Appendix I-4 Results of FHWA Pollutant Loading and Toler Analysis



Project: I-81 VIADUCT PROJECT

						SUMMA	RY ESTIMA	TE RES	ULTS C	OF MEAN EV	ENT POL	LUTANT L	DADI	NG ANA	LYSIS (V	VITHOUT I	BMPs) , po	und p	er mea	n event										
POLLUTANT		Viad	uct Alterr	native												Co	mmunity G	rid Alte	rnative)										
			Onondag ral Study	a Creek ⁄ Area)			Lower Or (Centra	nondaga al Study				Middle Or (South S		J			North-Brand Study Area:	,			(Eas	Butter t Study Area	nut Cre a: South		ction)		Muc (North S	d Creek Study Ar		
	No Builld	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff	% Dif	f Scaled % Diff	No Build	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff	%Diff	Scaled % Diff
Copper (Cu)	0.49	0.49	0.00	0.0%	0.0000%	0.52	0.49	-0.02	-4.5%	-0.010%	0.21	0.21	0.00	0.0%	0.0%	0.02	0.02	0.00	0.0%	0.00%	0.27	0.28	0.01	2.8%	0.014%	0.24	0.26	0.01	5.2%	0.36%
Lead (Pb)	3.64	3.60	-0.04	-1.1%	-0.0024%	3.83	3.65	-0.17	-4.5%	-0.010%	1.55	1.55	0.00	0.0%	0.0%	0.17	0.18	0.01	7.2%	0.22%	2.00	2.05	0.06	2.8%	0.014%	1.81	1.91	0.09	5.2%	0.36%
Zinc (Zn)	3.00	2.96	-0.03	-1.1%	-0.0024%	3.15	3.00	-0.14	-4.5%	-0.010%	1.27	1.27	0.00	0.0%	0.0%	0.14	0.15	0.01	7.2%	0.22%	1.64	1.69	0.05	2.8%	0.014%	1.49	1.57	0.08	5.2%	0.36%
Total organic carbon (TOC)	227.64	225.06	-2.58	-1.1%	-0.0024%	239.15	228.32	-10.83	-4.5%	-0.010%	96.81	96.81	0.00	0.0%	0.0%	10.76	11.53	0.77	7.2%	0.22%	124.90	128.38	3.48	2.8%	0.014%	113.42	119.35	5.93	5.2%	0.36%
Chemical oxygen demand (COD)	1038.03	1026.27	-11.76	-1.1%	-0.0024%	1090.53	1041.14	-49.39	-4.5%	-0.010%	441.45	441.45	0.00	0.0%	0.0%	49.05	52.58	3.53	7.2%	0.22%	569.54	585.41	15.87	2.8%	0.014%	517.21	544.25	27.04	5.2%	0.36%
Nitrate + nitrite nitrogen (NO2+3)	6.92	6.84	-0.08	-1.1%	-0.0024%	7.27	6.94	-0.33	-4.5%	-0.010%	2.94	2.94	0.00	0.0%	0.0%	0.33	0.35	0.02	7.2%	0.22%	3.80	3.90	0.11	2.8%	0.014%	3.45	3.63	0.18	5.2%	0.36%
Total kjeldahl nitrogen (TKN)	16.66	16.47	-0.19	-1.1%	-0.0024%	17.51	16.71	-0.79	-4.5%	-0.010%	7.09	7.09	0.00	0.0%	0.0%	0.79	0.84	0.06	7.2%	0.22%	9.14	9.40	0.25	2.8%	0.014%	8.30	8.74	0.43	5.2%	0.36%
Phosphorus (PO4-P)	3.64	3.60	-0.04	-1.1%	-0.0024%	3.83	3.65	-0.17	-4.5%	-0.010%	1.55	1.55	0.00	0.0%	0.0%	0.17	0.18	0.01	7.2%	0.22%	2.00	2.05	0.06	2.8%	0.014%	1.81	1.91	0.09	5.2%	0.36%
Total suspended solids (TSS)	1292.99	1278.34	-14.65	-1.1%	-0.0024%	1358.37	1,296.86	-61.52	-4.5%	-0.010%	549.88	549.88	0.00	0.0%	0.0%	61.10	65.49	4.39	7.2%	0.22%	709.42	729.19	19.77	2.8%	0.014%	644.24	677.93	33.69	5.2%	0.36%
Volatile suspended solids (VSS)	355.12	351.09	-4.02	-1.1%	-0.0024%	373.07	356.18	-16.90	-4.5%	-0.010%	151.02	151.02	0.00	0.0%	0.0%	16.78	17.99	1.21	7.2%	0.22%	194.84	200.27	5.43	2.8%	0.014%	176.94	186.19	9.25	5.2%	0.36%



Project: I-81 VIADUCT PROJECT

	SUMMARY ESTIMATE RESULTS OF ANNUAL MASS POLLUTANT LOADING ANALYSIS (WITHOUT BMPs) ¹ , pound per annual																												
POLLUTANT		Viadu	uct Alternati	ve												Community	Grid Alte	ernative											
			Onondaga C ral Study Ar					nondaga Cre al Study Area)					Onondaga Cr. Study Area)		(1	North-Br East Study Ar			tion)	(E	Butt East Study A	ternut Cree rea: South		on)			lud Creek n Study Ar		
	No Build	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff % Dif	Scaled %	No Build	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff	% Diff	Scaled % Diff	No Build	Proposed	Diff	%Diff	Scaled % Diff
Copper (Cu)	59.00	58.34	-0.67	-1.1%	-0.0024%	61.99	59.18	59.19	-4.5%	-0.010%	25.09	25.09	0.00 0.0%	0.0%	2.79	2.99	0.20	7.2%	0.22%	32.37	33.28	0.90	2.8%	0.014%	29.40	30.94	1.54	5.2%	0.36%
Lead (Pb)	437.07	432.11	-4.95	-1.1%	-0.0024%	459.17	438.37	438.39	-4.5%	-0.010%	185.87	185.87	0.00 0.0%	0.0%	20.65	22.14	1.49	7.2%	0.22%	239.80	246.49	6.68	2.8%	0.014%	217.77	229.16	11.39	5.2%	0.36%
Zinc (Zn)	359.49	355.41	-4.07	-1.1%	-0.0024%	377.67	360.56	360.57	-4.5%	-0.010%	152.88	152.88	0.00 0.0%	0.0%	16.99	18.21	1.22	7.2%	0.22%	197.24	202.74	5.50	2.8%	0.014%	179.12	188.48	9.37	5.2%	0.36%
Total organic carbon (TOC)	27316.62	27007.19	-309.44	-1.1%	-0.0024%	28698.04	27398.40	27398.41	-4.5%	-0.010%	11617.14	11617.14	0.00 0.0%	0.0%	1290.79	1383.62	92.83	7.2%	0.22%	14987.78	15405.52	417.74	2.8%	0.014%	13610.79	14322.50	711.70	5.2%	0.36%
Chemical oxygen demand (COD)	124563.80	123152.77	-1411.03	-1.1%	-0.0024%	130863.05	124936.72	124936.73	-4.5%	-0.010%	52974.14	52974.14	0.00 0.0%	0.0%	5886.02	6309.32	423.31	7.2%	0.22%	68344.30	70249.19	1904.89	2.8%	0.014%	62065.21	65310.58	3245.37	5.2%	0.36%
Nitrate + nitrite nitrogen (NO2+3)	830.43	821.02	-9.41	-1.1%	-0.0024%	872.42	832.91	832.92	-4.5%	-0.010%	353.16	353.16	0.00 0.0%	0.0%	39.24	42.06	2.82	7.2%	0.22%	455.63	468.33	12.70	2.8%	0.014%	413.77	435.40	21.64	5.2%	0.36%
Total kjeldahl nitrogen (TKN)	1999.58	1976.93	-22.65	-1.1%	-0.0024%	2100.70	2005.56	2005.57	-4.5%	-0.010%	850.37	850.37	0.00 0.0%	0.0%	94.49	101.28	6.80	7.2%	0.22%	1097.11	1127.68	30.58	2.8%	0.014%	996.31	1048.41	52.10	5.2%	0.36%
Phosphorus (PO4-P)	437.07	432.11	-4.95	-1.1%	-0.0024%	459.17	438.37	438.39	-4.5%	-0.010%	185.87	185.87	0.00 0.0%	0.0%	20.65	22.14	1.49	7.2%	0.22%	239.80	246.49	6.68	2.8%	0.014%	217.77	229.16	11.39	5.2%	0.36%
Total suspended solids (TSS)	155158.42	153400.82	-1757.60	-1.1%	-0.0024%	163,004.85	155,622.93	155622.94	-4.5%	-0.010%	65985.33	65985.33	0.00 0.0%	0.0%	7331.70	7858.98	527.28	7.2%	0.22%	85130.61	87503.37	2372.76	2.8%	0.014%	77309.29	81351.77	4042.48	5.2%	0.36%
Volatile suspended solids (VSS)	42613.93	42131.21	-482.72	-1.1%	-0.0024%	44768.94	42741.51	42741.52	-4.5%	-0.010%	18122.73	18122.73	0.00 0.0%	0.0%	2013.64	2158.45	144.82	7.2%	0.22%	23380.94	24032.62	651.67	2.8%	0.014%	21232.83	22343.09	1110.26	5.2%	0.36%
Chloride annual average concentration (CI) ¹ , ppm	2.65	3.12	0.47	17.7%	0.0377%	2.65	2.90	2.72	9.4%	0.022%	34.64	36.09	1.45 4.2%	0.26%	22.94	32.12	9.18	40.0%	1.22%	1.55	1.90	0.35	22.6%	0.113%	21.10	26.84	5.74	27.2%	1.87%

Note: 1 Toler Method are calculated as annual average concentration. FHWA are calculated for annual mass loading.



