertaken unless all feasible noise mitigation options have been analyzed and appropriate mitigations incorporated into the Project to reduce exposure of people to unacceptable noise levels.

Source: City of Berkeley. 2010. Draft Environmental Impact Report, West Berkeley Project. January. Accessed May 19, 2020.

3.3.2 - Berkeley Municipal Code

Title 13: Public Peace, Morals and Welfare, Chapter 13.40, Community Noise of the City of Berkeley Municipal Code addresses noise impacts. The Code establishes exterior and interior noise standards at receiving land uses and construction activity noise regulations as included below.

The City's maximum exterior and interior hourly average noise stationary source noise performance standards are shown in Table 7. The hourly noise level standards vary based on the receiving land use type and the time period. In order to assess intermittent or maximum noise levels, the time weighted noise level additions presented in Section 13.40.050, and described in further detail below, should be applied.

Table 7: Exterior and Interior Noise Limits

Zoning District	Time Period	Hourly Noise Level (dBA L_{eq})
Exterior Noise Limits		
R-1, R-2, R-1A, R-2A, and ESR	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	55 45
R-3 and above	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	60 55
Commercial	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	65 60
Industry	Anytime	70
Interior Noise Limits		
All	7:00 a.m. – 10:00 p.m. 10:00 p.m. – 7:00 a.m.	45 40
Source: City of Berkeley. 2014. Berkeley Municipal Code. Accessed May 19, 2020 https://www.codepublishing.com/CA/Berkeley/cgi/NewSmartCompile.pl?path=Berkeley13/Berkeley1340/Berkeley1340050.html#13.40.010		

The following exterior noise standards are outlined in Berkeley Municipal Code Section 13.40.050:

A. Maximum permissible sound levels shall be determined by the zoning district of the property subject to the noise, not the property from which the noise originates.

1. The noise standards for the various categories of land use in Table 7 shall, unless otherwise specifically indicated in other codes, apply to all such property within a designated zone.
2. No person shall operate or cause to be operated any source of sound at any location within the incorporated City or allow the creation of any noise on property owned, leased, occupied or otherwise controlled by such person, which causes the sound level when measured on any other property to exceed:
    a) The noise standard for that land use as specified in Table 7 for a cumulative period of more than 30 minutes in any hour; or
    b) The noise standard for that land use as specified in Table 7 plus 5 dBA for a cumulative period of more than 15 minutes in any hour; or
    c) The noise standard for that land use as specified in Table 7 plus 10 dBA for a cumulative period of more than 5 minutes in any hour; or
    d) The noise standard for that land use as specified in Table 7 plus 15 dBA for a cumulative period of more than 1 minute in any hour; or
    e) The noise standard for that land use as specified in Table 7 plus 20 dBA for any period of time.

Section 13.40.070 of the Berkeley Municipal Code restricts construction activities to weekdays between the hours of 7:00 a.m. and 7:00 p.m. and on weekends and holidays, between 9:00 a.m. and 8:00 p.m., except for emergency work. Construction activities are divided into two categories: mobile equipment and stationary equipment. Mobile equipment, as defined by the Section 13.40.070, would be sound levels for nonscheduled, intermittent, short-term operation of less than 10 days of jackhammers, drills, saws, sander grinder, etc. Stationary equipment, according to the Section 13.40.070, would be repetitively scheduled and relatively long-term operation for 10 days or more of stationary equipment. For purposes of the proposed project's construction schedule, the construction impacts would be considered stationary equipment such that construction would last longer than 10 days. Per the Municipal Code, where technically and economically feasible, construction activities shall be conducted in such a manner that maximum sound levels at affected properties will not exceed those listed in Table 8 below.

Table 8: Maximum Stationary Equipment Construction Noise Levels (dBA)

Construction Periods	R-1, R-2 Residential	R-3 and above Multi-Family Residential	Commercial/ Industrial
Weekdays 7:00 a.m. to 7:00 p.m.	60	65	70
Weekends 9:00 a.m. to 8:00 p.m. and legal holidays	50	55	60

Note: Identified maximum noise levels are required where technically and economically feasible.
Source: City of Berkeley. 2014. Berkeley Municipal Code. Accessed May 19, 2020.
https://www.codepublishing.com/CA/Berkeley/cgi/NewSmartCompile.pl?path=Berkeley13/Berkeley1340/Berkeley1340050.html#13.40.010

The Berkeley Municipal Code regulates vibration in Section 13.40.070, Prohibited acts. The City prohibits the operation of any device that creates a vibration, which annoys or disturbs at least two or more reasonable persons of normal sensitiveness who reside in separate residences (including apartments and condominiums) at or beyond the property boundary of the source, if on private property, or at least 150 feet (46 meters) from the source, if on a public space or public right-of-way.

3.3.3 - West Berkeley Plan

The West Berkeley Plan was developed in 1993 to reinforce the dynamic mix of industrial, office, arts and crafts, residential, retail and institutional activities in West Berkeley. The Environmental Quality Element's goals and policies follow the strategies included in the Land Use and Transportation Elements and address five specific areas of concern, one of which is noise.

The West Berkeley Plan describes noise pollution as a problem of contamination of the ambient environment. The West Berkeley Plan aspires to reduce irritating noise by mitigating existing noise conflicts and preventing the development of future noise conflicts. The following policies are included to work towards this goal and are applicable to the proposed project:

- **Policy 6.1:** To the extent feasible, separate noise emitters from sensitive receptors.
- **Policy 6.2**: Develop performance standards for new uses.
- **Policy 6.3**: Investigate problem noise sources and develop appropriate solutions through negotiation or enforcement.
- **Policy 6.5**: Construct sound walls around freeways where feasible.

SECTION 4: EXISTING NOISE CONDITIONS

The following section describes the existing ambient noise environment in the project vicinity.

4.1 - Existing Ambient Noise Levels

The proposed project site is located in the City of Berkeley, California. Surrounding the project site are industrial, commercial, and residential land uses to the north, commercial land uses to the east, and industrial and commercial land uses to the south. Adjacent to the western boundary of the project site is the Southern Pacific Railroad right-of-way, a waterfront park, and beyond is Interstate 80 (I-80). The dominant noise source in the project vicinity is traffic noise on local roadways and railroad activity.

It should be noted that, at the time of this analysis, due to changes in normal traffic patterns and levels of outdoor activity due to conditions related to COVID-19, the normal background ambient noise environment cannot be adequately measured through ambient noise measurements. Therefore, as a conservative approach, this analysis documents the existing baseline noise levels by relying on documented baseline traffic conditions and train activity noise contour data, as described below.

4.2 - Existing Rail Noise Levels

Noise contours for the Union Pacific Railroad (UPRR) were projected in the West Berkeley Circulation Master Plan Report. The UPRR line is located immediately adjacent to and west of the Project site. This track currently has operations from both freight and passenger (Amtrak) trains. Trains operating adjacent to the site generate noise levels that are noticeable as compared to the ambient environment.

Based on the West Berkeley Circulation Master Plan Report, on peak days, the adjacent rail line has approximately 70 train passbys per day averaging 1 to 2 minutes per passby. Activity on the rail line was documented to generates peak noise levels of up to 105 dBA L_{max} as measured at 50 feet from the centerline of the railroad tracks at the nearest at-grade crossing.

4.3 - Existing Traffic Noise Levels

Existing traffic noise levels along selected roadway segments in the project vicinity were modeled using the FHWA Traffic Noise Prediction Model (FHWA-RD-77-108). The average daily traffic (ADT) volumes were obtained directly from Fehr & Peers, the consultant firm that prepared the transportation impact analysis for this project.[7] The traffic volumes described here correspond to the existing (year 2019) traffic count data collected by Fehr & Peers in 2019, with peak hour traffic data multiplied by 10 to estimate the ADT. The ADT data provided by Fehr & Peers is provided in Appendix A. The traffic noise model inputs and outputs—including the 60 dBA, 65 dBA, and 70 dBA CNEL noise

[7] Email communication from Fehr & Peers, 2020. September 9. ADT spreadsheet is provided in Appendix A.

contour distances—are provided in Appendix A. A summary of the modeling results is shown in Table 9.

Table 9: Existing Traffic Noise Levels

Roadway Segment	Approximate ADT	Centerline to 70 L_{dn} (feet)	Centerline to 65 L_{dn} (feet)	Centerline to 60 L_{dn} (feet)	L_{dn} (dBA) 50 feet from Centerline of Outermost Lane
Interstate 80-Ashby Avenue to University Avenue	280,400	551	1,180	2,540	81.6
Sixth Street-south of University Avenue	11,900	< 50	< 50	66	61.1
Seventh Street-north of Ashby Avenue	16,100	< 50	< 50	81	62.4
Ashby Avenue-west of Seventh Street	26,600	< 50	90	191	66.9

Notes:
[1] Modeling results do not take into account mitigating features such as topography, vegetative screening, fencing, building design, or structure screening. Rather it assumes a worst case of having a direct line of site on flat terrain.
ADT=average daily traffic
Source: FCS 2020. Average daily traffic volumes provided by Fehr & Peers (Fehr & Peers, September 9, 2020).

