Traffic Operations Manual

Chapter 175 Transportation Analysis

Part 2 Daily Person Hours of Delay

Calculation Guidelines Appendices

September 2024

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Appendix 175 A Daily Person Hours of Delay Instruction and Calculation Sheets

The following are daily person hours of delay (DPHD) spreadsheet general instructions with two sets of example DPHD calculation sheets.

DPHD SPREADSHEET GENERAL INSTRUCTIONS

LOCATION/DESCRIPTION:

1. Please insert the route, location, county, and project description into this section. If you have more project information, please insert that as well.

2. Read the notes under the location/description section and see if that applies to your project.

3. Additionally, in column "P" on the top right corner of the worksheet, insert the county and route information, post mile limits, right of way + construction cost, calculations by, date, and phone number of the engineer who calculated the DHPD data in this worksheet.

FACTORS SECTION:

1. Insert the length segment of the project before and after. Typically, these values will be the same.

2. Insert the annual average daily traffic (AADT) values obtained from data collection or other historical data obtained into the highlighted cells related to AADT. Ensure that the future AADT is for 20 years plus an additional year (totaling 21 years).

3. Insert the justified *% Traffic Benefitted*, *% Trucks*, and *% RVs* into their respective highlighted blue cells. If the data does not have engineering justification or is not obtainable, please leave the highlighted cell empty, but do not leave the *% Traffic Benefitted* cell empty.

4. Insert the project location altitude.

5. Ensure that the average vehicle occupancy (*AVO)* is accurate. If necessary, and with justification, you may revise the *AVO* value. (Please discuss this with Headquarters Traffic Operations staff before making any changes to this value.)

6. Insert the existing transit volume, future volume, and transit capacity data. (If not applicable or not obtainable, please leave the highlighted cells empty.)

7. Insert the pedestrian- and bicyclist-related data into the last two highlighted cells within the "Factors" section.

DAILY DELAY CALCULATION SECTION:

1. Insert the key movement, average daily traffic, and a.m. and p.m. peak-hour volumes, respectively.

2. From your modeling, simulation, or engineering-based study, place your existing configuration data that includes the a.m. and p.m. peak-hour intersection delay, average off-peak delay, and average vehicle hours of delay in their respective cells. If you have transit and pedestrian and bicyclist data, insert that into the highlighted cells. If not, leave the associated cells empty.

3. After placing the existing configuration and data, input the proposed data from the model, engineering study, or any other form of engineering analysis that is justified into the proposed improvement section as needed. In this section you will place the a.m. and p.m. peak-hour intersection delay, average off-peak delay, and average vehicle hours of delay data based on the after or proposed improvements. Additionally, if there is data for transit or pedestrian and bicyclist delay, or both, insert them into the highlighted blue cells. If not, leave the associated cells empty.

RESULTS:

The result of the DPHD is then shown at the bottom right of the worksheet highlighted in the salmon color.

Figure A-1 Intersection-Delay-Based DPHD Calculation Sheet

DAILY PERSONS HOURS OF DELAY (DPHD)   SA

LOCATION / DESCRIPTION:	SR 26/49, in Mokelumne, Calaveras County
	Traffic Signal Alternative

INSTRUCTIONS: Fill in the areas that are marked in blue or with an asterisk.

NOTE: For certain parameters that are in the blue boxes or have asterisks, if there is no valid data, districts can place zero or use engine

NOTE: For reference to the parameters used in this DPHD spreadsheet, please refer to the DPHD guideline here:

CALCULATIONS

FACTORS		
"L1" BEFORE MILES	*	0.20
"L2" AFTER MILES	*	0.20
PRESENT AADT (YR 2020)	*	2024
FUTURE AADT (YR 2041)	*	2963
AVERAGE AADT		2493.5
% TRAFFIC BENEFITED	*	100
AVE. AADT BENEFITED		2493.5
% TRUCKS	*	4.0
% RV'S	*	2.0
ALTITUDE (FEET)	*	3000
DIRECTIONAL SPLIT		
Ave Vehicle Occupancy (AVO)		1.73
Ave Persons Beneffited		4313.8
Present Transit Volume		10.1
Future Transit Volume		29.6
Transit Capacity		40
Ave Transit Pax Volume		397.5
Present Ped/Bike Volume		140
Future Ped/Bike Volume		430
Ave Ped/Bike Benefitted		285

Daily Delay Calculation (Design Year 2041)

Inputs – to measure off peak variation[1]		
Key Movement		CAL 26-49
ADT		4567
AM Peak Hour Vol	(VPH)	293
PM Peak Hour Vol	(VPH)	457

