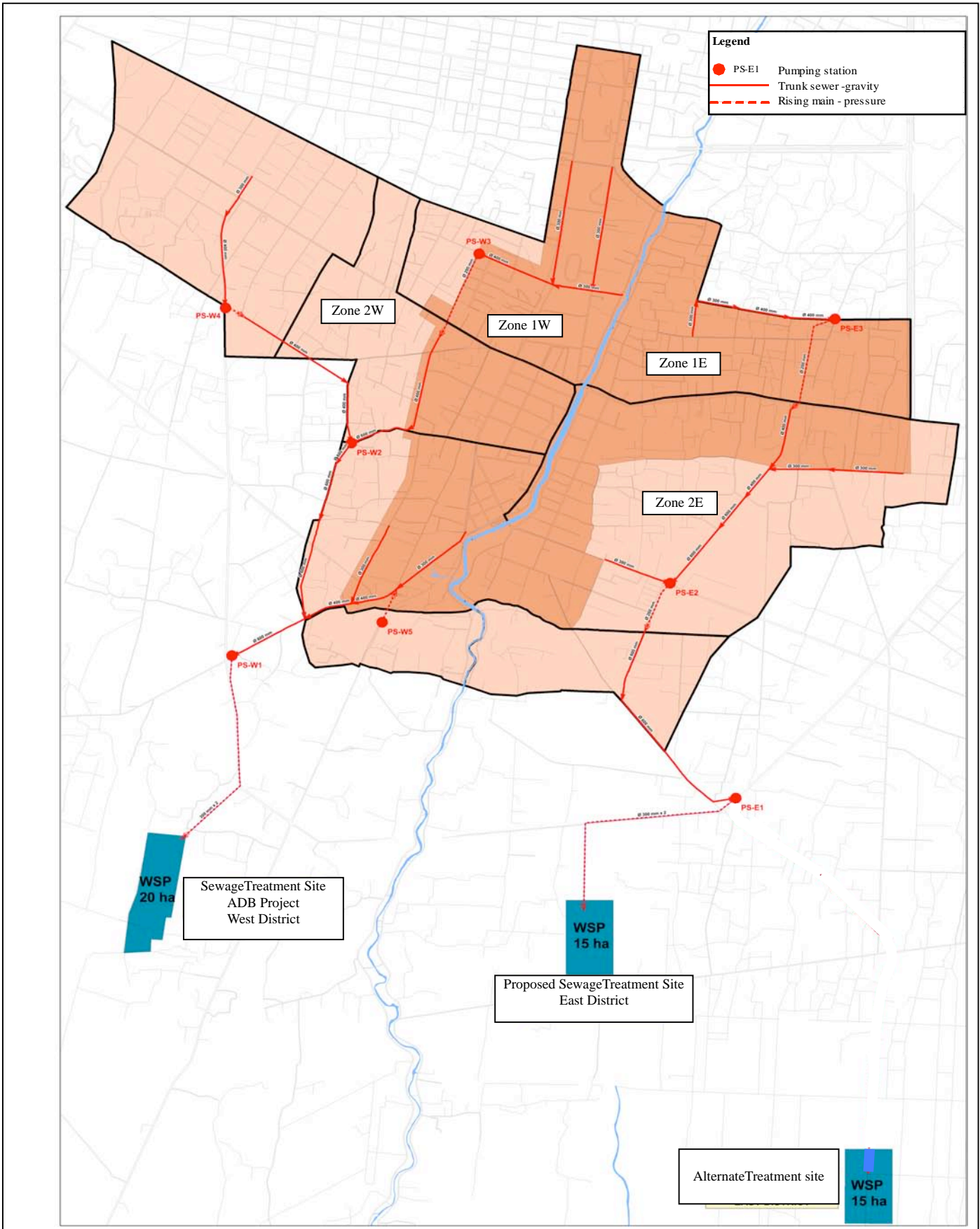


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Figure 7
Proposed Wastewater Management
Zones



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Figure 8
Proposed Wastewater System Layout