SECTION 5: THRESHOLDS OF SIGNIFICANCE AND IMPACT ANALYSIS

5.1 - Thresholds of Significance and Methodology

According to the California Environmental Quality Act (CEQA) Guidelines updated Appendix G, to determine whether impacts related to noise and vibration are significant environmental effects, the following questions are analyzed and evaluated.

5.1.1 - Thresholds of Significance

Would the proposed project:

a) Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

b) Generate excessive groundborne vibration or groundborne noise levels?

c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

5.1.2 - Methodology

Substantial Noise Increase

The City does not define “substantial increase;” therefore, for purpose of this analysis, a substantial increase is based on the following criteria. A characteristic of noise is that audible increases in noise levels generally refer to a change of 3 dBA or more, as this level has been found to be barely perceptible to the human ear in outdoor environments. A change of 5 dBA is considered the minimum readily perceptible change to the human ear in outdoor environments. Therefore, for purposes of this analysis, a significant impact would occur if project-related stationary noise sources would cause an exceedance of the City’s construction noise performance standards by 4 dBA or greater.

Construction Noise

The construction noise sources related to implementation of the proposed DA are, in essence, the same as what would have been experienced with buildout under the existing DA. Therefore, the analysis takes a very conservative approach of analyzing construction noise sources under the proposed DA as completely new noise sources, determines potential impacts under this very conservative scenario, and identifies mitigation to adequately reduce all potential impacts. For purposes of this analysis, a significant impact would occur if construction activities would result in a substantial temporary increase in ambient noise levels outside of the City’s permissible hours for construction in excess of the maximum noise levels thresholds shown in Table 8, as measured at affected properties. The City’s permissible hours for construction are between the hours of 7:00 a.m.

and 7:00 p.m. on weekdays, and between the hours of 9:00 a.m. and 8:00 p.m. on weekends and holidays. Consistent with the requirements of the City of Berkeley Municipal Code Section 13.40.070, and in compliance with City implementation practices of this section of the Code, construction activities should comply with the established maximum allowable noise performance standards to the extent that the activities occur during the permissible hours for construction and all technically and economically feasible noise reduction measures are incorporated.

Traffic Noise

The level of traffic noise depends on the three primary factors: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, the loudness of traffic noise is increased by heavier traffic volumes, higher speeds, and greater number of trucks. Vehicle noise is a combination of the noise produced by the engine, exhaust, and tires. Because of the logarithmic nature of traffic noise levels, a doubling of the traffic volume (assuming that the speed and truck mix do not change) results in a noise level increase of 3 dBA. Based on the FHWA community noise assessment criteria, this change is “barely perceptible”; for reference a doubling of perceived noise levels would require an increase of approximately 10 dBA. The truck mix on a given roadway also has an effect on community noise levels. As the number of heavy trucks increases and becomes a larger percentage of the vehicle mix, adjacent noise levels increase.

The FHWA highway traffic noise prediction model (FHWA RD-77-108) was used to evaluate traffic-related noise conditions in the vicinity of the project site. Model input data includes without- and with-project average daily traffic volumes on adjacent roadway segments, day/night percentages of autos, medium and heavy trucks, vehicle speeds, ground attenuation factors, and roadway widths. The roadway speeds are based on the posted speed limits along each modeled roadway segment. Traffic modeling was performed using the average daily traffic volume data obtained from the project-specific transportation analysis conducted by Fehr & Peers.[8] The resultant noise levels were weighed and summed over a 24-hour period to determine the L_{dn} values. The roadway traffic noise model assumptions and outputs are provided in Appendix A.

A significant impact would occur if project-generated traffic would result in a substantial increase in ambient noise levels compared baseline conditions. For purposes of this analysis, a significant impact would occur if project-related traffic would cause the L_{dn} along roadway segments in the project vicinity to increase by 4 dBA or greater.

Stationary Source Noise

Stationary noise sources associated with implementation of the proposed DA are, in essence, replacing existing similar stationary noise sources or are the same types of stationary noise sources that are permitted under the existing DA. For example, the new parking garage would replace an existing surface parking area. In year 10 under the proposed DA, it is expected that two generators would be replaced with two new generators and would be located in the proposed utility structure near Grayson Street. Overall, buildout under the existing DA would introduce similar noise sources. Therefore, this analysis takes a very conservative approach of analyzing the new stationary noise sources under the proposed DA as completely new noise sources and determines potential impacts

[8] Fehr & Peers, 2020. Bayer Berkeley Project – Transportation Findings. September 28.

under this very conservative scenario. For purposes of this analysis, a significant impact would occur if project-related stationary noise sources would exceed the City's noise performance standards, as measured at a receiving property, by 4 dBA or greater. For example, the City's nighttime exterior noise performance standard is 45 dBA $L_{eq(30)}$ for residential receptors.

Vibration

Groundborne vibration propagation was calculated using the methodology of the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual. The vibration levels at a distance from a point source are calculated using the vibration reference equation:

$$PPV=PPV_{ref} * (25/D)^{1.5} \text{ (in/sec)}$$

For operational vibration impacts, a significant impact would occur if implementation of the proposed project would cause vibration that annoys or disturbs at least two or more reasonable persons of normal sensitiveness who reside in separate residences (including apartments and condominiums) at or beyond the property boundary of the source, if on private property, or at least 150 feet (46 meters) from the source, if on a public space or public right-of-way, consistent with Section 13.40.070 of the Berkeley Municipal Code.

The City of Berkeley does not have adopted criteria for construction groundborne vibration impacts. Therefore, the FTA's vibration impact criteria is utilized to evaluate potential vibration impacts resulting from construction activities.

5.2 - Substantial Noise Increase in Excess of Standards

5.2.1 - Construction Noise Impacts

For purposes of this analysis, a significant impact would occur if construction activities would result in a substantial temporary increase in ambient noise levels outside of the City's permissible hours for construction in excess of the maximum noise levels thresholds shown in Table 8, as measured at affected properties. The City's permissible hours for construction are between the hours of 7:00 a.m. and 7:00 p.m. on weekdays, and between the hours of 9:00 a.m. and 8:00 p.m. on weekends and holidays. Consistent with the requirements of the City of Berkeley Municipal Code Section 13.40.070, and in compliance with City implementation practices of this section of the Code, construction activities should comply with the established maximum allowable noise performance standards to the extent that the activities occur during the permissible hours for construction and all technically and economically feasible noise reduction measures are incorporated.

The City does not define "substantial increase;" therefore, for purpose of this analysis, a substantial increase is based on the following criteria. A characteristic of noise is that audible increases in noise levels generally refer to a change of 3 dBA or more, as this level has been found to be barely perceptible to the human ear in outdoor environments. A change of 5 dBA is considered the minimum readily perceptible change to the human ear in outdoor environments. Therefore, for purposes of this analysis, a significant impact would occur if project-related stationary noise sources would cause an exceedance of the City's construction noise performance standards by 4 dBA or greater.

It should be noted that the construction noise sources related to implementation of the proposed DA are, in essence, the same as what would have been experienced with buildout under the existing DA. Therefore, the following analysis takes a very conservative approach of analyzing construction noise sources under the proposed DA as completely new noise sources, determines potential impacts under this very conservative scenario, and identifies mitigation to adequately reduce all potential impacts.

Construction-related Traffic Noise

Noise impacts from construction activities associated with the project would be a function of the noise generated by construction equipment, equipment location, sensitivity of nearby land uses, and the timing and duration of the construction activities. One type of short-term noise impacts that could occur during project construction would result from the increase in traffic flow on local streets, associated with the transport of workers, equipment, and materials to and from the project site. The transport of workers and construction equipment and materials to the project site would incrementally increase noise levels on access roads leading to the site. Because workers and construction equipment would use existing routes, noise from passing trucks would be similar to existing vehicle-generated noise on these local roadways.

As shown in Table 9, existing traffic noise levels along roadways segments in vicinity of the project site range from 61.1 dBA to 81.6 dBA L_{dn}, as measured at 50 feet from the centerline of the outermost travel lane of these roadways. Therefore, the proposed project would have a significant impact if construction worker related traffic would result in a minimum 4 dBA increase in existing traffic noise levels.