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Viaduct Alternative

LAKE - use accepted level for average Phosphorus concentration

c target concentration is 10 micrograms/liter

Area: Central Study Area

Date: 12/03/2019

Table 9. Worksheet A - Site characteristics 1 Drainage Area of Highway Segment (section 2.1) a Total right of way (Analysis area) AROW 212.5 acres b Paved surface **AHWY** 146.2 acres c Percent Impervious(= 100 * AHWY/AROW) IMP 68.8 % 2 Rainfall Characteristics (from section 2.2) MEAN Zone 1; Initial estimates from Figure 2. a Volume MVP 0.26 inch MIP 0.051 inch / hour b Intensity **MDP** 5.80 c Duration hour MTP 73.00 d Interval hour COEF of VARIATION **CVVP** 1.46 dimensionless e Volume **CVIP** Intensity 1.30 dimensionless **CVDP** g Duration 1.05 dimensionless h Interval **CVTP** 1.07 dimensionless NST i Number of storms per year (24*365 / MTP) 120 no. events 3 Surrounding Area Type a ADT over 30,000 vehicles/day, urbanized area **URBAN** b ADT under 30,000 vpd, undeveloped to low density suburban **RURAL** Oxygen Demand **Particulates** Heavy Metals Nutrients 4 Select pollutant for analysis FHWA Volume I (section 2.4) Cu Pb Zn TOC COD NO2+3 TKN PO4-P **TSS VSS** name estimate runoff quality characteristics (use table 3) **TCR** mg/1 a site median concentration 0.054 0.400 0.329 25 114 0.76 1.83 0.400 142 39 b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate) CVCR 0.75 dimensionless 5 Select receiving water target concentration (section 2.6) surface water Total Hardness (figure 4) TH 120 120 120 120 120 120 120 120 120 120 mg/1 STREAM -use table 4 for target concentrations 0.103 a EPA Acute Criterion 0.374 CTA 0.021 mg/1 b suggested Threshold Effect Level 0.450 0.785 CTT 0.045 mg/1

10

μg/1



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Viaduct Alternative

Date: 12/03/2019 Area: Central Study Area

6	Watershed Drainage Area	ATOT	156.0	square miles
	upstream of highway for a stream - total contributing ar	ea for a lake		
7	Average annual stream flow (section 2.3)			
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
	c Average stream flow (QSM * ATOT)	MQS	265.20	CFS



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Viaduct Alternative

a ratio of average stream flow (Worksheet A - 7b) to MQR

MQS/MQR

41.73

ratio

Date: 12/03/2019 Area: Central Study Area

Table 10. Worksheet B - Highway runoff characteristics

а	Compute runoff coefficient (Rv) (see section 3.1) Percent Impervious (Worksheet A - Item 1c) Runoff Coefficient (= 0.007 * IMP + 0.1)	IMP Rv	68.8	% ratio									
0	Occupants with the state (continue of a)												
	Compute runoff flow rates (section 3.1) flow rate from mean storm												
а	= Rv * MIP * AROW * (3630 / 3600)	MQR	6.356	CFS									
h	coefficient of variation of runoff flows	MQI	0.550	01 0									
٥	= CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimen	sionless								
	,												
3	Compute runoff volumes (section 3.1)												
а	Volume from the mean storm												
	= Rv * MVP * AROW * 3630	MVR	116644	cubic	feet								
b	coefficient of variation of runoff volumes												
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
			He	eavy Meta	ıls	Oxygen	Demand		Nutrients		Partic	ulates	
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	Site Median Conc (Worksheet A - Item 4a)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	dimensionless
	Number of storms per year (Worksheet A - 2i)	NST	120	120	120	120	120	120	120	120	120	120	number
а	mean event concentration (MCR)												
	= TCR * SQRT(1 + CVCR^2)	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29	0.50	177.50	48.75	mg/1
b	mean event mass load												
	= MCR * MVR * (0.00006245)	M{MASS)	0.49	3.64	3.00	227.64	1038.03	6.92	16.66	3.64	1292.99	355.12	pounds
С	annual mass load from runoff												
	= M(MASS) * NST	ANMASS	59.00	437.07	359.49	27317	124564	830.43	1999.58	437.07	155158	42614	pounds/year
_	Compute flow ratio (MQS/MQR) (section 3.3)												
S	Compute now ratio (MAS/MAN) (Section 3.3)												



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Viaduct Alternative

A further refinement in the analysis can be made using the procedure described in Appendix B.

Changes will usually be nominal, based on refined local estimates of variability of flows.

Date: 12/03/2019 Area: Central Study Area

Table 11. Worksheet C - Stream impact analysis

	I apr	C 11. 110 11	Silect O	Otic	a 1111 11111	Jact ai	iarysis						
1	Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	41.73	ratio									
2	Compute the event frequency for a 3 year recurrence interval												
	a Enter the average number of storms per year												
	{ from Worksheet A - Item 2i)	NST	120	number									
	b Compute the probability {%) of. the 3 year event												
	= 100 *(1 /(NST * 3))	PR	0.28	%									
3	Enter value from table 7												
	for MQS/MQR and frequency PR	CU	2.089	mg/1									
4	Select pollutant for analysis		He	eavy Meta	ls	Oxygen	Demand		Nutrients			ulates	name
			Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
а	Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b	Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
С	Acute Criteria Value (table 4)	СТА	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d	Threshold effects level (table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4	Compute the once in 3 year stream pollutant concentration												
	= CU * TCR * FSOL	CO	0.045	0.084	0.275								mg/1
5	Compare with target concentration, CTA					-							
	= CO / CTA	CRAT	2.15	0.81	0.73								ratio
6	Evaluate results												
а	If CRAT is less than about 0.75		STOP										
	A toxicity problem attributable to this pollutant is unlikely												
b	If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL										
С	If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level		EVALUATE										
	=CO / CTT	CRTE	1.00	ratio									



TOLER ANALYSIS FOR ESTIMATING CHLORIDES

PROJECT: I-81 VIADUCT PROJECT AREA: CENTRAL STUDY AREA

ALTERNATIVE: NO BUILD ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches

K = 8.37

Drainage Area #	Drainage Area (sq.mi.)	Lane Miles, M	Salt Applied Rate, T (Ton/lane mile)	Annual Average Concentration, C (ppm)	Discharge Location
Α	156	37.9	25	2.65	Lower Onondaga Creek



c target concentration is 10 micrograms/liter

FHWA POLLUTANT LOADINGS ANALYSIS

Date: 12/03/2019

Project: I-81 VIADUCT PROJECT

Project Number: 20433 Alternate: Viaduct Alternative

Table 9. Worksheet A - Site characteristics

Area: Central Study Area

1	Drainage Area of Highway Segment (section 2.1)												
	a Total right of way (Analysis area)	AROW	212.5	acres									
	b Paved surface	AHWY	144.2	acres									
	c Percent Impervious(= 100 * AHWY/AROW)	IMP	67.9	%									
2	Rainfall Characteristics (from section 2.2)	MEAN											
	Zone 1; Initial estimates from Figure 2.												
	a Volume	MVP	0.26	inch									
	b Intensity	MIP	0.051	inch / ho	our								
	c Duration	MDP	5.80	hour									
	d Interval	MTP	73.00	hour									
	COE	F of VARIATION	٧										
	e Volume	CVVP	1.46	dimension	onless								
	f Intensity	CVIP	1.30	dimension	onless								
	g Duration	CVDP	1.05	dimension									
	h Interval	CVTP	1.07	dimension	onless								
	i Number of storms per year (24*365 / MTP)	NST	120	no. even	ts								
3	Surrounding Area Type												
-	a ADT over 30,000 vehicles/day, urbanized area		URBAN										
	or			ш									
	b ADT under 30,000 vpd, undeveloped to low density suburba	an	RURAL										
	The finder 30,000 vpa, undeveloped to low defisity suburba	all	NONAL	ш									
			H	łeavy Meta	ls	Oxygen	Demand		Nutrients		Partic	ulates	
4	Select pollutant for analysis FHWA Volume I (section 2.4)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	and			•	•	•	•			•	•		-
	estimate runoff quality characteristics (use table 3)												
	a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimension	onless		•			•	•		_
5	Select receiving water target concentration (section 2.6)												
	surface water Total Hardness (figure 4)	TH	120	120	120	120	120	120	120	120	120	120	mg/1
	STREAM -use table 4 for target concentrations										''		_
	a EPA Acute Criterion	CTA	0.021	0.103	0.374								mg/1
	b suggested Threshold Effect Level	CTT	0.045	0.450	0.785								mg/1
	or												_ ~
	LAKE - use accepted level for average Phosphorus concentrate	ion											

μg/1



Project: I-81 VIADUCT PROJECT

Project Number: 20433 Alternate: Viaduct Alternative Date: 12/03/2019 Area: Central Study Area

6	Watershed Drainage Area	ATOT	156.0	square miles
	upstream of highway for a stream - total contributing area fo	r a lake		
7 /	Average annual stream flow (section 2.3)			
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
	c Average stream flow (QSM * ATOT)	MQS	265.20	CFS



a ratio of average stream flow (Worksheet A - 7b) to MQR

MQS/MQR

42.20

ratio

Project: I-81 VIADUCT PROJECT

Project Number: 20433 Alternate: Viaduct Alternative

FHWA POLLUTANT LOADINGS ANALYSIS

Date: 12/03/2019 Area: Central Study Area

Table 10. Worksheet B - Highway runoff characteristics

1	Compute runoff coefficient (Rv) (see section 3.1)												
а	Percent Impervious (Worksheet A - Item 1c)	IMP	67.9	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.58	ratio									
				•									
_													
	Compute runoff flow rates (section 3.1)												
а	flow rate from mean storm	MQR	0.004	CFS									
h	= Rv * MIP * AROW * (3630 / 3600) coefficient of variation of runoff flows	MQR	6.284	CF5									
b	= CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimon	sionless								
	= CVIF (VVOIKSHEELA - Item 21)	CVOR	1.30	dirileri	1510111655								
3	Compute runoff volumes (section 3.1)												
а	Volume from the mean storm												
	= Rv * MVP * AROW * 3630	MVR	115323	cubic	feet								
b	coefficient of variation of runoff volumes			•									
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
	,			l									
			Н	eavy Meta	ıls	Oxygen	Demand		Nutrients		Particu	ılates	
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	Site Median Conc (Worksheet A - Item 4a)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	dimensionless
	Number of storms per year (Worksheet A - 2i)	NST	120	120	120	120	120	120	120	120	120	120	number
			'										
а	mean event concentration (MCR)												
	= TCR * SQRT(1 + CVCR^2)	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29	0.50	177.50	48.75	mg/1
b	mean event mass load		-				•	•		-		-	
	= MCR * MVR * (0.00006245)	M{MASS)	0.49	3.60	2.96	225.06	1026.27	6.84	16.47	3.60	1278.34	351.09	pounds
С	annual mass load from runoff		-										
	= M(MASS) * NST	ANMASS	58.34	432.11	355.41	27007	123153	821.02	1976.93	432.11	153401	42131	pounds/year
	•		1					ļ.					•
5	Compute flow ratio (MQS/MQR) (section 3.3)												



Project: I-81 VIADUCT PROJECT

Project Number: 20433 Alternate: Viaduct Alternative Date: 12/03/2019 Area: Central Study Area

Table 11. Worksheet C - Stream impact analysis

1 Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	42.20	ratio									
2 Compute the event frequency for a 3 year recurrence interval												
a Enter the average number of storms per year												
{ from Worksheet A - Item 2i)	NST	120	number									
b Compute the probability (%) of. the 3 year event			-									
= 100 *(1 /(NST * 3))	PR	0.28	%									
3 Enter value from table 7												
for MQS/MQR and frequency PR	CU	2.071	mg/1									
4 Select pollutant for analysis		Н	eavy Meta	ls	Oxygen	Demand		Nutrients		Partic	ulates	name
		Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
a Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
c Acute Criteria Value (table 4)	CTA	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d Threshold effects level (table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4 Compute the once in 3 year stream pollutant concentration												
= CU * TCR * FSOL	СО	0.045	0.083	0.273								mg/1
5 Compare with target concentration, CTA					•							
= CO / CTA	CRAT	2.13	0.80	0.73								ratio
6 Evaluate results												
a If CRAT is less than about 0.75		STOP										
A toxicity problem attributable to this pollutant is unlikely			•									
b If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL										
c If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level		EVALUATE										
=CO / CTT	CRTE	0.99	ratio									

A further refinement in the analysis can be made using the procedure described in Appendix B. Changes will usually be nominal, based on refined local estimates of variability of flows.



