Environmental and Social Impact Assessment (Draft)

March 2018

THA: Chonburi Power Plant Project
(Part 4 of 6)

Prepared by Gulf SRC Company Limited for the Asian Development Bank.

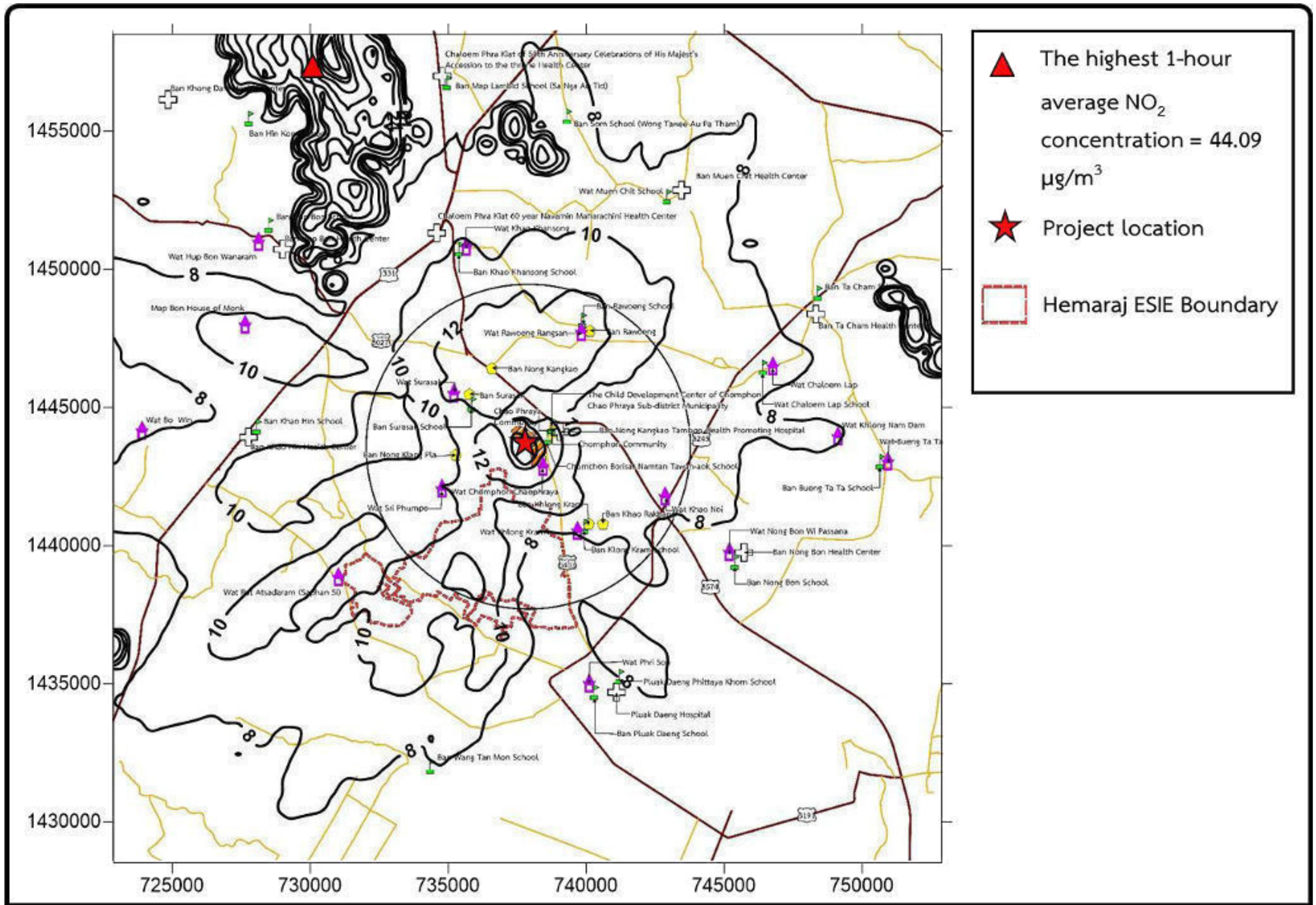

FIGURE 5.1.1.1-41 : CONTOUR MAP OF 1 HR AVERAGE NO_2 CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

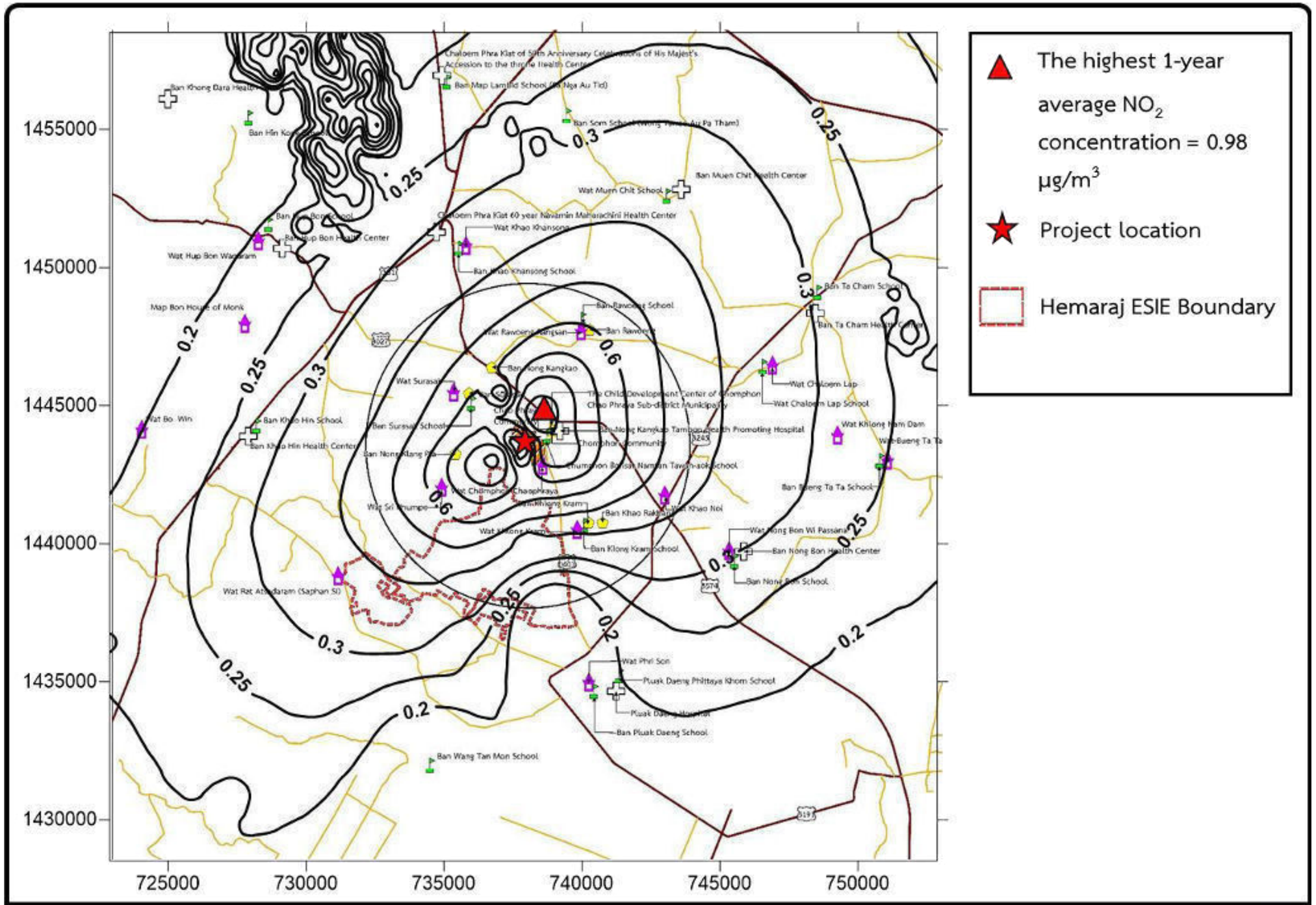

FIGURE 5.1.1.1-42 : CONTOUR MAP OF 1 YR AVERAGE NO_2 CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

The highest 1 yr average NO_2 concentration was found 1.32 km north-northeast (NNE) of the project area at coordinates: 738378 E 1444711 N where it is an indusrial area within Hemaraj ESIE. The value was 0.98 µg/m^3 or 1.72 % of the ambient air quality standard (NO_2 1 yr average must not exceed 57 µg/m^3). For 21 sensitive receptor areas, the 1 yr average NO_2 concentration in the atmosphere was between 0.45-0.95 µg/m^3 or 0.79-1.67 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-42**.

When combining the above with the highest value from the current measurement, the highest 1 yr average NO_2 concentration in the atmosphere was 16.42 µg/m^3 or 28.81 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 6.00-16.09 µg/m^3 or 10.53-28.23 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

- **1 hr average, 24 hr average and 1 yr average SO_2**

SO_2 is one of the major air substances which has been released to the atmosphere during the project operation and which resulted in the general areas having the highest 1 hr average SO_2 concentration at 11.27 km north-northwest (NNW) of the project area at coordinates: 731878 E 1453011 N where Nam Jone Mountain is located. The value was 116.38 µg/m^3 or 14.92 % of the ambient air quality standard (SO_2 1 hr average must not exceed 780 µg/m^3). For 21 sensitive receptor areas, the 1 hr average SO_2 concentration in the atmosphere was between 11.60-23.61 µg/m^3 or 1.49-3.03 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-43**.

When combining the above with the highest value from the current measurement, the highest SO_2 1 hr average concentration in the atmosphere was 223.29 µg/m^3 or 28.63 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 21.03-121.78 µg/m^3 or 2.70-15.61 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

The highest SO_2 24 hr average concentration was found 13.24 km north-northwest (NNW) of the project area at coordinates: 730378 E 1454511 N where Nam Jone Mountain is located. The value was 19.29 µg/m^3 or 6.43 % of the ambient air quality standard (SO_2 24 hr average must not exceed 300 µg/m^3). For 21 sensitive receptor areas, the 24 hr average SO_2 concentration in the atmosphere was between 2.12-4.79 µg/m^3 or 0.71-1.60 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-44**.

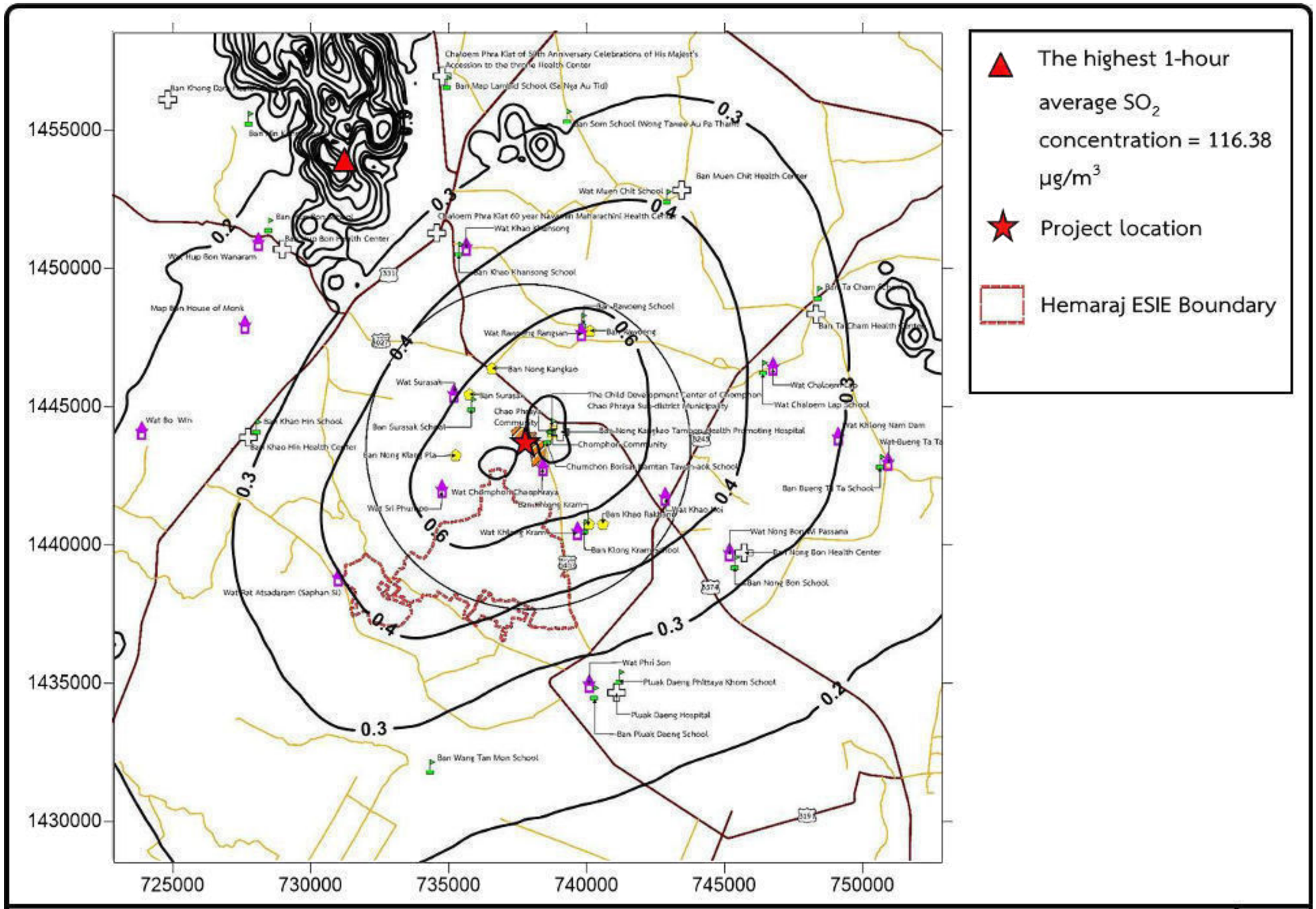

FIGURE 5.1.1.1-43 : CONTOUR MAP OF 1 HR AVERAGE SO_2 CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

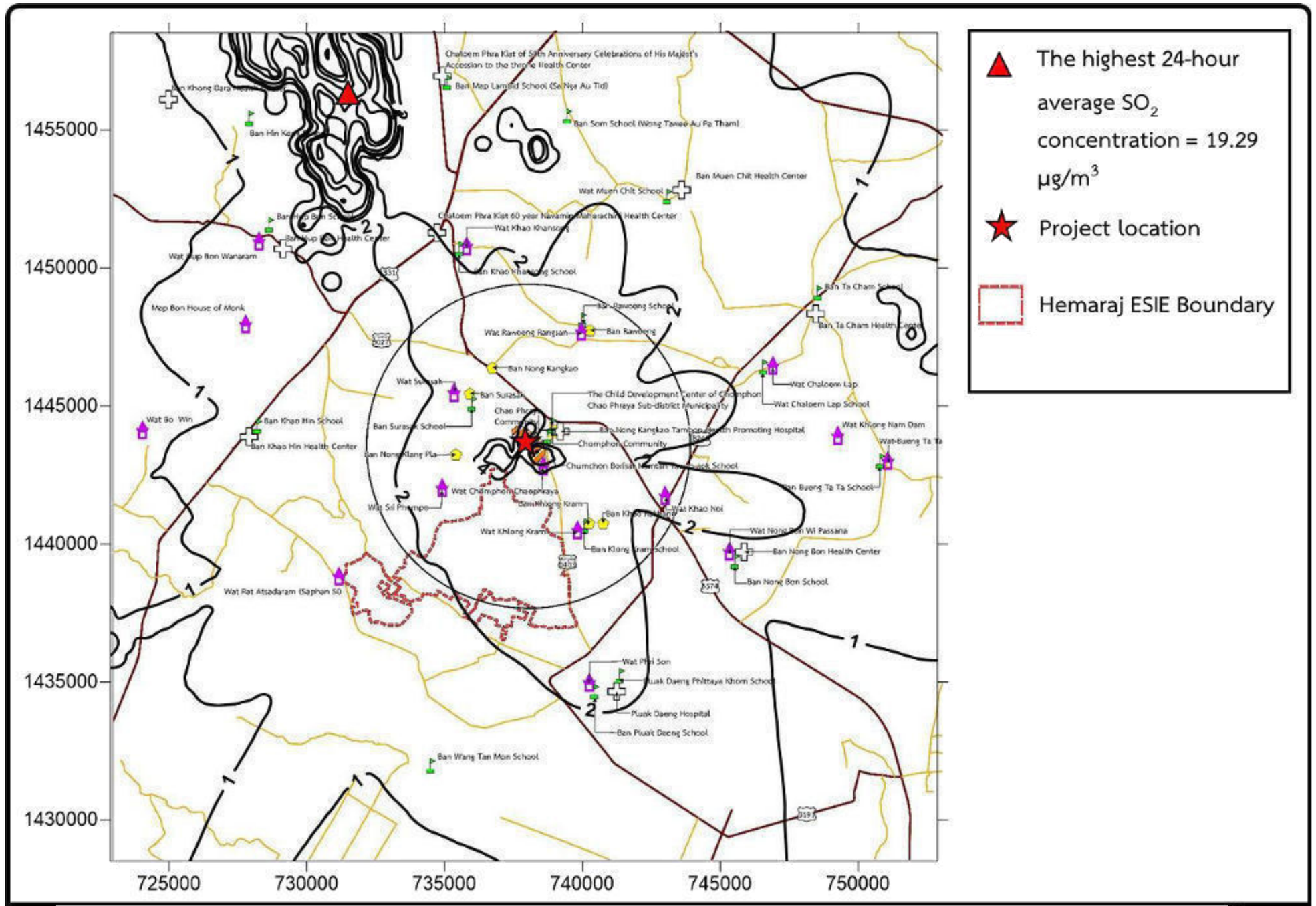

FIGURE 5.1.1.1-44 : CONTOUR MAP OF 24 HR AVERAGE SO_2 CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

When combining the above with the highest value from the current measurement, the highest 24 hr average SO_2 concentration in the atmosphere was 75.35 µg/m^3 or 25.12 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 8.12-58.82 µg/m^3 or 2.71-19.61 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

The highest SO_2 1 yr average concentration was found 13.34 km northwest (NW) of the project area at coordinates: 732378 E 1455011 N where Chomphu Mountain is located. The value was 2.58 µg/m^3 or 2.58 % of the ambient air quality standard (SO_2 1 yr average must not exceed 100 µg/m^3). For 21 sensitive receptor areas, the SO_2 1 yr average concentration in the atmosphere was between 0.52-1.16 µg/m^3 or 0.52-1.16 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-45**.

When combining the above with the highest value from the current measurement, the highest concentration of SO_2 1 yr average in the atmosphere was 18.30 µg/m^3 or 18.30 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 2.29-16.51µg/m^3 or 2.29-16.51 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

- **24 hr average and 1 yr average TSP**

The operation of the project resulted in the general areas having the highest 24 hr average TSP concentration at 12.34 km north-northwest (NNW) of the project area at coordinates: 730378 E 1454511 N where Chomphu Mountain is located. The value was 11.74 µg/m^3 or 3.56 % of the ambient air quality standard (24 hr average TSP must not exceed 330 µg/m^3). For 21 sensitive receptor areas, the 24 hr average TSP concentration in the atmosphere was between 1.29-2.93 µg/m^3 or 0.39-0.89 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-46**.

The above value when combined with the existing data, the highest 24 hr average TSP concentration in the atmosphere was 182.60 µg/m^3 or 55.33 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 94.68-172.55 µg/m^3 or 28.69-52.29 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

The highest 1 yr average TSP concentration was found 13.34 km northwest (NW) of the project area at coordinates: 732378 E 1455011 N where Chomphu Mountain is located. The value was 1.58 µg/m^3 or 1.58 % of the ambient air quality standard (1 yr average TSP must not exceed 100 µg/m^3). For 21 sensitive receptor areas, the 1 yr average TSP concentration in the atmosphere was between 0.32-0.71 µg/m^3 or 0.32-0.71 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-47**.