Typically, a doubling of the Average Daily Traffic (ADT) hourly volumes on a roadway segment is required in order to result in an increase of at least 3 dBA in traffic noise levels. The lowest existing ADT on a roadway segment by which construction vehicles would access the site would occur along Sixth Street, south of University Avenue. The documented existing ADT is 11,870. Estimated average daily construction trips range from 205 to 207 trips. Therefore, average daily project-related construction trips would not double these daily traffic volumes, nor would they double the ADT along any roadway segment in the project vicinity. For this reason, short-term intermittent noise from construction trips would not be expected to result in even a 3 dBA or greater increase in hourly- or daily-average traffic noise levels in the project vicinity; and would clearly not result in a 4 dBA increase which would be considered significant. Again, this analysis is very conservative, As noted previously, as these construction traffic noise levels would be similar to the construction-related traffic noise levels that would occur under buildout of the existing approved DA.

The more conservative analysis adopted above, which does not account for construction trips under baseline conditions but instead assumes an "existing conditions" baseline, demonstrates that under any conditions, with implementation of the proposed DA, short-term construction-related noise impacts associated with the transportation of workers and equipment to the project site would be less than significant.

Construction Equipment Operational Noise

The second type of short-term noise impact is related to noise generated during construction on the project site. Construction is completed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. These various sequential phases would change the character of the noise generated on the site and, therefore, the noise levels surrounding the site as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction related noise ranges to be categorized by work phase. Table 1 lists typical construction equipment noise levels, based on a distance of 50 feet between the equipment and a noise receptor. Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full-power operation followed by 3 or 4 minutes at lower power settings. Impact equipment such as pile drivers are not expected to be used during construction of this project.

The site preparation phase, which includes excavation and grading of the site, tends to generate the highest noise levels because the noisiest construction equipment is earthmoving equipment. Earthmoving equipment includes excavating machinery and compacting equipment, such as bulldozers, draglines, backhoes, front loaders, roller compactors, scrapers, and graders. Typical operating cycles for these types of construction equipment may involve 1 or 2 minutes of full power operation followed by 3 or 4 minutes at lower power settings.

Construction of the project is expected to require the use of scrapers, bulldozers, water trucks, haul trucks, and pickup trucks. Based on the information provided in Table 2, the maximum noise level generated by each scraper is assumed to be 85 dBA L_{max} at 50 feet from this equipment. Each bulldozer would also generate 85 dBA L_{max} at 50 feet. The maximum noise level generated by graders is approximately 85 dBA L_{max} at 50 feet. A characteristic of sound is that each doubling of sound sources with equal strength increases a sound level by 3 dBA. Assuming that each piece of construction equipment operates at some distance from the other equipment, a reasonable worst-case combined noise level during this phase of construction would be 90 dBA L_{max} at a distance of 50 feet from the acoustic center of a construction area. This would result in a reasonable worst-case hourly average of 86 dBA L_{eq}, at a distance of 50 feet from the acoustic center of a construction area when multiple pieces of heavy equipment operate simultaneously in relatively the same location for an hour period.

The acoustic center reference is used because construction equipment must operate at some distance from one another on a project site, and the combined noise level as measured at a point equidistant from the sources (acoustic center) would be the worst-case maximum noise level. The following analysis assumes this reasonable worst-case condition of multiple pieces of heavy construction equipment operating simultaneously at the reasonably closest points possible to an identified off-site receptor. These reasonable worst-case construction noise levels would reduce at a rate of 6 dBA per doubling of distance as construction equipment move across a construction site, further from the receptor. Again, these reasonable worst-case construction noise levels are associated with the loudest phase of construction, the site-preparation phase, as that is when the loudest pieces of heavy construction would operate. All other phases of construction would result in significantly lower noise levels.

For the first phase of development, lasting to year 10 of the proposed DA, it is anticipated that construction is expected to last for up to a total of 5 years (dispersed throughout the phase 1 period, and not necessarily consecutive). Within this construction period, only a portion of the development would involve site preparation of each site (this is the loudest phase of construction as it is the phase when the loudest pieces of construction equipment would operate on-site). Therefore, a conservative estimate would be that heavy construction equipment would operate on-site for a maximum of a 2-year total operational period (although not continuously). For the second phase of development, lasting from year 11 through year 30, it is anticipated construction would also last for 5 years with a similar conservative estimate that heavy construction equipment could be operating over a total 2-year operational time period (although not continuously). For individual buildings on Bayer's campus, it is estimated that construction per building, from site preparation to completion of building envelope, would last 2 months to 1 year, with larger production buildings, such as those contemplated in the western portion of the campus, taking longer periods of time within that range.

The following analysis identifies the closest sensitive receptors around the borders of the project site and the potential impacts for each receptor.

North Boundary

The closest noise-sensitive receptor in the residential zone to the north of the proposed parking garage in the northeast corner of the project site is the duplex residence located at 907 Dwight Way. The façade of this closest home would be located approximately 150 feet from the acoustic center of construction activity where multiple pieces of heavy construction equipment would operate simultaneously. At this distance, relative worst-case construction noise levels could range up to approximately 80 dBA L_{max}, with a relative worst-case hourly average of 76 dBA L_{eq} at this residential receptor during the site preparation phase of construction of the proposed parking garage. These noise levels would exceed the City’s weekday and weekend thresholds of 60 dBA and 50 dBA $L_{eq(h)}$ for R-1 and R-2 residential zone receptors.

East Boundary

The closest noise-sensitive receptor in the commercial/industrial zone around the proposed parking garage in the northeast corner of the project site is the church located at 2525 Eighth Street. The façade of this church would be located approximately 145 feet from the acoustic center of construction activity where multiple pieces of heavy construction equipment would operate simultaneously. Relative worst-case construction noise levels could range up to approximately 81 dBA L_{max}, with a relative worst-case hourly average of 77 dBA L_{eq} at this church land use receptor during the site preparation phase of construction of the proposed parking garage. These noise levels would exceed the City’s weekday and weekend thresholds of 70 dBA and 60 dBA $L_{eq(h)}$ for receiving commercial/industrial zone receptors.

South Boundary

The closest noise-sensitive receptor to the southern boundary of the project site is the manufacturing building located at 742 Grayson Street. The façade of this manufacturing building would be located approximately 115 feet from the acoustic center of construction activity where multiple pieces of heavy construction equipment would operate simultaneously. Relative worst-case construction noise levels could range up to approximately 83 dBA L_{max}, with a relative worst-case hourly average of 79 dBA L_{eq} at this receptor during the site preparation phase of construction of the proposed parking lot and buildings by the project's southern border adjoining Grayson Street. These noise levels would exceed the City's weekday and weekend thresholds of 70 dBA and 60 dBA $L_{eq(h)}$ for receiving commercial/industrial zone receptors.

West Boundary

The closest noise-sensitive receptor to the western boundary of the project site is the picnic areas in the Aquatic Park. The nearest picnic areas would be located approximately 175 feet from the acoustic center of construction activity where multiple pieces of heavy construction equipment would operate simultaneously. The intervening railroad tracks elevation would block the line of sight to construction footprint where the heavy construction equipment would operate. Therefore, at this distance and with the terrain shielding, relative worst-case construction noise levels could range up to approximately 74 dBA L_{max}, with a relative worst-case hourly average of 70 dBA L_{eq} as measured at the nearest picnic areas in Aquatic Park, during the site preparation phase of construction of the buildings that would be located adjacent to the project's western border. The City does not have a designated threshold for park land uses; however, these noise levels would exceed the City's most conservative weekday and weekend thresholds of 60 dBA and 50 dBA $L_{eq(h)}$ for R-1 and R-2 residential zone receptors.

Overall Construction Equipment Operation Noise Impacts

These reasonable worst-case maximum and hourly average construction noise levels would result in temporary increases in ambient noise levels in the project vicinity, and would be a significant impact.

According to the City of Berkeley Municipal Code Section 13.40.070, noise from construction activities should comply with the established maximum allowable noise performance standards to the extent that the activities occur during the permissible hours for construction and all technically and economically feasible noise reduction measures are incorporated. Construction impacts at residential land uses, although permitted and exempted during the construction hours specified by the City, would exceed the suggested maximum noise levels for stationary sources as established by the City. Therefore, construction noise would result in a potentially adverse impact.

Implementation of Mitigation Measure (MM) NOI-1 and NOI-2 would help reduce construction noise impacts on the off-site nearby sensitive receptors and would require the applicant to implement all technically and economically feasible measures to reduce construction noise, consistent with the requirements of the City of Berkeley Municipal Code Section 13.40.070. Therefore, compliance with the City's permissible hours of construction would ensure construction would not result in a substantial increase in nighttime noise levels that could result in sleep disturbance of nearby residential receptors. In addition, implementation of the best management noise reduction techniques and practices outlined in MM NOI-1 and NOI-2, would ensure that construction noise would be reduced to the extent feasible and temporary construction noise impacts would be less than significant.

Mitigation Measures

Project demolition and construction activity could result in a temporary increase in ambient noise levels in the project vicinity in excess of established standards. Implementation of the following mitigation measures would help reduce construction noise impacts on the off-site nearby sensitive receptors and would require the applicant to implement all technically and economically feasible measures to reduce construction noise, consistent with the requirements of the City of Berkeley Municipal Code Section 13.40.070.