1. Vehicle count

Existing Configuration AWSC (Design Year 2041)		
AM Peak Hr Intersection Delay (vehicular)	(sec/veh)	135
PM Peak Hr Intersection Delay (vehicular)	(sec/veh)	155.5
Ave Off Peak Delay (vehicular)	(sec/veh)	67.20
Ave Vehicular Hours of Delay (vehicular)	(sec/veh)	73.7
Ave Transit Delay	(sec/veh)	60.0
Ave Ped/Bike Delay	(sec/person)	20.0

W/ Proposed Improvement Traffic Signal (Design Year 2041)		
AM Peak Hr Intrsn Delay (vehicular)	(sec/veh)	25.0
PM Peak Hr Intrsn Delay (vehicular)	(sec/veh)	31.0
Ave Off Peak Delay (vehicular)	(sec/veh)	12.95
Ave Vehicular Hours of Delay (vehicular)	(sec/veh)	14.2
Ave Transit Delay	(sec/veh)	30.0
Ave Daily Ped/Bike Delay	(sec/person)	15.0

Figure A-2 Intersection-Delay-Based DPHD Calculation Sheet

SAVINGS WORK SHEET (Intersection-Delay Based)

COUNTY-RTE :	*	CAL 26-49
P.M. LIMITS :	*	18.1
EA :	*	10-1k820
R/W+CONST $:	*	$ 3,819,543
CALC. BY :	*	Vu H Nguyen
DATE:	*	5/4/2021
PHONE NO. :	*	(209) 603-5126

DPHD OUTPUT

Delay Outputs			
Average off-peak hourly vol	(vph)	174	
% of peak delay in "average" off-peak hour		0.46	
Delay without improvement (vehicular)	(min/vch)	1.228	
Delay with improvement (vehicular)	(min/vch)	0.237	
Delay Savings (vehicular)	(min/vch)	0.992	
Ave Daily Vehicular Delay Savings	(minutes)	2472.6	DVHD = 41.2
DPHD (Vehicles)	(minutes)	4277.7	
Ave Transit Delay Savings	(min/vch)	0.500	
DPHD (Transit)	(minutes)	198.8	
Ave Ped/Bike Delay Savings	(min per ped/bike)	0.083	
DPHD (Ped/Bike)	(minutes)	23.8	
DPHD (Total)	(minutes)	4500.2	DPHD = 75.0

Figure A-3 Speed-Based DPHD Calculation Sheet

PRIORITY INDEX NUMBER CALCULATION WORK SHEET (Freeway - Speed-Based)

LOCATION /PROJECT DESCRIPTION:	Adding Aux Lanes to I-10 WB to connet El Monte Toll/Bus Lane onramp with Mission Road offramp

INSTRUCTIONS: FILL IN AREAS THAT ARE MARKED IN BLUE OR WITH AN ASTERISK.

CALCULATIONS

INPUT

PASSENGER VEHICLES INPUT		
"L1" BEFORE MILES	*	0.33
"L2" AFTER MILES	*	0.33
"S1" BEFORE MPH	*	44.9
"S2" AFTER MPH	*	59.2
PRESENT AADT	*	71,000
FUTURE AADT	*	72,320
AVERAGE AADT	*	71,660
% TRAFFIC BENEFITED	*	31.5
AVO	*	1.75
% TRUCKS	*	5
AVE. AADT BENEFITED		39,503
TRANSIT INPUT		
TRANSIRT CAPACITY PERSO	*	40
"S1" TRANSIT BEFORE MPH	*	44.9
"S2" TRANSIT AFTER MPH	*	59.2
% PRESENT TRANSIT SHARE	*	1
% FUTURE TRANSIT SHARES	*	1.5
PRESENT TRANSIT AADT		710
FUTURE TRANSIT AADT		1,085
AVERAGE TRANSIT AADT		897
AVE. TRANSIRT AADT BENEFITED		5,654

COUNTY-RTE :	*	LA-10, LA-101
P.M. LIMITS :	*	Rte 10 0.4/Rte 101 0.37
EA :	*	10-1k820
R/W+CONST $:	*	$ 10,000,000
CALC. BY :	*	ANALYST'S NAME
DATE:	*	1/1/2023
PHONE NO. :	*	(...)...-....