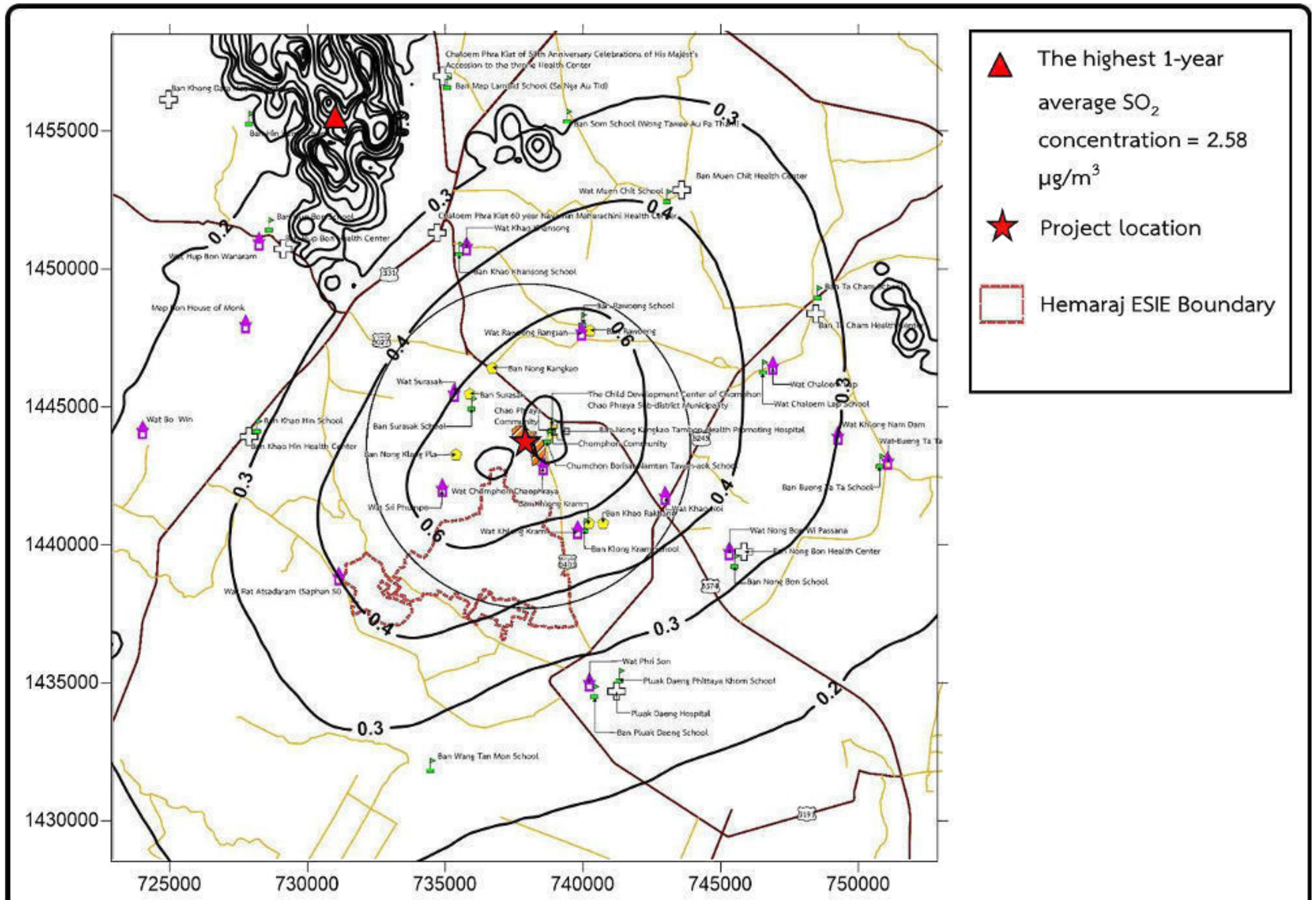

FIGURE 5.1.1.1-45 : CONTOUR MAP OF 1 YR AVERAGE SO_2 CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

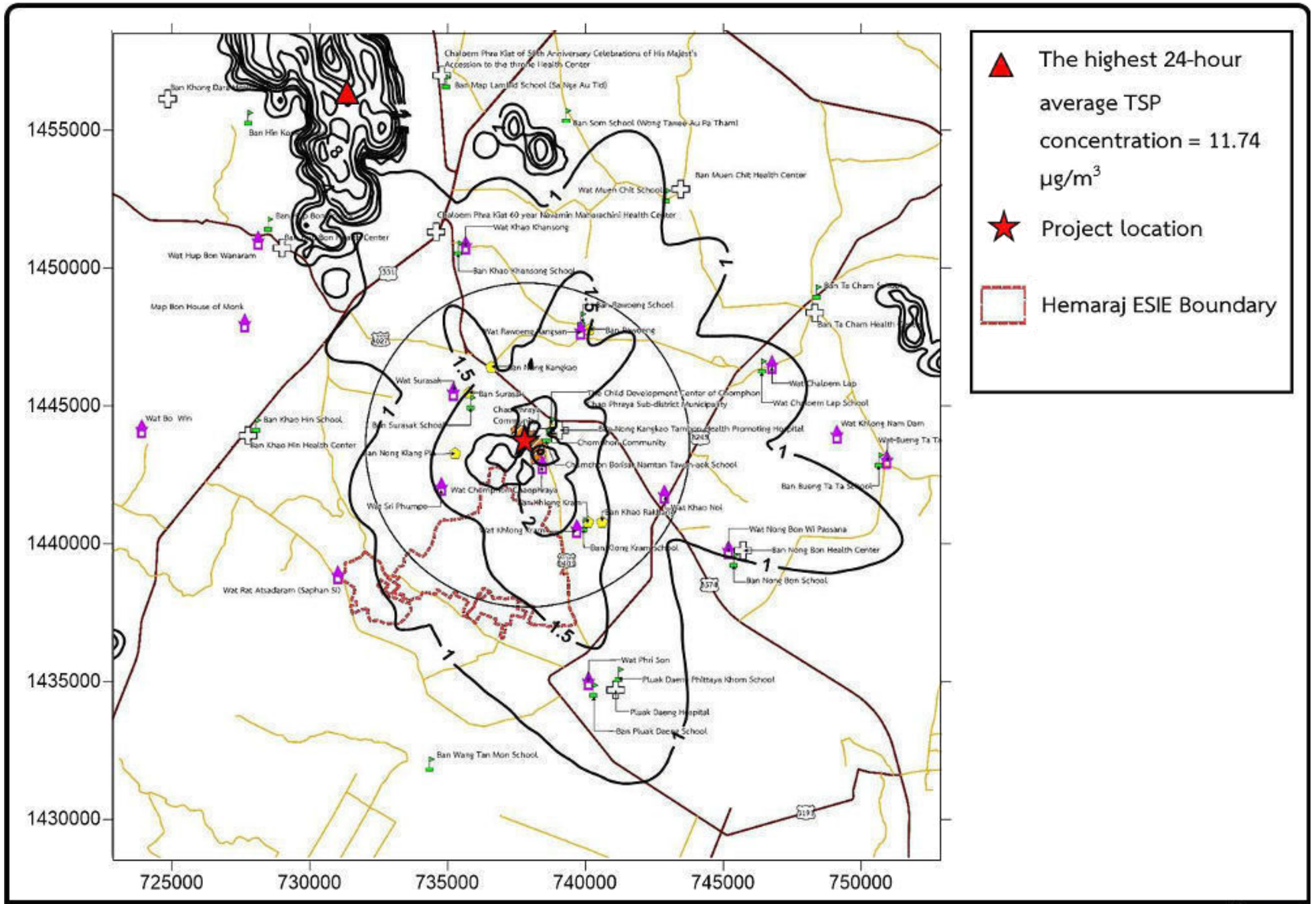

FIGURE 5.1.1.1-46 : CONTOUR MAP OF 24 HR AVERAGE TSP CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

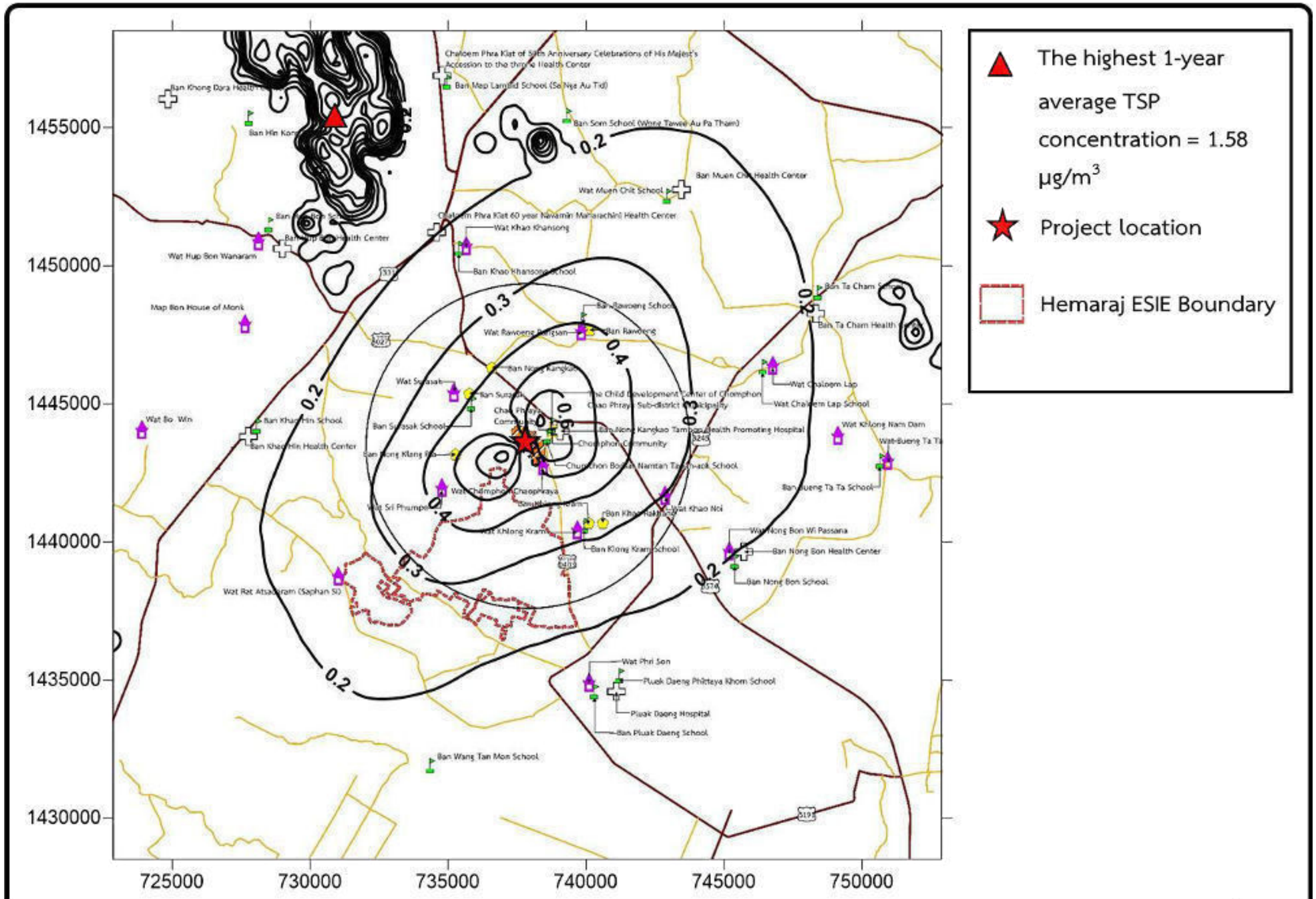

FIGURE 5.1.1.1-43 : CONTOUR MAP OF 1 YR AVERAGE TSP CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

When combining the above with the highest value from the current measurement, the highest 1 yr average TSP concentration in the atmosphere was 50.73µg/m^3 or 50.73 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 28.98-49.63 µg/m^3 or 28.98-49.63 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

- **24 hr average and 1 yr average PM-10**

The operation of the project resulted in the general areas having the highest 24 hr average PM-10 concentration at 12.34 km north-northwest (NNW) of the project area at coordinates: 730378 E 1454511 N where Chomphu Mountain is located. The value was 11.74 µg/m^3 or 9.78 % of the ambient air quality standard (24 hr average PM-10 must not exceed 120 µg/m^3). For 21 sensitive receptor areas, the 24 hr average TSP concentration in the atmosphere was between 1.29-2.93 µg/m^3 or 1.08-2.44 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-48**.

When combining the above with the highest value from the current measurement, the highest 24 hr average PM-10 concentration in the atmosphere was 113.74 µg/m^3 or 94.78 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 43.68-103.69 µg/m^3 or 36.40-86.41 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

The highest 1 yr average PM-10 concentration was found 13.34 km northwest (NW) of the project area at coordinates: 732378 E 1455011 N where Chomphu Mountain is located. The value was 1.58 µg/m^3 or 3.16 % of the ambient air quality standard (1 yr average PM-10 must not exceed 50 µg/m^3). For 21 sensitive receptor areas, the 1 yr average PM-10 concentration in the atmosphere was between 0.32-0.71 µg/m^3 or 0.64-1.42 % of the ambient air quality standard as shown in **Table 5.1.1.1-14** and **Figure 5.1.1.1-49**.

When combining the above with the highest value from the current measurement, the highest concentration of PM-10 1 yr average in the atmosphere was 44.58 µg/m^3 or 88.90 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 13.31-43.48 µg/m^3 or 26.62-86.96 % of the ambient air quality standard as shown in **Table 5.1.1.1-14**.

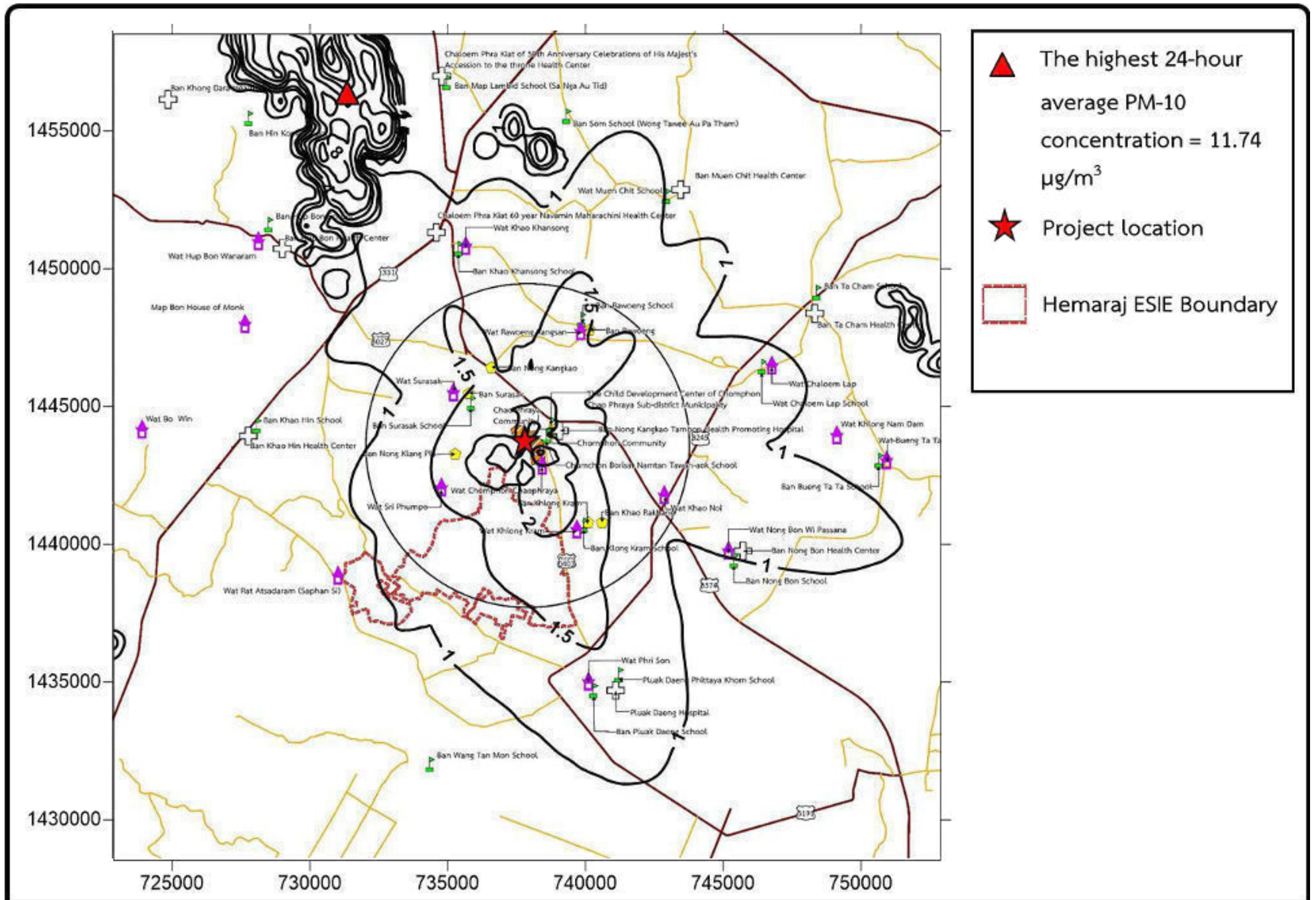

FIGURE 5.1.1.1-48 : CONTOUR MAP OF 24 HR AVERAGE PM-10 CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

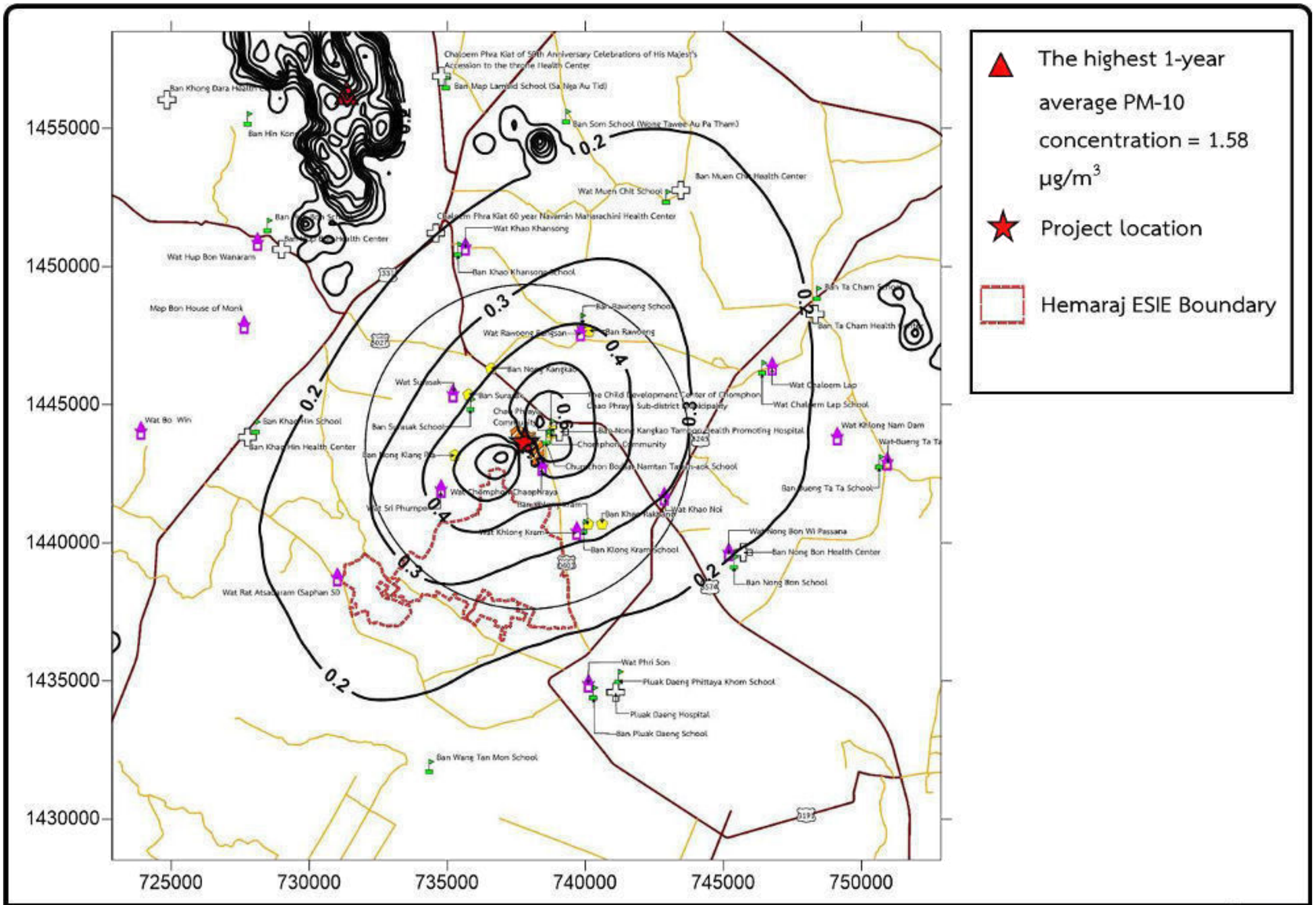

FIGURE 5.1.1.1-49 : CONTOUR MAP OF 1 YR AVERAGE PM-10 CONCENTRATION.