MM NOI-1 At least 2 weeks prior to initiating any construction activities at the Project site, the applicant shall provide notice to businesses and residents within 500 feet of the Project site, including: (1) a description of the Project; (2) a description of construction activities; (3) a daily construction schedule (i.e., time of day) and expected duration (number of weeks or months); (4) the name and phone number of the "Noise Management Individual" for the Project; (5) a commitment to notify neighbors at least four days in advance of any authorized extended work hours and the reason for extended hours; (6) notice that construction work is about to commence; and (7) the designated "Noise Management Individual" responsible for responding to any local complaints about construction noise. The noise manager would determine the cause of the noise complaints (e.g., starting too early, bad muffler) and institute reasonable measures to correct the problem. A copy of such notice and methodology for distributing the notice shall be provided in advance to the City for review and approval.

MM NOI-2 The Project applicant shall develop a site-specific noise reduction program prepared by a qualified acoustical consultant to reduce construction noise impacts to the maximum extent feasible, subject to review and approval of the Zoning Officer or a delegate. The noise reduction program shall include time limits for construction and all technically and economically feasible measures to ensure that construction complies with the City of Berkeley Municipal Code Section 13.40.070. The noise reduction program should include, but shall not be limited to, the following available controls to reduce construction noise levels as low as practical:

- All construction activities (including the loading and unloading of materials and truck movements) shall be limited to the hours of 7:00 a.m. and 7:00 p.m. on weekdays and between the hours of 9:00 a.m. and 8:00 p.m. on weekends or holidays. For construction activities near receptors where it would be difficult to meet the weekend noise performance threshold, the loudest noise construction activities shall be limited to weekdays only where necessary to effect reductions that result in compliance with the City's quantified noise construction thresholds, as determined by the noise control plan.
- Construction equipment should be well maintained and used judiciously to be as quiet as practical.
- All internal combustion engine-driven equipment shall be equipped with mufflers, which are in good condition and appropriate for the equipment.

- Utilize "quiet" models of air compressors and other stationary noise sources where technology exists. Select hydraulically or electrically powered equipment and avoid pneumatically powered equipment where feasible.
- Locate stationary noise-generating equipment as far as possible from sensitive receptors when adjoining construction sites. Construct temporary noise barriers or partial enclosures to acoustically shield such equipment where feasible.
- Prohibit unnecessary idling of internal combustion engines. Construction equipment that would not be used for more than five minutes should be turned off completely.
- Construct 8-foot high solid plywood fences around construction sites adjacent to operational business, residences or other noise-sensitive land uses where the noise control plan analysis determines that a barrier would be effective at reducing noise to meet applicable thresholds. These fences shall be outfitted with noise control blanket barriers where necessary to effect reductions that result in compliance with the City's quantified noise construction thresholds, as determined by the noise control plan.
- Insofar as the development occurs on the portion of the site east of Seventh Street, implement the other measures set forth in MM NOI-2 and either: (1) Erect temporary noise control blanket barriers, where necessary, along building facades facing construction sites; (2) Restrict construction to weekdays; or (3) implement other noise reductions alternatives that could feasibly reduce noise to achieve the City's quantified noise construction thresholds, at the applicant's election. Noise control blanket barriers can be rented and quickly erected.
- Route construction-related traffic along major roadways and away from sensitive receptors, where feasible.

As described above in MM NOI-2, construction of an 8-foot high solid wood fence, with no vertical or horizontal gaps, would provide an expected minimum noise reduction of 10 dBA as measured at the nearest receptors identified above. Industry available outdoor sound control blankets have documented sound transmission class (STC) ratings of 20 STC to 32 STC.[9] Thus, the addition of noise control blankets on the fence would result in an expected minimum 15 dBA reduction as measured at the ground floor of the nearest receptors identified above. All other measures would provide expected additional individual noise reductions of at least 3 dBA to 6 dBA each. Thus, the expected achievable combined minimum noise reductions would be 18 dBA to 21 dBA. Notwithstanding the above, where construction noise potentially could exceed applicable thresholds by more than 21 dBA, as in the vicinity of the project site east of Seventh Street should the applicant build out this portion between years 10 and 30, the placement of acoustic blankets on building facades where sensitive receptors reside or work could be added to achieve even higher reductions. Implementation of noise control blanket barriers along building façades facing construction sites

[9] eNoise Control. Outdoor Sound Curtain Specifications. https://www.enoisecontrol.com/products/outdoor-sound-curtains/?gclid=CjwKCAiA7939BRBMEiwA-hX5JyvkgGvQLbw4IGLV5--j3mnR1Tp8WFjCkgtJIzUDj1A2Dk1BegjTGhoCoKQQAvD_BwE. Accessed on November 19, 2020.

would provide an expected minimum noise reduction of 20 dBA as measured inside the nearest receptors identified in the analysis above. This would provide a combined 35 dBA reduction in construction noise,[10] as measured at the interior of the highest impacted receptor location identified above, the multi-family receptor north of the project site. Therefore, construction noise would be reduced to below the City's weekday and weekend thresholds of 60 dBA and 50 dBA $L_{eq(h)}$ for receiving R-1 and R-2 residential zone receptors (i.e., 76 dBA – 35 dBA = 41 dBA).

Furthermore, is should be noted that with these noise reduction measures, the resulting interior noise levels would be below the City's daytime maximum permissible dwelling interior noise level standard of 45 dBA, as described in section 13.40.060 of the Municipal Code.

It should also be noted that the mitigation strategy outlined under MM NOI-2 provides the applicant, in the vicinity of construction occurring east of Seventh Street, the option of restricting some of the loudest construction activities to weekdays, which would eliminate exceeding the City's more restrictive weekend noise thresholds (e.g., 76 dBA – 18 dBA = 58 dBA, which satisfies weekday thresholds of 60 dBA $L_{eq(h)}$). As technology improves, other similarly effective noise mitigation techniques or products might be developed, and MM NOI-2 allows for their adoption so long as quantitative noise thresholds can be met, as shown in the prescribed noise control plan. Therefore, implementation of MM NOI-1 and MM NOI-2 would feasibly and effectively reduce construction noise impacts to less-than-significant levels.

5.2.2 - Mobile Source Operational Noise Impacts

A significant impact would occur if project-generated traffic would result in a substantial increase in ambient noise levels compared baseline conditions. The City does not define "substantial increase;" therefore, for purpose of this analysis, a substantial increase is based on the following criteria. A characteristic of noise is that audible increases in noise levels generally refer to a change of 3 dBA or more, as this level has been found to be barely perceptible to the human ear in outdoor environments. A change of 5 dBA is considered the minimum readily perceptible change to the human ear in outdoor environments. Therefore, for purposes of this analysis, a significant impact would occur if project-related traffic would cause the L_{dn} along roadway segments in the project vicinity to increase by 4 dBA or greater. Typically, a doubling of the ADT hourly volumes on a roadway segment is required in order to result in an increase of at least 3 dBA in traffic noise levels

Traffic noise levels along selected roadway segments in the project vicinity were modeled using the FHWA Traffic Noise Prediction Model (FHWA-RD-77-108). The average daily traffic volumes were obtained directly from Fehr & Peers, the consultant firm that prepared the transportation impact analysis for this project.[11] The ADT data provided by Fehr & Peers is provided in Appendix A. According to the trip generation analysis provided by Fehr & Peers,[12] the DA modifications would result in approximately 260 average additional daily trips, 23 AM peak-hour addition trips, and 21 PM peak-hour additional trips when compared with baseline conditions. The model inputs and outputs—including the 60 dBA, 65 dBA, and 70 dBA L_{dn} noise contour distances—are provided in

[10] Interior noise reduction calculation is based on a minimum 15 dB reduction for 8-foot high solid plywood fence with sound blankets, plus a minimum 20 dB reduction for sound control blankets on the façade of a receiving building.
[11] Email communication from Fehr & Peers, 2020. September 9. ADT spreadsheet is provided in Appendix A.
[12] Fehr & Peers, 2020. Bayer Berkeley Project – Transportation Findings, September 29.

Appendix A. Table 10 provides a summary of the traffic noise levels for existing, year 2032 without project, year 2032 with project, year 2052 without project, and year 2052 with project conditions as measured at 50 feet from the centerline of the outermost travel lane. The "without project" conditions assume the conditions that would occur under buildout of the existing DA, as described in the transportation analysis for the project.