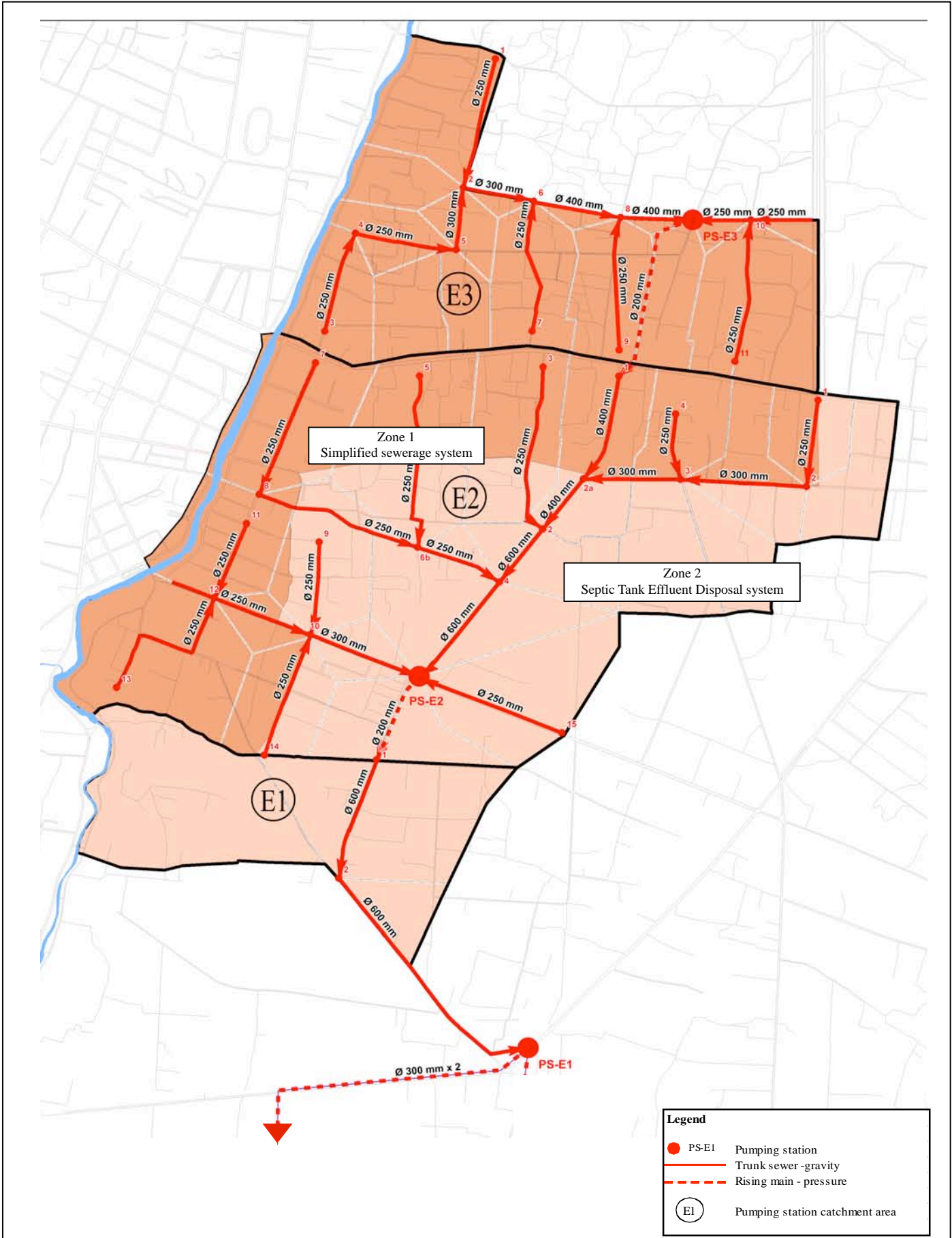


Figure 9
Proposed Trunk Sewers and Type of
Collection System: East District

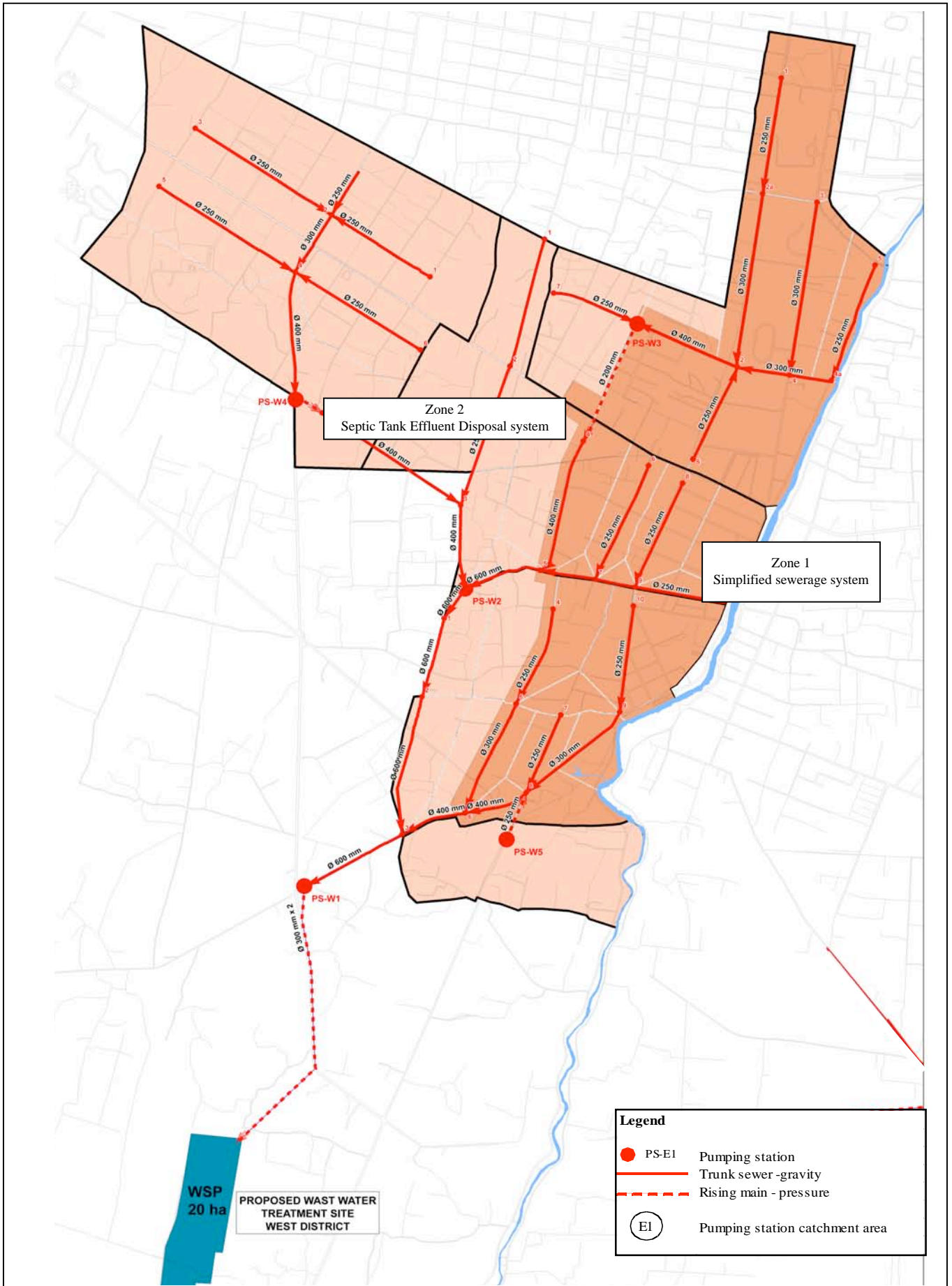


Figure 10
Proposed Trunk Sewers and Type of
Collection System: West District

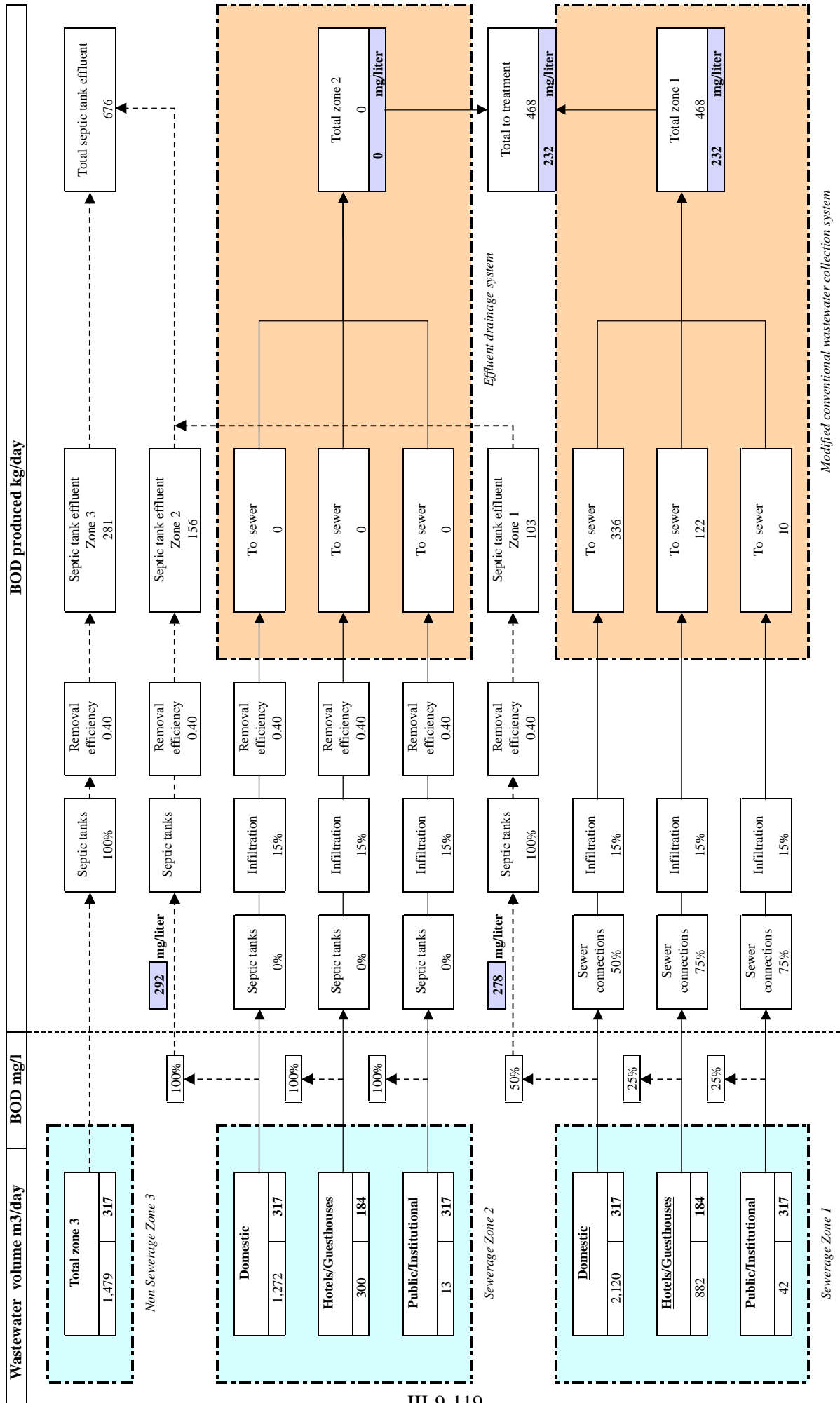


Figure 11 BOD calculations East District (peak month) 2012

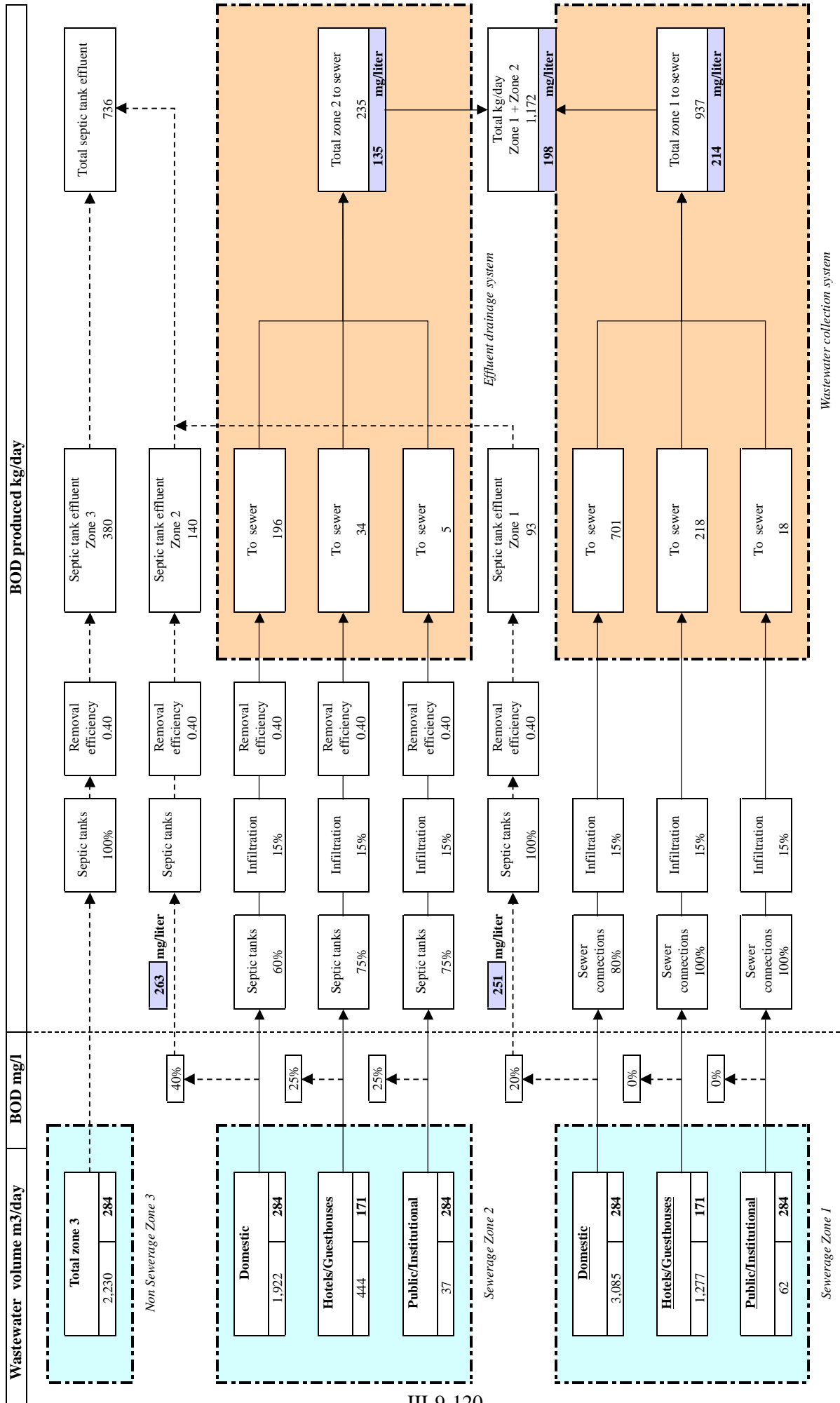


Figure 12 BOD calculations East District (peak month) 2020

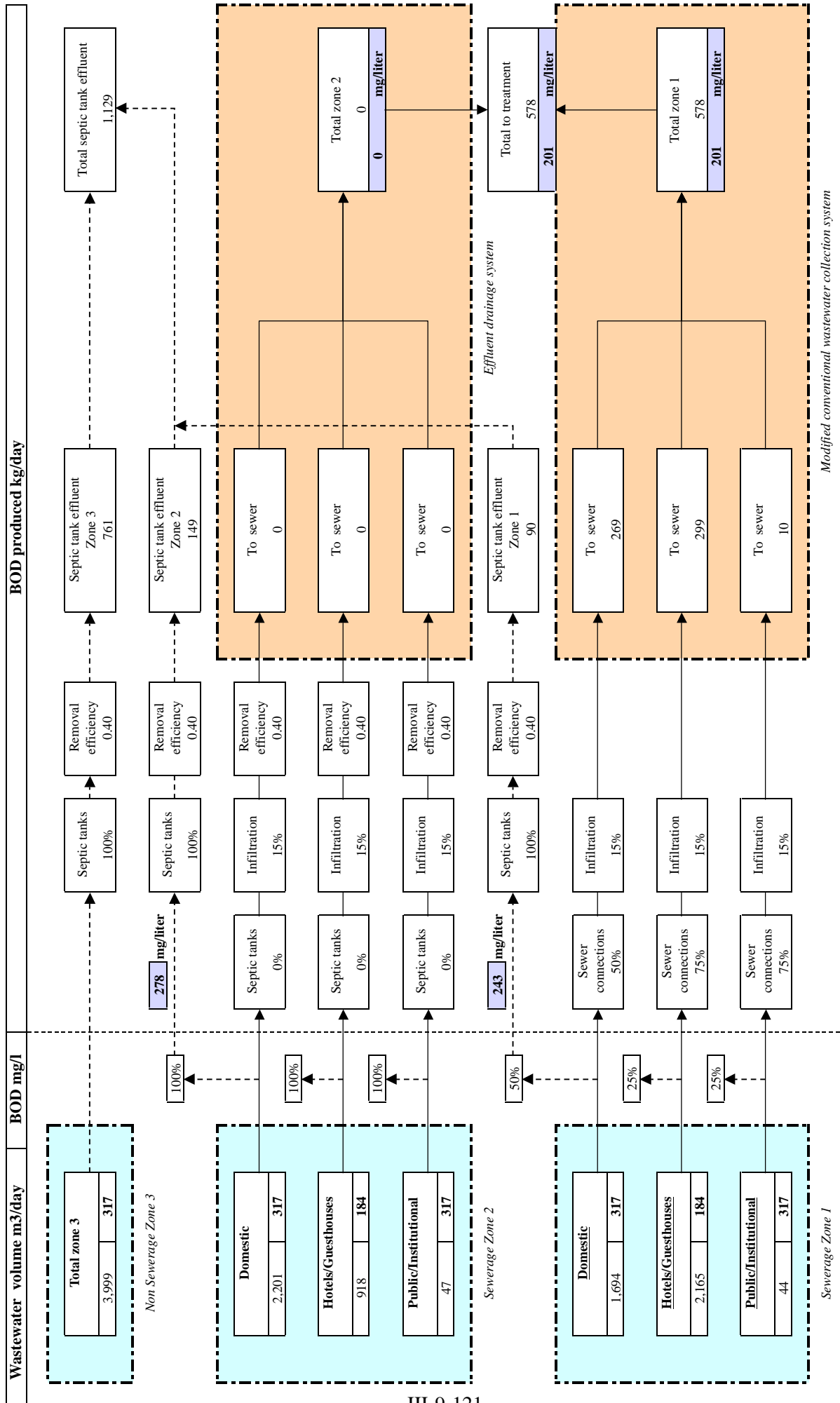


Figure 6.13 BOD Calculations West District (peak month) 2012

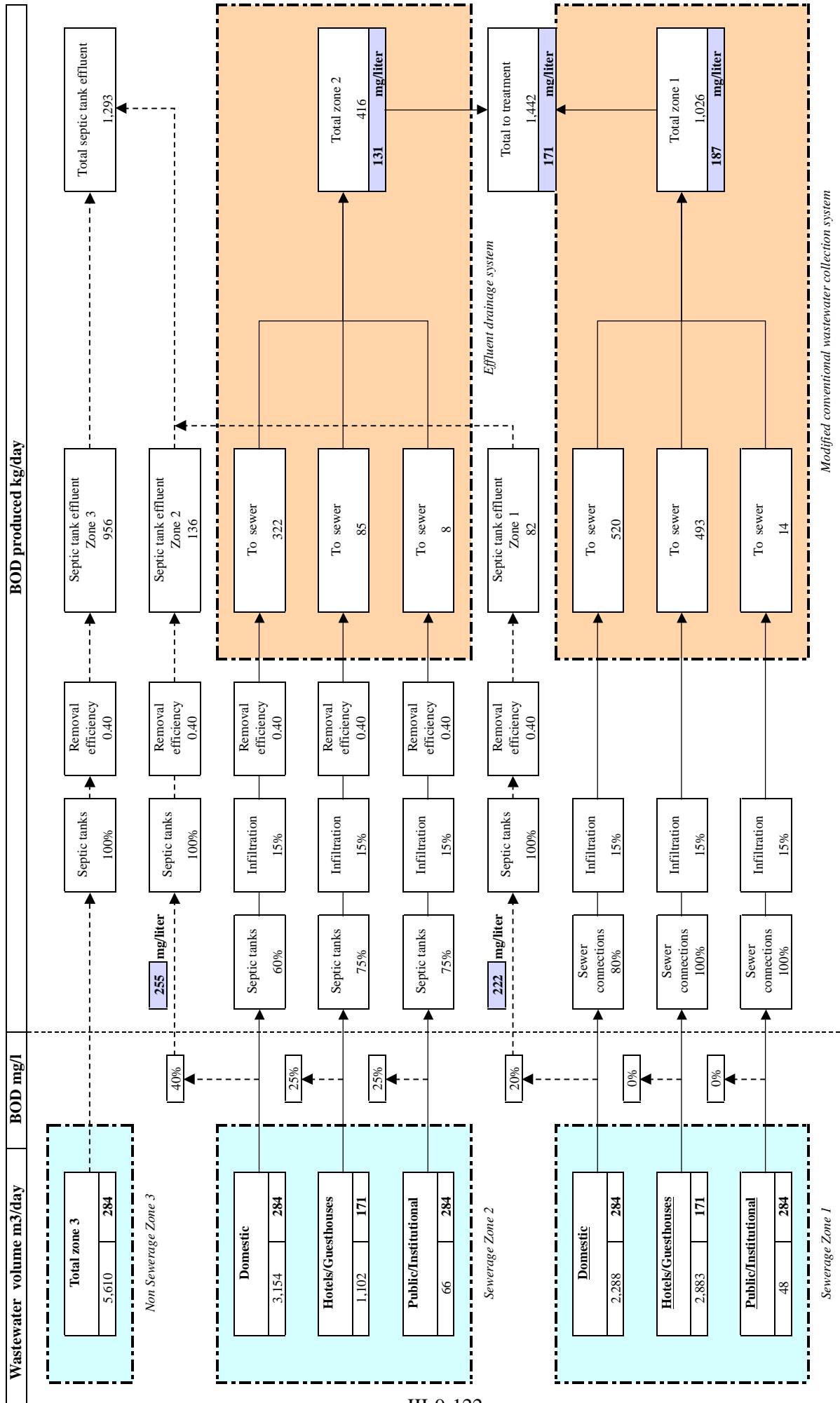


Figure 14 BOD Calculations West District (peak month) 2020

Customer Category	Estimated No. of Customers	Proposed Fixed Fee Rates	Estimated Billings
Residential			
Low Income (32%)	1,013	1,100	1,114,000
Middle Income (60%)	1,899	7,100	13,481,000
High Income (8%)	253	33,100	8,379,000