SCENARIO 4 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD

(e) Scenario 5: Impact from Sriracha Power Plant when diesel is used as fuel and operated at 69 % load.

- **1 hr average and 1 yr average NO_2**

NO_2 is one of the major air substances which has been released to the atmosphere during the project operation and which resulted in the general areas having the highest 1 hr average NO_2 concentration at 11.27 km north-northwest (NNW) of the project at coordinates: 732878E 1457011N where Nam Jone Mountain is located. The value was 41.05 µg/m^3 or 12.83 % of the ambient air quality standard (1 hr average NO_2 must not exceed 320 µg/m^3). For 21 sensitive receptor areas, the 1 hr average NO_2 concentration in the atmosphere was between 7.55-12.87 µg/m^3 or 2.36-4.02 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-50**.

When combining the above with the highest value from the current measurement, the highest 1 hr average NO_2 concentration in the atmosphere was 143.68 µg/m^3 or 44.90 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 7.51-12.87µg/m^3 or 2.36-4.02 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

The highest 1 yr average NO_2 concentration was found 12.34 km north-northwest (NNW) of the project area at coordinates: 738378E 1444711N where Chompho Mountain is located. The value was 0.95 µg/m^3 or 1.66 % of the ambient air quality standard (NO_2 1 yr average must not exceed 57 µg/m^3). For 21 sensitive receptor areas, the 1 yr average NO_2 concentration in the atmosphere was between 0.40-0.95 µg/m^3 or 0.70-1.67 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-51.**

When combining the above with the highest value from the current measurement, the highest 1 yr average NO_2 concentration in the atmosphere was 16.39 µg/m^3 or 28.75 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 6.03-16.09 µg/m^3 or 10.58-28.23 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**

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TABLE 5.1.1.1-15

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 5: IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69 % LOAD

Unit : µg/m^3

Study Area	Highest concentration value from results of assessment, case 5																									
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	Total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total
Highest concentration value	41.05	102.63[1/]	143.68	0.95	15.44[1/]	16.39	114.27	106.91[1/]	221.18	17.86	56.06[1/]	73.92	2.39	15.72[1/]	18.11	10.94	170.86[1/]	181.80	1.47	49.15[1/]	50.62	10.94	102[1/]	112.94	1.47	43[1/]	44.47
Coordinates	731878E, 1453011N			738378E, 1444511N			731878E, 1453011N			730378E, 1454511N			732878E, 1455011N			730378E, 1454511N			732878E, 1455011N			730378E, 1454511N			732878E, 1455011N		
Area	Nam Jone Mountain			Chompho Mountain			Nam Jone Mountain			Chompho Mountain			Chompho Mountain			Chompho Mountain			Chompho Mountain			Chompho Mountain			Chompho Mountain		
Direction and distance	NNW (11.27 km)			NNW (12.34 km)			NNW (11.27 km)			NNW (12.34 km)			NNW (13.48 km)			NNW (12.34 km)			NNW (13.48 km)			NNW (12.34 km)			NNW (13.48 km)		
Land utilization	Mountain			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain		
Sensitive Area																										
1. Ban Nong Kangkao Tambon Health Promoting Hospital	11.87	31.80	11.87	0.91	5.18	6.09	14.40	11.53	25.93	3.32	6.29	9.61	1.09	1.93	3.02	2.03	129	131.03	0.67	39.64	40.31	2.03	67	69.03	0.67	20.59	21.26
2. Ban Rawoeng School	12.72	38.01	12.72	0.54	6.19	6.73	13.68	9.43	23.11	2.60	5.76	8.36	0.59	1.77	2.36	1.59	93	94.59	0.36	28.58	28.94	1.59	42	43.59	0.36	12.91	13.27
3. Ban Surasak School	10.76	47.23	10.76	0.53	7.69	8.22	15.73	11.27	27.00	2.20	6.29	8.49	0.58	1.93	2.51	1.35	153	154.35	0.35	47.01	47.36	1.35	81	82.35	0.35	24.89	25.24
4. Chumchon Borisat Namtan Tawan-aok School	11.53	31.80	11.53	0.85	5.18	6.03	18.84	11.53	30.37	4.75	6.29	11.04	1.15	1.93	3.08	2.91	129	131.91	0.71	39.64	40.35	2.91	67	69.91	0.71	20.59	21.30
5. Ban Khlong Kram School	8.26	37.26	8.25	0.41	6.06	6.47	13.25	9.43	22.68	2.96	5.76	8.72	0.51	1.77	2.28	1.81	131	132.81	0.32	40.25	40.57	1.81	61	62.81	0.32	18.74	19.06
6. Wat Rawoeng Rangsan	12.87	38.01	12.86	0.56	6.19	6.75	13.72	9.43	23.15	2.61	5.76	8.37	0.60	1.77	2.37	1.60	93	94.60	0.37	28.58	28.95	1.60	42	43.60	0.37	12.91	13.28
7. Wat Surasak	12.08	47.23	12.08	0.46	15.44	15.90	15.02	12.84	27.86	2.06	7.34	9.40	0.50	15.72	16.22	1.26	118	119.26	0.31	49.15	49.46	1.26	45	46.26	0.31	43.00	43.31
8. Wat Chompon Chao Phraya	11.60	47.23	11.60	0.65	15.44	16.09	23.52	11.27	34.79	4.52	6.29	10.81	0.80	15.72	16.52	2.77	153	155.77	0.49	49.15	49.64	2.77	81	83.77	0.49	43.00	43.49
9. Wat Khlong Kram	8.00	37.26	7.99	0.40	6.06	6.46	13.42	9.43	22.85	2.95	5.76	8.71	0.51	1.77	2.28	1.81	131	132.81	0.31	40.25	40.56	1.81	61	62.81	0.31	18.74	19.05
10. Wat Khao Noi	7.55	37.26	7.51	0.42	6.06	6.48	11.38	9.43	20.81	2.24	5.76	8.00	0.47	1.77	2.24	1.37	131	132.37	0.28	40.25	40.53	1.37	61	62.37	0.28	18.74	19.02
11. Wat Sri Phumpo	8.75	34.25	8.72	0.56	5.57	6.13	13.26	12.84	26.10	2.20	7.34	9.54	0.64	2.26	2.90	1.35	118	119.35	0.39	36.26	36.65	1.35	45	46.35	0.39	13.83	14.22
12. Moo 7 Ban Rawoeng, Khao Khansong Sub-district	12.87	38.01	12.84	0.55	6.19	6.74	13.85	9.43	23.28	2.55	5.76	8.31	0.60	1.77	2.37	1.56	93	94.56	0.37	28.58	28.95	1.56	42	43.56	0.37	12.91	13.28
13. Moo 5 Ban Surasak, Khao Khansong Sub-district	11.66	47.23	11.66	0.50	7.69	8.19	16.06	11.27	27.33	2.14	6.29	8.43	0.54	1.93	2.47	1.31	153	154.31	0.33	47.01	47.34	1.31	81	82.31	0.33	24.89	25.22
14. Moo 7 Ban Nong Kang Pla, Bowin Sub-district	8.74	34.25	8.59	0.58	5.57	6.15	14.97	12.84	27.81	2.42	7.34	9.76	0.65	2.26	2.91	1.48	118	119.48	0.40	36.26	36.66	1.48	45	46.48	0.40	13.83	14.23
15. Moo 3 Ban Nong Kangkao, Ta Sit Sub-district	12.54	102.63	12.46	0.50	15.44	15.94	14.35	106.91	121.26	2.57	56.06	58.63	0.54	11.26	11.80	1.58	171	172.44	0.33	49.15	49.48	1.58	102	103.58	0.33	33.92	34.25
16. Moo 2 Ban Khao Rakhang, Ta Sit Sub-district	7.65	37.26	7.65	0.68	6.06	6.74	12.18	9.43	21.61	2.32	5.76	8.08	0.77	1.77	2.54	1.42	131	132.42	0.47	40.25	40.72	1.42	61	62.42	0.47	18.74	19.21
17. Moo 1 Ban Khlong Kram, Ta Sit Sub-district	8.28	37.26	8.20	0.42	6.06	6.48	12.52	9.43	21.95	2.90	5.76	8.66	0.52	1.77	2.29	1.78	131	132.78	0.32	40.25	40.57	1.78	61	62.78	0.32	18.74	19.06
18. Chao Phraya Community, Chompon Chao Phraya Sub-district Municipality	11.67	31.80	11.67	0.92	5.18	6.10	17.02	11.53	28.55	4.38	6.29	10.67	1.15	1.93	3.08	2.68	129	131.68	0.70	39.64	40.34	2.68	67	69.68	0.70	20.59	21.29

TABLE 5.1.1.1-15

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 5: IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69 % LOAD (Cont'd)

Unit : µg/m^3

Study Area	Highest concentration value from results of assessment, case 5																									
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total
19. Chompon Community, Chompon Chao Phraya Sub-district Municipality	11.61	31.80	11.61	0.93	5.18	6.11	15.79	11.53	27.32	4.05	6.29	10.34	1.13	1.93	3.06	2.48	129	131.48	0.69	39.64	40.33	2.48	67	69.48	0.69	20.59	21.28
20. The Praow Village	10.16	47.23	10.16	0.57	7.69	8.26	18.77	11.27	30.04	3.16	6.29	9.45	0.70	1.93	2.63	1.93	153	154.93	0.43	47.01	47.44	1.93	81	82.93	0.43	24.89	25.32
21. The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	11.85	31.80	11.71	0.95	5.18	6.13	15.67	11.53	27.20	4.83	6.29	11.12	1.16	1.93	3.09	2.95	129	131.95	0.71	39.64	40.35	2.95	67	69.95	0.71	20.59	21.30
Standard[2/]	320			57			780			300			100			330			100			120			50		

Remark : [1/] Reference **Table 5.1.1.1-3** Highest values from ambient air quality monitoring near the project area.

[2/] Reference **Table 5.1.1.1-4** Highest value of the current air quality monitoring used as representative at sensitive receptors.

[3/] Standard reference:

- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 24 B.E.2547 (2004)
- Ambient nitrogen dioxide standard in accordance with the notification of National Environmental Committee Vol. 33 B.E.2552 (2009)
- Ambient sulfur dioxide 1 hour standard in accordance with the notification of National Environmental Committee Vol. 12 B.E.2538 (1995)
- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 10 B.E.2538 (1995)

Source : Team Consulting Engineering and Management Co., Ltd., 2015

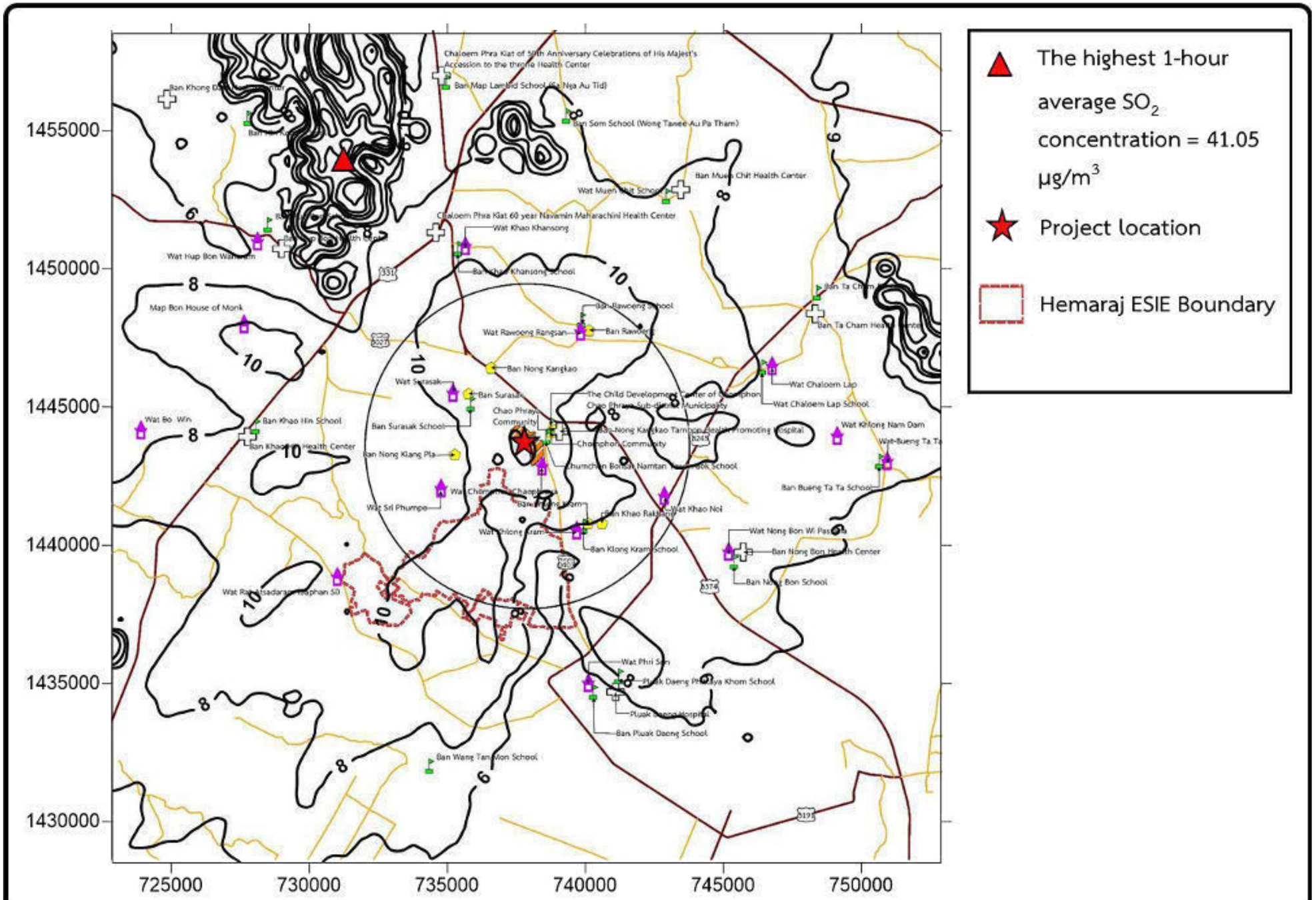


FIGURE 5.1.1.1-50 : CONTOUR MAP OF 1 HR AVERAGE NO_2 CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

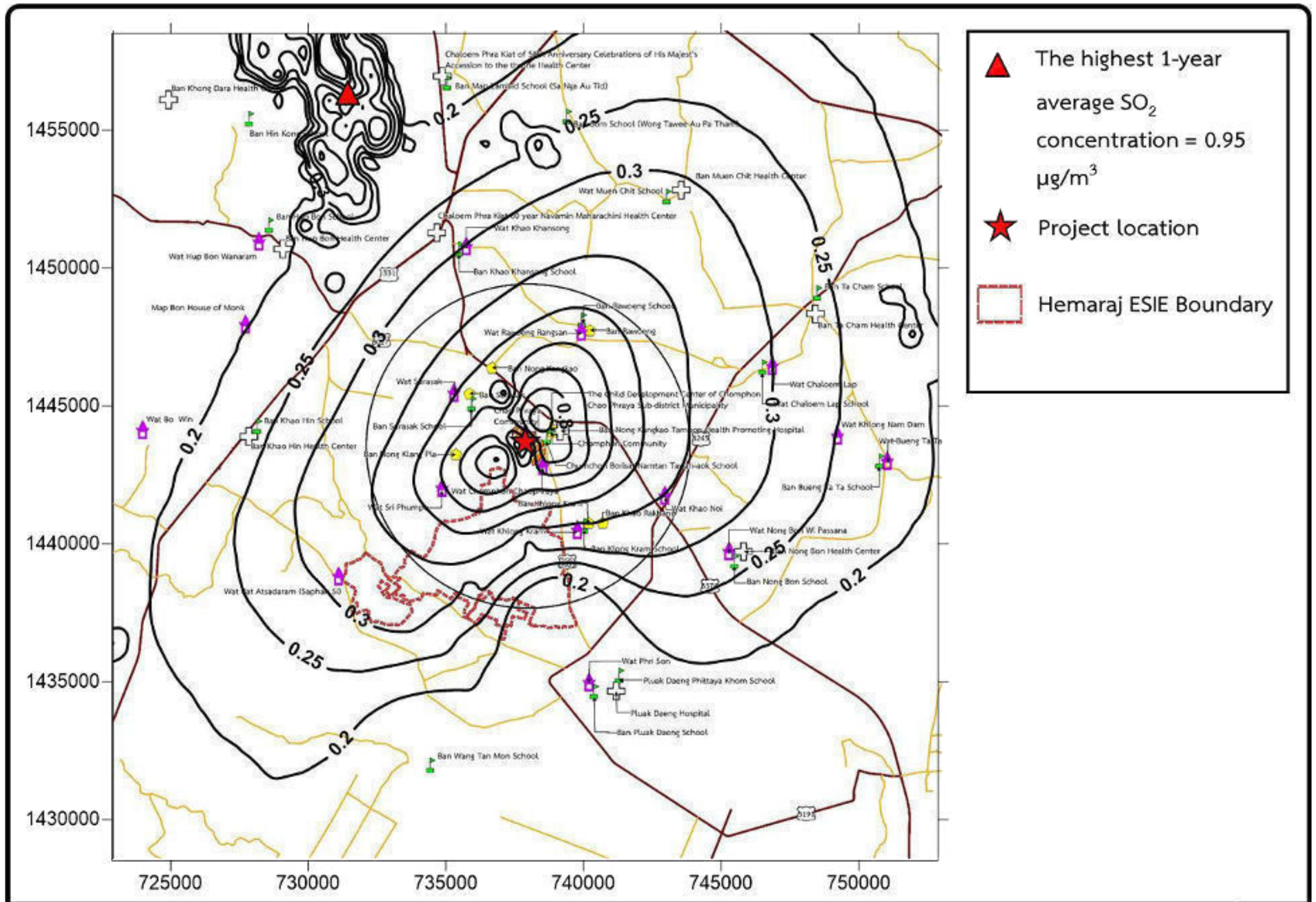


FIGURE 5.1.1.1-51 : CONTOUR MAP OF 1-YEA AVERAGE NO_2 CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

- **1 hr average, 24 hr average and 1 yr average SO_2**

SO_2 is one of the major air substances which has been released to the atmosphere during the project operation and which resulted in the general areas having the highest 1 hr average SO_2 concentration at 11.27 km north-northwest (NNW) of the project area at coordinates: 731878 E 1453011 N where Nam Jone Mountain is located. The value was 114.27 µg/m^3 or 14.65 % of the ambient air quality standard (SO_2 1 hr average must not exceed 780 µg/m^3). For 21 sensitive receptor areas, the 1 hr average SO_2 concentration in the atmosphere was between 11.38-23.52 µg/m^3 or 1.46-3.02 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-52**.

