Appendix K

Noise Calculations

Noise Calculation, Construction Equipment & Stationary Source Noise

Project Number: Easley

Model Description: Composite Noise Level Calc, Various Distances, No Shielding
Model Approach and Cite: General Assesessment: FTA, 2018: Transit Noise and Vibration Impact Assessment Guidelines. Section 7.1
Levels and Use Factors: FHWA, 2006: Roadway Construction Noise Model, User's Guide. Table 1 (Actual measured Lmax).

		Refc (ft)						
		50						
Sources / Activity	**Equipment**	**Lmax @ Refc**	**Acoustic Use Factor**	**Refc Leq(h)**	**Recept @ (ft)**	**Item @ Recept Leq (dBA)**		**Composite @ Recept Leq (dBA)**
PV Panel System Installation (Light-Duty Hammer [e.g., Vermeer PD10, 49 hp: 114 dBA contin @ 1m])						Composite >>>>>>>>>>>>>>		62
	Mounted Impact Hammer (FHWA, 2006)	90	20	83	656	61	1.2E+06	
	Crane	81	20	74	656	52	1.5E+05	
	Backhoe or Loader	79	40	75	656	53	1.8E+05	
	Dump Truck	76	40	72	656	50	9.3E+04	
Site Preparation						Composite >>>>>>>>>>>>>>		61
	Grader	85	40	81	656	59	7.3E+05	
	Dozer	82	40	78	656	56	3.7E+05	
	Backhoe or Loader	79	40	75	656	53	1.8E+05	
	Dump Truck	76	40	72	656	50	9.3E+04	
						Composite >>>>>>>>>>>>>>		61
Electrical System Installation	Crane	81	20	74	656	52	1.5E+05	
	Drill rig, auger	84	20	77	656	55	2.9E+05	
	Concrete Mixer Truck	79	40	75	656	53	1.8E+05	
	Compactor	83	20	76	656	54	2.3E+05	
	Generator	81	50	78	656	56	3.7E+05	

Individual Construction Equipment (Typical Noise Levels)

Pile Driver (Impact; Table 7-1: FTA, 2018)	101	20	94
Pile Driver (Sonic; Table 7-1: FTA, 2018 & FHWA, 2006)	95	20	88
Mounted Impact Hammer (FHWA, 2006)	90	20	83
Scraper	84	40	80
Dozer	82	40	78
Grader	85	40	81
Forklift or Man Lift	75	20	68
Crane	81	20	74
Backhoe or Loader	79	40	75
Excavator	81	40	77
Compactor	83	20	76
Generator	81	50	78
Drill rig, auger	84	20	77

Helicopter Operations	**Lmax @ Refc**	**Acoustic Use Factor**	**Refc Leq(h)**	**Recept @ (ft)**	**Item @ Recept Leq (dBA)**
Kmax (92 dBA contour @ 100 feet)	98	25	92	656	70
Vertol 107 (92 dBA contour @ 450 feet)	111	25	105	656	83

Ref: USFS Sound Measurements Toolkit. https://www.fs.usda.gov/t-d/programs/im/sound_measure/helo_conclusions.shtml.

Operation Phase	**Equipment**	**Lmax @ Refc**	**Acoustic Use Factor**	**Refc Leq(h)**	**Recept @ (ft)**	**Item @ Recept Leq (dBA)**	**Composite @ Recept Leq (dBA)**
						Composite >>>>>>>>>>>>>>	45
Operations (Inverters/Tracker Motors)	Inverters (spec. 67dBA @ 10m, TMEIC)	63	100	63	1000	37	5.0E+03
	Inverter 2 of 6	63	100	63	1000	37	5.0E+03
	Inverter 3 of 6	63	100	63	1000	37	5.0E+03
	Inverter 4 of 6	63	100	63	1000	37	5.0E+03
	Inverter 5 of 6	63	100	63	1000	37	5.0E+03
	Inverter 6 of 6	63	100	63	1000	37	5.0E+03
	Tracker Motors (estd. PVMS DEIR p.3.11-15)	50	10	40	1000	14	2.5E+01
	Pickup Truck (RCNM, sporadic use factor)	75	1	55	1000	29	7.9E+02
						Composite >>>>>>>>>>>>>>	43
Operations (Inverters/Tracker Motors)	Inverters (spec. 67dBA @ 10m, TMEIC)	63	100	63	1200	35	3.5E+03
	Inverter 2 of 6	63	100	63	1200	35	3.5E+03
	Inverter 3 of 6	63	100	63	1200	35	3.5E+03
	Inverter 4 of 6	63	100	63	1200	35	3.5E+03
	Inverter 5 of 6	63	100	63	1200	35	3.5E+03
	Inverter 6 of 6	63	100	63	1200	35	3.5E+03
	Tracker Motors (estd. PVMS DEIR p.3.11-15)	50	10	40	1200	12	1.7E+01
	Pickup Truck (RCNM, sporadic use factor)	75	1	55	1200	27	5.5E+02