TOLER ANALYSIS FOR ESTIMATING CHLORIDES

PROJECT: I-81 VIADUCT PROJECT AREA: CENTRAL STUDY AREA

ALTERNATIVE: VIADUCT ALTERNATIVES

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches K = 8.37

Drainage	Drainage Area	Lane Miles, M	Salt Applied Rate, T	Annual Average Concentration, C	Discharge Location
Area #	(sq.mi.)		(Ton/lane mile)	(ppm)	
Α	156	44.7	25	3.12	Lower Onondaga Creek



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Community Grid Alternative

c target concentration is 10 micrograms/liter

Date: 12/03/2019 Area: Central Study Area

Table 9. Worksheet A - Site characteristics

	Drainage Area of Highway Segment (section 2.1) a Total right of way (Analysis area) b Paved surface	AROW AHWY	229.5 152.7	acres acres									
	c Percent Impervious(= 100 * AHWY/AROW)	IMP	66.5	%									
2	Rainfall Characteristics (from section 2.2) Zone 1; Initial estimates from Figure 2.	MEAN											
	a Volume	MVP	0.26	inch									
	b Intensity	MIP	0.051	inch / ho	ur								
	c Duration	MDP	5.80	hour									
	d Interval	MTP	73.00	hour									
	COE	F of VARIATION	N										
	e Volume	CVVP	1.46	dimensio	nless								
	f Intensity	CVIP	1.30	dimensio	nless								
	g Duration	CVDP	1.05	dimensio	nless								
	h Interval	CVTP	1.07	dimensio	nless								
	i Number of storms per year (24*365 / MTP)	NST	120	no. event	ts								
	Surrounding Area Type a ADT over 30,000 vehicles/day, urbanized area or b ADT under 30,000 vpd, undeveloped to low density suburb	pan	URBAN RURAL										
			П	eavy Metal	c	Ovygen	Demand		Nutrients		Partic	ulates	
4	Select pollutant for analysis FHWA Volume I (section 2.4)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
•	and	TidiTio	- Ou			.00	002	110210	1144		.00	,,,,	
	estimate runoff quality characteristics (use table 3)												
	a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)		0.75	dimensio		20		0.70	1.00	0.100		00	
	,												
5	Select receiving water target concentration (section 2.6)												
		TH	120	120	120	120	120	120	120	120	120	120	mg/1
	STREAM -use table 4 for target concentrations							1				J	
	a EPA Acute Criterion	CTA	0.021	0.103	0.374								mg/1
	b suggested Threshold Effect Level	CTT	0.045	0.450	0.785								mg/1
	or		<u> </u>				1	I I				l	-
	LAKE - use accepted level for average Phosphorus concentra	ation											

μg/1

10



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Community Grid Alternative

Date: 12/03/2019 Area: Central Study Area

6 Watershed Drainage Area upstream of highway for a stream - total contributing a	ATOT area for a lake	156.0	square miles
7 Average annual stream flow (section 2.3)			
a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
c Average stream flow (QSM * ATOT)	MQS	265.20	CFS



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Community Grid Alternative

5 Compute flow ratio (MQS/MQR) (section 3.3)

a ratio of average stream flow (Worksheet A - 7b) to MQR

Date: 12/03/2019 Area: Central Study Area

Table 10. Worksheet B - Highway runoff characteristics

а	Compute runoff coefficient (Rv) (see section 3.1) Percent Impervious (Worksheet A - Item 1c)	IMP	66.5	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.57	ratio									
2	Compute runoff flow rates (section 3.1)												
а	flow rate from mean storm												
	= Rv * MIP * AROW * (3630 / 3600)	MQR	6.677	CFS									
D	coefficient of variation of runoff flows = CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimen	sionless								
	- Ovii (Workshoet / Rein zi)	OVOIC	1.50	diricii	310111033								
3	Compute runoff volumes (section 3.1)												
а	Volume from the mean storm												
	= Rv * MVP * AROW * 3630	MVR	122543	cubic	feet								
b	coefficient of variation of runoff volumes												
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
											Τ		
				eavy Meta			Demand		Nutrients		Partic		
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	Site Median Conc (Worksheet A - Item 4a)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	dimensionless
	Number of storms per year (Worksheet A - 2i)	NST	120	120	120	120	120	120	120	120	120	120	number
0	mean event concentration (MCR)												
а	= TCR * SQRT(1 + CVCR^2)	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29	0.50	177.50	48.75	mg/1
h	mean event mass load	IVICK	0.07	0.50	0.41	31.23	142.50	0.93	2.29	0.50	177.50	40.73	ilig/ i
D	= MCR * MVR * (0.00006245)	M{MASS)	0.52	3.83	3.15	239.15	1090.53	7.27	17.51	3.83	1358.37	373.07	pounds
C	annual mass load from runoff	INITINITION)	0.52	3.03	3.13	200.10	1030.33	1.41	17.51	3.03	1000.07	313.01	ρουπασ
C	= M(MASS) * NST	ANMASS	61.99	459.17	377.67	28698	130863	872.42	2100.70	459.17	163005	44769	pounds/year
	- m(m 30) 1101	, 11 411/1/100	01.00	100.17	311.01	20000	100000	012.72	2100.70	100.17	100000	11700	podrido/your

39.72

ratio

MQS/MQR



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build for Community Grid Alternative

A further refinement in the analysis can be made using the procedure described in Appendix B.

Changes will usually be nominal, based on refined local estimates of variability of flows.

Date: 12/03/2019 Area: Central Study Area

Table 11. Worksheet C - Stream impact analysis

	I abi	C 11. 11 011	Silect O	Otic	a 1111 11111	Jact ai	iarysis						
1	Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	39.72	ratio									
2	Compute the event frequency for a 3 year recurrence interval												
	a Enter the average number of storms per year												
	{ from Worksheet A - Item 2i)	NST	120	number									
	b Compute the probability {%) of. the 3 year event												
	= 100 *(1 /(NST * 3))	PR	0.28	%									
3	Enter value from table 7												
	for MQS/MQR and frequency PR	CU	1.082	mg/1									
4	Select pollutant for analysis		He	eavy Meta	S	Oxygen	Demand		Nutrients		Partic	ulates	name
			Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
а	Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b	Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
С	Acute Criteria Value (table 4)	СТА	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d	Threshold effects level (table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4	Compute the once in 3 <i>year</i> stream pollutant concentration												
	= CU * TCR * FSOL	CO	0.023	0.043	0.142								mg/1
5	Compare with target concentration, CTA					-							
	= CO / CTA	CRAT	1.11	0.42	0.38								ratio
6	Evaluate results												
а	If CRAT is less than about 0.75		STOP										
	A toxicity problem attributable to this pollutant is unlikely												
b	If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL										
C	If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level		EVALUATE										
	=CO / CTT	CRTE	0.52	ratio									
			5										



TOLER ANALYSIS FOR ESTIMATING CHLORIDES

PROJECT: I-81 VIADUCT PROJECT AREA: CENTRAL STUDY AREA

ALTERNATIVE: NO BUILD ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches

K = 8.37

Drainage Area #	Drainage Area (sq.mi.)	Lane Miles, M	Salt Applied Rate, T (Ton/lane mile)	Annual Average Concentration, C (ppm)	Discharge Location
Α	156	37.9	25	2.65	Lower Onondaga Creek



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

c target concentration is 10 micrograms/liter

Date: 12/03/2019 Area: Central Study Area

Table 9. Worksheet A - Site characteristics

1	Drainage Area of Highway Segment (section 2.1)												
	a Total right of way (Analysis area)	AROW	229.5	acres									
	b Paved surface	AHWY	144.3	acres									
	c Percent Impervious(= 100 * AHWY/AROW)	IMP	62.9	%									
2	Rainfall Characteristics (from section 2.2)	MEAN											
	Zone 1; Initial estimates from Figure 2.												
	a Volume	MVP	0.26	inch									
	b Intensity	MIP	0.051	inch / hou	ur								
	c Duration	MDP	5.80	hour									
	d Interval	MTP	73.00	hour									
	COE	F of VARIATION	1										
	e Volume	CVVP	1.46	dimensio	nless								
	f Intensity	CVIP	1.30	dimensio	nless								
	g Duration	CVDP	1.05	dimensio	nless								
	h Interval	CVTP	1.07	dimensio	nless								
	i Number of storms per year (24*365 / MTP)	NST	120	no. event	S								
3	Surrounding Area Type												
Ů	a ADT over 30,000 vehicles/day, urbanized area		URBAN										
	or			Ш									
	b ADT under 30,000 vpd, undeveloped to low density suburb	on	RURAL										
	ADT under 50,000 vpa, undeveloped to low density suburb	an	RUKAL	Ц									
			Н	leavy Metal	S		Demand		Nutrients		Partic		
4	Select pollutant for analysis FHWA Volume I (section 2.4) and	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	estimate runoff quality characteristics (use table 3)												
	a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensio		20	114	0.70	1.00	0.400	142	39	ilig/i
	b coel of variation (0.7) orban . 0.04 Rulai . 0.73 Estimate)	CVCIC	0.73	dimensio	111699								
5	Select receiving water target concentration (section 2.6)												
	surface water Total Hardness (figure 4)	TH	120	120	120	120	120	120	120	120	120	120	mg/1
	STREAM -use table 4 for target concentrations												
	a EPA Acute Criterion	CTA	0.021	0.103	0.374								mg/1
	b suggested Threshold Effect Level	CTT	0.045	0.450	0.785								mg/1
	or							I				1	
	LAKE - use accepted level for average Phosphorus concentra	tion											

μg/1

10



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019 Area: Central Study Area

6 Watershed Drainage Area upstream of highway for a stream - total contributing are	ATOT ea for a lake	156.0	square miles
7 Average annual stream flow (section 2.3)			
a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
c Average stream flow (QSM * ATOT)	MQS	265.20	CFS



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

a ratio of average stream flow (Worksheet A - 7b) to MQR

MQS/MQR

41.60

ratio

FHWA POLLUTANT LOADINGS ANALYSIS

Date: 12/03/2019 Area: Central Study Area

Table 10. Worksheet B - Highway runoff characteristics

	Compute runoff coefficient (Rv) (see section 3.1) Percent Impervious (Worksheet A - Item 1c) Runoff Coefficient (= 0.007 * IMP + 0.1)	IMP Rv	62.9	% ratio									
а	Compute runoff flow rates (section 3.1) flow rate from mean storm = Rv * MIP * AROW * (3630 / 3600) coefficient of variation of runoff flows = CVIP (Worksheet A - Item 2f)	MQR CVOR	6.375	CFS dimen	ısionless								
а	= Rv * MVP * AROW * 3630	MVR	116993	cubic	feet								
b	coefficient of variation of runoff volumes = CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
			Н	eavy Meta	als	Oxygen	Demand		Nutrients		Partic	ulates	
4	Compute mass Loads (section 3.2)	name	Cu	eavy Meta Pb	als Zn	Oxygen TOC	Demand COD	NO2+3	Nutrients TKN	PO4-P	Partice TSS	ulates VSS	
4	Compute mass Loads (section 3.2) Site Median Conc (Worksheet A - Item 4a)	name TCR						NO2+3 0.76	1	PO4-P 0.400	1		mg/1
4	· · · · · · · · · · · · · · · · · · ·		Cu	Pb	Zn	TOC	COD		TKN		TSS	VSS	mg/1 dimensionless
4	Site Median Conc (Worksheet A - Item 4a)	TCR	Cu 0.054	Pb 0.400	Zn 0.329	TOC 25	COD 114	0.76	TKN 1.83	0.400	TSS 142	VSS 39	•
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	0.76 0.75 120	1.83 0.75 120	0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
а	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75	0.76 0.75	1.83 0.75	0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
а	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120 31.25	COD 114 0.75 120 142.50	0.76 0.75 120 0.95	TKN 1.83 0.75 120 2.29	0.400 0.75 120 0.50	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	0.76 0.75 120	1.83 0.75 120	0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245) annual mass load from runoff	TCR CVCR NST MCR M(MASS)	Cu 0.054 0.75 120 0.07	Pb 0.400 0.75 120 0.50	2n 0.329 0.75 120 0.41	TOC 25 0.75 120 31.25	COD 114 0.75 120 142.50	0.76 0.75 120 0.95	TKN 1.83 0.75 120 2.29	0.400 0.75 120 0.50	TSS 142 0.75 120 177.50	VSS 39 0.75 120 48.75	dimensionless number mg/1 pounds
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120 31.25	COD 114 0.75 120 142.50	0.76 0.75 120 0.95	TKN 1.83 0.75 120 2.29	0.400 0.75 120 0.50	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019 Area: Central Study Area