Subtotal Residential	3,164		22,974,000
Hotels, Guesthouses & Restaurants			
Hotels 1 to 20 Rooms (Cat. 1)	5	77,000	396,000
Hotels 21 to 40 Rooms (Cat. 2)	10	102,000	1,049,000
Hotels 41 to 60 Rooms (Cat. 3)	7	152,000	1,094,000
Hotels 61 to 100 Rooms (Cat. 4)	5	329,000	1,691,000
Hotels 100+ Rooms and Over (Cat. 5)	10	594,000	6,106,000
Subtotal Hotels	38		10,336,000
Guesthouse 1 to 7 Rooms (Cat. 1)	10	16,000	166,000
Guesthouse 8 to 15 Rooms (Cat. 2)	51	28,000	1,426,000
Guesthouse 16 and over Rooms (Cat. 3)	27	61,000	1,648,000
Subtotal Guesthouses	88		3,240,000
Restaurants 1 to 40 Seats (Cat. 1)	3	22,000	74,000
Restaurants 41 to 100 Seats (Cat. 2)	42	36,000	1,527,000
Restaurants 101 and over Seats (Cat. 3)	7	114,000	763,000
Subtotal Restaurants	52		2,364,000
Other			
Warehouse/Car Park	8	34,000	279,000
Gas Stations/Garages	6	57,000	351,000