When combining the above with the highest value from the current measurement, the highest SO_2 1 hr average concentration in the atmosphere was 221.18 µg/m^3 or 28.36 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 20.81-121.26 µg/m^3 or 2.67-15.55 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

The highest SO_2 24 hr average concentration was found 12.34 km north-northwest (NNW) of the project area at coordinates: 730378 E 1454511 N where Chompho Mountain is located. The value was 17.86 µg/m^3 or 5.95 % of the ambient air quality standard (SO_2 24 hr average must not exceed 300 µg/m^3). For 21 sensitive receptor areas, the 24 hr average SO_2 concentration in the atmosphere was between 2.06-4.83 µg/m^3 or 0.69-1.61 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-53**.

When combining the above with the highest value from the current measurement, the highest 24 hr average SO_2 concentration in the atmosphere was 73.92 µg/m^3 or 24.64 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 8.00-58.63 µg/m^3 or 2.67-19.54 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

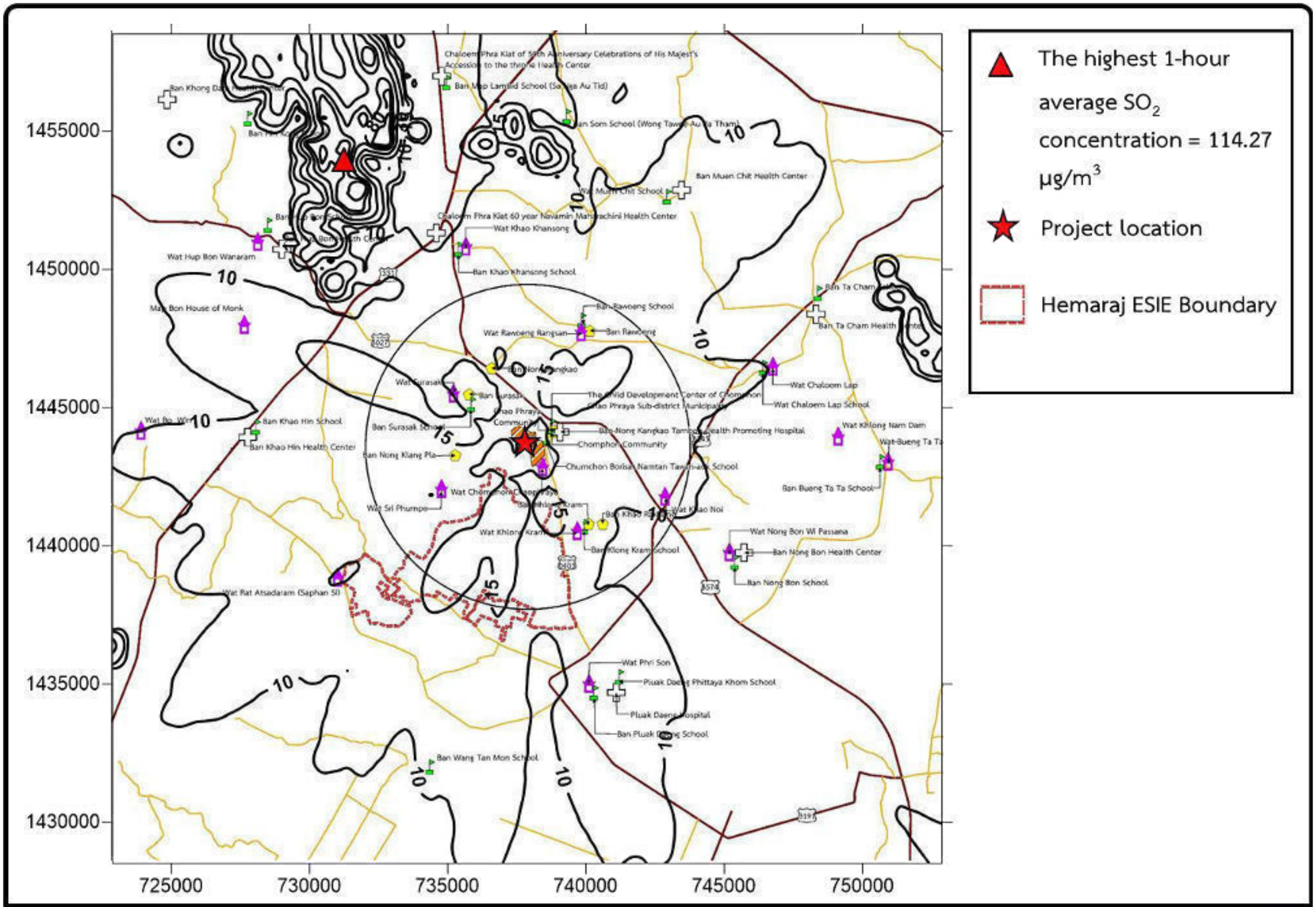


FIGURE 5.1.1.1-52 : CONTOUR MAP OF 1 HR AVERAGE SO_2 CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

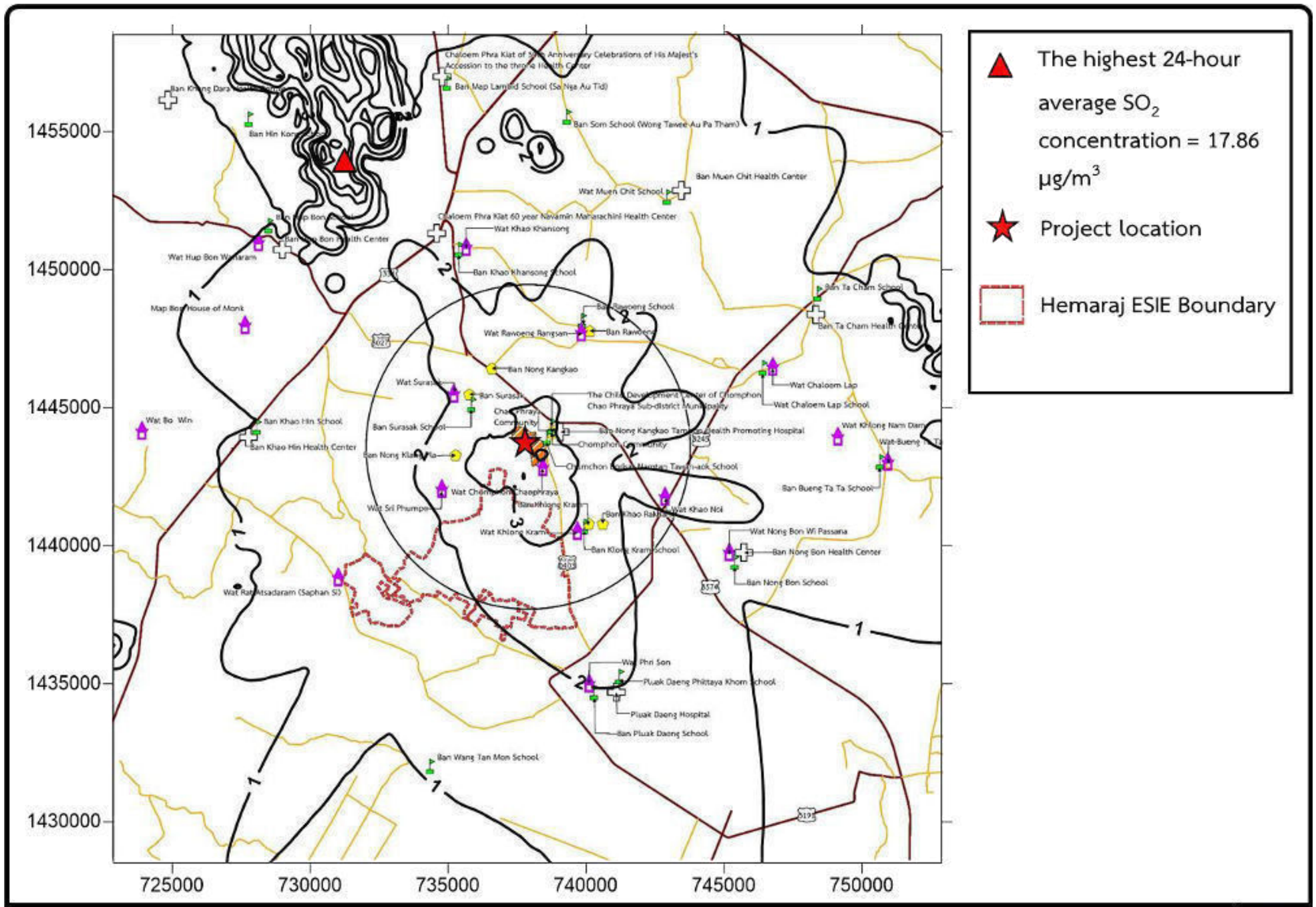


FIGURE 5.1.1.1-53 : CONTOUR MAP OF 24 HR AVERAGE SO_2 CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

The highest SO_2 1 yr average concentration was found 13.48 km north-northwest (NNW) of the project area at coordinates: 732878 E 1455011 N where Chompho Mountain is located. The value was 2.39 µg/m^3 or 2.39 % of the ambient air quality standard (SO_2 1 yr average must not exceed 100 µg/m^3). For 21 sensitive receptor areas, the SO_2 1 yr average concentration in the atmosphere was between 0.47-1.16 µg/m^3 or 0.47-1.16 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-54**.

When combining the above with the highest value from the current measurement, the highest concentration of SO_2 1 yr average in the atmosphere was 18.11 µg/m^3 or 18.11 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 2.24-16.52 µg/m^3 or 2.24-16.52 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

- **24 hr average and 1 yr average TSP**

The operation of the project resulted in the general areas having the highest 24 hr average TSP concentration at 12.34 km north-northwest (NNW) of the project area at coordinates: 730378 E 1454511 N where Chompho Mountain is located. The value was 10.94 µg/m^3 or 3.32 % of the ambient air quality standard (24 hr average TSP must not exceed 330 µg/m^3). For 21 sensitive receptor areas, the 24 hr average TSP concentration in the atmosphere was between 1.26-2.95 µg/m^3 or 0.38-0.89 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-55**.

The above value when combined with the existing data, the highest 24 hr average TSP concentration in the atmosphere was 181.80 µg/m^3 or 55.09 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 94.56-172.44 µg/m^3 or 28.65-52.25 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

The highest 1 yr average TSP concentration was found 13.48 km north-northwest (NNW) of the project area at coordinates: 732878 E 1455011 N where Chompho Mountain is located. The value was 1.47 µg/m^3 or 1.47 % of the ambient air quality standard (1 yr average TSP must not exceed 100 µg/m^3). For 21 sensitive receptor areas, the 1 yr average TSP concentration in the atmosphere was between 0.28-0.71 µg/m^3 or 0.28-0.71 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-56**.

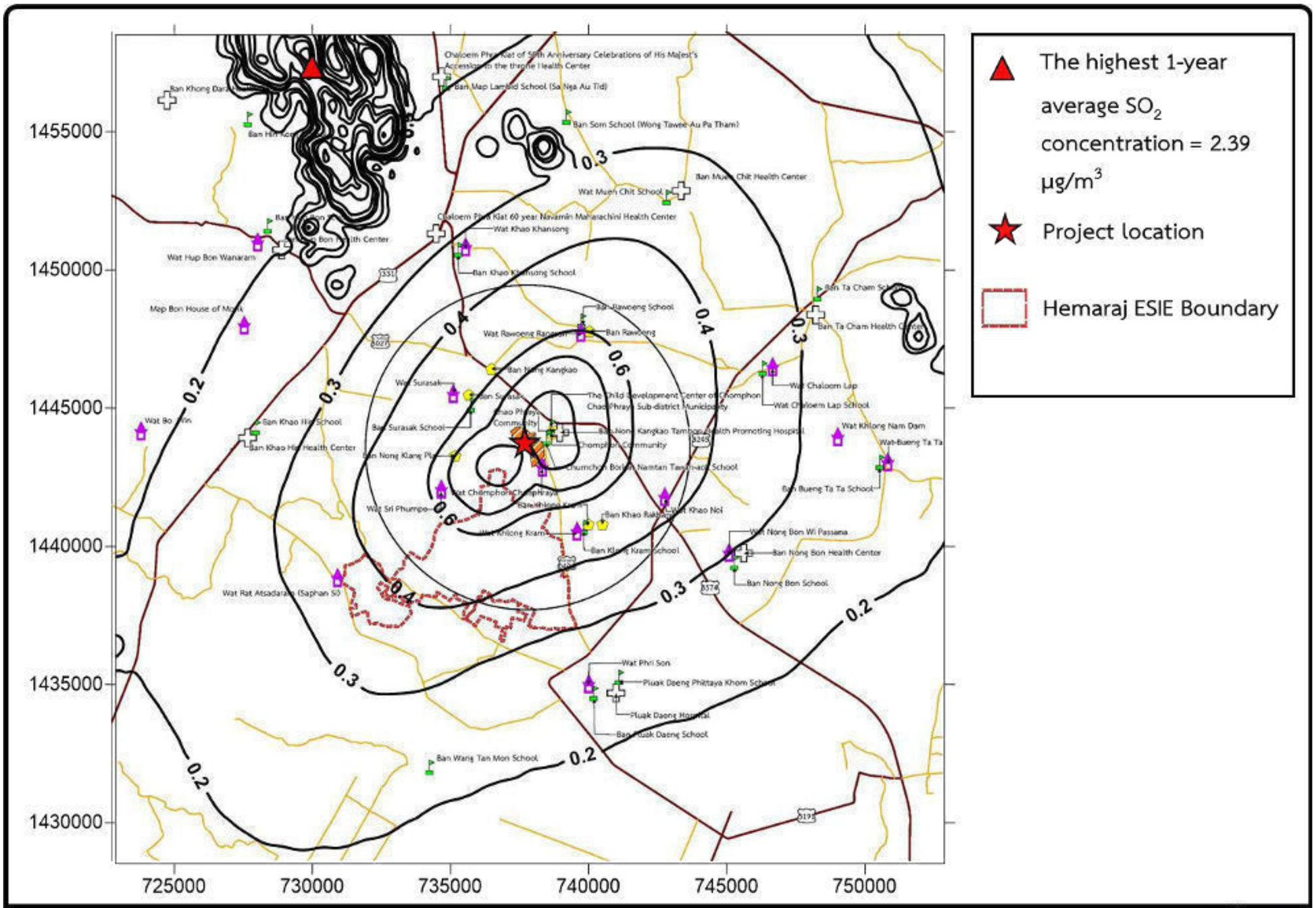


FIGURE 5.1.1.1-54 : CONTOUR MAP OF 1 YR AVERAGE SO_2 CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

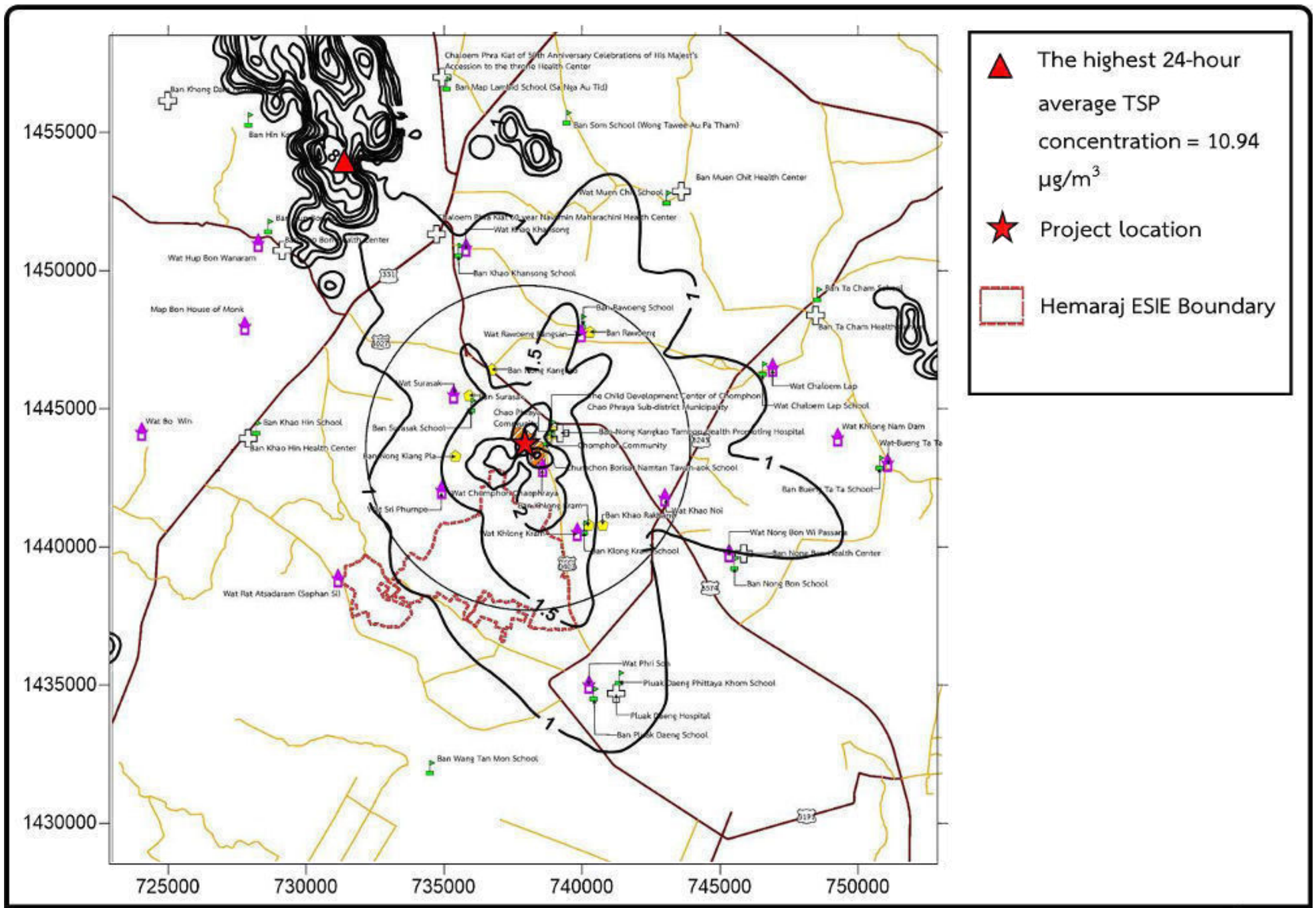


FIGURE 5.1.1.1-55 : CONTOUR MAP OF 24 HR AVERAGE TSP CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