Table 11. Worksheet C - Stream impact analysis

				.		paoi a.	, 0.0						
1 Define the flow ratio MQS	S/MQR (Worksheet B - 5a)	MQS/MQR	41.60	ratio									
2 Compute the event freque	ency for a 3 year recurrence interval												
a Enter the average nur	mber of storms per year												
{ from Worksheet A -	Item 2i)	NST	120	number									
b Compute the probabi	ility {%) of. the 3 year event												
= 100 *(1 /(NST * 3))		PR	0.28	%									
3 Enter value from table 7													
for MQS/MQR and fr	requency PR	CU	2.093	mg/1									
4 Select pollutant for analys	sis		Н	eavy Meta	ls	Oxygen	Demand		Nutrients		Partic	culates	name
			Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
a Site median concentration	on (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b Soluble fraction (section	2.5)	FSOL	0.400	0.100	0.400								fraction
c Acute Criteria Value (tab	le 4)	CTA	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d Threshold effects level (t	table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4 Compute the once in 3 y	rear stream pollutant concentration												
= CU * TCR * FSOL		CO	0.045	0.084	0.275								mg/1
5 Compare with target cond	centration, CTA					•							
= CO / CTA		CRAT	2.15	0.81	0.74								ratio
6 Evaluate results													
a If CRAT is less than abo	out 0.75		STOP										
A toxicity problem attribute	table to this pollutant is unlikely												
Estimate the level of redu	5 reduction will definitely be required action possible and repeat the analysis ther concentration or flow or both		CONTROL										
•			EVALUATE										
=CO / CTT		CRTE	1.00	ratio									

A further refinement in the analysis can be made using the procedure described in Appendix B. Changes will usually be nominal, based on refined local estimates of variability of flows.



TOLER ANALYSIS FOR ESTIMATING CHLORIDES

PROJECT: I-81 VIADUCT PROJECT AREA: CENTRAL STUDY AREA

ALTERNATIVE: COMMUNITY GRID ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches

K = 8.37

Drainage Area #	Drainage Area (sq.mi.)	Lane Miles, M	Salt Applied Rate, T (Ton/lane mile)	Annual Average Concentration, C (ppm)	Discharge Location
Alea #			•		
Α	156	41.5	25	2.90	Lower Onondaga Creek



Area: South Study Area

Date: 12/03/2019

Project: I-81 VIADUCT PROJECT Project Number: 20433

Alternate: No Build Alternatives

Table 9. Worksheet A - Site characteristics

1 Drainage Area of Highway Segment (section 2.1)												
a Total right of way (Analysis area)	AROW	180.5	acres									
b Paved surface	AHWY	49.3	acres									
c Percent Impervious(= 100 * AHWY/AROW)	IMP	27.3	%									
2 Rainfall Characteristics (from section 2.2)	MEAN											
Zone 1; Initial estimates from Figure 2.												
a Volume	MVP	0.26	inch									
b Intensity	MIP	0.051	inch / ho	our								
c Duration	MDP	5.80	hour									
d Interval	MTP	73.00	hour									
COL	EF of VARIATIO	N										
e Volume	CVVP	1.46	dimensio	onless								
f Intensity	CVIP	1.30	dimensio									
g Duration	CVDP	1.05	dimensio	onless								
h Interval	CVTP	1.07	dimension	onless								
i Number of storms per year (24*365 / MTP)	NST	120	no. even	ts								
3 Surrounding Area Type												
a ADT over 30,000 vehicles/day, urbanized area		URBAN	П									
or												
b ADT under 30,000 vpd, undeveloped to low density suburb	an	RURAL										
		Н	leavy Meta	ls	Oxygen	Demand		Nutrients	;	Partic	ulates	7
4 Select pollutant for analysis FHWA Volume I (section 2.4) and	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS]
estimate runoff quality characteristics (use table 3)												_
a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg
b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensio	onless								_
5 Select receiving water target concentration (section 2.6)												
surface water Total Hardness (figure 4)	TH	120	120	120	120	120	120	120	120	120	120	mg
STREAM -use table 4 for target concentrations							I					_ ~
a EPA Acute Criterion	CTA	0.021	0.103	0.374								mg
b suggested Threshold Effect Level	CTT	0.045	0.450	0.785								mg
or				1	1	1	ı	1				_ ~
LAKE - use accepted level for average Phosphorus concentra	tion											
c target concentration is 10 micrograms/liter		10	μg/1									



Project: I-81 VIADUCT PROJECT

Project Number: 20433 Alternate: No Build Alternatives Date: 12/03/2019 Area: South Study Area

6	Watershed Drainage Area	ATOT	4.5	square miles
	upstream of highway for a stream - total contributing are	a for a lake	-	
7	Average annual stream flow (section 2.3)			
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
	c Average stream flow (QSM * ATOT)	MQS	7.70	CFS



a ratio of average stream flow (Worksheet A - 7b) to MQR

FHWA POLLUTANT LOADINGS ANALYSIS

Project: I-81 VIADUCT PROJECT

Project Number: 20433 Alternate: No Build Alternatives Date: 12/03/2019 Area: South Study Area

Table 10. Worksheet B - Highway runoff characteristics

	Compute runoff coefficient (Rv) (see section 3.1)	IMP	07.0	0/									
	Percent Impervious (Worksheet A - Item 1c)	IMP	27.3	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.29	ratio									
2	Compute runoff flow rates (section 3.1)												
а	flow rate from mean storm												
	= Rv * MIP * AROW * (3630 / 3600)	MQR	2.703	CFS									
b	coefficient of variation of runoff flows												
	= CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimen	sionless								
3	Compute runoff volumes (section 3.1)												
а													
и	= Rv * MVP * AROW * 3630	MVR	49606.1	cubic	feet								
h		IVIVIX	43000.1	Cubic	icci								
b													
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
				oova Moto	No.	Overgon	Domand	I	Nutrionto		Dortio	ulotoo	
4	Compute mass Leads (section 2.2)			eavy Meta			Demand		Nutrients		Partic		
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
4	Site Median Conc (Worksheet A - Item 4a)	TCR	Cu 0.054	Pb 0.400	Zn 0.329	TOC 25	COD 114	NO2+3 0.76	TKN 1.83	PO4-P 0.400	TSS 142	VSS 39	mg/1
4	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75	NO2+3 0.76 0.75	1.83 0.75	PO4-P 0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
4	Site Median Conc (Worksheet A - Item 4a)	TCR	Cu 0.054	Pb 0.400	Zn 0.329	TOC 25	COD 114	NO2+3 0.76	TKN 1.83	PO4-P 0.400	TSS 142	VSS 39	9
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75	NO2+3 0.76 0.75	1.83 0.75	PO4-P 0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b)	TCR CVCR NST	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75 120	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120	PO4-P 0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75	NO2+3 0.76 0.75	1.83 0.75	PO4-P 0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
а	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	NO2+3 0.76 0.75 120	1.83 0.75 120	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
а	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	NO2+3 0.76 0.75 120	1.83 0.75 120	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120 31.25	COD 114 0.75 120	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120 2.29	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120 31.25	COD 114 0.75 120	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120 2.29	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1
a b c	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245) annual mass load from runoff	TCR CVCR NST MCR M(MASS)	Cu 0.054 0.75 120 0.07	Pb 0.400 0.75 120 0.50	Zn 0.329 0.75 120 0.41	TOC 25 0.75 120 31.25	COD 114 0.75 120 142.50	NO2+3 0.76 0.75 120 0.95	TKN 1.83 0.75 120 2.29 7.09	PO4-P 0.400 0.75 120 0.50	TSS 142 0.75 120 177.50	VSS 39 0.75 120 48.75	dimensionless number mg/1 pounds

MQS/MQR

2.85

ratio



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019 Area: South Study Area

Table 11. Worksheet C - Stream impact analysis

	iabi	C I I. VVOIN	Silect O	Otici	4111 1111 5	Jact ai	iaiyəiə						
1	Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	2.85	ratio									
2	Compute the event frequency for a 3 year recurrence interval												
	a Enter the average number of storms per year												
	{ from Worksheet A - Item 2i)	NST	120	number									
	b Compute the probability (%) of. the 3 year event												
	= 100 *(1 /(NST * 3))	PR	0.28	%									
3	Enter value from table 7												
	for MQS/MQR and frequency PR	CU	2.951	mg/1									
4	Select pollutant for analysis		He	eavy Metal	s	Oxygen	Demand		Nutrients		Partic	ulates	name
			Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
а	Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b	Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
С	Acute Criteria Value (table 4)	СТА	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d	Threshold effects level (table 4)	СТТ	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4	Compute the once in 3 <i>year</i> stream pollutant concentration												
	= CU * TCR * FSOL	СО	0.064	0.118	0.388								mg/1
5	Compare with target concentration, CTA					•							
	= CO / CTA	CRAT	3.04	1.15	1.04								ratio
6	Evaluate results												
а	If CRAT is less than about 0.75		STOP										
	A toxicity problem attributable to this pollutant is unlikely												
b	If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL										
С	If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level		EVALUATE										
	=CO / CTT	CRTE	1.42	ratio									

A further refinement in the analysis can be made using the procedure described in Appendix B. Changes will usually be nominal, based on refined local estimates of variability of flows.