						Composite >>>>>>>>>>>>>>		44
Operations (BESS w/ hvac, inverters)	Megapack Equiv (spec. 75 dB @ 10 m, IP)	71	100	71	1200	43	2.2E+04	
	Inverters (spec. 67dBA @ 10m, TMEIC)	63	100	63	1200	35	3.5E+03	
	Tracker Motors (estd. PVMS DEIR p.3.11-15)	50	10	40	1200	12	1.7E+01	
	Pickup Truck (RCNM, sporadic use factor)	75	1	55	1200	27	5.5E+02	

Traffic Noise Calculations

		7am-7pm	7pm-10pm	10pm-7am
Project Number:	Easley	12	3	9
Model Description:	Reference Energy Mean Emission Levels (REMEL): originally from FHWA-RD-77-108			
	See Caltrans Technical Noise Supplement (TeNS 2013): Table 4-2			
Model Assumptions:	no shielding, no barriers, no finite road adjustment			
	Peak Hour from Peak vph [in terms of Leq(h)]; or CNEL from ADT vpd-distributed per time fractions			
	AM-to-PM split approximated from Riverside Co 2015 General Plan, Appendix I-1			
	Caltrans AADT, annual average daily traffic and truck counts for 2020, from:			
	https://dot.ca.gov/programs/traffic-operations/census			

Road Segment, Single Receptor

Road Name/Segment: SR-177

Scenario: Baseline: Caltrans volume (2020) w trucks = 14% of total

			Average Daily Traffic Mix (%)				
			7am-7pm	7pm-10pm	10pm-7am	**Receptor Distance: >15m Ref:**	30.5 (m)
							100.1 (ft)
			75	15	10	**Drop-off (alpha 0.5=soft, 0=hard):**	0.00 (alpha)
	ADT	**Peak Hr**	Day	Evening	Night	**Speed:**	55 (mph)
	(vpd)	**(vph)**	(vph)	(vph)	(vph)		89 (kph)
	2150	325	134.4	107.5	23.9		

Vehicle Type Mix		Peak Hr	Day	Evening	Night
	ADT Mix (%)	(vph)	(vph)	(vph)	(vph)
Autos	86.0	279.5	115.6	92.5	20.5
Medium Duty Trucks	5.0	16.3	6.7	5.4	1.2
Heavy Duty Trucks	9.0	29.3	12.1	9.7	2.2

REMEL Traffic Flow Adjustment

	(TeNS 2013)	Peak Hr	Day	Evening	Night	A	B	C
Autos	73.8	-8.3	-12.1	-13.1	-19.6	41.7408	1.1485	50.128
MD Trucks	79.9	-20.6	-24.5	-25.4	-32.0	33.919	20.591	68.003
HD Trucks	84.0	-18.1	-21.9	-22.9	-29.4	35.8799	21.0197	74.298

@ Receptor, Distance Adjustment

-3.1

Scenario Results						*Centerline Distance to CNEL Contour*			
						70	*65*	*60*	*55*
	Leq(h)	Leq(h)	Leq(h)	Leq(h)	Ldn	CNEL	*Contour*	*Contour*	*Contour*	*Contour*
	Peak Hour	Day	Evening	Night	@ Rec	@ Rec	*XX CNEL*	*YY CNEL*	*ZZ CNEL*	*ZZ CNEL*

(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	*(ft)*	*(ft)*	*(ft)*	*(ft)*
66.1	62.3	61.3	54.8	63.3	64.0	*40*	*86*	*184*	*397*

Road Name/Segment: SR-177 w Construction traffic

Scenario: Project Construction: adding 530 peak hour vehicles, increasing HDT in mix

Average Daily Traffic Mix (%)

			7am-7pm	7pm-10pm	10pm-7am
			75	15	10
	ADT	**Peak Hr**	Day	Evening	Night
	(vpd)	**(vph)**	(vph)	(vph)	(vph)
	3310	855	206.9	165.5	36.8

Vehicle Type Mix		Peak Hr	Day	Evening	Night
	ADT Mix (%)	(vph)	(vph)	(vph)	(vph)
Autos	80.0	684.0	165.5	132.4	29.4
Medium Duty Trucks	5.0	42.8	10.3	8.3	1.8
Heavy Duty Trucks	15.0	128.3	31.0	24.8	5.5

REMEL Traffic Flow Adjustment

	(TeNS 2013)	Peak Hr	Day	Evening	Night	A	B	C
Autos	73.8	-4.4	-10.5	-11.5	-18.1	41.7408	1.1485	50.128
MD Trucks	79.9	-16.4	-22.6	-23.6	-30.1	33.919	20.591	68.003
HD Trucks	84.0	-11.7	-17.8	-18.8	-25.3	35.8799	21.0197	74.298