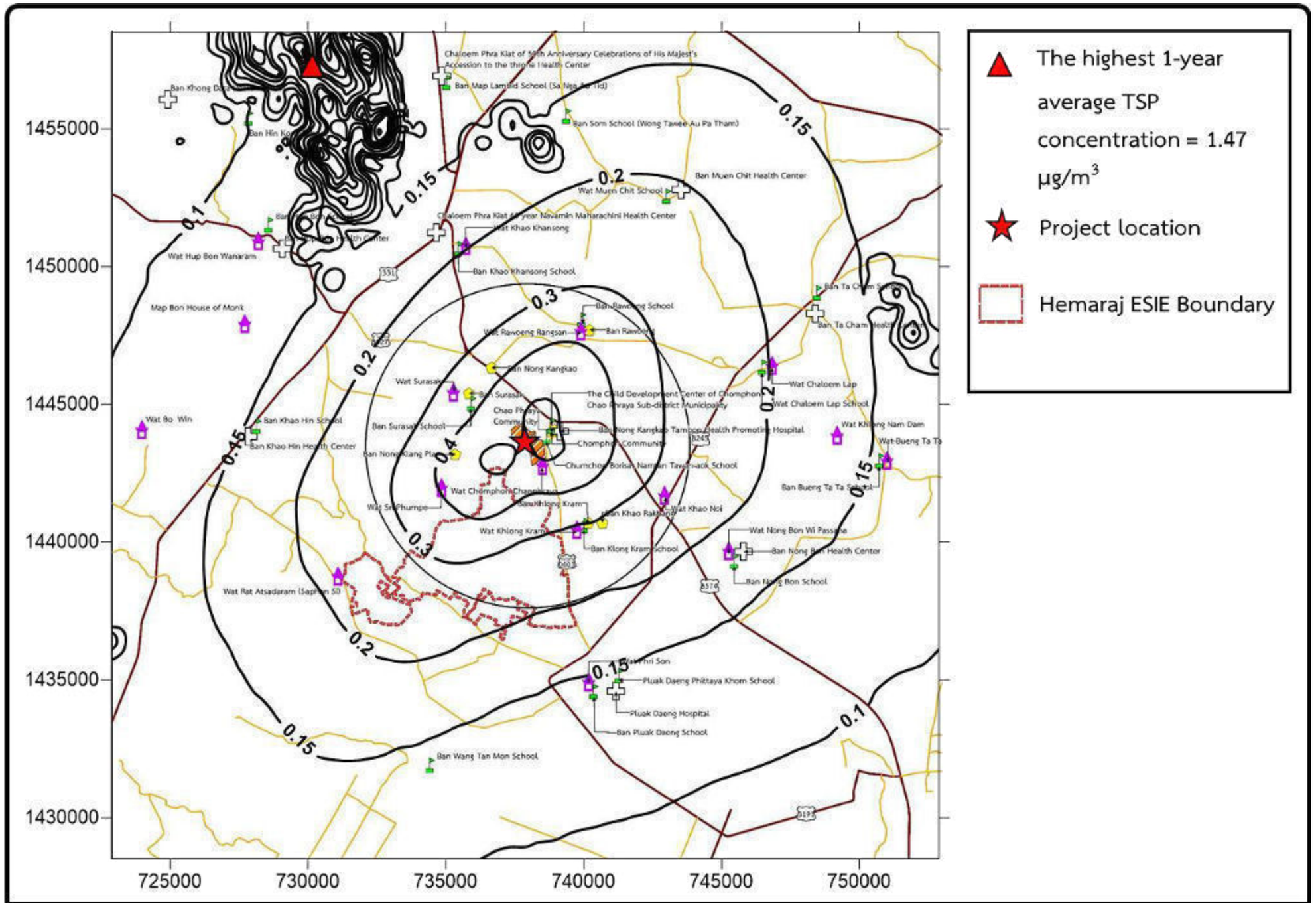


FIGURE 5.1.1.1-56 : CONTOUR MAP OF 1 YR AVERAGE TSP CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

When combining the above with the highest value from the current measurement, the highest 1 yr average TSP concentration in the atmosphere was 50.62 µg/m^3 or 50.62 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 28.94-49.64 µg/m^3 or 28.94-49.64 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

- **24 hr average and 1 yr average PM-10**

The operation of the project resulted in the general areas having the highest 24 hr average PM-10 concentration at 12.34 km north-northwest (NNW) of the project area at coordinates: 730378 E 1454511 N where Chompho Mountain is located. The value was 10.94 µg/m^3 or 9.12 % of the ambient air quality standard (24 hr average PM-10 must not exceed 120 µg/m^3). For 21 sensitive receptor areas, the 24 hr average TSP concentration in the atmosphere was between 1.26-2.95µg/m^3 or 1.05-2.46 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-57**.

When combining the above with the highest value from the current measurement, the highest 24 hr average PM-10 concentration in the atmosphere was 112.94 µg/m^3 or 94.12 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 43.56-103.58 µg/m^3 or 36.30-86.32 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

The highest 1 yr average PM-10 concentration was found 13.48 km north-northwest (NNW) of the project area at coordinates: 732878 E 1455011 N where Chompho Mountain is located. The value was 1.47 µg/m^3 or 2.94 % of the ambient air quality standard (1 yr average PM-10 must not exceed 50 µg/m^3). For 21 sensitive receptor areas, the 1 yr average PM-10 concentration in the atmosphere was between 0.28-0.71 µg/m^3 or 0.56-1.42 % of the ambient air quality standard as shown in **Table 5.1.1.1-15** and **Figure 5.1.1.1-58**.

When combining the above with the highest value from the current measurement, the highest concentration of PM-10 1 yr average in the atmosphere was 44.47 µg/m^3 or 88.94 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 13.27-43.49 µg/m^3 or 26.54-86.98 % of the ambient air quality standard as shown in **Table 5.1.1.1-15**.

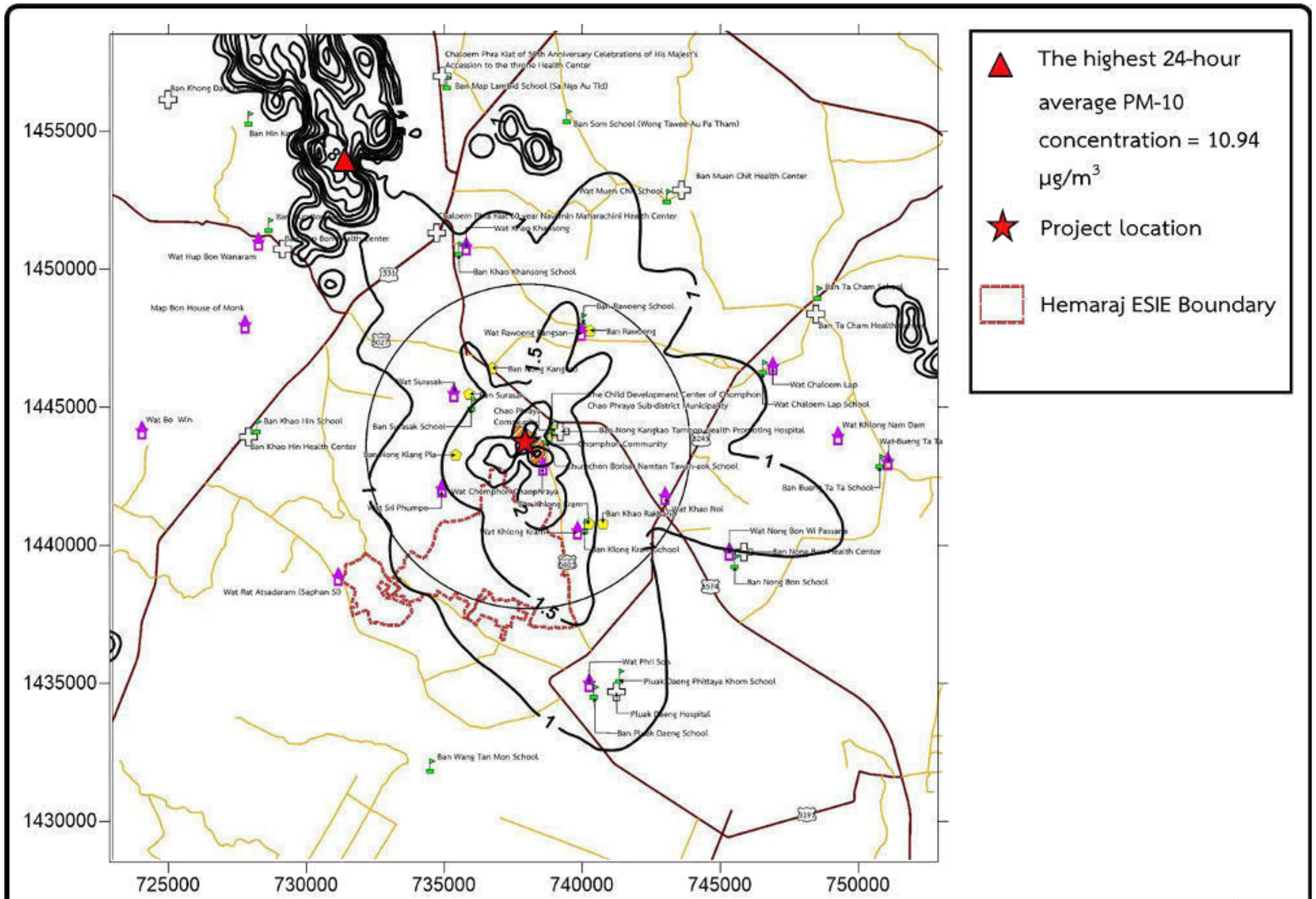


FIGURE 5.1.1.1-57 : CONTOUR MAP OF 24 HR AVERAGE PM-10 CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

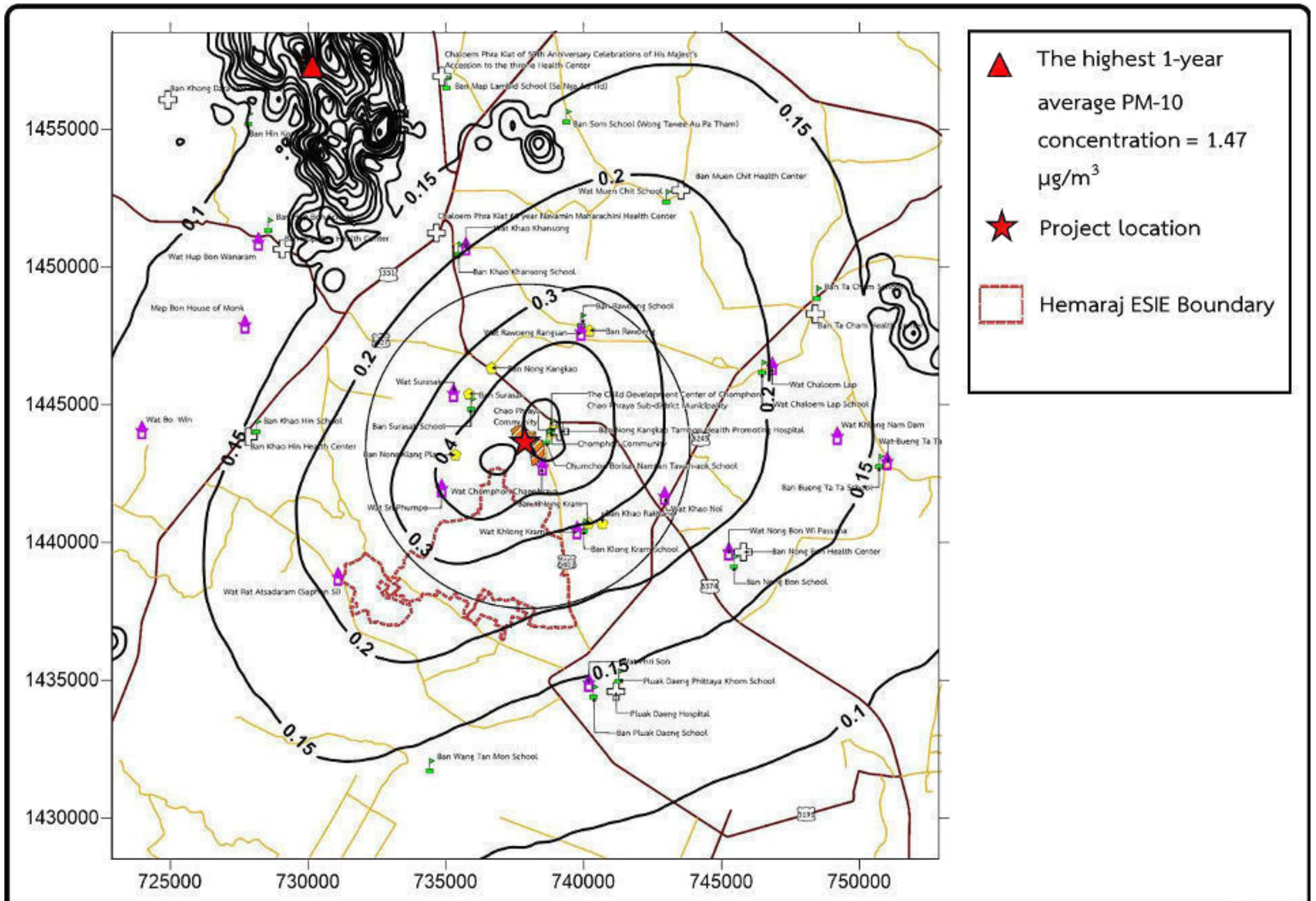


FIGURE 5.1.1.1-58 : CONTOUR MAP OF 1 YR AVERAGE PM-10 CONCENTRATION.

SCENARIO 5 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 69% LOAD

(f) Scenario 6: Impact from Sriracha Power Plant when diesel is used as fuel and operated at 100 % load, combined with current impact from other industrial factories that have been approved in the environmental impact assessment report but have not yet released any air substance, and from the power plants in the development plan by Gulf Group Company that are located within the radius of 15 km from the project location.

- **1 hr average and 1 yr average NO_2**

NO_2 is one of the major air substances which has been released to the atmosphere during the project operation and which resulted in the general areas having the highest 1 hr average NO_2 concentration at 12.06 km north (N) of the project at coordinates: 736878E 1455511N where Mai Rai Mountain is located. The value was 180.53 µg/m^3 or 56.42 % of the ambient air quality standard (1 hr average NO_2 must not exceed 320 µg/m^3). For 21 sensitive receptor areas, the 1 hr average NO_2 concentration in the atmosphere was between 52.44-71.16 µg/m^3 or 16.39-22.24 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-59**.

When combining the above with the highest value from the current measurement, the highest 1 hr average NO_2 concentration in the atmosphere was 283.16 µg/m^3 or 88.49 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 84.24-173.79 µg/m^3 or 26.32-54.31 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

The highest 1 yr average NO_2 concentration was found 3.00 km south (S) of the project area at coordinates: 738378 E 14440511 N where it is a Industrial area within Hemaraj ESIE. The value was 6.18 µg/m^3 or 10.84 % of the ambient air quality standard (NO_2 1 yr average must not exceed 57 µg/m^3). For 21 sensitive receptor areas, the 1 yr average NO_2 concentration in the atmosphere was between 3.44-5.05 µg/m^3 or 6.03-8.86 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-60**.

When combining the above with the highest value from the current measurement, the highest 1 yr average NO_2 concentration in the atmosphere was 21.62 µg/m^3 or 37.93 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 9.51-19.91 µg/m^3 or 16.68-34.93 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

TABLE 5.1.1.1-16

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 6: IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100 % LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

Unit : µg/m^3

Study Area	Highest concentration value from results of assessment, case 6																										
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total
Highest concentration value	180.53	102.63[1/]	283.16	6.18	15.44[1/]	21.62	116.7	106.91[1/]	223.61	22.06	56.06[1/]	78.12	4.45	15.72[1/]	20.17	14.74	170.86[1/]	185.60	2.67	49.15[1/]	51.82	14.74	102[1/]	116.74	2.67	43[1/]	45.67
Coordinates	736878E, 1455511N			738378E, 1440511N			731878E, 1453011N			732878E, 1455011N			732878E, 1455011N			738878E, 1454011N			732878E, 1455011N			738878E, 1454011N			732878E, 1455011N		
Area	Mai Rai Mountain			Industrial			Nam Jone Mountain			Chompho Mountain			Chompho Mountain			Ruean Tok Mountain			Chompho Mountain			Ruean Tok Mountain			Chompho Mountain		
Direction and distance	N (12.06 km)			S (3.00 km)			NNW (11.27 km)			NNW (13.48 km)			NNW (13.48 km)			NNE (14.09 km)			NNW (13.48 km)			NNE (14.09 km)			NNW (13.48 km)		
Land utilization	Mountain			Industrial Estate			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain		
Sensitive Area																											
1. Ban Nong Kangkao Tambon Health Promoting Hospital	55.79	31.8	87.59	4.64	5.18	9.82	18.19	11.53	29.72	4.77	6.29	11.06	1.8	1.93	3.73	3.47	129	132.47	1.31	39.64	40.95	3.47	67	70.47	1.31	20.59	21.90
2. Ban Rawoeng School	68.26	38.01	106.27	3.49	6.19	9.68	24.95	9.43	34.38	5.17	5.76	10.93	1.18	1.77	2.95	3.69	93	96.69	0.87	28.58	29.45	3.69	42	45.69	0.87	12.91	13.78
3. Ban Surasak School	53.04	47.23	100.27	3.93	7.69	11.62	17.16	11.27	28.43	4.04	6.29	10.33	1.27	1.93	3.20	3.08	153	156.08	1	47.01	48.01	3.08	81	84.08	1	24.89	25.89
4. Chumchon Borisat Namtan Tawan-aok School	57.41	31.8	89.21	4.38	5.18	9.56	18.51	11.53	30.04	5.54	6.29	11.83	1.8	1.93	3.73	3.55	129	132.55	1.31	39.64	40.95	3.55	67	70.55	1.31	20.59	21.90
5. Ban Khlong Kram School	59.75	37.26	97.01	5.03	6.06	11.09	17.44	9.43	26.87	5.3	5.76	11.06	1.39	1.77	3.16	4.11	131	135.11	1.09	40.25	41.34	4.11	61	65.11	1.09	18.74	19.83
6. Wat Rawoeng Rangsan	68.14	38.01	106.15	3.55	6.19	9.74	24.82	9.43	34.25	5.18	5.76	10.94	1.21	1.77	2.98	3.68	93	96.68	0.89	28.58	29.47	3.68	42	45.68	0.89	12.91	13.80
7. Wat Surasak	54.18	47.23	101.41	3.44	15.44	18.88	17.52	12.84	30.36	3.63	7.34	10.97	1.12	15.72	16.84	2.91	118	120.91	0.84	49.15	49.99	2.91	45	47.91	0.84	43	43.84
8. Wat Chompon Chao Phraya	54.33	47.23	101.56	4.47	15.44	19.91	23.93	11.27	35.20	5.02	6.29	11.31	1.52	15.72	17.24	3.81	153	156.81	1.12	49.15	50.27	3.81	81	84.81	1.12	43	44.12
9. Wat Khlong Kram	59.57	37.26	96.83	5.05	6.06	11.11	17.54	9.43	26.97	5.3	5.76	11.06	1.39	1.77	3.16	4.13	131	135.13	1.09	40.25	41.34	4.13	61	65.13	1.09	18.74	19.83
10. Wat Khao Noi	60.83	37.26	98.09	4.11	6.06	10.17	17.97	9.43	27.40	3.26	5.76	9.02	1.12	1.77	2.89	2.34	131	133.34	0.8	40.25	41.05	2.34	61	63.34	0.8	18.74	19.54
11. Wat Sri Phumpo	54.16	34.25	88.41	3.97	5.57	9.54	19.71	12.84	32.55	4.12	7.34	11.46	1.37	2.26	3.63	3	118	121.00	0.99	36.26	37.25	3	45	48.00	0.99	13.83	14.82
12. Moo 7 Ban Rawoeng, Khao Khansong Sub-district	67.62	38.01	105.63	3.52	6.19	9.71	24.72	9.43	34.15	5.08	5.76	10.84	1.19	1.77	2.96	3.59	93	96.59	0.88	28.58	29.46	3.59	42	45.59	0.88	12.91	13.79
13. Moo 5 Ban Surasak, Khao Khansong Sub-district	53.76	47.23	100.99	3.69	7.69	11.38	18.03	11.27	29.30	3.8	6.29	10.09	1.2	1.93	3.13	2.92	153	155.92	0.92	47.01	47.93	2.92	81	83.92	0.92	24.89	25.81
14. Moo 7 Ban Nong Kang Pla, Bowin Sub-district	53.01	34.25	87.26	3.94	5.57	9.51	18.21	12.84	31.05	4.26	7.34	11.60	1.37	2.26	3.63	3.19	118	121.19	1	36.26	37.26	3.19	45	48.19	1	13.83	14.83
15. Moo 3 Ban Nong Kangkao, Ta Sit Sub-district	71.16	102.63	173.79	3.64	15.44	19.08	18.6	106.91	125.51	4.35	56.06	60.41	1.18	11.26	12.44	3.54	170.86	174.40	0.91	49.15	50.06	3.54	102	105.54	0.91	33.92	34.83
16. Moo 2 Ban Khao Rakhang, Ta Sit Sub-district	64.05	37.26	101.31	4.41	6.06	10.47	19.82	9.43	29.25	3.89	5.76	9.65	1.47	1.77	3.24	2.83	131	133.83	1.08	40.25	41.33	2.83	61	63.83	1.08	18.74	19.82
17. Moo 1 Ban Khlong Kram, Ta Sit Sub-district	57.41	37.26	94.67	4.97	6.06	11.03	17.78	9.43	27.21	5.19	5.76	10.95	1.37	1.77	3.14	4.01	131	135.01	1.06	40.25	41.31	4.01	61	65.01	1.06	18.74	19.80
18. Chao Phraya Community, Chompon Chao Phraya Sub-district Municipality	52.44	31.8	84.24	4.55	5.18	9.73	17.83	11.53	29.36	5.31	6.29	11.60	1.83	1.93	3.76	3.46	129	132.46	1.34	39.64	40.98	3.46	67	70.46	1.34	20.59	21.93