TOLER ANALYSIS FOR ESTIMATING CHLORIDES

PROJECT: I-81 VIADUCT PROJECT AREA: SOUTH STUDY AREA

ALTERNATIVE: NO BUILD ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches K = 8.37

Drainage Area #	Drainage Area (sq.mi.)	Lane Miles, M	Salt Applied Rate, T (Ton/lane mile)	Annual Average Concentration, C (ppm)	Discharge Location
В	4.53	14.4	25	34.64	Middle Onondaga Creek
D	4.55	14.4	25	54.04	Middle Offordaga Creek



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

c target concentration is 10 micrograms/liter

Date: 12/03/2019 Area: South Study Area

Table 9. Worksheet A - Site characteristics

1	Drainage Area of Highway Segment (section 2.1)												
	a Total right of way (Analysis area)	AROW	180.5	acres									
	b Paved surface	AHWY	49.3	acres									
	c Percent Impervious(= 100 * AHWY/AROW)	IMP	27.3	%									
2	Rainfall Characteristics (from section 2.2)	MEAN											
	Zone 1; Initial estimates from Figure 2.												
	a Volume	MVP	0.26	inch									
	b Intensity	MIP	0.051	inch / ho	ur								
	c Duration	MDP	5.80	hour									
	d Interval	MTP	73.00	hour									
	COE	EF of VARIATIO	N										
	e Volume	CVVP	1.46	dimensio	nless								
	f Intensity	CVIP	1.30	dimension	nless								
	g Duration	CVDP	1.05	dimensio									
	h Interval	CVTP	1.07	dimension	nless								
	i Number of storms per year (24*365 / MTP)	NST	120	no. even	ts								
3	Surrounding Area Type												
	a ADT over 30,000 vehicles/day, urbanized area		URBAN	П									
	or		•	Ш									
	b ADT under 30,000 vpd, undeveloped to low density suburb	an	RURAL	П									
	~ AD1 under 30,000 vpd, undeveloped to low density suburb	an	NONAL	Щ									
			Н	leavy Meta	ls	Oxygen	Demand		Nutrients		Partic	ulates	
4	Select pollutant for analysis FHWA Volume I (section 2.4) and	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS]
	estimate runoff quality characteristics (use table 3)												
	a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensio		23	114	0.70	1.00	0.400	142	39	I IIIg/ I
	b coel of variation (0.71 orban : 0.04 Nural : 0.73 Estimate)	OVOIC	0.73	difference	111033								
5	Select receiving water target concentration (section 2.6)												
	surface water Total Hardness (figure 4)	TH	120	120	120	120	120	120	120	120	120	120	mg/1
	STREAM -use table 4 for target concentrations						I			I			
	a EPA Acute Criterion	CTA	0.021	0.103	0.374								mg/1
	b suggested Threshold Effect Level	CTT	0.045	0.450	0.785								mg/1
	or									<u> </u>			
	LAKE - use accepted level for average Phosphorus concentra	tion											

μg/1

10



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019 Area: South Study Area

6	Watershed Drainage Area	ATOT	4.5	square miles
	upstream of highway for a stream - total contributing area	a for a lake		
7	Average annual stream flow (section 2.3)			
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
	c Average stream flow (QSM * ATOT)	MQS	7.70	CFS



Project: I-81 VIADUCT PROJECT

a ratio of average stream flow (Worksheet A - 7b) to MQR

MQS/MQR

2.85

ratio

Project Number: 20433

Alternate: Community Grid Alternative

FHWA POLLUTANT LOADINGS ANALYSIS

Date: 12/03/2019 Area: South Study Area

Table 10. Worksheet B - Highway runoff characteristics

	Compute runoff coefficient (Rv) (see section 3.1) Percent Impervious (Worksheet A - Item 1c) Runoff Coefficient (= 0.007 * IMP + 0.1)	IMP Rv	27.3 0.29	% ratio									
а	Compute runoff flow rates (section 3.1) flow rate from mean storm = Rv * MIP * AROW * (3630 / 3600) coefficient of variation of runoff flows = CVIP (Worksheet A - Item 2f)	MQR CVOR	2.703	CFS dimen	sionless								
а	Compute runoff volumes (section 3.1) Volume from the mean storm = Rv * MVP * AROW * 3630 coefficient of variation of runoff volumes = CVVP (Worksheet A - Item 2e)	MVR CVVR	49606.1	cubic	feet								
	,		Н	eavy Meta	ıls		Demand		Nutrients	5015	Partic		
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	44
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b)	TCR CVCR	0.054	0.400	0.329	25 0.75	114 0.75	0.76 0.75	1.83	0.400	142	39	mg/1 dimensionless
	Number of storms per year (Worksheet A - 4b)	NST	120	0.75 120	0.75 120	120	120	120	0.75 120	0.75 120	0.75 120	0.75 120	number
							120	0					
а	mean event concentration (MCR)							-					
	= TCR * SQRT(1 + CVCR^2)	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29	0.50	177.50	48.75	mg/1
	= TCR * SQRT(1 + CVCR^2) mean event mass load	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29				Ü
b	= TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245)							-		0.50	177.50 549.88	48.75 151.02	mg/1 pounds
b	= TCR * SQRT(1 + CVCR^2) mean event mass load	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29				Ü



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019 Area: South Study Area

Table 11. Worksheet C - Stream impact analysis

1 Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	2.85 ra	atio		•	-						
2 Compute the event frequency for a 3 year recurrence interval												
a Enter the average number of storms per year												
{ from Worksheet A - Item 2i)	NST	120 ni	umber									
b Compute the probability {%) of. the 3 year event												
= 100 *(1 /(NST * 3))	PR	0.28 %	6									
3 Enter value from table 7												
for MQS/MQR and frequency PR	CU	2.951 m	ng/1									
4 Select pollutant for analysis		Heav	y Metals	S	Oxygen	Demand		Nutrients		Partic	ulates	name
		Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
a Site median concentration (table 3)	TCR	0.054 0	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b Soluble fraction (section 2.5)	FSOL	0.400 0	0.100	0.400								fraction
c Acute Criteria Value (table 4)	СТА	0.021 0	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d Threshold effects level (table 4)	CTT	0.045 0	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4 Compute the once in 3 <i>year</i> stream pollutant concentration												
= CU * TCR * FSOL	CO	0.064 0).118	0.388								mg/1
5 Compare with target concentration, CTA												
= CO / CTA	CRAT	3.04 1	1.15	1.04								ratio
6 Evaluate results												
a If CRAT is less than about 0.75		STOP										
A toxicity problem attributable to this pollutant is unlikely												
b If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL										
c If CRAT is still greater than 1 and greater reduction levels are not practical		EVALUATE										
Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level												
=CO / CTT	CRTE	1.42 ra	atio									

A further refinement in the analysis can be made using the procedure described in Appendix B. Changes will usually be nominal, based on refined local estimates of variability of flows.



TOLER ANALYSIS FOR ESTIMATING CHLORIDES

PROJECT: I-81 VIADUCT PROJECT AREA: SOUTH STUDY AREA

ALTERNATIVE: COMMUNITY GRID ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches

K = 8.37

Drainage	Drainage Area	Lane Miles,	Salt Applied Rate, T	Annual Average Concentration, C	Discharge Location		
Area #	(sq.mi.)	М	(Ton/lane mile)	(ppm)			
В	4.53 15		25	36.09	Middle Onondaga Creek		



c target concentration is 10 micrograms/liter

FHWA POLLUTANT LOADINGS ANALYSIS

Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019

Area: Eastern Study Area- Northern Region to Ley Creek

Table 9. Worksheet A - Site characteristics

	Drainage Area of Highway Segment (section 2.1) a Total right of way (Analysis area) b Paved surface c Percent Impervious(= 100 * AHWY/AROW)	AROW AHWY IMP	18.5 5.7 30.8	acres acres %								
2	Rainfall Characteristics (from section 2.2) Zone 1; Initial estimates from Figure 2.	MEAN										
	a Volume	MVP	0.26	inch								
	b Intensity	MIP	0.051	inch / hour								
	c Duration	MDP	5.80	hour								
	d Interval	MTP	73.00	hour								
	COE	F of VARIATION	N									
	e Volume	CVVP	1.46	dimensionless								
	f Intensity	CVIP	1.30	dimensionless								
	g Duration	CVDP	1.05	dimensionless								
	h Interval	CVTP	1.07	dimensionless								
	i Number of storms per year (24*365 / MTP)	NST	120	no. events								
3	Surrounding Area Type											
	a ADT over 30,000 vehicles/day, urbanized area		URBAN	П								
	or			—								
	b ADT under 30,000 vpd, undeveloped to low density suburba	an	RURAL									
			Н	eavy Metals	Oxygen	Demand		Nutrients		Partic	ulates	
4	Select pollutant for analysis FHWA Volume I (section 2.4)	name	Cu	Pb Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	·
	and		L	<u> </u>	1		lI		l l			
	estimate runoff quality characteristics (use table 3)											
	a site median concentration	TCR	0.054	0.400 0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensionless	1	I			l l			
5	Select receiving water target concentration (section 2.6)											
J	surface water Total Hardness (figure 4)	TH	120	120 120	120	120	120	120	120	120	120	mg/1
	STREAM -use table 4 for target concentrations	111	120	120 120	120	120	120	120	120	120	120	ilig/ i
	a EPA Acute Criterion	СТА	0.021	0.103 0.374								mg/1
	b suggested Threshold Effect Level	CTT	0.021	0.450 0.785								mg/1
	Or	011	0.040	0.700	1	I						1119/1
	LAKE - use accepted level for average Phosphorus concentrate	tion										

μg/1



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019

Area: Eastern Study Area- Northern Region to Ley Creek

6	Watershed Drainage Area	ATOT	1.0	square miles
	upstream of highway for a stream - total contributing are	ea for a lake		
7	Average annual stream flow (section 2.3)			
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
	c Average stream flow (QSM * ATOT)	MQS	1.62	CFS



Project: I-81 VIADUCT PROJECT

a ratio of average stream flow (Worksheet A - 7b) to MQR

Project Number: 20433 Alternate: No Build Alternatives Date: 12/03/2019

Area: Eastern Study Area- Northern Region to Ley Creek

Table 10. Worksheet B - Highway runoff characteristics

1	Compute runoff coefficient (Rv) (see section 3.1)												
а	Percent Impervious (Worksheet A - Item 1c)	IMP	30.8	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.32	ratio									
	Compute runoff flow rates (section 3.1)												
а	flow rate from mean storm		0.000	050									
	= Rv * MIP * AROW * (3630 / 3600)	MQR	0.300	CFS									
D	coefficient of variation of runoff flows	CVOR	4.20	ما ما الم	ء:ممامم								
	= CVIP (Worksheet A - Item 2f)	CVOR	1.30	aimen	sionless								
3	Compute runoff volumes (section 3.1)												
а	Volume from the mean storm												
	= Rv * MVP * AROW * 3630	MVR	5511.79	cubic	feet								
b	coefficient of variation of runoff volumes												
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
			H	eavy Meta	ls	Oxygen	Demand		Nutrients		Partic	ulates	
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	Site Median Conc (Worksheet A - Item 4a)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	dimensionless
	Number of storms per year (Worksheet A - 2i)	NST	120	120	120	120	120	120	120	120	120	120	number
а	mean event concentration (MCR)												
	= TCR * SQRT(1 + CVCR^2)	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29	0.50	177.50	48.75	mg/1
b	mean event mass load												
	= MCR * MVR * (0.00006245)	M{MASS)	0.02	0.17	0.14	10.76	49.05	0.33	0.79	0.17	61.10	16.78	pounds
С	annual mass load from runoff												
	= M(MASS) * NST	ANMASS	2.79	20.65	16.99	1291	5886	39.24	94.49	20.65	7332	2014	pounds/year
5	Compute flow ratio (MQS/MQR) (section 3.3)												

MQS/MQR

5.38

ratio



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019

Area: Eastern Study Area- Northern Region to Ley Creek

Table 11. Worksheet C - Stream impact analysis

1	Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	5.38	ratio	•		•						
2	Compute the event frequency for a 3 year recurrence interval a Enter the average number of storms per year												
	{ from Worksheet A - Item 2i) b Compute the probability {%) of. the 3 year event	NST	120	number									
	= 100 *(1 /(NST * 3))	PR	0.28	%									
3	Enter value from table 7		<u>. </u>										
	for MQS/MQR and frequency PR	CU	2.586	mg/1									
4	Select pollutant for analysis		He	eavy Metal	S	Oxygen	Demand		Nutrients		Partic	ulates	name
			Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
а	Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b	Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
С	Acute Criteria Value (table 4)	СТА	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d	Threshold effects level (table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4	Compute the once in 3 <i>year</i> stream pollutant concentration												
	= CU * TCR * FSOL	CO	0.056	0.103	0.340								mg/1
5	Compare with target concentration, CTA					•							
	= CO / CTA	CRAT	2.66	1.00	0.91								ratio
	Evaluate results If CRAT is less than about 0.75		STOP										
	A toxicity problem attributable to this pollutant is unlikely												
	If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL										
	If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level		EVALUATE										
	=CO / CTT	CRTE	1.24	ratio									

A further refinement in the analysis can be made using the procedure described in Appendix B. Changes will usually be nominal, based on refined local estimates of variability of flows.