Table 10: Traffic Noise Increase Summary

Roadway Segment	Existing (dBA) L_{dn}	Year 2032 without Project (dBA) L_{dn}	Year 2032 with Project (dBA) L_{dn}	Increase over Year 2032 without Project (dBA)	Year 2052 without Project (dBA) L_{dn}	Year 2052 with Project (dBA) L_{dn}	Increase over Year 2052 without Project (dBA)
Interstate 80-Ashby Avenue to University Avenue	81.6	82.3	82.3	0.0	83.2	83.2	0.0
Sixth Street-south of University Avenue	61.1	62.0	61.9	-0.1	62.8	62.8	0.0
Seventh Street-north of Ashby Avenue	62.4	63.4	63.2	-0.2	64.2	64.2	0.0
Ashby Avenue-west of Seventh Street	66.9	67.7	67.7	0.0	68.6	68.6	0.0

Note:
Modeling results do not take into account mitigating features such as topography, vegetative screening, fencing, building design, or structure screening. Rather it assumes a worst case of having a direct line of site on flat terrain.
Source: FCS 2020.

These roadway segments were modeled because they are the roadway segments in the project vicinity that would receive the highest percentages of project trips, based on the project trip distribution of the traffic study.

As shown in Table 10, the traffic noise levels with implementation of the proposed DA would not result in any perceptible increase over the conditions that would occur under buildout conditions under the existing DA. The slight decreases in traffic noise levels for the year 2032 plus project conditions compared to year 2032 without project conditions is due to the fact that the proposed DA would generate fewer trips that what is anticipated to occur under the existing DA conditions. Therefore, impacts from project-related traffic noise levels would not result in a substantial permanent increase in traffic noise levels in excess of applicable standards, and would be less than significant.

5.2.3 - Stationary Source Operational Noise Impacts

A significant impact would occur if operational noise levels generated by stationary noise sources at the proposed project site would result in a substantial permanent increase in ambient noise levels in excess of any of the City's Municipal Code exterior or interior noise limits summarized in Table 7. The City does not define "substantial increase;" therefore, for purpose of this analysis; a substantial increase is based on the following criteria. A characteristic of noise is that audible increases in noise levels generally refer to a change of 3 dBA or more, as this level has been found to be barely perceptible to the human ear in outdoor environments. A change of 5 dBA is considered the minimum readily perceptible change to the human ear in outdoor environments. Therefore, for purposes of this analysis, a significant impact would occur if project-related stationary noise sources would exceed the City's noise performance standards, as measured at a receiving property, by 4 dBA or greater.

The proposed project would include new stationary noise sources, including parking lot activities and mechanical equipment operation, including backup generators. Impacts associated with these noise sources are analyzed below.

Typical parking lot activities include people conversing, doors shutting, and vehicles idling, which generate noise levels ranging from approximately 60 dBA to 70 dBA L_{max} at 50 feet. These activities are expected to occur sporadically throughout the day as cars arrive and leave the two proposed parking areas on the project site. Typical commercial-grade mechanical ventilation system operations generate noise levels ranging from 50 dBA to 60 dBA L_{eq} at a distance of 25 feet.

Currently there are six emergency generators that operate on the project site, but this equipment only operates during routine tests that occur 12 times per year (for 30 minutes at a time, though once a year the generators are run for 1 hour) and in the unlikely circumstances where Bayer loses power to its site.

It should be noted that these stationary noise sources associated with implementation of the proposed DA are, in essence, replacing existing similar stationary noise sources or are the same types of stationary noise sources that are permitted under the existing DA. For example, the new parking garage would replace an existing surface parking area. In year 10 under the proposed DA, it is expected that two generators would be replaced with two new generators and would be located in the proposed utility structure near Grayson Street. Overall, buildout under the existing DA would introduce similar noise sources. Therefore, the following analysis takes a very conservative approach of analyzing the new stationary noise sources under the proposed DA as completely new noise sources and determines potential impacts under this very conservative scenario.

North Boundary

The nearest noise-sensitive receptors to the northern project boundary is the duplex residence located at 907 Dwight Way. This residence would be located approximately 125 feet from the nearest acoustic center of parking lot activity within the parking garage facility. It would be located approximately 190 feet from the nearest location where mechanical ventilation systems could be located on the proposed office building at the southwest corner of Dwight Way and Seventh Street. The new backup generators would be located near the southern boundary of the campus and therefore would not result in any potential noise impact at this location.

Assuming a minimum of one parking movement per stall per hour in the ground level of the parking structure proposed on the eastern side of Seventh Avenue, and assuming a 75 percent hourly operation of the commercial grade rooftop mechanical ventilation systems on the nearest proposed office building, the resulting hourly average project operational noise levels would be approximately

50 dBA L_{eq} at the nearest residential receptor. Detailed assumptions and calculations are proved in the Appendix.

These noise levels would not exceed the City's daytime exterior noise limit of 55 dBA $L_{eq(30)}$ for residential receptors. Because parking lot activity would be greatly reduced at this parking garage at nighttime,[13] a reasonable worst-case combined hourly average noise levels would range up to 45 dBA L_{eq}. This assumes approximately 50 percent of the parking stalls experiencing a parking movement in a single hour and the mechanical ventilation equipment still operating 75 percent of the same hour. Detailed assumptions and calculations are proved in the Appendix. The applicant reports that nighttime employment usage of parking areas is roughly 25 percent of daily levels of activity, and that this distribution of workers among shifts is not expected to change through the modified DA term. Therefore, the foregoing assumptions are conservative, and these operational noise levels would also not exceed the City's nighttime exterior noise limit of 45 dBA $L_{eq(30)}$ for residential receptors. Furthermore, as shown in Table 9, existing traffic noise levels in the project vicinity are above 60 dBA L_{dn}. Therefore, these noise levels would not exceed existing background ambient noise levels in the project vicinity.

Therefore, project operational noise levels would not result in substantial increase in ambient noise levels in excess of established standards as measured at this nearest sensitive receptor.

East Boundary

The closest noise-sensitive receptor in the commercial/industrial zone to the east of the project site is the church located at 2525 Eighth Street. The façade of this church would be located approximately 120 feet from the nearest acoustic center of parking lot activity within the parking garage facility. It would be located over 480 feet from the nearest location where mechanical ventilation systems could be located on the proposed office building near the eastern boundary along Seventh Street. At this distance, and with the intervening parking structure, the nearest proposed rooftop mechanical ventilation system operations would not be audible. The new backup generators, located near the southern boundary of the campus, would similarly not result in any potential noise impact at this location.

Assuming a minimum of one parking movement per stall per hour in the ground level of the parking structure, and assuming operation of the commercial grade rooftop mechanical ventilation systems on the nearest proposed office building, the resulting hourly average project operational noise levels would be approximately 49 dBA L_{eq} at this receptor. Detailed assumptions and calculations are proved in the Appendix.

These noise levels would not exceed the City's daytime or nighttime exterior noise limits of 65 dBA and 60 dBA $L_{eq(30)}$, respectively, for receptors in commercial zones. Furthermore, as shown in Table 9, existing traffic noise levels in the project vicinity are above 60 dBA L_{dn}. Therefore, these noise levels would not exceed existing background ambient noise levels in the project vicinity.

[13] Predicted usage of the parking garage at nighttime, based on staffing work shift projections is 25% usage of the garage. This modeling assumed a reasonable worst-case scenario of approximately 50 percent% usage of the garage at nighttime.

Therefore, project operational noise levels would not result in substantial increase in ambient noise levels in excess of established standards as measured at this nearest sensitive receptor.

South Boundary

The closest noise-sensitive receptor to the southern boundary of the project site is the single-family residence located at 902 Grayson Street. The nearest façade of this residence would be located approximately 225 feet from the nearest acoustic center of parking lot activity of the surface parking area near the corner of Seventh Street and Grayson Street. It would be located over 390 feet from the nearest location where mechanical ventilation systems could be located on the proposed office building nearest the southern boundary along Grayson Street. The new backup generators would be located near the southern boundary of the campus over 840 feet from this residential receptor. The backup generators would replace the existing generators and would similarly be enclosed in the existing utility building structure.

A reasonable worst-case operational noise condition would be to assume a minimum of one parking movement per stall per hour in the surface parking area, assume a 75 percent hourly operation of the commercial grade rooftop mechanical ventilation systems on the nearest proposed office building, and assume the testing of both generators at the same time. The resulting hourly average project operational noise levels as measured at this nearest residential receptor would be approximately 45 dBA L_{eq}. Detailed assumptions and calculations are proved in the Appendix.

These reasonable worst-case combined operational noise levels would not exceed the City's daytime or nighttime exterior noise limits of 50 dBA and 45 dBA $L_{eq(30)}$, respectively, for residential receptors. Furthermore, as shown in Table 9, existing traffic noise levels in the project vicinity are above 60 dBA L_{dn}. Therefore, these noise levels would not exceed existing background ambient noise levels in the project vicinity.

Therefore, project operational noise levels would not result in substantial increase in ambient noise levels in excess of established standards as measured at this nearest sensitive receptor.