Nightclubs, Karaoke	18	33,000	609,000
Government Buildings	8	25,000	205,000
Wats, Churches	7	11,000	79,000
Schools	12	31,000	382,000
Hospitals, Clinics	8	47,000	386,000
Factory	1	48,000	49,000
Car/ Moto Wash	15	58,000	893,000
Banks	8	53,000	435,000
NGO/ Company Office	3	41,000	126,000
Souvenir Shop	97	19,000	1,852,000
Snooker	3	19,000	58,000
Other Public Center	1	121,000	124,000
Other Small Commercial Businesses	357	5,000	1,785,000
Market Areas (1,201stalls)*	4	384,000	1,576,000
Public Latrine Area**	3	5,000	15,000
Septage Charges	1	4,305,000	4,305,000
Subtotal Other	563		13,509,000
Total	3,906		52,423,000
Total Converted to \$ @ 4,100 KHR			\$ 13,000
Provision for Bad Debts 10%			\$ 12,000
Annual Income			\$ 144,000
Cost Recovery Requirement			\$134,000

* 1,201 stalls in total of Kandal Market (140stalls), Old Market (363stall), Nhe Market (103stalls), and Kroum Market (595stalls)

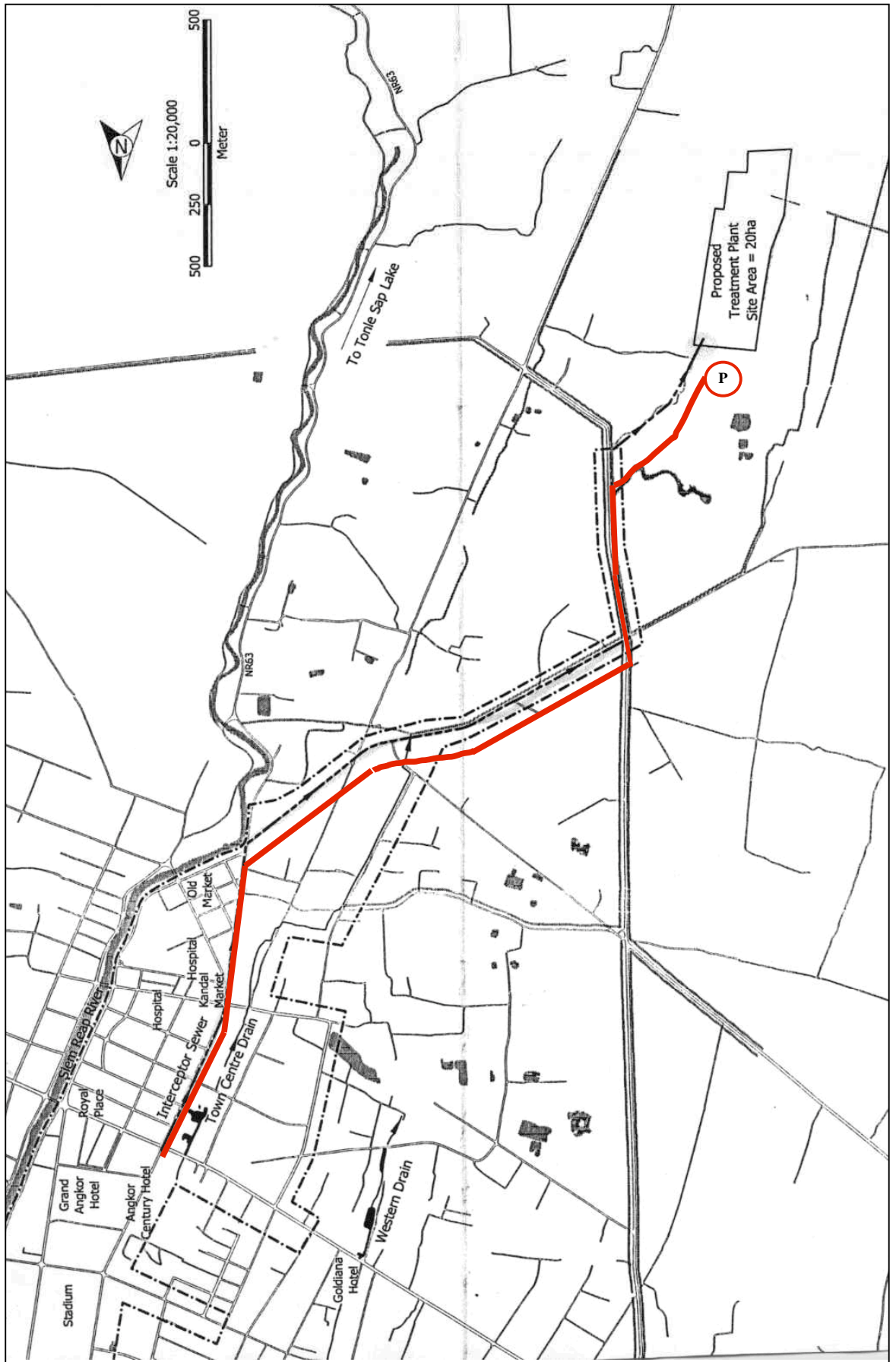
** 3 public latrines servicing 50 HH each

Customer Category	Charge Per Cleaning	Estimates Per Month Potential	Potential Income		Assume 70% Efficiency	Projected Annual Income
			Per Month	Per Year		
CAT. I (Residential)	\$ 25	43	\$ 1,075	\$ 12,900	70%	\$ 9,030
CAT. II (Cat. 1&2 of Hotels, Restaurants, Guesthouses)	\$ 45	5	\$ 225	\$ 2,700	70%	\$ 1,890
CAT. III (Cat. 3, 4&5 of Hotels, Restaurants, Guesthouses)	\$ 100	2	\$ 200	\$ 2,400	70%	\$ 1,680
Total Septage Charges		50	1,500	18,000		\$ 12,600

Source: ADB Mekong Tourism Development Project, Siem Reap Wastewater

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Figure 15
Sewer User Fees Proposed by ADB
Study



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**Figure 16
Proposed Interceptor Sewer (ADB):
Location plan**