PROJECT: I-81 VIADUCT PROJECT

AREA: EAST STUDY AREA - NORTHERN SECTION

ALTERNATIVE: NO BUILD ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches K = 8.37

Drainage Area #	Drainage Area (sq.mi.)	Lane Miles, M	Salt Applied Rate, T (Ton/lane mile)	Annual Average Concentration, C (ppm)	Discharge Location
C-North	0.95	2	25	22.94	North Branch Ley Creek



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

c target concentration is 10 micrograms/liter

Date: 12/03/2019

Area: East Study Area- Northern Region to Ley Creek

Table 9. Worksheet A - Site characteristics

1	Drainage Area of Highway Segment (section 2.1)											
	a Total right of way (Analysis area)	AROW	18.5	acres								
	b Paved surface	AHWY	6.3	acres								
	c Percent Impervious(= 100 * AHWY/AROW)	IMP	34.1	%								
2	Rainfall Characteristics (from section 2.2)	MEAN										
	Zone 1; Initial estimates from Figure 2.											
	a Volume	MVP	0.26	inch								
	b Intensity	MIP	0.051	inch / hour								
	c Duration	MDP	5.80	hour								
	d Interval	MTP	73.00	hour								
	COE	F of VARIATION	٧									
	e Volume	CVVP	1.46	dimensionless								
	f Intensity	CVIP	1.30	dimensionless								
	g Duration	CVDP	1.05	dimensionless								
	h Interval	CVTP	1.07	dimensionless								
	i Number of storms per year (24*365 / MTP)	NST	120	no. events								
3	Surrounding Area Type											
	a ADT over 30,000 vehicles/day, urbanized area		URBAN									
	or											
	b ADT under 30,000 vpd, undeveloped to low density suburba	an	RURAL									
	, ,			<u> </u>	•							•
				leavy Metals		Demand		Nutrients		Partic		
4	Select pollutant for analysis FHWA Volume I (section 2.4) and	name	Cu	Pb Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	estimate runoff quality characteristics (use table 3)											
	a site median concentration	TCR	0.054	0.400 0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensionless								
5	Select receiving water target concentration (section 2.6)											
J	surface water Total Hardness (figure 4)	TH	120	120 120	120	120	120	120	120	120	120	mg/1
	STREAM -use table 4 for target concentrations	111	120	120 120	120	120	120	120	120	120	120	ilig/ i
	a EPA Acute Criterion	СТА	0.021	0.103 0.374								mg/1
	b suggested Threshold Effect Level	CTA	0.021	0.450 0.785								mg/1
	or	011	0.043	0.430 0.765								mg/1
	LAKE - use accepted level for average Phosphorus concentrate	tion										
	Litte add accepted level for average i hospitorus concentrat											

μg/1



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019

Area: East Study Area- Northern Region to Ley Creek

6	Watershed Drainage Area	ATOT	1.0	square miles
	upstream of highway for a stream - total contributing are			
7	Average annual stream flow (section 2.3)			
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
	c Average stream flow (QSM * ATOT)	MQS	1.62	CFS



PROJECT: I-81 VIADUCT PROJECT

AREA: EAST STUDY AREA - NORTHERN SECTION ALTERNATIVE: COMMUNITY GRID ALTERNATIVE

Constituent evaluation =	Chloride	
Mean Annual Runoff =	19.2	inches
K =	8.37	

Drainage Area #	Drainage Area (sq.mi.)	Lane Miles, M	Salt Applied Rate, T (Ton/lane mile)	Annual Average Concentration, C (ppm)	Discharge Location
C-North	0.95	2.8	25	32.12	North Branch Ley Creek



c target concentration is 10 micrograms/liter

FHWA POLLUTANT LOADINGS ANALYSIS

Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

Table 9. Worksheet A - Site characteristics

1	Drainage Area of Highway Segment (section 2.1)												
	a Total right of way (Analysis area)	AROW	221.0	acres									
	b Paved surface	AHWY	65.3	acres									
	c Percent Impervious(= 100 * AHWY/AROW)	IMP	29.5	%									
2	Rainfall Characteristics (from section 2.2)	MEAN											
	Zone 1; Initial estimates from Figure 2.												
	a Volume	MVP	0.26	inch									
	b Intensity	MIP	0.051	inch / ho	ur								
	c Duration	MDP	5.80	hour									
	d Interval	MTP	73.00	hour									
	COE	EF of VARIATIO	N										
	e Volume	CVVP	1.46	dimensio	onless								
	f Intensity	CVIP	1.30	dimension	onless								
	g Duration	CVDP	1.05	dimension									
	h Interval	CVTP	1.07	dimension	onless								
	i Number of storms per year (24*365 / MTP)	NST	120	no. even	ts								
3	Surrounding Area Type												
	a ADT over 30,000 vehicles/day, urbanized area		URBAN										
	or		•	Ш									
	b ADT under 30,000 vpd, undeveloped to low density suburb	an	RURAL	П									
	7.D1 under 30,000 vpd, undeveloped to low defisity suburb	an	KOKKL	Щ									
			H	leavy Meta	ls	Oxygen	Demand		Nutrients		Partic	ulates	Ī
4	Select pollutant for analysis FHWA Volume I (section 2.4) and	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS]
	estimate runoff quality characteristics (use table 3)												
	a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensio		23	114	0.70	1.00	0.400	142	39	I llig/ i
	b coel of variation (0.71 orban : 0.04 india: 0.73 Estimate)	CVCK	0.73	uimensic) IIC33								
5	Select receiving water target concentration (section 2.6)												
	surface water Total Hardness (figure 4)	TH	120	120	120	120	120	120	120	120	120	120	mg/1
	STREAM -use table 4 for target concentrations				I	ı	ı			I			
	a EPA Acute Criterion	CTA	0.021	0.103	0.374								mg/1
	b suggested Threshold Effect Level	CTT	0.045	0.450	0.785								mg/1
	or									<u> </u>			
	LAKE - use accepted level for average Phosphorus concentra	tion											

μg/1



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

6		ATOT	68.9	square miles	
	upstream of highway for a stream - total contributing ar				
7	Average annual stream flow (section 2.3)				
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile	
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless	
	c Average stream flow (QSM * ATOT)	MQS	117.13	CFS	



Project: I-81 VIADUCT PROJECT

a ratio of average stream flow (Worksheet A - 7b) to MQR

Project Number: 20433 Alternate: No Build Alternatives Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

Table 10. Worksheet B - Highway runoff characteristics

1	Compute runoff coefficient (Rv) (see section 3.1)												
а	Percent Impervious (Worksheet A - Item 1c)	IMP	29.5	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.31	ratio									
	Compute runoff flow rates (section 3.1)												
а	flow rate from mean storm												
	= Rv * MIP * AROW * (3630 / 3600)	MQR	3.487	CFS									
b	coefficient of variation of runoff flows	0) (0.5		l									
	= CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimen	sionless								
3	Compute runoff volumes (section 3.1)												
а													
а	= Rv * MVP * AROW * 3630	MVR	63999.1	cubic	foot								
		IVIVIX	03333.1	Cubic	1001								
b	coefficient of variation of runoff volumes			•									
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
			H	eavy Meta	als		Demand		Nutrients		Partic		
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	Site Median Conc (Worksheet A - Item 4a)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	dimensionless
	Number of storms per year (Worksheet A - 2i)	NST	120	120	120	120	120	120	120	120	120	120	number
												_	
а	mean event concentration (MCR)												
	= TCR * SQRT(1 + CVCR^2)	MCR	0.07	0.50	0.41	31.25	142.50	0.95	2.29	0.50	177.50	48.75	mg/1
b	mean event mass load							•			•	•	
	= MCR * MVR * (0.00006245)	M{MASS)	0.27	2.00	1.64	124.90	569.54	3.80	9.14	2.00	709.42	194.84	pounds
С	annual mass load from runoff				•							•	
	= M(MASS) * NST	ANMASS	32.37	239.80	197.24	14988	68344	455.63	1097.11	239.80	85131	23381	pounds/year
5	Compute flow ratio (MQS/MQR) (section 3.3)												

MQS/MQR

33.59

ratio



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

Table 11. Worksheet C - Stream impact analysis

	I UDI		511001 0		u	Juot ai	iaryoro						
1	Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	33.59	ratio									
2	2 Compute the event frequency for a 3 year recurrence interval												
	a Enter the average number of storms per year												
	{ from Worksheet A - Item 2i)	NST	120	number									
	b Compute the probability {%) of. the 3 year event												
	= 100 *(1 /(NST * 3))	PR	0.28	%									
3	B Enter value from table 7												
	for MQS/MQR and frequency PR	CU	1.246	mg/1									
2	Select pollutant for analysis		He	Heavy Metals Oxygen Demand Nutrients Partic				ulates	name				
	'		Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
a	a Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
t	Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400]							fraction
c	Acute Criteria Value (table 4)	СТА	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
c	Threshold effects level (table 4)	СТТ	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
2	Compute the once in 3 <i>year</i> stream pollutant concentration												
	= CU * TCR * FSOL	CO	0.027	0.050	0.164								mg/1
5	5 Compare with target concentration, CTA					-							
	= CO / CTA	CRAT	1.28	0.48	0.44								ratio
6	S Evaluate results												
8	a If CRAT is less than about 0.75		STOP										
	A toxicity problem attributable to this pollutant is unlikely												
k	If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL										
C	If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level		EVALUATE										
	=CO / CTT	CRTE	0.60	ratio									
		l: ll : A											

A further refinement in the analysis can be made using the procedure described in Appendix B.

Changes will usually be nominal, based on refined local estimates of variability of flows.



PROJECT: I-81 VIADUCT PROJECT

AREA: EAST STUDY AREA - SOUTHERN SECTION

ALTERNATIVE: NO BUILD ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff = 19.2 inches

K = 8.37

Drainage	Drainage Area	Lane Miles,	Salt Applied Rate, T	Annual Average Concentration, C	Discharge Location
Area #	(sq.mi.)	mi.) M (Ton/lane mile)		(ppm)	
C-South	68.9	9.8	25	1.55	Butternut Creek



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

Table 9. Worksheet A - Site characteristics

Drainage Area of Highway Segment (section 2.1)												
a Total right of way (Analysis area)	AROW	221.0	acres									
b Paved surface	AHWY	68.0	acres									
c Percent Impervious(= 100 * AHWY/AROW)	IMP	30.8	%									
2 Rainfall Characteristics (from section 2.2)	MEAN											
Zone 1; Initial estimates from Figure 2.												
a Volume	MVP	0.26	inch									
b Intensity	MIP	0.051	inch / ho	ur								
c Duration	MDP	5.80	hour									
d Interval	MTP	73.00	hour									
COE	F of VARIATIO	N										
e Volume	CVVP	1.46	dimensio	nless								
f Intensity	CVIP	1.30	dimensio	nless								
g Duration	CVDP	1.05	dimensio	nless								
h Interval	CVTP	1.07	dimensio	nless								
i Number of storms per year (24*365 / MTP)	NST	120	no. even	ts								
3 Surrounding Area Type												
a ADT over 30,000 vehicles/day, urbanized area		URBAN										
or												
b ADT under 30,000 vpd, undeveloped to low density suburb	an	RURAL										
		Н	eavy Meta	ls	Oxygen Demand			Nutrients		Partic	ulates	1
4 Select pollutant for analysis FHWA Volume I (section 2.4) and	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS]
estimate runoff quality characteristics (use table 3)												
a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensio	nless					I.			1 0
5 Select receiving water target concentration (section 2.6)												
surface water Total Hardness (figure 4)	TH	120	120	120	120	120	120	120	120	120	120	mg/1
STREAM -use table 4 for target concentrations		0							0			
a EPA Acute Criterion	CTA	0.021	0.103	0.374								mg/1
b suggested Threshold Effect Level	CTT	0.045	0.450	0.785								mg/1
or	O / 1	0.0-10	3.400	0.700]9/1
LAKE - use accepted level for average Phosphorus concentration	tion											
c target concentration is 10 micrograms/liter		10	μg/1									
o target contentiation is no interegrants/inter		10	μ·g/ i									