TABLE 5.1.1.1-16

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 6: IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100 % LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION (Cont'd)

Unit : µg/m^3

Study Area	Highest concentration value from results of assessment, case 6																									
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total
19. Chompon Community, Chompon Chao Phraya Sub-district Municipality	53.7	31.8	85.50	4.61	5.18	9.79	17.99	11.53	29.52	5.05	6.29	11.34	1.83	1.93	3.76	3.45	129	132.45	1.34	39.64	40.98	3.45	67	70.45	1.34	20.59	21.93
20. The Praow Village	52.93	47.23	100.16	4.3	7.69	11.99	18.79	11.27	30.06	4.32	6.29	10.61	1.4	1.93	3.33	3.47	153	156.47	1.05	47.01	48.06	3.47	81	84.47	1.05	24.89	25.94
21. The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	52.8	31.8	84.60	4.6	5.18	9.78	18.03	11.53	29.56	5.83	6.29	12.12	1.86	1.93	3.79	3.78	129	132.78	1.37	39.64	41.01	3.78	67	70.78	1.37	20.59	21.96
Standard[2/]	320			57			780			300			100			330			100			120			50		

Remark : [1/] Reference **Table 5.1.1.1-3** Highest values from ambient air quality monitoring near the project area.

[2/] Reference **Table 5.1.1.1-4** Highest value of the current air quality monitoring used as representative at sensitive receptors.

[3/] Standard reference:

- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 24 B.E.2547 (2004)
- Ambient nitrogen dioxide standard in accordance with the notification of National Environmental Committee Vol. 33 B.E.2552 (2009)
- Ambient sulfur dioxide 1 hour standard in accordance with the notification of National Environmental Committee Vol. 12 B.E.2538 (1995)
- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 10 B.E.2538 (1995)

Source : Team Consulting Engineering and Management Co., Ltd., 2015

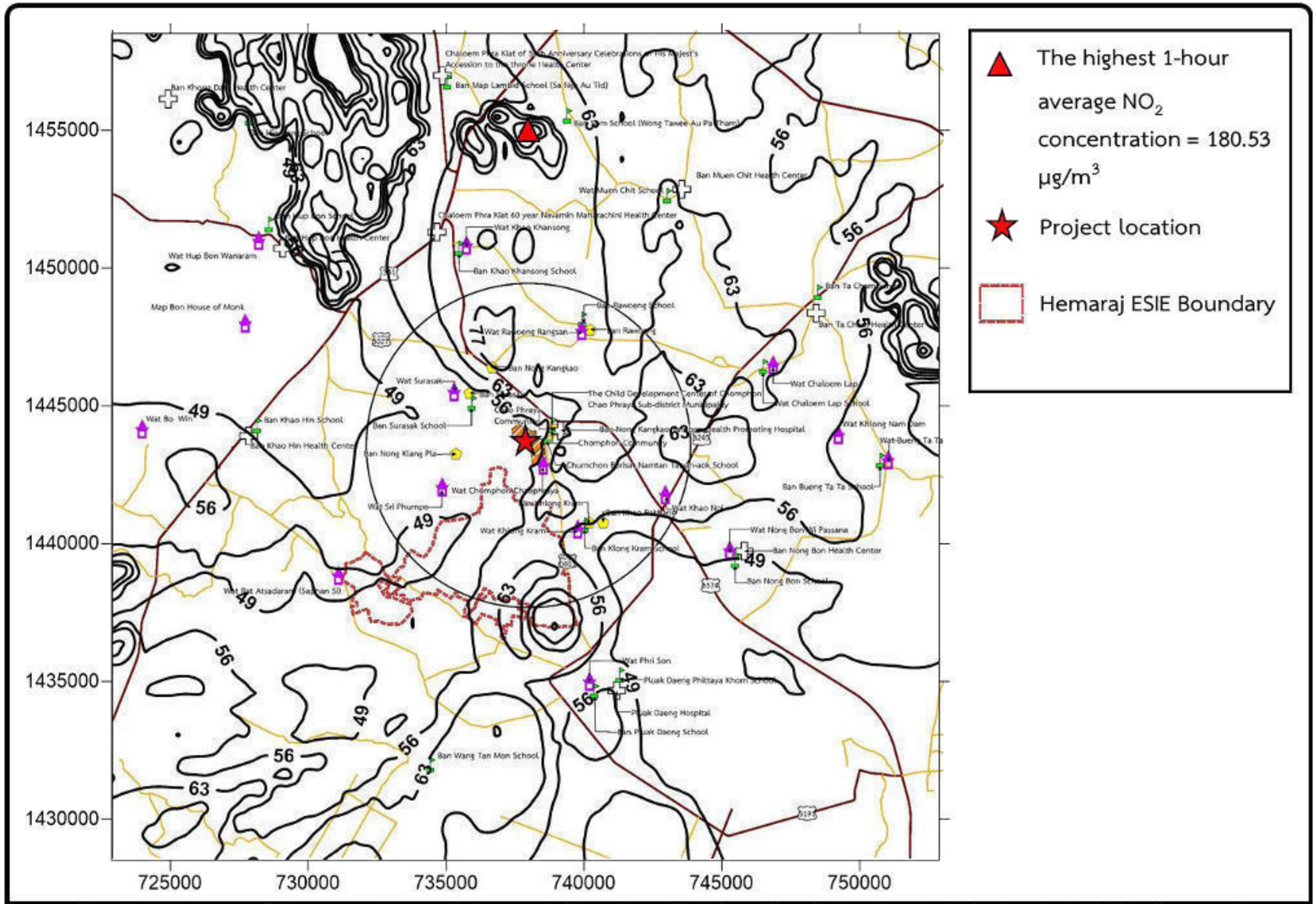


FIGURE 5.1.1.1-59 : CONTOUR MAP OF 1 HR AVERAGE NO_2 CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

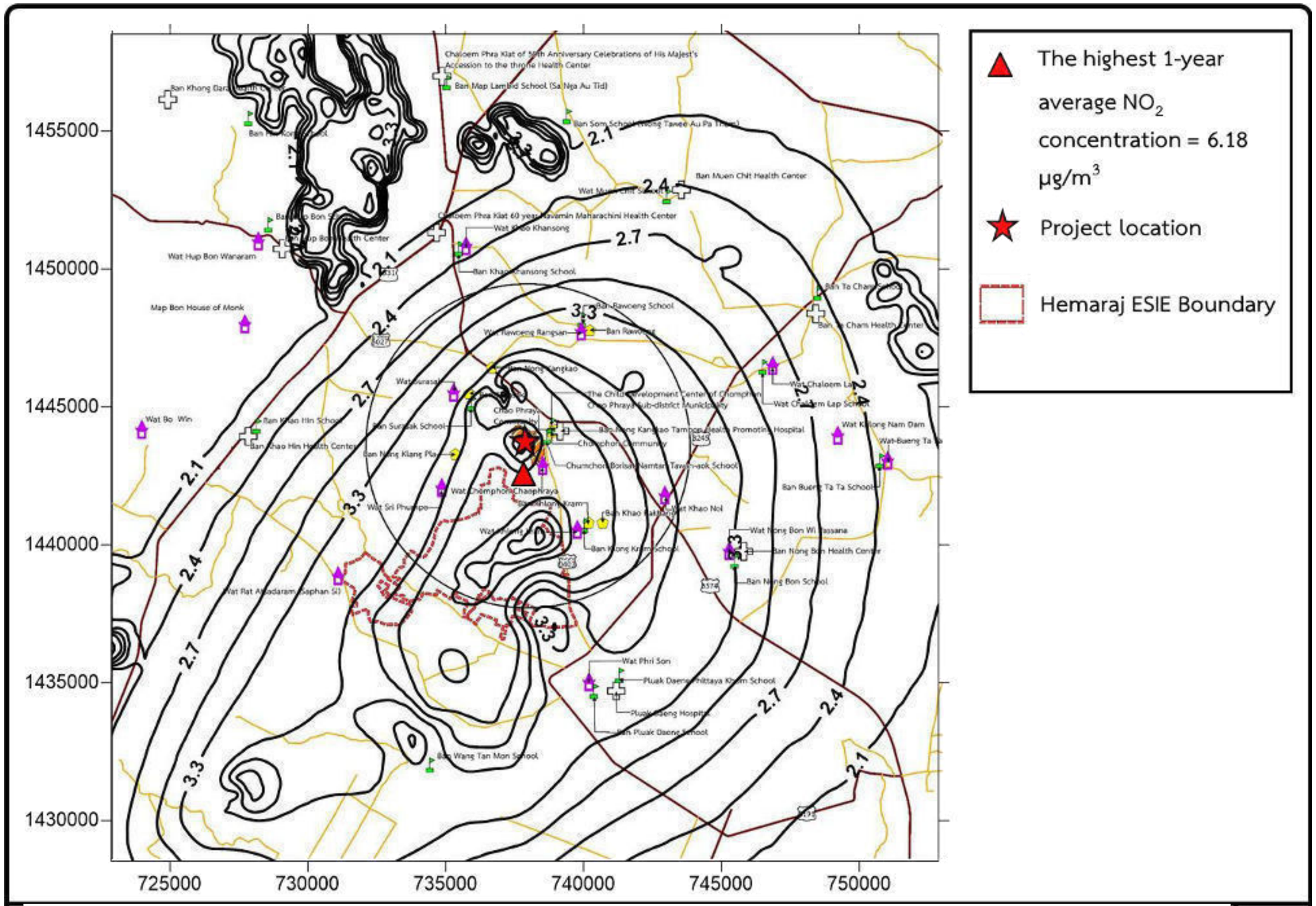


FIGURE 5.1.1.1-60 : CONTOUR MAP OF 1 YR AVERAGE NO_2 CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

- **1 hr average, 24 hr average and 1 yr average SO_2**

SO_2 is one of the major air substances which has been released to the atmosphere during the project operation and which resulted in the general areas having the highest 1 hr average SO_2 concentration at 11.27 km north-northwest (NNW) of the project area at coordinates: 731878 E 1453011 N where Nam Jone Mountain is located. The value was 116.70 µg/m^3 or 14.96 % of the ambient air quality standard (SO_2 1 hr average must not exceed 780 µg/m^3). For 21 sensitive receptor areas, the 1 hr average SO_2 concentration in the atmosphere was between 17.16-24.95 µg/m^3 or 2.20-3.20 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-61**.

When combining the above with the highest value from the current measurement, the highest SO_2 1 hr average concentration in the atmosphere was 223.61 µg/m^3 or 28.68 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 26.87-125.51 µg/m^3 or 3.44-16.09 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

The highest SO_2 24 hr average concentration was found 13.48 km north-northwest (NNW) of the project area at coordinates: 732878 E 1455011 N where Chompho Mountain is located. The value was 22.06 µg/m^3 or 7.35 % of the ambient air quality standard (SO_2 24 hr average must not exceed 300 µg/m^3). For 21 sensitive receptor areas, the 24 hr average SO_2 concentration in the atmosphere was between 3.26-5.83 µg/m^3 or 1.09-1.94 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-62**.

When combining the above with the highest value from the current measurement, the highest 24 hr average SO_2 concentration in the atmosphere was 78.12 µg/m^3 or 26.04 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 9.02-60.41 µg/m^3 or 3.01-20.14 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

The highest SO_2 1 yr average concentration was found 13.48 km north-northwest (NNW) of the project area at coordinates: 728878 E 1431011 N where Ruean Tok Mountain is located. The value was 4.45 µg/m^3 or 4.45 % of the ambient air quality standard (SO_2 1 yr average must not exceed 100 µg/m^3). For 21 sensitive receptor areas, the SO_2 1 yr average concentration in the atmosphere was between 1.12-1.86 µg/m^3 or 1.12-1.86 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-63.**

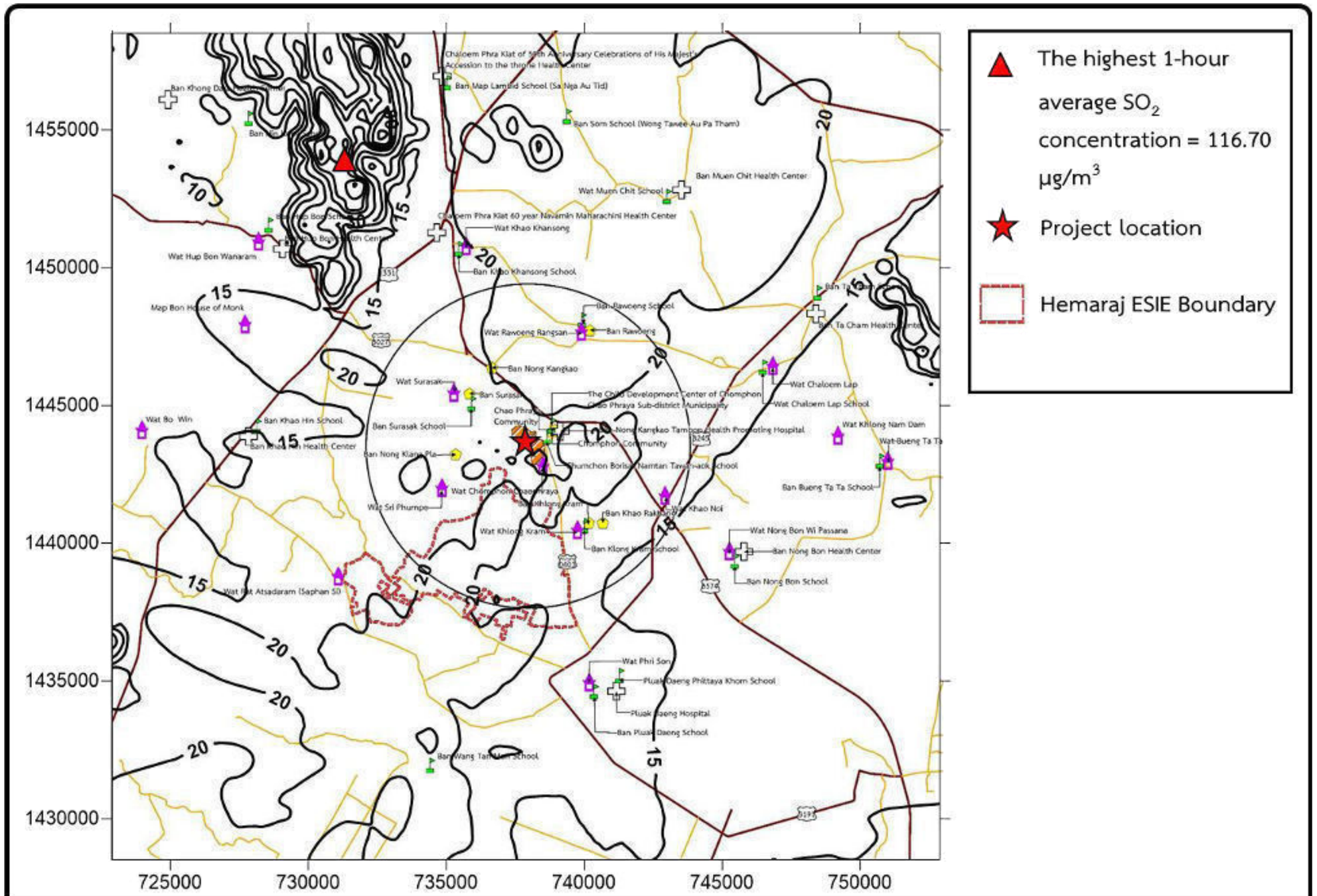


FIGURE 5.1.1.1-61 : CONTOUR MAP OF 1 HR AVERAGE SO_2 CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

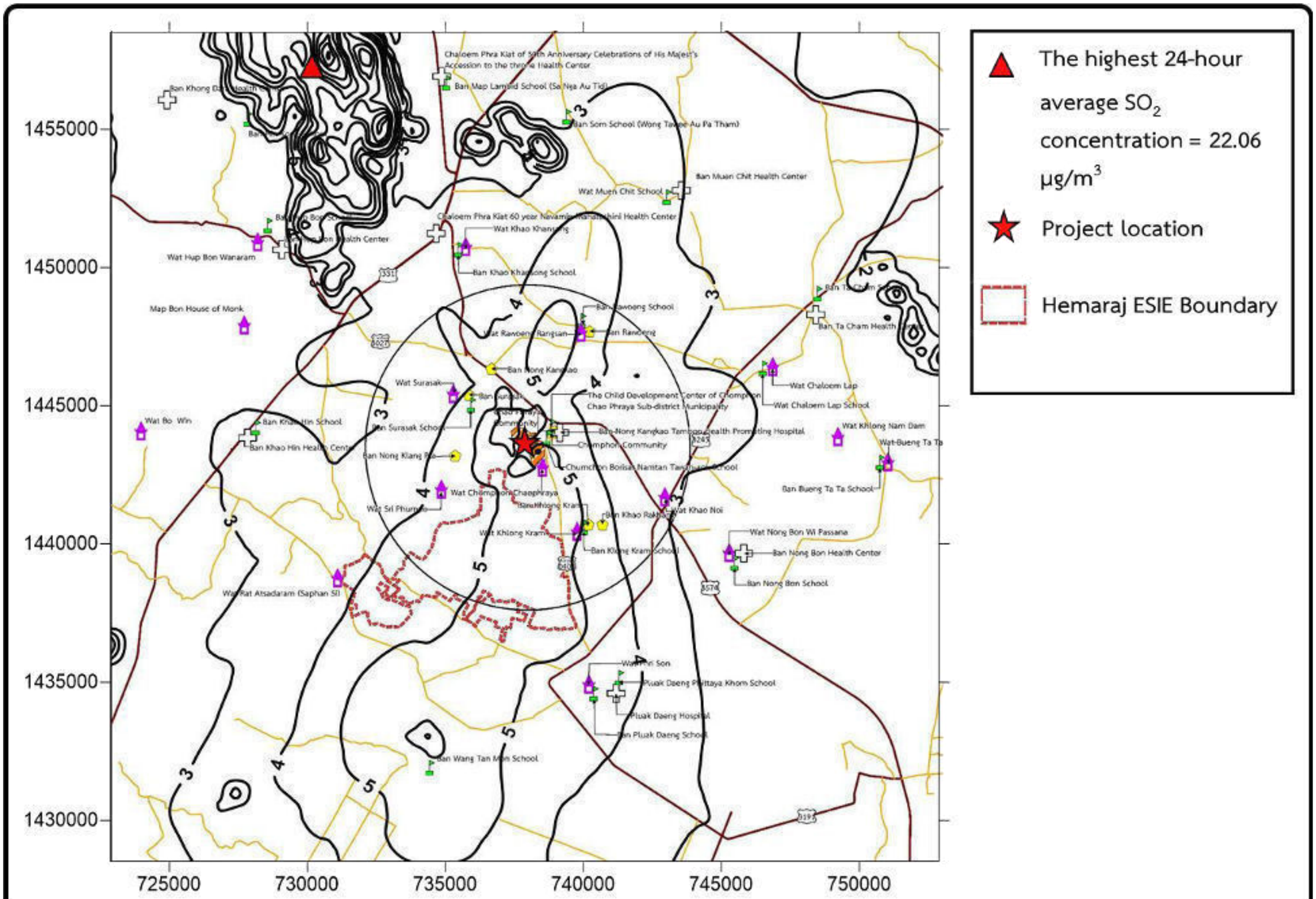


FIGURE 5.1.1.1-62 : CONTOUR MAP OF 24 HR AVERAGE SO_2 CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