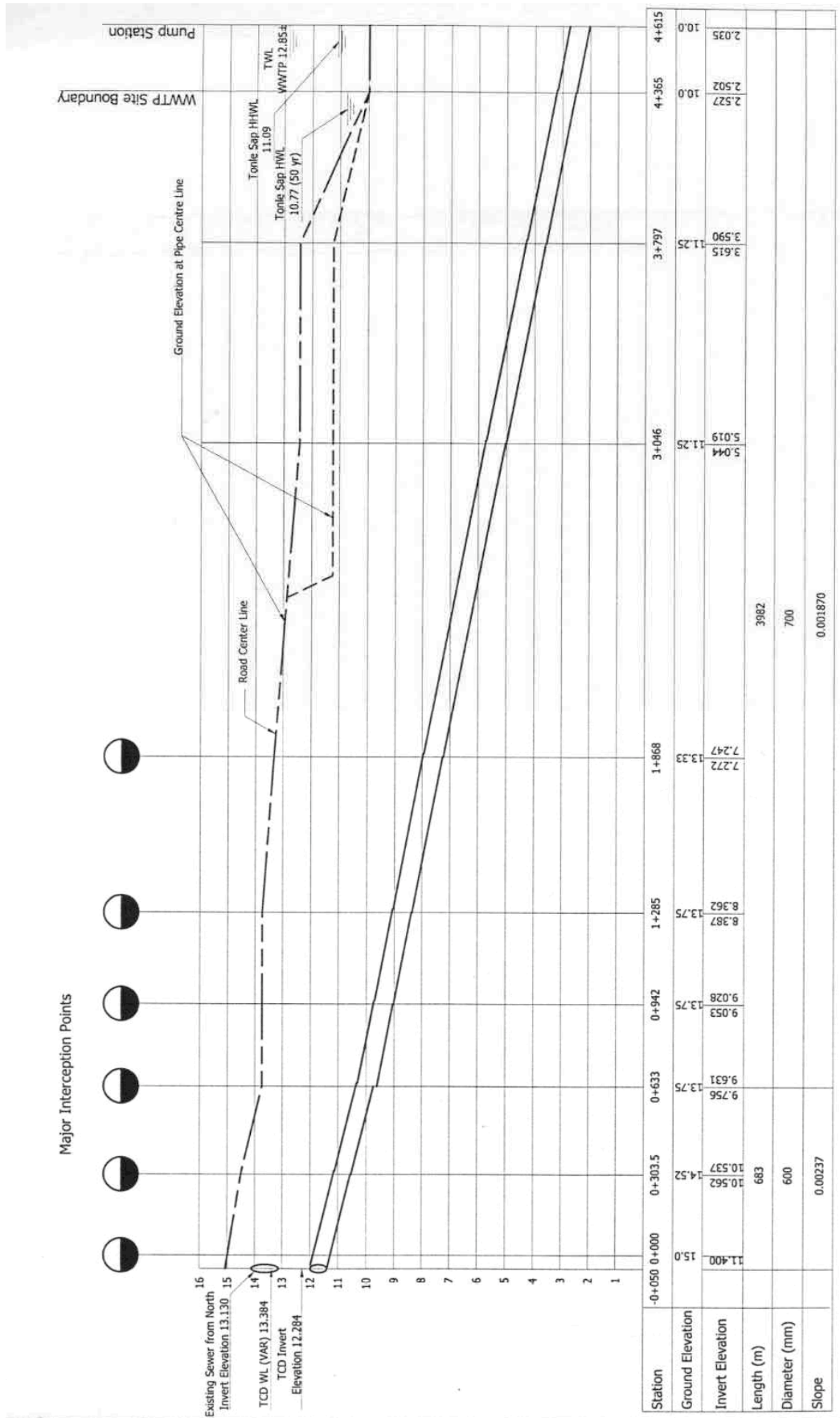
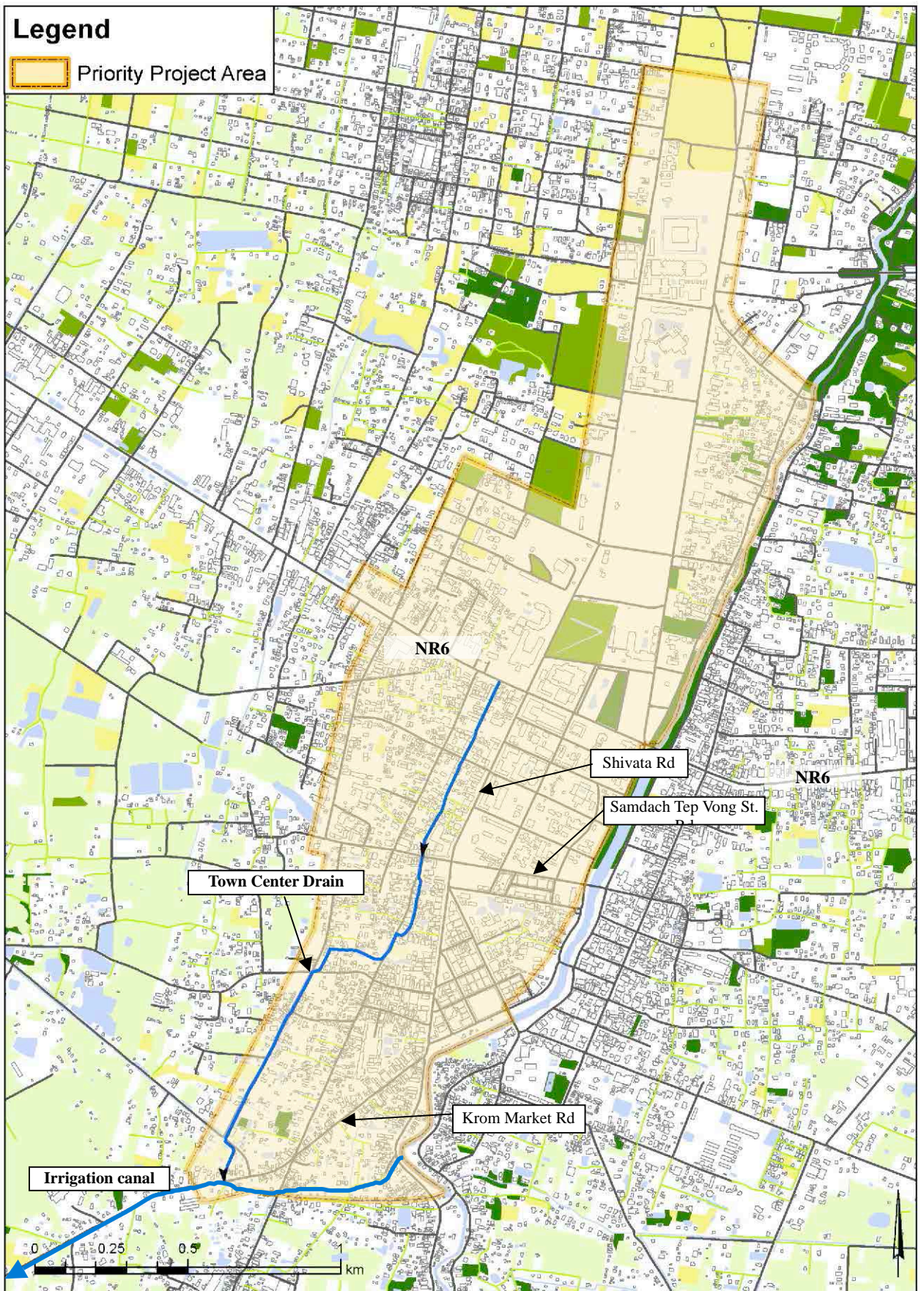