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

6 Watershed Drainage Area upstream of highway for a stream - total contribution	ATOT ng area for a lake	68.9	square miles
7 Average annual stream flow (section 2.3)			
a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
c Average stream flow (QSM * ATOT)	MQS	117.13	CFS



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

5 Compute flow ratio (MQS/MQR) (section 3.3)

a ratio of average stream flow (Worksheet A - 7b) to MQR

MQS/MQR

32.68

ratio

Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

Table 10. Worksheet B - Highway runoff characteristics

	Compute runoff coefficient (Rv) (see section 3.1)												
а	Percent Impervious (Worksheet A - Item 1c)	IMP	30.8	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.32	ratio									
	Compute runoff flow rates (section 3.1)												
а	flow rate from mean storm		0.504	050									
	= Rv * MIP * AROW * (3630 / 3600)	MQR	3.584	CFS									
b	coefficient of variation of runoff flows = CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimon	sionless								
	= CVIP (WORKSHEELA - Item 21)	CVOR	1.30	amen	Sioriless								
3	Compute runoff volumes (section 3.1)												
а	Volume from the mean storm												
	= Rv * MVP * AROW * 3630	MVR	65782.9	cubic	feet								
b	coefficient of variation of runoff volumes												
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
												1	
				eavy Meta			Demand		Nutrients		Partic		
4	Compute mass Loads (section 3.2)	name	Cu	eavy Meta Pb	ls Zn	Oxygen TOC	Demand COD	NO2+3	Nutrients TKN	PO4-P	Partic TSS	ulates VSS	
4	Compute mass Loads (section 3.2) Site Median Conc (Worksheet A - Item 4a)	name TCR								PO4-P 0.400			mg/1
4	,		Cu	Pb	Zn	TOC	COD	NO2+3	TKN		TSS	VSS	mg/1 dimensionless
4	Site Median Conc (Worksheet A - Item 4a)	TCR	Cu 0.054	Pb 0.400	Zn 0.329	TOC 25	COD 114	NO2+3 0.76	TKN 1.83	0.400	TSS 142	VSS 39	•
4	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	114 0.75	NO2+3 0.76 0.75	TKN 1.83 0.75	0.400	TSS 142 0.75	VSS 39 0.75	dimensionless
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	114 0.75	NO2+3 0.76 0.75	TKN 1.83 0.75	0.400	TSS 142 0.75	VSS 39 0.75	dimensionless
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	114 0.75	NO2+3 0.76 0.75	TKN 1.83 0.75	0.400	TSS 142 0.75	VSS 39 0.75	dimensionless
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	2n 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120	0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	2n 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120	0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	2n 0.329 0.75 120 0.41	TOC 25 0.75 120 31.25	COD 114 0.75 120 142.50	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120 2.29	0.400 0.75 120 0.50	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	2n 0.329 0.75 120 0.41	TOC 25 0.75 120 31.25	COD 114 0.75 120 142.50	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120 2.29	0.400 0.75 120 0.50	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019

Area: East Study Area- Southern Region to Butternut Creek

Table 11. Worksheet C - Stream impact analysis

1 Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	32.68	ratio	·	paora	naryon	-					
2 Compute the event frequency for a 3 year recurrence interval												
a Enter the average number of storms per year												
{ from Worksheet A - Item 2i)	NST	120	number									
b Compute the probability (%) of. the 3 year event												
= 100 *(1 /(NST * 3))	PR	0.28	%									
3 Enter value from table 7			-									
for MQS/MQR and frequency PR	CU	1.270	mg/1									
4 Select pollutant for analysis		Н	eavy Meta	ıls	Oxygen	Demand		Nutrients		Partic	ulates	name
		Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
a Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
c Acute Criteria Value (table 4)	СТА	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d Threshold effects level (table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4 Compute the once in 3 <i>year</i> stream pollutant concentration												
= CU * TCR * FSOL	CO	0.027	0.051	0.167								mg/1
5 Compare with target concentration, CTA												
= CO / CTA	CRAT	1.31	0.49	0.45								ratio
6 Evaluate results												
a If CRAT is less than about 0.75		STOP										
A toxicity problem attributable to this pollutant is unlikely			•									
b If CRAT is greater than 5 reduction will definitely be required Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both		CONTROL	-									
c If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects level		EVALUATE										
=CO/CTT	CRTE	0.61	ratio									

A further refinement in the analysis can be made using the procedure described in Appendix B. Changes will usually be nominal, based on refined local estimates of variability of flows.



PROJECT: I-81 VIADUCT PROJECT

AREA: EAST STUDY AREA - SOUTHERN SECTION ALTERNATIVE: COMMUNITY GRID ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff 19.2 inches

K = 8.37

Drainage Area #	Drainage Area (sq.mi.)	Lane Miles, M	Salt Applied Rate, T (Ton/lane mile)	Annual Average Concentration, C (ppm)	Discharge Location
C-South	68.9	12	25	1.90	Butternut Creek



c target concentration is 10 micrograms/liter

FHWA POLLUTANT LOADINGS ANALYSIS

Project: I-81 VIADUCT PROJECT

Project Number: 20433 Alternate: No Build Alternatives Date: 12/03/2019 Area: North Study Area

Table 9. Worksheet A - Site characteristics

1 Drainage Area of Highway Segment (section 2.1)												
a Total right of way (Analysis area)	AROW	233.6	acres									
b Paved surface	AHWY	54.6	acres									
c Percent Impervious(= 100 * AHWY/AROW)	IMP	23.4	%									
2 Rainfall Characteristics (from section 2.2)	MEAN											
Zone 1; Initial estimates from Figure 2.												
a Volume	MVP	0.26	inch									
b Intensity	MIP	0.051	inch / ho	ur								
c Duration	MDP	5.80	hour									
d Interval	MTP	73.00	hour									
COE	F of VARIATIO	N										
e Volume	CVVP	1.46	dimensio	nless								
f Intensity	CVIP	1.30	dimension	nless								
g Duration	CVDP	1.05	dimension	nless								
h Interval	CVTP	1.07	dimension	nless								
i Number of storms per year (24*365 / MTP)	NST	120	no. even	ts								
3 Surrounding Area Type												
a ADT over 30,000 vehicles/day, urbanized area		URBAN	П									
or		•	Ш									
b ADT under 30,000 vpd, undeveloped to low density suburb	an	RURAL	П									
, , , ,			leavy Meta	le	Ovvden	Demand	I	Nutrients		Partic	ılates	7
4 Select pollutant for analysis FHWA Volume I (section 2.4)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	1
and	Hame	Ou	1.0	211	100	OOD	110213	11014	1041	100	700]
estimate runoff quality characteristics (use table 3)												
a site median concentration	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b coef of variation (0.71 Urban : 0.84 Rural : 0.75 Estimate)	CVCR	0.75	dimensio	nless						l		1 0
5 Select receiving water target concentration (section 2.6)												
surface water Total Hardness (figure 4)	TH	120	120	120	120	120	120	120	120	120	120	mg/1
STREAM -use table 4 for target concentrations	111	120	120	120	120	120	120	120	120	120	120	ilig/ i
a EPA Acute Criterion	СТА	0.021	0.103	0.374								T ma/1
b suggested Threshold Effect Level	CTA	0.021	0.103	0.785								mg/1 mg/1
or	011	0.043	0.430	0.703								J IIIg/I
LAKE - use accepted level for average Phosphorus concentra	··											

μg/1



Project: I-81 VIADUCT PROJECT Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019 Area: North Study Area

6 Watershed Drainage Area	ATOT	5.3	square miles
upstream of highway for a stream - total contributing	area for a lake	'	
7 Average annual stream flow (section 2.3)			
a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
c Average stream flow (QSM * ATOT)	MQS	9.04	CFS



Project: I-81 VIADUCT PROJECT

a ratio of average stream flow (Worksheet A - 7b) to MQR

Project Number: 20433 Alternate: No Build Alternatives Date: 12/03/2019 Area: North Study Area

Table 10. Worksheet B - Highway runoff characteristics

1	Compute runoff coefficient (Rv) (see section 3.1)												
а	Percent Impervious (Worksheet A - Item 1c)	IMP	23.4	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.26	ratio									
2	Compute runoff flow rates (section 3.1)												
	flow rate from mean storm												
u	= Rv * MIP * AROW * (3630 / 3600)	MQR	3.167	CFS									
b	,												
	= CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimen	sionless								
3	Compute runoff volumes (section 3.1)												
	Volume from the mean storm												
а	= Rv * MVP * AROW * 3630	MVR	58119.2	cubic	foot								
		IVIVIX	30113.2	Cubic	ieei								
b	coefficient of variation of runoff volumes		į .	•									
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
								1			ı		
												ulotoo	
				eavy Meta		Oxygen			Nutrients		Partic		
4	Compute mass Loads (section 3.2)	name	Cu	eavy Meta Pb	ıls Zn	Oxygen TOC	COD	NO2+3	TKN	PO4-P	Partic TSS	VSS	
4	Compute mass Loads (section 3.2) Site Median Conc (Worksheet A - Item 4a)	name TCR		· ·									mg/1
4	, , ,		Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	mg/1 dimensionless
4	Site Median Conc (Worksheet A - Item 4a)	TCR	Cu 0.054	Pb 0.400	Zn 0.329	TOC 25	COD 114	NO2+3 0.76	TKN 1.83	PO4-P 0.400	TSS 142	VSS 39	•
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75	NO2+3 0.76 0.75	TKN 1.83 0.75	PO4-P 0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75	NO2+3 0.76 0.75	TKN 1.83 0.75	PO4-P 0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i)	TCR CVCR	Cu 0.054 0.75	Pb 0.400 0.75	Zn 0.329 0.75	TOC 25 0.75	COD 114 0.75	NO2+3 0.76 0.75	TKN 1.83 0.75	PO4-P 0.400 0.75	TSS 142 0.75	VSS 39 0.75	dimensionless
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	NO2+3 0.76 0.75 120	1.83 0.75 120	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
a	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120	COD 114 0.75 120	NO2+3 0.76 0.75 120	1.83 0.75 120	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120	dimensionless number
a b	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120 31.25	COD 114 0.75 120	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120 2.29	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1
a b	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245)	TCR CVCR NST	Cu 0.054 0.75 120	Pb 0.400 0.75 120	Zn 0.329 0.75 120	TOC 25 0.75 120 31.25	COD 114 0.75 120	NO2+3 0.76 0.75 120	TKN 1.83 0.75 120 2.29	PO4-P 0.400 0.75 120	TSS 142 0.75 120	VSS 39 0.75 120 48.75	dimensionless number mg/1
a b c	Site Median Conc (Worksheet A - Item 4a) Coef of var. of site EMC's (Worksheet A - 4b) Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245) annual mass load from runoff	TCR CVCR NST MCR M(MASS)	Cu 0.054 0.75 120 0.07	Pb 0.400 0.75 120 0.50	Zn 0.329 0.75 120 0.41	TOC 25 0.75 120 31.25	COD 114 0.75 120 142.50	NO2+3 0.76 0.75 120 0.95	TKN 1.83 0.75 120 2.29 8.30	PO4-P 0.400 0.75 120 0.50	TSS 142 0.75 120 177.50	VSS 39 0.75 120 48.75	dimensionless number mg/1 pounds

MQS/MQR

2.86

ratio



Changes will usually be nominal, based on refined local estimates of variability of flows.