CALCULATIONS

WEIGHTED AVERAGE COST PER VEHICLE MINUTE (TRUCKS & AUTOS)

% TRUCKS	X	TRUCK TIME VALUE ($ PER VEH. MIN.)	/	CONVERT TO DECIMAL	+	% AUTOS	X	AUTO TIME VALUE ($ PER VEH. MIN.)	/	CONVERT TO DECIMAL	=	COST PER VEH. MIN. ($ PER VEH. MIN.) A
5.0		0.48		100		95.0		0.21		100	=	0.224
		(new)		100				(new)				

PASSENGER VEHICLES DAILY DELAY SAVINGS (MINUTES PER VEHICLE)

BEFORE CONDITIONS				AFTER CONDITIONS				CONVERSION FACTOR		DAILY DELAY SAVINGS (MINS. PER VEH)
LENGTH (MILES) (L1	/	SPEED (MPH) S1	–	LENGTH (MILES) L2	/	SPEED (MPH) S2)	X	(MIN. PER HOUR) 60	=	B
0.33		44.9		0.33		59.2		60		0.107

AVERAGE DIRECTIONAL PERSONS DEMAND FOR PASSENGER CARS (PERSONS)

BEFORE CONDITIONS				AFTER CONDITIONS			AVERAGE DIRECTIONAL PERSONS DEMAND (PERSON)
AADT (VEH/DAY) ((AADT1	+	AADT (VEH/DAY) AADT2)	/	2)	X	AVO (PERSON/VEH) PS	=	C
71,000		72,320		2.000		1.750	125,405

Figure A-4 Freeway-Speed-Based DPHD Calculation Sheet

TRANSIT DAILY DELAY SAVINGS (VEHICLE MINUTES PER DAY)

BEFORE CONDITIONS				AFTER CONDITIONS				CONVERSION FACTOR		DAILY DELAY SAVINGS (VEH. MINS. PER DAY)
LENGTH (MILES) (L_1)	l	SPEED (MPH) S_1	$-$	LENGTH (MILES) L_2	l	SPEED (MPH) S_2	X	(MIN. PER HOUR) 60	=	D
0.33		44.9		0.33		59.2		60	=	0.107

AVERAGE DIRECTIONAL PERSONS DEMAND FOR TRANSIT

BEFORE CONDITIONS						AFTER CONDITIONS				HALF OF TRANSIT CAPACITY				AVERAGE DIRECTIONAL PERSONS DEMAND FOR TRANSIT (PERSON)
AADT (VEH/DAY) (($AADT_1$	X	TRANSIT SHARE (%) PS_1	X	TRANSIT CAPACITY (PERSON) C)	+	AADT (VEH/DAY) ($AADT2$	X	TRANSIT SHARE (%) PS2	X	(PERSON) C))	l	2	=	E
71,000	X	0.010	X	20.0	+	72,320	X	0.015	X	20.0			=	17,948

DELAY INDEX

DAILY DELAY SAVINGS (VEH-MIN. PER DAY) B	X	COST PER VEH MIN ($ PER VEH. MIN.) A	X	DAYS PER YEAR APPLIED (DAYS PER YEAR) D	X	PRESENT WORTH FACTOR P_L	X	CONVERSION FACTOR 100	l	TOTAL PROJECT COST [1] ($) C	=	DELAY INDEX D.I.
4810	X	0.224	X	365	X	12.6	X	100		$ 10,000,000	=	49

DISCOUNTED SAFETY INDEX

SAFETY INDEX [1] S.I.	X	PRESENT WORTH FACTOR P_L	l	PROJECT LIFE (YEARS) L	=	DISCOUNTED SAFETY INDEX S.I. (DIS)
35	X	12.6		20	=	22

PRIORITY INDEX NUMBER CALCULATION WORK SHEET

PRIORITY INDEX NUMBER (PIN)

DELAY INDEX D.I.	+	DISCOUNTED INDEX S.I. (DIS)	=	PIN
49	+	22	=	71

DPHD VEHICLES

DAILY DELAY SAVINGS (VEH. MINS. PER DAY) B	X	AVERAGE DIRECTIONAL PERSONS DEMAND (PERSON) C	X	% TRAFFIC BENEFITED (%)	l	CONVERSION FACTOR (MIN. PER HOUR) 60	=	PERFORMANCE MEASURE (PASSENGER VEHICLES DAILY PERSON HOURS OF
0.107	X	125,405	X	0.315		60	=	70

DPHD TRANSIT

DAILY DELAY SAVINGS (VEH. MINS. PER DAY) D	X	AVERAGE DIRECTIONAL PERSONS DEMAND (PERSON) E	X	% TRAFFIC BENEFITED (%)	l	CONVERSION FACTOR (MIN. PER HOUR) 60	=	PERFORMANCE MEASURE (TRANSIT VEHICLES DAILY PERSON HOURS OF DELAY)
0.107	X	17,948	X	0.315		60	=	10

DAILY PERSON HOURS OF DELAY (DPHD)

DPHD VEHICLES	+	DPHD TRANSIT	=	DPHD
70.131	+	10.037	=	80