Scenario Results

						Centerline Distance to CNEL Contour			
						70	*65*	*60*	*55*
Leq(h)	Leq(h)	Leq(h)	Leq(h)	Ldn	CNEL	*Contour*	*Contour*	*Contour*	*Contour*
Peak Hour	Day	Evening	Night	@ Rec	@ Rec	*XX CNEL*	*YY CNEL*	*ZZ CNEL*	*ZZ CNEL*
(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	*(ft)*	*(ft)*	*(ft)*	*(ft)*
71.4	65.2	64.3	57.7	66.3	66.9	*63*	*135*	*290*	*625*

Vibration Source Levels for Construction Equipment

Project Number: Easley

Model Approach and Cite: FTA, 2018: Table 7-4 and Eq. 7-2, 7-3.
Caltrans, 2020 = "Distinctly Perceptible" over 0.24 in/sec

Vibration Assessment, Individual Source

Reference Source (at 25 ft): PPV 0.644 in/sec , Pile Driver (impact, typical)
Reference Source (at 25 ft): Lv 104 VdB, Pile Driver (impact, typical)

	D (ft) =	ppv(eq) =		Damage Criterion (over 0.5 in/sec)	Riv Co 2015: annoying to people in buildings (over 0.2 in/sec)	Lv(D) =		Human Perceptibilty (over 65 Vdb)	Human Annoyance (over 80 VdB)
(ref)	25	0.644	in/sec	Yes	Yes	104.0	VdB	Yes	Yes
At 50 feet	50	0.228	in/sec	No	Yes	95.0	VdB	Yes	Yes
At 100 feet	100	0.081	in/sec	No	No	85.9	VdB	Yes	Yes
At 200 feet	200	0.028	in/sec	No	No	76.9	VdB	Yes	No
At 600 feet	600	0.005	in/sec	No	No	62.6	VdB	No	No

Vibration Assessment, Individual Source

Reference Source (at 25 ft): PPV 0.210 in/sec , Vibratory Roller (compactor)
Reference Source (at 25 ft): Lv 94 VdB, Vibratory Roller (compactor)

	D (ft) =	ppv(eq) =		Damage Criterion (over 0.5 in/sec)	Riv Co 2015: annoying to people in buildings (over 0.2 in/sec)	Lv(D) =		Human Perceptibilty (over 65 Vdb)	Human Annoyance (over 80 VdB)
(ref)	25	0.210	in/sec	No	Yes	94.0	VdB	Yes	Yes
At 50 feet	50	0.074	in/sec	No	No	85.0	VdB	Yes	Yes
At 100 feet	100	0.026	in/sec	No	No	75.9	VdB	Yes	No
At 200 feet	200	0.009	in/sec	No	No	66.9	VdB	Yes	No
At 600 feet	600	0.002	in/sec	No	No	52.6	VdB	No	No

Vibration Assessment, Individual Source

Reference Source (at 25 ft): PPV 0.089 in/sec , Large Bulldozer
Reference Source (at 25 ft): Lv 87 VdB, Large Bulldozer

	D (ft) =	ppv(eq) =		Damage Criterion (over 0.5 in/sec)	Riv Co 2015: annoying to people in buildings (over 0.2 in/sec)	Lv(D) =		Human Perceptibilty (over 65 Vdb)	Human Annoyance (over 80 VdB)
(ref)	25	0.089	in/sec	No	No	87.0	VdB	Yes	Yes
At 50 feet	50	0.031	in/sec	No	No	78.0	VdB	Yes	No
At 100 feet	100	0.011	in/sec	No	No	68.9	VdB	Yes	No
At 200 feet	200	0.004	in/sec	No	No	59.9	VdB	No	No
At 600 feet	600	0.001	in/sec	No	No	45.6	VdB	No	No

Vibration Assessment, Individual Source

Reference Source (at 25 ft): PPV 0.076 in/sec , Loaded Trucks
Reference Source (at 25 ft): Lv 86 VdB, Loaded Trucks

	D (ft) =	ppv(eq) =		Damage Criterion (over 0.5 in/sec)	Riv Co 2015: annoying to people in buildings (over 0.2 in/sec)	Lv(D) =		Human Perceptibilty (over 65 Vdb)	Human Annoyance (over 80 VdB)
(ref)	25	0.076	in/sec	No	No	86.0	VdB	Yes	Yes
At 50 feet	50	0.027	in/sec	No	No	77.0	VdB	Yes	No
At 100 feet	100	0.010	in/sec	No	No	67.9	VdB	Yes	No
At 200 feet	200	0.003	in/sec	No	No	58.9	VdB	No	No
At 600 feet	600	0.001	in/sec	No	No	44.6	VdB	No	No