West Boundary

The closest noise-sensitive receptor to the western boundary of the project site is the picnic areas in the Aquatic Park. This noise sensitive location would be located over 740 feet from the nearest proposed parking area, the parking garage adjacent to Grayson Street. At this distance, and with the intervening structures, noise from the new parking garage would not be audible in the nearest picnic areas of Aquatic Park. The nearest picnic areas would be located over 435 feet from the nearest location where mechanical ventilation systems could be located on the proposed buildings nearest the western boundary of the campus. The new backup generators would be located near the southern boundary of the campus over 510 feet from this receptor location. The backup generators would replace the existing generators and would similarly be enclosed in the existing utility building structure.

A reasonable worst-case operational noise condition would be to assume a minimum of one parking movement per stall per hour in the surface parking area, assume a 75 percent hourly operation of the commercial grade rooftop mechanical ventilation systems on the nearest proposed buildings, and assume the testing of both generators at the same time. The resulting hourly average project operational noise levels as measured at the nearest picnic areas in Aquatic Park would be approximately 36 dBA L_{eq}. Detailed assumptions and calculations are proved in the Appendix.

These reasonable worst-case combined operational noise levels would not even exceed the City's most restrictive (for residential land uses) daytime or nighttime exterior noise limits of 55 dBA and 45 dBA $L_{eq(30)}$, respectively. Furthermore, as noted in Section 4.2, noise levels from rail activity are documented to generate peak noise levels of up to 105 dBA L_{max} as measured at 50 feet from the tracks. Therefore, these noise levels would not exceed existing background ambient noise levels in the vicinity of the picnic areas of Aquatic Park.

Therefore, project operational noise levels would not result in substantial increase in ambient noise levels in excess of established standards as measured at this nearest sensitive receptor.

Conclusion of Stationary Source Operational Noise Impacts

Impacts from project-related stationary noise sources would not result in a substantial permanent increase in ambient noise levels in excess of applicable standards, and would be less than significant.

5.2.4 - Land Use Compatibility

For informational purposes only, the following analysis is provided to identify whether the proposed project would be exposed to noise levels in excess of the City's Noise and Land Use Compatibility Guidelines; it has been included for informational purposed only. It should be noted that the proposed DA would not introduce any "new" land use types of development to the project site compared to the types of existing land uses (office, research and development, etc.). Furthermore, the proposed DA would not result in an increase in total development on the campus compared to what is permitted under the existing DA. Thus, the following discussion is included for informational purposes only, and it not required under CEQA and therefore does not contain any impact conclusion.

The City considers environments with ambient noise levels of up to 70 dBA L_{dn} to be "normally acceptable," for new office buildings, business commercial and professional land use developments; environments with noise levels above 70 dBA and up to 80 dBA L_{dn} are considered "conditionally acceptable" for these uses, while ambient noise levels above 80 dBA L_{dn} are considered "unacceptable" for office buildings, business commercial and professional land use developments. Please note that administration buildings are unlikely to be constructed along the project site's western border, and that production and warehouse space along this boundary is the most reasonably foreseeable result. As such, the analysis presented below is conservative to the extent it contemplates administrative spaces along the project site's western border.

The dominant noise sources in the project vicinity are railroad noise and traffic noise.

Railroad Noise

As noted in the Section 4: Existing Noise Conditions, activity on the UPRR rail line generates peak noise levels of up to 105 dBA L_{max} as measured at 50 feet from the tracks. Based on the West

Berkeley Circulation Master Plan Report, on peak days, the adjacent rail line has approximately 70 train passbys per day averaging 1 to 2 minutes per passby. Under the proposed DA, the nearest proposed new uses on the project site would be setback 33 feet from the project's western boundary. Therefore, proposed new uses would be located a minimum of 85 feet from the centerline of the railroad tracks.

Using the CREATE Rail Noise Model, this level of train activity would generate average hourly noise levels of up to 63 dBA L_{eq} as measured at the nearest proposed uses on the project site. When averaged over a 24-hour period, noise levels from this level of train activity could range up to approximately 69 dBA L_{dn}. The modeling data is provided in the appendix. Therefore, train activity noise levels would be below the City's normally acceptable noise land use compatibility threshold of 70 dBA L_{dn} for new office and professional land use developments.

Traffic Noise

Traffic noise levels on Seventh Street adjacent to the project site would range up to approximately 64 dBA L_{dn} under 2052 conditions as measured at 50 feet from the centerline of the outermost travel lane. Under the proposed DA, the nearest proposed new uses on the project site would be setback 80 feet from Seventh Street. At this distance, traffic noise levels would attenuate to below 60 dBA L_{dn}. Therefore, traffic noise levels from traffic on Seventh Street adjacent to the project site would be below the City's normally acceptable noise land use compatibility threshold of 70 dBA L_{dn} for new office and professional land use developments.

The nearest travel lanes of I-80 are located approximately 950 feet west of the project site's western boundary. At this distance noise levels from traffic on I-80 would attenuate to below 64 dBA L_{dn} under year 2052 conditions. Therefore, traffic noise levels from I-80 would be below the City's normally acceptable noise land use compatibility threshold of 70 dBA L_{dn} for new office and professional land use developments. Therefore, traffic noise levels in the project vicinity would not expose the proposed land use development to noise levels in excess of normally acceptable standards.

5.3 - Groundborne Vibration/Noise Levels

This section analyzes both construction and operational groundborne vibration and noise impacts. Groundborne vibrations consist of rapidly fluctuating motions within the ground that have an average motion of zero. Vibrating objects in contact with the ground radiate vibration waves through various soil and rock strata to the foundations of nearby buildings.

Groundborne noise is generated when vibrating building components radiate sound, or noise generated by groundborne vibration. In general, if groundborne vibration levels do not exceed levels considered to be perceptible, then groundborne noise levels would not be perceptible in most interior environments. Therefore, this analysis focuses on determining exceedances of groundborne vibration levels.

A significant impact would occur if implementation of the proposed project would cause vibration that annoys or disturbs at least two or more reasonable persons of normal sensitiveness who reside in separate residences (including apartments and condominiums) at or beyond the property boundary of the source, if on private property, or at least 150 feet (46 meters) from the source, if on a public space or public right-of-way, consistent with Section 13.40.070 of the Berkeley Municipal Code.

While the City does not include vibration regulations related to construction activities, for purposes of this analysis in compliance with CEQA, a significant impact would also occur if construction activities associated with buildout resulting from implementation of the proposed project would result in vibration levels that could produce visual or structural damage to existing structures. The FTA has established industry accepted standards for construction vibration impact criteria and assessment. These guidelines are summarized in Table 5. Therefore, for purposes of this analysis, the FTA's vibration impact criteria are utilized.

5.3.1 - Short-term Construction Vibration Impacts

Construction activity can result in varying degrees of ground vibration, depending on the equipment used on the site. Operation of construction equipment causes ground vibrations that spread through the ground and diminish in strength with distance. Buildings in the vicinity of a construction site respond to these vibrations with varying results ranging from no perceptible effects at the low levels, to slight damage at the highest levels. As shown in Section 2.2, Noise and Vibration Fundamentals, Table 3 provides approximate vibration levels associated with the operation of particular pieces of construction equipment. Pile installation, if deemed necessary for the construction of facilities, would be performed through the use of augur-drilled piles rather than through pile driving. Therefore, of the variety of equipment used during construction, the small vibratory rollers that are anticipated to be used in the site preparation phase of some of the proposed construction would produce the greatest groundborne vibration levels. Small vibratory rollers produce groundborne vibration levels ranging up to 0.101 inch per second (in/sec) PPV at 25 feet from the operating equipment.

The heaviest construction equipment would potentially operate as close as 60 feet from the nearest off-site structure, the warehouse building located south of the project site across Grayson Street. At this distance, groundborne vibration levels would range up to 0.027 PPV from operation of the types of equipment that would produce the highest vibration levels. As a result, predicted vibration levels at the nearest off-site structure would not exceed even the conservative threshold of 0.3 inch per second PPV for buildings of engineered concrete and masonry (no plaster) construction. Therefore, the impact of short-term groundborne vibration associated with construction to off-site receptors would be less than significant.

5.3.2 - Operational Vibration Impacts

No permanent noise sources that would expose persons to excessive groundborne vibration or noise levels would be located within the project site. In addition, long-term operational activities associated with the proposed project would not involve the use of any equipment or processes that would result in potentially significant levels of ground vibration. Therefore, project operational groundborne vibration impacts would be less than significant.

5.4 - Excessive Noise Levels from Airport Activity

A significant impact would occur if the project would expose people working in the project area to excessive noise levels for a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport.