Figure 3.2.1
 Interceptor Sewer
 Preliminary Longitudinal Profile

Scale
 V 1:200
 H 1:20000



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Figure 18
Priority Project SD-3: Target Area

Table 1 - Rainfall intensity duration frequency

a	8949	7324	5220	3490
b	-0.98	-0.97	-0.95	-0.95
t0	29.51	28.20	25.39	25.39

Intensity	T10 (mm/hr)	T5 (mm/hr)	T2 (mm/hr)	T1 (mm/hr)
t (hours)	$i=8949x (t+29.51)^{-0.98}$	$i=7324x (t+28.20)^{-0.97}$	$i=5220x (t+25.39)^{-0.95}$	$i=3490x (t+25.39)^{-0.95}$
0.5	163.2	142.2	115.2	77.0
1	109.4	95.0	76.4	51.0
2	66.2	57.4	46.1	30.8
3	47.5	41.3	33.2	22.2
4	37.1	32.3	26.0	17.4
5	30.5	26.6	21.4	14.3
6	25.9	22.6	18.2	12.2
12	13.6	11.9	9.7	6.5
24	7.0	6.2	5.1	3.4

in the rainfall intensity formula "t " is in minutes

Duration t (hours)	Rainfall depth			
	T10 (mm)	T5 (mm)	T2 (mm)	T1 (mm)
0.5	81.6	71.1	57.6	38.5
1	109.4	95.0	76.4	51.0
2	132.3	114.8	92.1	61.6
3	142.6	123.9	99.5	66.5
4	148.5	129.2	104.0	69.5
5	152.5	132.8	107.1	71.6
6	155.3	135.4	109.5	73.2
12	163.6	143.3	117.0	78.2
24	169.1	149.0	123.1	82.3

$R(\text{mm})= i(\text{mm/hr}) \times t$

Caractéristiques principales des voies, des chenaux et des ouvrages

Objet : Etude Hydraulique & Programme de Travaux Prioritaire

n°	désignation	longueur	largeur de voie	type de voie	nombre de chenaux	largeur en fond chenaux	profondeur des chenaux	ouvrages sur chenaux tous les	volumes stockés en m3	h stock aval en m	ouvrages spécifiques ou remarques
n°1	VT01.A	3 200	5,00 m	asphaltée	2	3,00 m	1,00 m	250 ml	29 120 m3	0,90 m	
n°2	VP02.A	1 700	7,00 m	asphaltée	2	3,50 m	1,50 m	500 ml	14 620 m3	0,90 m	
n°3	VP03.A	2 450	7,00 m	asphaltée	1	3,50 m	1,50 m	500 ml	14 945 m3	0,90 m	
n°4	VS04.L	1 800	6,00 m	latérite	2	3,00 m	1,00 m	100 ml	22 320 m3	1,40 m	
n°5	VS05.L	450	6,00 m	latérite	2	3,00 m	1,00 m	250 ml	4 095 m3	0,90 m	
n°6	VS06.L	400	6,00 m	latérite	1	3,00 m	1,50 m				
n°7	VS07.L	1 450	6,00 m	latérite	1	3,00 m	1,50 m				
n°8	VS08.L	2 350	6,00 m	latérite	2	3,50 m	1,00 m	100 ml	24 440 m3	0,90 m	
n°9	VS09.L	1 000	6,00 m	latérite	2	1,00 m	1,00 m	500 ml	4 600 m3	0,90 m	
n°10	VS10.L	1 450	6,00 m	latérite							voir C10
n°11	VT11.L	400	5,00 m	latérite	1	0,50 m	0,50 m				
n°12	VT12.L	400	5,00 m	latérite	1	0,50 m	0,50 m				
n°13	VT13.L	550	5,00 m	latérite	2	1,00 m	1,00 m	500 ml	2 530 m3	0,90 m	
n°14	VT14.L	800	5,00 m	latérite	1	3,00 m	1,50 m	100 ml	5 120 m3	0,90 m	
n°15	VT15.L	850	5,00 m	latérite	2	2,00 m	1,00 m	250 ml	6 035 m3	0,90 m	
n°16	VT16.L	950	5,00 m	latérite	2	2,00 m	1,00 m	250 ml	6 745 m3	0,90 m	
n°17	VT17.L	1 200	5,00 m	latérite	2	2,00 m	1,00 m	100 ml	8 880 m3	0,90 m	
n°18	VT18.L	1 300	5,00 m	latérite	2	2,00 m	1,00 m	100 ml	9 620 m3	0,90 m	
n°19	VT19.L	450	5,00 m	latérite	2	1,00 m	1,00 m	100 ml	2 430 m3	0,90 m	
n°20	C10	1 850			1	8,00 m	2,00 m	500 ml			chenal primaire
n°21	C20	1 500			1	3,00 m	1,50 m	250 ml			chenal primaire
n°22	C21	3 800			1	3,50 m	2,00 m	1 000 ml			chenal primaire
n°23	D7	30									C2.50m x 1.50m
n°24	D2	30									2 x D1200mm
n°25	D10	30									C5.70m x 2.40m
pm	CT1	1 600									pour mémoire
pm	CT2	3 400									pour mémoire
TOTAL									126 380 m3		

volume total de stockage dynamique linéaire en zone urbaine (hors VT01.A) ---> 126 380 m3

h stock aval désigne la hauteur d'eau en aval du compartiment de stockage dynamique linéaire
 le volume de stockage dynamique linéaire est calculé sur la base d'une pente de 0,1%
 C2.50m x 1.50m désigne un dalot de forme rectangulaire (ou cadre) de largeur totale 2,50 m et de hauteur 1,50 m ; il peut être décomposé en 2 sections homogènes
 C5.70m x 2.40m désigne un dalot de forme rectangulaire (ou cadre) de largeur totale 5,70 m et de hauteur 2,40 m ; il peut être décomposé en 2 sections homogènes

Table 3 - West Side: Volume of Storage for Runoff Control

Return period	Runoff coefficient	Unit Storage Volume	Rainfall duration
T (years)	C	Vs m ³ /ha	Dr (hours)
10	0.85	1034	4.3
5	0.8	810	3.9
2	0.75	565	3.3
1	0.6	240	2.2