FHWA POLLUTANT LOADINGS ANALYSIS

Project: I-81 VIADUCT PROJECT Project Number: 20433

Alternate: No Build Alternatives

Date: 12/03/2019 Area: North Study Area

Table 11. Worksheet C - Stream impact analysis

ias	,	KSIICCE O	Olic	a	Jact ai	iaryoro						
1 Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	2.86	ratio									
2 Compute the event frequency for a 3 year recurrence interval												
a Enter the average number of storms per year												
{ from Worksheet A - Item 2i)	NST	120	number									
b Compute the probability (%) of. the 3 year event												
= 100 *(1 /(NST * 3))	PR	0.28	%									
3 Enter value from table 7												
for MQS/MQR and frequency PR	CU	2.950	mg/1									
4 Select pollutant for analysis		He	eavy Meta	ls	Oxygen	Demand		Nutrients		Partic	ulates	name
		Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
a Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
c Acute Criteria Value (table 4)	СТА	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d Threshold effects level (table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4 Compute the once in 3 <i>year</i> stream pollutant concentration												
= CU * TCR * FSOL	СО	0.064	0.118	0.388								mg/1
5 Compare with target concentration, CTA												
= CO / CTA	CRAT	3.03	1.15	1.04								ratio
6 Evaluate results												
a If CRAT is less than about 0.75		STOP										
A toxicity problem attributable to this pollutant is unlikely												
b If CRAT is greater than 5 reduction will definitely be required		CONTROL										
Estimate the level of reduction possible and repeat the analysis with revised values for either concentration or flow or both												
c If CRAT is still greater than 1		EVALUATE										
and greater reduction levels are not practical												
Estimate the potential for an adverse impact (as opposed to a criteria violation) by a comparison with the threshold effects leve	l											
=CO / CTT	CRTE	1.42	ratio									
A further refinement in the analysis can be made using the procedu	re described in A	Appendix B.										



PROJECT: I-81 VIADUCT PROJECT AREA: NORTH STUDY AREA

ALTERNATIVE: NO BUILD ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff = 19.2 inches

K = 8.37

Drainage	Drainage Area	Lane Miles,	Salt Applied Rate, T	Annual Average Concentration, C	Discharge Location
Area #	(sq.mi.)	М	(Ton/lane mile)	(ppm)	
D	5.32	10.3	25	21.10	Mud Creek



Date: 12/03/2019

Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Table 9. Worksheet A - Site characteristics

Area: North Study Area

1 Drainage Area of Highway Segment (sec	,												
a Total right of way (Analysis area)		AROW	233.6	acres									
b Paved surface		AHWY	59.2	acres									
c Percent Impervious(= 100 * AHWY/A	ROW) I	MP	25.3	%									
2 Rainfall Characteristics (from section 2.2	•	MEAN											
Zone 1; Initial estimates from Figure 2	2.												
a Volume	Ī	MVP	0.26	inch									
b Intensity	ſ	MIP	0.051	inch / ho	our								
c Duration	ſ	MDP	5.80	hour									
d Interval	ſ	MTP	73.00	hour									
	COEF	of VARIATION	N										
e Volume		CVVP	1.46	dimension	onless								
f Intensity	(CVIP	1.30	dimension	onless								
g Duration	(CVDP	1.05	dimension	onless								
h Interval	(CVTP	1.07	dimension	onless								
i Number of storms per year (24*365 /	MTP)	NST	120	no. even	its								
3 Surrounding Area Type													
a ADT over 30,000 vehicles/day, urbani	zed area		URBAN	П									
or				ш									
b ADT under 30,000 vpd, undeveloped	to low density suburban	1	RURAL										
			Н	eavy Meta	ls	Oxygen	Demand		Nutrients		Partic	ulates	Ţ
4 Select pollutant for analysis FHWA Volum	me I (section 2.4)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	<u> </u>
and													
estimate runoff quality characteristics (us													_
a site median concentration		TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg
b coef of variation (0.71 Urban : 0.84 R	Rural: 0.75 Estimate) (CVCR	0.75	dimension	onless								
5 Select receiving water target concentration	on (section 2.6)												
surface water Total Hardness (figure	4)	ГН	120	120	120	120	120	120	120	120	120	120	mg
STREAM -use table 4 for target conce	ntrations				1		1			l.			
a EPA Acute Criterion	(CTA	0.021	0.103	0.374								mg
b suggested Threshold Effect Level		CTT	0.045	0.450	0.785								mg
or					1	1	ı	ı		1			
LAKE - use accepted level for average P	hosphorus concentratio	n											
c target concentration is 10 micrograms	•		10	μg/1									
J			- 1	1 - 3 '									



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019 Area: North Study Area

6	Watershed Drainage Area	ATOT	5.3	square miles
	upstream of highway for a stream - total contributing are	a for a lake		
7	Average annual stream flow (section 2.3)			
	a unit area flow rate per square mile (figure 3)	QSM	1.70	CFS/square mile
	b Coef of variation of stream flows(section 2.3)	CVQS	1.10	dimensionless
	c Average stream flow (QSM * ATOT)	MQS	9.04	CFS



Project: I-81 VIADUCT PROJECT

Project Number: 20433

Alternate: Community Grid Alternative

a ratio of average stream flow (Worksheet A - 7b) to MQR

MQS/MQR

2.71

ratio

FHWA POLLUTANT LOADINGS ANALYSIS

Date: 12/03/2019 Area: North Study Area

Table 10. Worksheet B - Highway runoff characteristics

	Compute runoff coefficient (Rv) (see section 3.1)												
а	Percent Impervious (Worksheet A - Item 1c)	IMP	25.3	%									
b	Runoff Coefficient (= 0.007 * IMP + 0.1)	Rv	0.28	ratio									
				•									
•	Occupate was # flow astes (see fig. 0.4)												
	Compute runoff flow rates (section 3.1) flow rate from mean storm												
а	= Rv * MIP * AROW * (3630 / 3600)	MQR	3.332	CFS									
h	o coefficient of variation of runoff flows	MAIN	3.332	013									
D	= CVIP (Worksheet A - Item 2f)	CVOR	1.30	dimen	sionless								
	(0.0											
3	Compute runoff volumes (section 3.1)												
а	Volume from the mean storm												
	= Rv * MVP * AROW * 3630	MVR	61158.2	cubic	feet								
b	coefficient of variation of runoff volumes												
	= CVVP (Worksheet A - Item 2e)	CVVR	1.46	dimen	sionless								
			Н	eavy Meta	ıls		Demand		Nutrients		Partic	ulates	
4	Compute mass Loads (section 3.2)	name	Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
	Site Median Conc (Worksheet A - Item 4a)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	dimensionless
				00			0.70	00	00	00			airriorioriorii
	Number of storms per year (Worksheet A - 2i)	NST	120	120	120	120	120	120	120	120	120	120	number
	,											120	
a	,											120	
а	Number of storms per year (Worksheet A - 2i)											120 48.75	
	Number of storms per year (Worksheet A - 2i) mean event concentration (MCR)	NST	120	120	120	120	120	120	120	120	120		number
	Number of storms per year (Worksheet A - 2i) a mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2)	NST	120	120	120	120	120	120	120	120	120		number
b	Number of storms per year (Worksheet A - 2i) a mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load	NST	0.07	0.50	0.41	120 31.25	120	0.95	2.29	0.50	120	48.75	number mg/1
b	Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245)	NST	0.07	0.50	0.41	120 31.25	120	0.95	2.29	0.50	120	48.75	number mg/1
b	Number of storms per year (Worksheet A - 2i) mean event concentration (MCR) = TCR * SQRT(1 + CVCR^2) mean event mass load = MCR * MVR * (0.00006245) annual mass load from runoff	MCR M(MASS)	0.07	0.50	0.41 1.57	31.25 119.35	120 142.50 544.25	0.95	2.29 8.74	0.50	120 177.50 677.93	48.75 186.19	number mg/1 pounds



Project: I-81 VIADUCT PROJECT Project Number: 20433

Alternate: Community Grid Alternative

Date: 12/03/2019 Area: North Study Area

Table 11. Worksheet C - Stream impact analysis

Table 11. Worksheet C - Stream impact analysis												
1 Define the flow ratio MQS/MQR (Worksheet B - 5a)	MQS/MQR	2.71	ratio									
2 Compute the event frequency for a 3 year recurrence in	nterval											
a Enter the average number of storms per year												
{ from Worksheet A - Item 2i)	NST	120	number									
b Compute the probability (%) of. the 3 year event		<u> </u>										
= 100 *(1 /(NST * 3))	PR	0.28	%									
3 Enter value from table 7												
for MQS/MQR and frequency PR	CU	2.977	mg/1									
4 Select pollutant for analysis		H	eavy Meta	als	Oxygen	Demand		Nutrients		Partic	ulates	name
		Cu	Pb	Zn	TOC	COD	NO2+3	TKN	PO4-P	TSS	VSS	
a Site median concentration (table 3)	TCR	0.054	0.400	0.329	25	114	0.76	1.83	0.400	142	39	mg/1
b Soluble fraction (section 2.5)	FSOL	0.400	0.100	0.400								fraction
c Acute Criteria Value (table 4)	CTA	0.021	0.103	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
d Threshold effects level (table 4)	CTT	0.045	0.450	0.785	0.000	0.000	0.000	0.000	0.000	0.000	0.000	mg/1
4 Compute the once in 3 <i>year</i> stream pollutant concentr	ation											
= CU * TCR * FSOL	СО	0.064	0.119	0.392								mg/1
5 Compare with target concentration, CTA												
= CO / CTA	CRAT	3.06	1.16	1.05								ratio
6 Evaluate results												
a If CRAT is less than about 0.75		STOP										
A toxicity problem attributable to this pollutant is unlikely	ly	<u> </u>										
b If CRAT is greater than 5 reduction will definitely be re- Estimate the level of reduction possible and repeat the with revised values for either concentration or flow or b	analysis	CONTROL										
c If CRAT is still greater than 1 and greater reduction levels are not practical Estimate the potential for an adverse impact (as oppose criteria violation) by a comparison with the threshold ef		EVALUATE										
=CO/CTT	CRTE	1.43	ratio									

A further refinement in the analysis can be made using the procedure described in Appendix B.

Changes will usually be nominal, based on refined local estimates of variability of flows.



PROJECT: I-81 VIADUCT PROJECT AREA: NORTH STUDY AREA

ALTERNATIVE: COMMUNITY GRID ALTERNATIVE

Constituent evaluation = Chloride

Mean Annual Runoff = $\frac{19.2}{K}$ inches

Drainage	Drainage Area	Lane Miles,	Salt Applied Rate, T	Annual Average Concentration, C	Discharge Location
Area #	(sq.mi.)	M	(Ton/lane mile)	(ppm)	
D	5.32	13.1	25	26.84	Mud Creek