The project site is not located within the vicinity of a private airstrip. The nearest public airport to the project site is the Oakland International Airport, located approximately 9 miles south of the project site. Because of the distance of the project site from the airport runways, the project site is located outside of the 65 dBA CNEL airport noise contours. While aircraft noise is occasionally audible on the project site from aircraft flyovers, aircraft noise associated with nearby airport activity would not expose people working near the project site to excessive noise levels. Therefore, implementation of the project would not expose persons residing or working in the project vicinity to noise levels from airport activity that would be in excess of normally acceptable standards for the proposed land use development, and no impact would occur.

5.5 - Cumulative Impacts

The geographic scope of the cumulative noise analysis is the project site vicinity, including surrounding sensitive land use receptors. Noise impacts tend to be localized; therefore, the area near the project site (500-foot radius) would be the area that could be most affected by cumulative projects (including the proposed project) construction and operational activities. Cumulative groundborne vibration impacts are even more localized with potential construction and operational cumulative vibration impacts limited to areas within 100 feet of project construction and operations. There are no known approved cumulative development projects that would lie within these boundaries.

Construction Noise

The proposed project's loudest phase of construction activity (the site preparation phase) would not overlap with any other current or planned cumulative development projects located within 500-feet of the project site. As such, there would be no possibility of combination of potential construction noise associated with the cumulative projects. Therefore, there would be no cumulative impact related to construction noise.

Operational Traffic Noise

The significance threshold for a cumulative traffic noise impact would be if proposed DA traffic noise levels that would cause the L_{dn} to increase by 4 dBA or more above existing conditions. As shown in Table 10, none of the modeled roadway segments in the project site vicinity would experience a 4 dBA or greater increase under proposed DA project conditions compared to baseline conditions. In fact, the project, given its smaller development footprint and limited increase in employees, would not further contribute to cumulative noise and, in mid-term years, would in fact produce less noise under baseline condition, as demonstrated in Table 10. As such, there would be no considerable contribution to any cumulative impact with respect to traffic noise.

Operational Stationary Noise

As shown in the analysis above, impacts from project-related stationary noise sources would not result in a substantial permanent increase in ambient noise levels in excess of applicable standards. Since there are no known proposed projects located within 500-feet of the project site, the proposed project would not combine with any other planned projects in the project vicinity to result in a cumulatively considerable contribution to existing ambient noise conditions in the project site vicinity. Therefore, the cumulative operational stationary noise impact would be less than significant.

Construction Vibration

The proposed project would not result in vibration during construction activity that could overlap with any other current or planned cumulative development projects located within 100 feet of the project site. As such, there would be no possibility of combination of potential construction vibration associated with the cumulative projects. Therefore, there would be no cumulative impact related to construction vibration.

Operational Vibration

Implementation of the proposed project would not include any permanent sources of vibration that would expose persons in the project vicinity to groundborne vibration levels that could be perceptible without instruments at any existing sensitive land use in the vicinity of the project site. The only cumulative contribution to vibration conditions in the vicinity of the project site could result from introduction of new permanent sources of groundborne vibration in the project site vicinity. The only major sources of groundborne vibration in the project vicinity is railroad activity along the rail line, located west of the project site. Implementation of the proposed project would not introduce any new permanent sources of groundborne vibration to the project site vicinity and would not increase existing off-site railroad activity. Therefore, implementation of the proposed project would not result in a contribution to cumulative operational groundborne vibration conditions in the project site vicinity. Therefore, the cumulative impact related to project operational vibration would be less than significant.

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Appendix A: Noise Modeling Data

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TABLE Existing Conditions-01

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Interstate 80 - Ashby Avenue to University Avenue
NOTES: Bayer Development Agreement Extension Project - Existing Conditions

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 280400 SPEED (MPH): 65 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 60 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 81.60

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
550.6	1180.4	2540.1	5470.2

TABLE Existing Conditions-02

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Sixth Street - south of University Avenue
NOTES: Bayer Development Agreement Extension Project - Existing Conditions

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 11900 SPEED (MPH): 25 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6 SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 61.08

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	65.9	141.6

TABLE Existing Conditions-03

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Seventh Street - north of Ashby Avenue
NOTES: Bayer Development Agreement Extension Project - Existing Conditions

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 16100   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.39

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	80.5	173.1

TABLE Existing Conditions-04
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Ashby Avenue - west of Seventh Street
NOTES: Bayer Development Agreement Extension Project - Existing Conditions

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 26600   SPEED (MPH): 35   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 18   SITE CHARACTERISTICS: SOFT

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* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 66.92

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	89.9	190.5	409.0

TABLE 2032 No Project-01
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Interstate 80 - Ashby Avenue to University Avenue
NOTES: Bayer Development Agreement Extension Project - 2032 No Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 327800   SPEED (MPH): 65   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 60   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 82.28

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
610.3	1309.7	2818.7	6070.4

TABLE 2032 No Project-02

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Sixth Street - south of University Avenue
NOTES: Bayer Development Agreement Extension Project - 2032 No Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 14700   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 61.99

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	75.8	162.9

TABLE 2032 No Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Seventh Street - north of Ashby Avenue
NOTES: Bayer Development Agreement Extension Project - 2032 No Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 20100   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 63.35

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	93.3	200.7

TABLE 2032 No Project-04

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020

ROADWAY SEGMENT: Ashby Avenue - west of Seventh Street

NOTES: Bayer Development Agreement Extension Project - 2032 No Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 32100   SPEED (MPH): 35   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 18   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 67.74

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	101.4	215.8	463.5

TABLE 2032 Plus Project-01

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020

ROADWAY SEGMENT: Interstate 80 - Ashby Avenue to University Avenue

NOTES: Bayer Development Agreement Extension Project - 2032 Plus Project

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* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 327800   SPEED (MPH): 65   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 60   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 82.28

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
610.3	1309.7	2818.7	6070.4

TABLE 2032 Plus Project-02

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Sixth Street - south of University Avenue
NOTES: Bayer Development Agreement Extension Project - 2032 Plus Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 14400   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 61.90

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	74.8	160.7

TABLE 2032 Plus Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Seventh Street - north of Ashby Avenue
NOTES: Bayer Development Agreement Extension Project - 2032 Plus Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 19500   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 63.22

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	91.5	196.7

TABLE 2032 Plus Project-04

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Ashby Avenue - west of Seventh Street
NOTES: Bayer Development Agreement Extension Project - 2032 Plus Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 31700   SPEED (MPH): 35   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 18   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 67.68

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	100.6	214.0	459.6

TABLE 2052 No Project-01

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020

ROADWAY SEGMENT: Interstate 80 - Ashby Avenue to University Avenue

NOTES: Bayer Development Agreement Extension Project - 2052 No Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 400700   SPEED (MPH): 65   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 60   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 83.15

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
697.0	1496.9	3222.3	6939.8

TABLE 2052 No Project-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Sixth Street - south of University Avenue
NOTES: Bayer Development Agreement Extension Project - 2052 No Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 17800   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.82

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	86.1	185.1

TABLE 2052 No Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Seventh Street - north of Ashby Avenue
NOTES: Bayer Development Agreement Extension Project - 2052 No Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 24200   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.16

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	105.6	227.1

TABLE 2052 No Project-04

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020

ROADWAY SEGMENT: Ashby Avenue - west of Seventh Street

NOTES: Bayer Development Agreement Extension Project - 2052 No Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 39000   SPEED (MPH): 35   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 18   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 68.58

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
55.7	115.0	245.4	527.5

TABLE 2052 Plus Project-01

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Interstate 80 - Ashby Avenue to University Avenue
NOTES: Bayer Development Agreement Extension Project - 2052 Plus Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 400700 SPEED (MPH): 65 GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 60 SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 83.15

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
697.0	1496.9	3222.3	6939.8

TABLE 2052 Plus Project-02
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Sixth Street - south of University Avenue
NOTES: Bayer Development Agreement Extension Project - 2052 Plus Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 17900   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 62.85

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	86.4	185.8

TABLE 2052 Plus Project-03
FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020
ROADWAY SEGMENT: Seventh Street - north of Ashby Avenue
NOTES: Bayer Development Agreement Extension Project - 2052 Plus Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 24400   SPEED (MPH): 25   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 6   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 64.19

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
0.0	0.0	106.1	228.3

TABLE 2052 Plus Project-04

FHWA ROADWAY NOISE LEVEL ANALYSIS

RUN DATE: 09/24/2020

ROADWAY SEGMENT: Ashby Avenue - west of Seventh Street

NOTES: Bayer Development Agreement Extension Project - 2052 Plus Project

---

* * ASSUMPTIONS * *

AVERAGE DAILY TRAFFIC: 39100   SPEED (MPH): 35   GRADE: .5

TRAFFIC DISTRIBUTION PERCENTAGES

	DAY	NIGHT
AUTOS	88.08	9.34
M-TRUCKS	1.65	0.19
H-TRUCKS	0.66	0.08

ACTIVE HALF-WIDTH (FT): 18   SITE CHARACTERISTICS: SOFT

---

* * CALCULATED NOISE LEVELS * *

Ldn AT 50 FT FROM NEAR TRAVEL LANE CENTERLINE (dB) = 68.60

DISTANCE (FEET) FROM ROADWAY CENTERLINE TO Ldn

70 Ldn	65 Ldn	60 Ldn	55 Ldn
55.8	115.2	245.8	528.4

Noise Model Based on Federal Transit Adminstration General Transit Noise Assessment
Developed for Chicago Create Project

Case: Bayer DA Extension Project

RESULTS			
Noise Source	**Ldn (dB)**	**Leq - daytime (dB)**	**Leq - nighttime (dB)**
All Sources	69	63	63
Source 1	69	63	63
Source 2	0	0	0
Source 3	0	0	0
Source 4	0	0	0
Source 5	0	0	0
Source 6	0	0	0
Source 7	0	0	0
Source 8	0	0	0

Enter noise receiver land use category below.