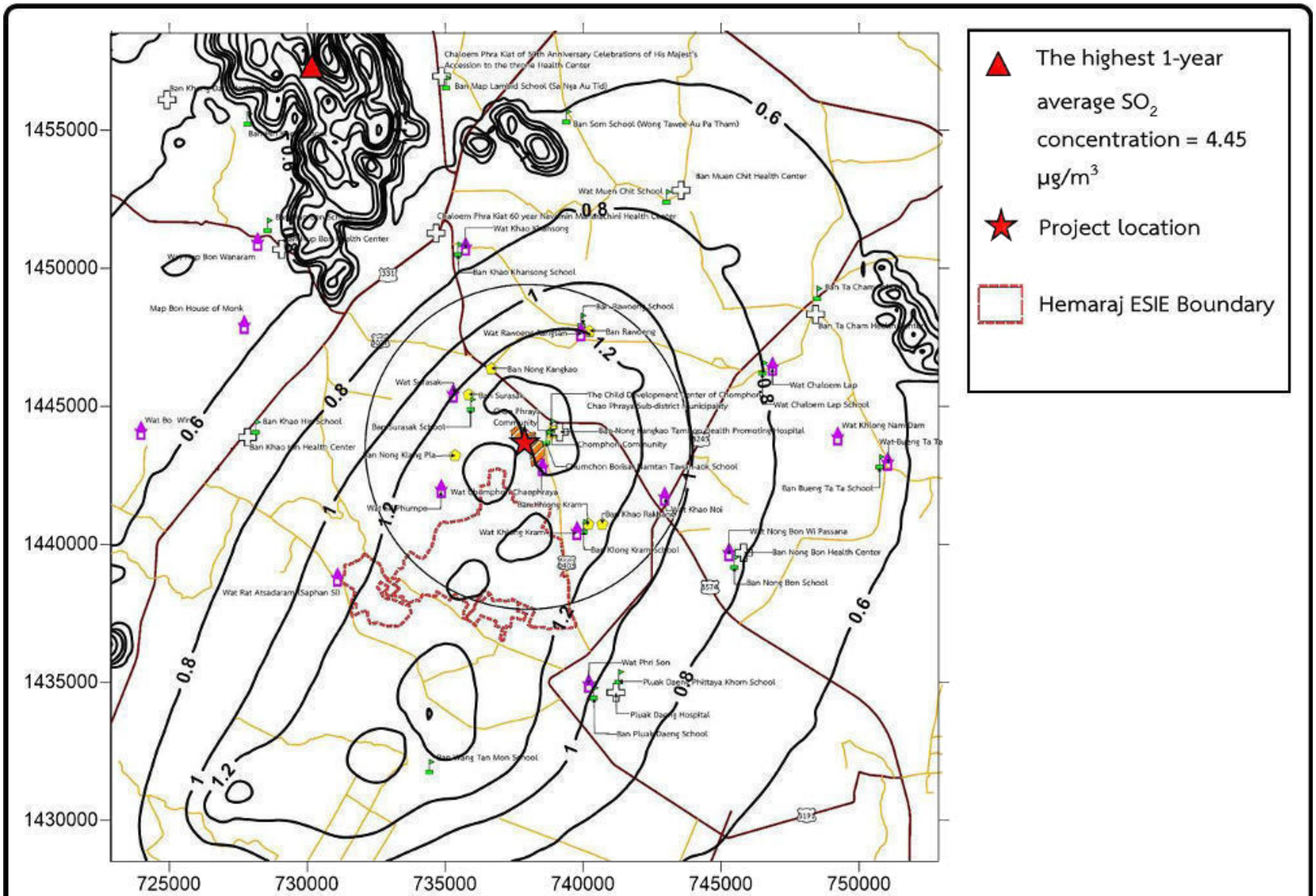


FIGURE 5.1.1.1-63 : CONTOUR MAP OF 1 YR AVERAGE SO_2 CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

When combining the above with the highest value from the current measurement, the highest concentration of SO_2 1 yr average in the atmosphere was 20.17 µg/m^3 or 20.17 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 2.89-17.24µg/m^3 or 2.89-17.24 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

- **24 hr average and 1 yr average TSP**

The operation of the project resulted in the general areas having the highest 24 hr average TSP concentration at 14.09 km north-northeast (NNE) of the project area at coordinates: 735878 E 1439511 N where Ruean Tok Mountain is located. The value was 14.74 µg/m^3 or 4.47 % of the ambient air quality standard (24 hr average TSP must not exceed 330 µg/m^3). For 21 sensitive receptor areas, the 24 hr average TSP concentration in the atmosphere was between 2.34-4.13 µg/m^3 or 0.71-1.25 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-64**.

The above value when combined with the existing data, the highest 24 hr average TSP concentration in the atmosphere was 185.60 µg/m^3 or 56.24 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 96.59-174.40 µg/m^3 or 29.27-52.85 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

The highest 1 yr average TSP concentration was found 13.48 km north-northwest (NNW) of the project area at coordinates: 735878 E 1439511 N where Chom Pho Mountain is located. The value was 2.67 µg/m^3 or 2.67 % of the ambient air quality standard (1 yr average TSP must not exceed 100 µg/m^3). For 21 sensitive receptor areas, the 1 yr average TSP concentration in the atmosphere was between 0.87-1.37 µg/m^3 or 0.87-1.37 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-65**.

When combining the above with the highest value from the current measurement, the highest 1 yr average TSP concentration in the atmosphere was 51.82 µg/m^3 or 51.82 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 29.45-50.27 µg/m^3 or 29.45-50.27 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

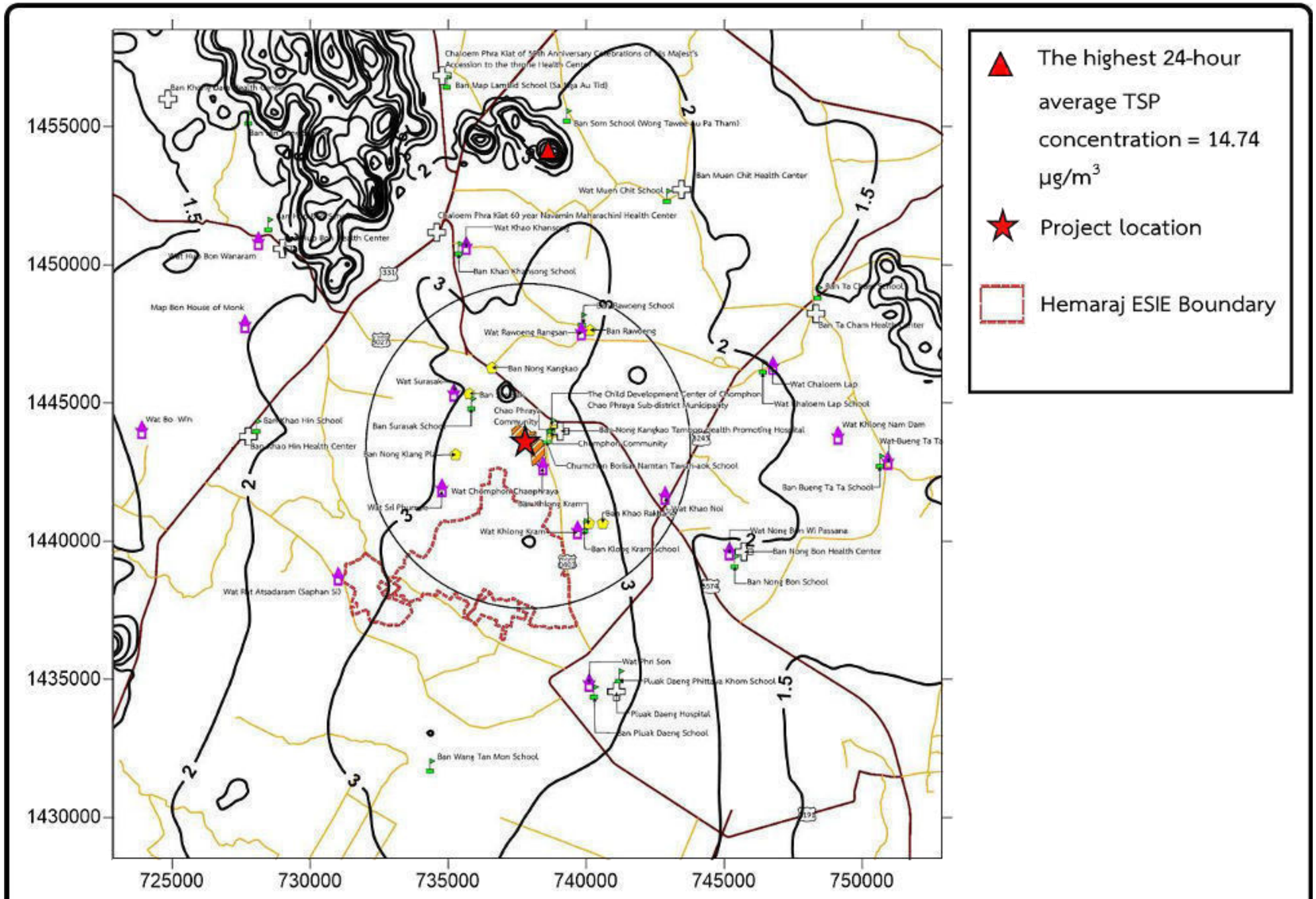


FIGURE 5.1.1.1-64 : CONTOUR MAP OF 24 HR AVERAGE TSP CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

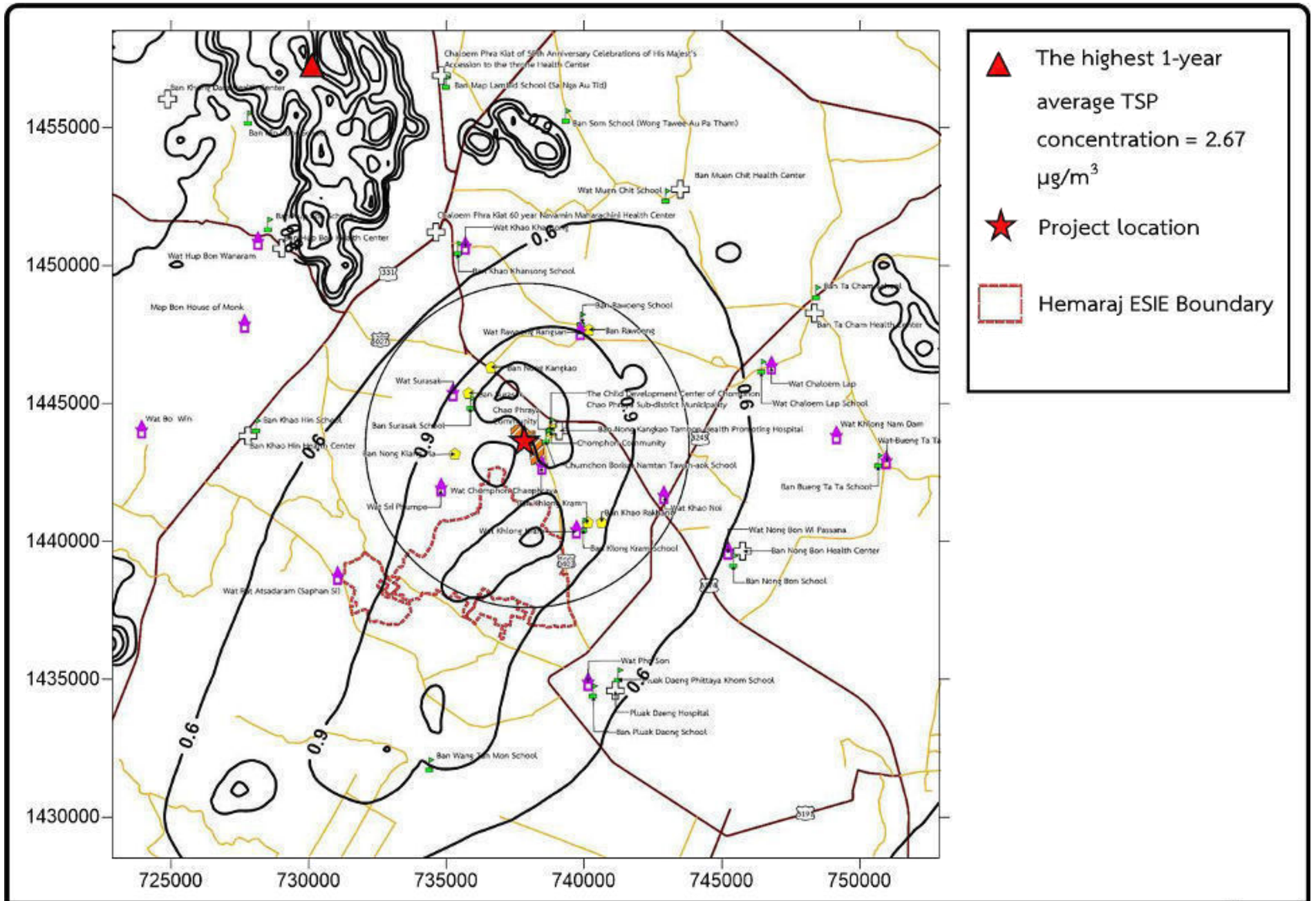


FIGURE 5.1.1.1-65 : CONTOUR MAP OF 1 YR AVERAGE TSP CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

- **24 hr average and 1 yr average PM-10**

The operation of the project resulted in the general areas having the highest 24 hr average PM-10 concentration at 14.09 km north-northeast (NNE) of the project area at coordinates: 735878 E 1439511 N where Ruean Tok Mountain is located. The value was 14.74 µg/m^3 or 12.28 % of the ambient air quality standard (24 hr average PM-10 must not exceed 120 µg/m^3). For 21 sensitive receptor areas, the 24 hr average TSP concentration in the atmosphere was between 2.34-4.13 µg/m^3 or 1.95-3.44 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-66**.

When combining the above with the highest value from the current measurement, the highest 24 hr average PM-10 concentration in the atmosphere was 116.74 µg/m^3 or 97.28 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 45.59-105.54 µg/m^3 or 37.99-87.95 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

The highest 1 yr average PM-10 concentration was found 13.48 km north-northwest (NNW) of the project area at coordinates: 735878 E 1439511 N where Chom Pho Mountain is located. The value was 2.67 µg/m^3 or 5.34 % of the ambient air quality standard (1 yr average PM-10 must not exceed 50 µg/m^3). For 21 sensitive receptor areas, the 1 yr average PM-10 concentration in the atmosphere was between 0.80-1.37 µg/m^3 or 1.60-2.74 % of the ambient air quality standard as shown in **Table 5.1.1.1-16** and **Figure 5.1.1.1-67**.

When combining the above with the highest value from the current measurement, the highest concentration of PM-10 1 yr average in the atmosphere was 45.67 µg/m^3 or 91.34 % of the ambient air quality standard. For 21 sensitive receptor areas, the value was between 13.78-44.12 µg/m^3 or 27.56-88.24 % of the ambient air quality standard as shown in **Table 5.1.1.1-16**.

(2.3) Circumstance with influence of downwash

According to the assessment of impact on air quality with influence of potential downwash due to the project's emission stack being lower than the height specified in the Guideline for Determination of Good Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised) U.S.EPA (1985), it was found that the levels of concentration of all air substances equal to the results from the assessment of impact of the 6 scenarios in a normal circumstance. This means it is not likely for downwash to occur with the air substances released through the project's emission stacks.