Unit discharge 10.00 l/s/ha

Major catchment	Sub-catchment	Area (ha)	Runoff m ³ /s	Required Storage Capacity m ³			
				T10	T5	T2	T1
V	V.1	80	0.80	82,477	64,609	45,067	19,143
	V.2	44	0.44	45,467	35,617	24,844	10,553
	sub-total	124	1.24	127,944	100,227	69,911	29,697
VI	VI.1	29	0.29	30,097	23,577	16,446	6,986
	VI.2	15	0.15	15,754	12,341	8,608	3,657
		44	0.44	45,851	35,918	25,054	10,642
	VI.3	22	0.22	22,299	17,468	12,184	5,176
	VI.4	13	0.13	13,622	10,671	7,443	3,162
	VI.5	5	0.05	5,603	4,389	3,062	1,301
	VI.6	22	0.22	22,942	17,972	12,536	5,325
	VI.7	16	0.16	16,027	12,555	8,758	3,720
	VI.8	6	0.06	5,997	4,698	3,277	1,392
	VI.9	7	0.07	7,548	5,913	4,125	1,752
	VI.10	11	0.11	11,581	9,072	6,328	2,688
sub-total	102	1.02	105,619	82,738	57,713	24,515	
S1		421	4.21	435,314	341,010	237,865	101,040
VII north	VII.1	25	0.25	26,063	20,417	14,241	6,049
	VII.2	27	0.27	27,587	21,611	15,074	6,403
		52	0.52	53,650	42,028	29,316	12,453
VII south	VII.3	68	0.68	70,519	55,242	38,533	16,368
	VII.4	17	0.17	17,164	13,446	9,379	3,984
	VII.5	25	0.25	25,747	20,169	14,069	5,976
	VII.6	21	0.21	21,404	16,767	11,696	4,968
	VII.7	22	0.22	22,645	17,739	12,374	5,256
sub-total	152	1.52	157,478	123,363	86,050	36,552	
S2		433	4.33	447,722	350,730	244,645	103,920
VIII north	VIII.1n	53	0.53	54,802	42,930	29,945	12,720
VIII south	VIII.1s	63	0.63	65,142	51,030	35,595	15,120
	VIII.2	32	0.32	32,752	25,657	17,896	7,602
	VIII.3	34	0.34	35,601	27,888	19,453	8,263
	VIII.4	36	0.36	36,909	28,913	20,168	8,567
	VIII.5	19	0.19	19,671	15,410	10,749	4,566
	VIII.6	10	0.10	10,340	8,100	5,650	2,400
	VIII.7	124	1.24	128,216	100,440	70,060	29,760
	VIII.8	31	0.31	32,054	25,110	17,515	7,440
sub-total	349	3.49	360,684	282,548	197,086	83,718	
X	X.1	13	0.13	13,297	10,416	7,266	3,086
	X.2	15	0.15	15,375	12,044	8,401	3,569
	X.3	21	0.21	21,216	16,620	11,593	4,924
	X.4	9	0.09	9,671	7,576	5,284	2,245
	X.5	19	0.19	20,160	15,793	11,016	4,679
	sub-total	77	0.77	79,719	62,449	43,560	18,503
IX	IX.1	102	1.02	105,667	82,776	57,739	24,526
	IX.2	80	0.80	82,449	64,588	45,052	19,137
	sub-total	182	1.82	188,116	147,364	102,791	43,663
Total West		1,989		2,056,899	1,611,304	1,123,934	477,423

Table 4 - Required Conveyance Capacity of Town Center Drain

Return period T (years)	Runoff coefficient C	Unit Storage Volume Vs m3	Rainfall duration Rd hours
10	0.85	1034	4.3
5	0.8	810	3.9
2	0.75	565	3.3
1	0.6	240	2.2

Unit discharge 10.00 l/s/ha
 side slope on bank 1, Z1 (H:V) 2
 side slope on bank 2, Z2 (H:V) 2
 Manning roughness, n 0.030 earth with vegetation
 channel slope, S 0.001 m/m

Major catchment	Sub-catchment	Area (ha)	Conveyance capacity (m3/s)	Cumulative (m3/s)	Dimensions of trapezoidal channel				
					Bottom Width (m)	Top Width (m)	water depth y (m)	Flow Q (m3/s)	Velocity V (m/s)
V	V.1	80	0.80	0.80	0.30	4.30	1.00	1.49	0.65
	V.2	44	0.44	1.24	0.30	4.30	1.00	1.49	0.65
VI	VI.1	29	0.29	0.29	0.30	4.30	1.00	1.49	0.65
	VI.5	5	0.05	1.58	0.60	4.60	1.00	1.76	0.68
	VI.6	22	0.22	1.80	0.60	4.60	1.00	1.76	0.68
	VI.7	16	0.16	1.96	0.90	4.90	1.00	2.03	0.70
X	VI.8	6	0.06	2.02	0.90	4.90	1.00	2.03	0.70
	X.1	13	0.13	2.15	1.25	5.25	1.00	2.35	0.72
	X.2	15	0.15	2.29	1.25	5.25	1.00	2.35	0.72
	X.3	21	0.21	2.50	1.50	5.50	1.00	2.58	0.74

Table 5 - Required Conveyance Capacity of Western Drain

Return period T (years)	Runoff coefficient C	Unit Storage Volume Vs m3	Rainfall duration Rd hours
10	0.85	1034	4.3
5	0.8	810	3.9
2	0.75	565	3.3
1	0.6	240	2.2

Unit discharge
10 l/s/ha
2
2
0.030 earth with vegetation
0.001 m/m

side slope on bank 1, Z1 (H:V)
side slope on bank 2, Z2 (H:V)
manning roughness, n
channel slope, S

Major catchment	Sub-catchment	Area (ha)	Conveyance capacity (m3/s)	Cummulative (m3/s)	Bottom Width (m)	Top Width (m)	water depth y (m)	Flow Q (m3/s)	Velocity V (m/s)
VI									
VI.1	VI.1	29	0.29	0.29	0.30	4.30	1.00	1.49	0.65
VI.2	VI.2	15	0.15	0.44	0.30	4.30	1.00	1.49	0.65
VI									
VI.3	VI.3	22	0.22	0.37	0.30	4.30	1.00	1.49	0.65
VI.4	VI.4	13	0.13	0.42	0.30	4.30	1.00	1.49	0.65
VI.5	VI.5	5	0.05	0.05	0.30	4.30	1.00	1.49	0.65
VI.6	VI.6	22	0.22	0.22	0.30	4.30	1.00	1.49	0.65
VI.7	VI.7	16	0.16	0.16	0.30	4.30	1.00	1.49	0.65
VI.8	VI.8	6	0.06	0.49	0.60	4.60	1.00	1.76	0.68
VI.9	VI.9	7	0.07	0.98	1.25	5.25	1.00	2.35	0.72
VI.10	VI.10	11	0.11	1.46	1.75	5.75	1.00	2.82	0.75
			1.46						
VII									
VII.1	S1	421	4.21	4.21	1.50	6.50	1.25	4.18	0.84
VII.2	VII.1	25	0.25	4.46	1.75	6.75	1.25	4.51	0.85
VII.3	VII.2	27	0.27	4.73	2.00	7.00	1.25	4.86	0.86
VII									
VII.4	VII.3	68	0.68	5.41	2.50	7.50	1.25	5.55	0.89
VII.5	VII.4	17	0.17	5.58	2.50	7.50	1.25	5.55	0.89
VII.6	VII.5	25	0.25	7.29	4.00	9.00	1.25	7.67	0.94
VII.7	VII.6	21	0.21	7.50	4.00	9.00	1.25	7.67	0.94
VII.8	VII.7	22	0.22	7.72	4.00	9.00	1.25	7.67	0.94