LAND USE CATEGORY	
Noise receiver land use category (1, 2 or 3)	2

Enter data for up to 8 noise sources below - see reference list for source numbers.

NOISE SOURCE PARAMETERS						
Parameter	**Source 1**		**Source 2**		**Source 3**	
Source Num.	Freight Locomotive	9				
Distance (source to receiver)	distance (ft)	85				
Daytime Hours	speed (mph)	40				
(7 AM - 10 PM)	trains/hour	3				
	locos/train	1				
Nighttime Hours	speed (mph)	40				
(10 PM - 7 AM)	trains/hour	3				
	locos/train	1				
Wheel Flats?		N				
Jointed Track?	Y/N	N				
Embedded Track?	Y/N	N				
Aerial Structure?	Y/N	N				
Barrier Present?	Y/N	N				
Intervening Rows of of Buildings	number of rows	0				

SOURCE REFERENCE LIST	
Source	**Number**
Commuter Electric Locomotive	1
Commuter Diesel Locomotive	2
Commuter Rail Cars	3
RRT/LRT	4
AGT, Steel Wheel	5
AGT, Rubber Tire	6
Monorail	7
Maglev	8
Freight Locomotive	9
Freight Cars	10
Hopper Cars (empty)	11
Hopper Cars (full)	12
Crossover	13
Automobiles	14
City Buses	15
Commuter Buses	16
Rail Yard or Shop	17
Layover Tracks	18
Bus Storage Yard	19
Bus Op. Facility	20
Bus Transit Center	21
Parking Garage	22
Park & Ride Lot	23

Parking Lot Activity & Mechanical System Operations

Receptor: 907 Dwight Way - residential receptor

No.	Equipment Description	Reference (dBA) 50 ft Lmax	Quantity	Usage factor[1]	Distance to Receptor	Ground Effect[2]	Shielding (dBA)[3]	Calculated (dBA) Lmax	Calculated (dBA) Leq	Energy
1	parking lot activity	70	10	1	125	1	5	57.0	43.1	20238.57703
2	parking lot activity	70	20	1	150	1	6	54.5	42.7	18606.56616
3	parking lot activity	70	40	1	200	1	6	52.0	42.0	15699.2902
4	parking lot activity	70	60	1	250	1	6	50.0	40.8	12057.05487
5	mechanical ventilation operation [5]	54	1	75	190	1	6	36.4	29.4	862.4034268
6	mechanical ventilation operation	54	2	75	215	1	10	31.3	26.8	473.8991092
7	mechanical ventilation operation	54	4	75	240	1	10	30.4	28.3	681.3928037
8										
9										
10										
							Lmax[4]	57.0	Leq	48

Notes:
[1] Percentage of time activity occurs each hour
[2] Soft ground terrain between project site and receptor.
[3] Shielding due to terrain or structures
[4] Calculated Lmax is the Loudest value.
[5] Equates to reference level of 60 dBA Leq/Lmax at 25-feet

Parking Lot Activity & Mechanical System Operations

Receptor: 907 Dwight Way - residential receptor

No.	Equipment Description	Reference (dBA) 50 ft Lmax	Quantity	Usage factor[1]	Distance to Receptor	Ground Effect[2]	Shielding (dBA)[3]	Calculated (dBA) Lmax	Calculated (dBA) Leq	Energy
1	parking lot activity	70	5	1	125	1	5	57.0	40.1	10119.28851
2	parking lot activity	70	10	1	150	1	6	54.5	39.7	9303.28308
3	parking lot activity	70	15	1	200	1	6	52.0	37.7	5887.233824
4	parking lot activity	70	20	1	250	1	6	50.0	36.0	4019.01829
5	mechanical ventilation operation [5]	54	1	75	190	1	6	36.4	29.4	862.4034268
6	mechanical ventilation operation	54	2	75	215	1	10	31.3	26.8	473.8991092
7	mechanical ventilation operation	54	4	75	240	1	10	30.4	28.3	681.3928037
8										
9										
10										
							Lmax[4]	57.0	Leq	45

Notes:
[1] Percentage of time activity occurs each hour
[2] Soft ground terrain between project site and receptor.
[3] Shielding due to terrain or structures
[4] Calculated Lmax is the Loudest value.
[5] Equates to reference level of 60 dBA Leq/Lmax at 25-feet

Parking Lot Activity

Receptor: 2525 Eight Street - church receptor

No.	Equipment Description	Reference (dBA) 50 ft Lmax	Quantity	Usage factor[1]	Distance to Receptor	Ground Effect[2]	Shielding (dBA)[3]	Calculated (dBA) Lmax	Leq	Energy
1	parking lot activity	70	10	1	120	1	3	59.4	45.6	36254.86354
2	parking lot activity	70	20	1	145	1	6	54.8	43.1	20598.51926
3	parking lot activity	70	40	1	195	1	6	52.2	42.3	16938.15763
4	parking lot activity	70	60	1	245	1	6	50.2	41.1	12810.40943
5										
6										
7										
8										
9										
10										
							Lmax[4]	59.0	Leq	49

Notes:
[1] Percentage of time activity occurs each hour
[2] Soft ground terrain between project site and receptor.
[3] Shielding due to terrain or structures
[4] Calculated Lmax is the Loudest value.

Parking Lot Activity & Mechanical System Operations

Receptor: 902 Grayson Street - commercial receptor

No.	Equipment Description	Reference (dBA) 50 ft Lmax	Quantity	Usage factor[1]	Distance to Receptor	Ground Effect[2]	Shielding (dBA)[3]	Calculated (dBA) Lmax	Calculated (dBA) Leq	Energy
1	parking lot activity	70	10	1	225	1	3	53.9	37.4	5499.997077
2	parking lot activity	70	20	1	250	1	3	53.0	39.0	8018.995738
3	parking lot activity	70	40	1	300	1	3	51.4	39.7	9281.245067
4	parking lot activity	70	40	1	350	1	3	50.1	37.7	5844.74908
5	mechanical ventilation operation [5]	54	1	75	390	1	10	26.2	16.0	39.69880695
6	mechanical ventilation operation	54	2	75	415	1	10	25.6	18.2	65.89568576
7	mechanical ventilation operation	54	4	75	440	1	10	25.1	20.4	110.5791477
8	generator	80	2	50	465	1	14	46.6	36.9	4949.384049
9										
10										
							Lmax[4]	**54.0**	**Leq**	**45**

Notes:

[1] Percentage of time activity occurs each hour

[2] Soft ground terrain between project site and receptor.

[3] Shielding due to terrain or structures

[4] Calculated Lmax is the Loudest value.

Parking Lot Activity & Mechanical System Operations

Receptor: Aquatic Park

No.	Equipment Description	Reference (dBA) 50 ft Lmax	Quantity	Usage factor[1]	Distance to Receptor	Ground Effect[2]	Shielding (dBA)[3]	Calculated (dBA) Lmax	Calculated (dBA) Leq	Energy
1	parking lot activity	70	10	1	740	1	25	21.6	-0.1	0.975472103
2	parking lot activity	70	20	1	765	1	25	21.3	2.5	1.765857699
3	parking lot activity	70	40	1	815	1	25	20.8	4.7	2.920768782
4	parking lot activity	70	40	1	865	1	25	20.2	3.9	2.442989959
5	mechanical ventilation operation [5]	54	1	75	435	1	10	25.2	14.6	28.60905453
6	mechanical ventilation operation	54	2	75	460	1	10	24.7	16.8	48.38689754
7	mechanical ventilation operation	54	4	75	485	1	10	24.3	19.2	82.56691383
8	generator	80	2	50	510	1	14	45.8	35.7	3751.452784
9										
10										
							Lmax[4]	46.0	Leq	36

Notes:

[1] Percentage of time activity occurs each hour

[2] Soft ground terrain between project site and receptor.

[3] Shielding due to terrain or structures

[4] Calculated Lmax is the Loudest value.

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