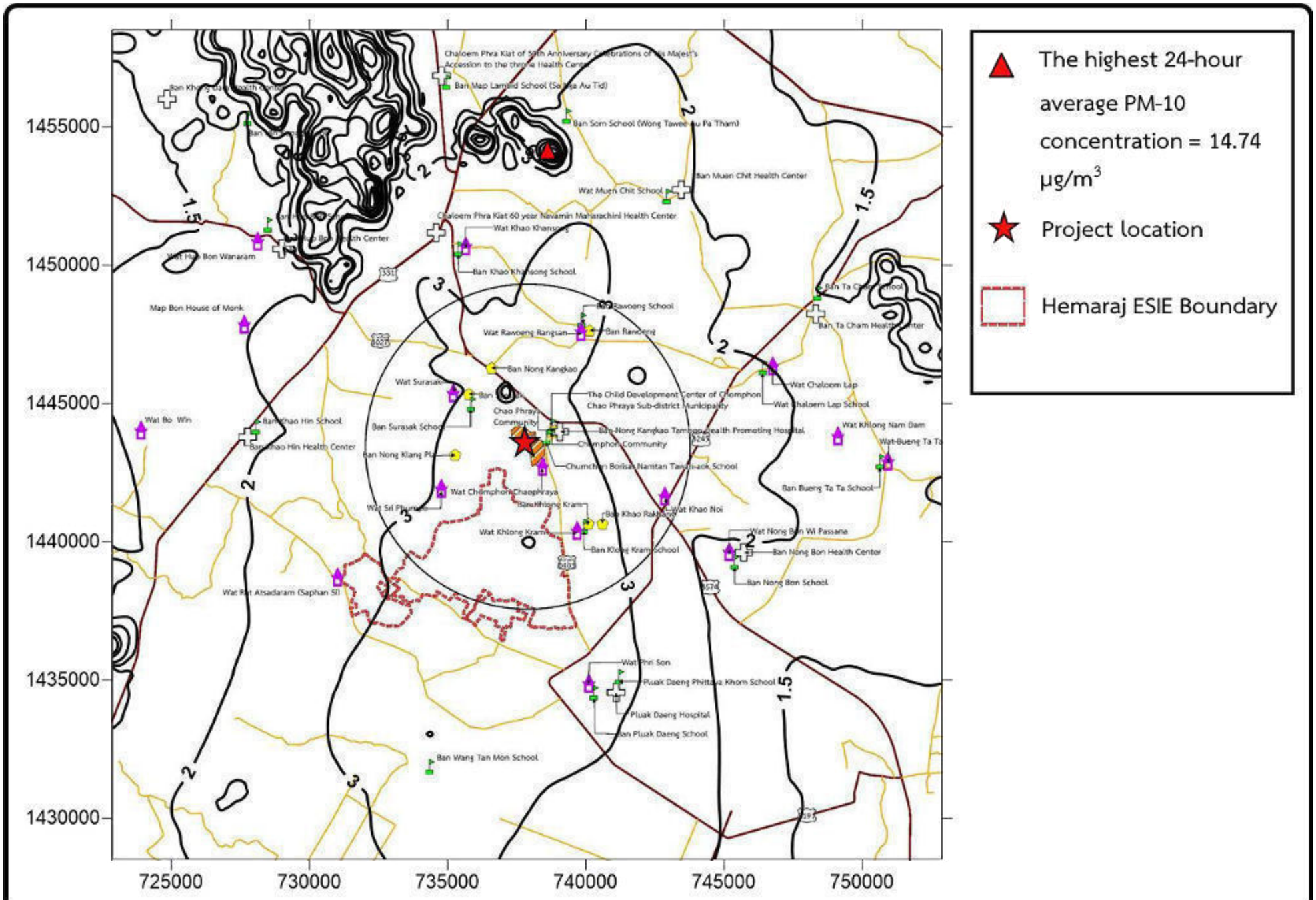


FIGURE 5.1.1.1-66 : CONTOUR MAP OF 24 HR AVERAGE PM-10 CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

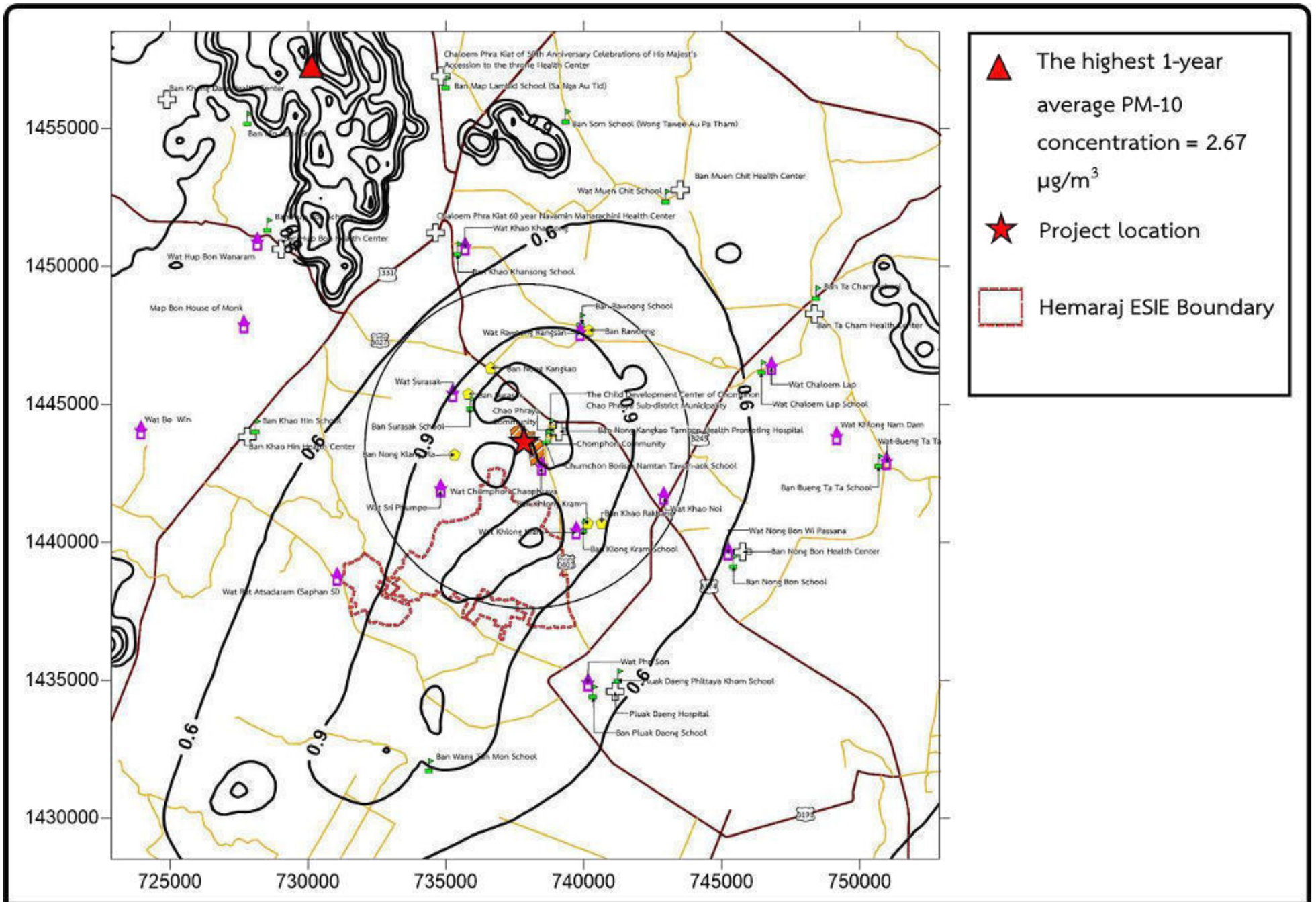


FIGURE 5.1.1.1-67 : CONTOUR MAP OF 1 YR AVERAGE PM-10 CONCENTRATION. SCENARIO 6 : IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100% LOAD, COMBINED WITH CURRENT IMPACT FROM OTHER INDUSTRIAL FACTORIES THAT HAVE BEEN APPROVED IN THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT BUT HAVE NOT YET RELEASED ANY AIR SUBSTANCE, AND FROM THE POWER PLANTS IN THE DEVELOPMENT PLAN BY GULF GROUP COMPANY THAT ARE LOCATED WITHIN THE RADIUS OF 15 KM FROM THE PROJECT LOCATION

Regarding the data from the design of the emission stack according to Good Engineering Practice: GEP which suggested that the height of the emission stack should be at least 65.68 m, there is no substantial difference between the specified height and the actual height of the project's emission stack at 60 m. So that the prediction of values for impact on air quality in a circumstance with influence of downwash were not different from the assessment of the specified impact in other scenarios. Details are as shown in **Table 5.1.1.1-17** to **Table 5.1.1.1-18**.

(5) Conclusion

Results of the prediction for air quality using mathematical model AERMOD shown the values of the highest concentration of air substances, including NO_2, SO_2, TSP and PM-10 in the atmosphere in 6 scenarios within the radius of 15 km of the project area. **Results of the prediction of 1 yr average substances in case of using natural gas as fuel were lower than the actual values due to the use of diesel as fuel during some operation periods. Also, the prediction of 1 yr average substances in case of using diesel as fuel were higher than the actual values** because the project primarily uses natural gas to generate electricity while diesel is the backup source in case PTT cannot deliver natural gas or the Electricity Generating Authority of Thailand orders testing and commissioning using diesel. The amount of diesel stored by the project is sufficient to operate for 3 days so that the assessment on air quality was designed to assess the case of operation that used single type of fuel throughout the year because it was not able to specify which type of fuel is used on which day.

Regarding the vicinity affected by air substances from the emission sources, 2 factors were considered: 1) the height of the area of the point of observation comparing with that of the emission source and 2) the location of the point of observation according to wind direction. Using, the mathematical model, the results of the prediction for ambient air quality corresponded to the above factors as described below.

1) Height: Point of sensitive area is higher than that of the emission source causing higher exposure than other areas

The highest 1 hr average SO_2 concentration, 24 hr average SO_2 concentration, 1 yr average SO_2 concentration, 1 yr average TSP concentration and PM-10 1 yr average concentration was found at northwest (NW) and north (N) of the project area which geographically features mountainous terrain at northwest (NW) and north (N) of the project. This resulted in the highest values of the substances caused by the project to be found primarily on the mountainous areas. The contour map of SO_2 1 hr average concentration is shown in **Figure 5.1.1.1-61**.

TABLE 5.1.1.1-17

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 1: IMPACT FROM SRIRACHA POWER PLANT WHEN NATURAL GAS IS USED AS FUEL AND OPERATED AT 100 % LOAD

Unit : µg/m^3

Study Area	Highest concentration value from results of assessment, case 1																										
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total
Highest concentration value	71.52	102.63[1/]	174.15	1.67	15.44[1/]	17.11	62.21	106.91[1/]	169.12	9.28	56.06[1/]	65.34	1.14	15.72[1/]	16.86	11.82	170.86[1/]	182.68	1.45	49.15[1/]	50.60	11.82	102[1/]	113.82	1.45	43[1/]	44.45
Coordinates	731878E, 1452011N			738278E, 1444211N			731878E, 1452011N			731878E, 1453011N			732378E, 1454511N			731878E, 1453011N			732378E, 1454511N			731878E, 1453011N			732378E, 1454511N		
Area	Nam Jone Mountain			vacant area within Hemaraj ESIE			Nam Jone Mountain			Nam Jone Mountain			Chomphu Mountain			Nam Jone Mountain			Chomphu Mountain			Nam Jone Mountain			Chomphu Mountain		
Direction and distance	NNW (10.34 km)			NE (0.81 km)			NNW (10.34 km)			NNW (11.27 km)			NNW (12.34 km)			NNW (11.27 km)			NNW (12.34 km)			NNW (11.27 km)			NNW (12.34 km)		
Land utilization	Mountain			vacant area			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain		
Sensitive Area																											
1. Ban Nong Kangkao Tambon Health Promoting Hospital	17.68	31.8	49.48	1.56	5.18	6.74	7.22	11.53	18.75	1.76	6.29	8.05	0.62	1.93	2.55	2.24	129	131.24	0.79	39.64	40.43	2.24	67	69.24	0.79	20.59	21.38
2. Ban Rawoeng School	19.31	38.01	57.32	0.75	6.19	6.94	6.88	9.43	16.31	1.27	5.76	7.03	0.27	1.77	2.04	1.61	93	94.61	0.34	28.58	28.92	1.61	42	43.61	0.34	12.91	13.25
3. Ban Surasak School	17.48	47.23	64.71	0.74	7.69	8.43	8.61	11.27	19.88	1.13	6.29	7.42	0.27	1.93	2.20	1.44	153	154.44	0.34	47.01	47.35	1.44	81	82.44	0.34	24.89	25.23
4. Chumchon Borisat Namtan Tawan-aok School	19.59	31.8	51.39	1.63	5.18	6.81	10.28	11.53	21.81	2.73	6.29	9.02	0.73	1.93	2.66	3.47	129	132.47	0.93	39.64	40.57	3.47	67	70.47	0.93	20.59	21.52
5. Ban Khlong Kram School	12.66	37.26	49.92	0.57	6.06	6.63	6.57	9.43	16.00	1.39	5.76	7.15	0.24	1.77	2.01	1.77	131	132.77	0.3	40.25	40.55	1.77	61	62.77	0.3	18.74	19.04
6. Wat Rawoeng Rangsan	19.95	38.01	57.96	0.77	6.19	6.96	7.05	9.43	16.48	1.28	5.76	7.04	0.27	1.77	2.04	1.63	93	94.63	0.35	28.58	28.93	1.63	42	43.63	0.35	12.91	13.26
7. Wat Surasak	18.35	47.23	65.58	0.64	15.44	16.08	8.36	12.84	21.20	1.08	7.34	8.42	0.23	15.72	15.95	1.37	118	119.37	0.29	49.15	49.44	1.37	45	46.37	0.29	43	43.29
8. Wat Chompon Chao Phraya	18.47	47.23	65.70	1.17	15.44	16.61	12.13	11.27	23.40	2.5	6.29	8.79	0.47	15.72	16.19	3.18	153	156.18	0.6	49.15	49.75	3.18	81	84.18	0.6	43	43.60
9. Wat Khlong Kram	12.51	37.26	49.77	0.55	6.06	6.61	6.58	9.43	16.01	1.39	5.76	7.15	0.23	1.77	2.00	1.77	131	132.77	0.29	40.25	40.54	1.77	61	62.77	0.29	18.74	19.03
10. Wat Khao Noi	11.69	37.26	48.95	0.58	6.06	6.64	6.2	9.43	15.63	1.13	5.76	6.89	0.21	1.77	1.98	1.44	131	132.44	0.27	40.25	40.52	1.44	61	62.44	0.27	18.74	19.01
11. Wat Sri Phumpo	13.15	34.25	47.40	0.78	5.57	6.35	7.2	12.84	20.04	1.08	7.34	8.42	0.29	2.26	2.55	1.37	118	119.37	0.37	36.26	36.63	1.37	45	46.37	0.37	13.83	14.20
12. Moo 7 Ban Rawoeng, Khao Khansong Sub-district	19.84	38.01	57.85	0.76	6.19	6.95	7.06	9.43	16.49	1.24	5.76	7.00	0.27	1.77	2.04	1.58	93	94.58	0.34	28.58	28.92	1.58	42	43.58	0.34	12.91	13.25
13. Moo 5 Ban Surasak, Khao Khansong Sub-district	18.74	47.23	65.97	0.7	7.69	8.39	8.96	11.27	20.23	1.16	6.29	7.45	0.25	1.93	2.18	1.48	153	154.48	0.32	47.01	47.33	1.48	81	82.48	0.32	24.89	25.21
14. Moo 7 Ban Nong Kang Pla, Bowin Sub-district	14.49	34.25	48.74	0.82	5.57	6.39	8.62	12.84	21.46	1.12	7.34	8.46	0.3	2.26	2.56	1.43	118	119.43	0.39	36.26	36.65	1.43	45	46.43	0.39	13.83	14.22
15. Moo 3 Ban Nong Kangkao, Ta Sit Sub-district	22.74	102.63	125.37	0.7	15.44	16.14	9.02	106.91	115.93	1.26	56.06	57.32	0.25	11.26	11.51	1.6	170.86	172.46	0.32	49.15	49.47	1.6	102	103.60	0.32	33.92	34.24
16. Moo 2 Ban Khao Rakhang, Ta Sit Sub-district	11.67	37.26	48.93	1	6.06	7.06	6.6	9.43	16.03	1.1	5.76	6.86	0.37	1.77	2.14	1.4	131	132.40	0.47	40.25	40.72	1.4	61	62.40	0.47	18.74	19.21
17. Moo 1 Ban Khlong Kram, Ta Sit Sub-district	12.41	37.26	49.67	0.58	6.06	6.64	6.23	9.43	15.66	1.35	5.76	7.11	0.24	1.77	2.01	1.72	131	132.72	0.3	40.25	40.55	1.72	61	62.72	0.3	18.74	19.04
18. Chao Phraya Community, Chompon Chao Phraya Sub-district Municipality	18.56	31.8	50.36	1.64	5.18	6.82	9.01	11.53	20.54	2.48	6.29	8.77	0.68	1.93	2.61	3.16	129	132.16	0.87	39.64	40.51	3.16	67	70.16	0.87	20.59	21.46

TABLE 5.1.1.1-17

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 1: IMPACT FROM SRIRACHA POWER PLANT WHEN NATURAL GAS IS USED AS FUEL AND OPERATED AT 100 % LOAD (Cont'd)

Unit : µg/m^3

Study Area	Highest concentration value from results of assessment, case 1																							
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total
19. Chompon Community, Chompon Chao Phraya Sub-district Municipality	18.11	31.8	49.91	1.62	5.18	6.80	8.18	11.53	19.71	2.26	6.29	8.55	0.65	1.93	2.58	2.88	129	131.88	0.83	39.64	40.47	2.88	67	69.88	0.83	20.59	21.42
20. The Praow Village	17.03	47.23	64.26	1.09	7.69	8.78	10.45	11.27	21.72	1.79	6.29	8.08	0.44	1.93	2.37	2.28	153	155.28	0.56	47.01	47.57	2.28	81	83.28	0.56	24.89	25.45
21. The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	19.22	31.8	51.02	1.65	5.18	6.83	8.33	11.53	19.86	2.7	6.29	8.99	0.67	1.93	2.60	3.44	129	132.44	0.86	39.64	40.50	3.44	67	70.44	0.86	20.59	21.45
Standard[3/]	320			57			780			300			100			330			100			120			50		

Remark : [1/] Reference **Table 5.1.1.1-3** Highest values from ambient air quality monitoring near the project area.

[2/] Reference **Table 5.1.1.1-4** Highest value of the current air quality monitoring used as representative at sensitive receptors.

[3/] Standard reference:

- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 24 B.E.2547 (2004)
- Ambient nitrogen dioxide standard in accordance with the notification of National Environmental Committee Vol. 33 B.E.2552 (2009)
- Ambient sulfur dioxide 1 hour standard in accordance with the notification of National Environmental Committee Vol. 12 B.E.2538 (1995)
- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 10 B.E.2538 (1995)

Source : Team Consulting Engineering and Management Co., Ltd., 2015

TABLE 5.1.1.1-18

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 4: IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100 % LOAD

Unit : μg/m^3

Study Area	Highest concentration value from results of assessment, case 4																								
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total
Highest concentration value	44.09	102.63[1/]	146.72	0.98	15.44[1/]	16.42	116.38	106.91[1/]	223.29	19.29	56.06[1/]	75.35	2.58	15.72[1/]	18.30	11.74	170.86[1/]	182.60	1.58	49.15[1/]	50.73	11.74	102[1/]	113.74	1.58	43[1/]	44.58
Coordinates	730878E, 1455011N			738378E, 1444711N			731878E, 1453011N			730378E, 1454511N			732378E, 1455011N			730378E, 1454511N			732378E, 1455011N			730378E, 1454511N			732378E, 1455011N		
Area	Chomphu Mountain			Industrial			731878E, 1452011N			Chomphu Mountain			Chomphu Mountain			Chomphu Mountain			Chomphu Mountain			Chomphu Mountain			Chomphu Mountain		
Direction and distance Land utilization	NNW (13.48 km)			NNE (1.32 km)			NNW (11.27 km)			NNW (12.34 km)			NW (13.34 km)			NNW (12.34 km)			NW (13.34 km)			NNW (12.34 km)			NW (13.34 km)		
Sensitive Area	Mountain			Industrial Estate			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain			Mountain		
1. Ban Nong Kangkao Tambon Health Promoting Hospital	12.67	31.8	44.47	0.93	5.18	6.11	14.89	11.53	26.42	3.43	6.29	9.72	1.1	1.93	3.03	2.10	129	131.10	0.68	39.64	40.32	2.10	67	69.10	0.68	20.59	21.27
2. Ban Rawoeng School	13.40	38.01	51.41	0.6	6.19	6.79	14.52	9.43	23.95	2.80	5.76	8.56	0.65	1.77	2.42	1.71	93	94.71	0.40	28.58	28.98	1.71	42	43.71	0.40	12.91	13.31
3. Ban Surasak School	11.48	47.23	58.71	0.58	7.69	8.27	15.43	11.27	26.70	2.49	6.29	8.78	0.63	1.93	2.56	1.52	153	154.52	0.39	47.01	47.40	1.52	81	82.52	0.39	24.89	25.28
4. Chumchon Borisat Namtan Tawan-aok School	11.60	31.8	43.40	0.82	5.18	6.00	18.40	11.53	29.93	4.67	6.29	10.96	1.11	1.93	3.04	2.85	129	131.85	0.68	39.64	40.32	2.85	67	69.85	0.68	20.59	21.27
5. Ban Khlong Kram School	9.06	37.26	46.32	0.46	6.06	6.52	13.09	9.43	22.52	3.20	5.76	8.96	0.57	1.77	2.34	1.95	131	132.95	0.35	40.25	40.60	1.95	61	62.95	0.35	18.74	19.09
6. Wat Rawoeng Rangsan	13.45	38.01	51.46	0.62	6.19	6.81	14.43	9.43	23.86	2.81	5.76	8.57	0.67	1.77	2.44	1.71	93	94.71	0.41	28.58	28.99	1.71	42	43.71	0.41	12.91	13.32
7. Wat Surasak	12.76	47.23	59.99	0.52	15.44	15.96	14.93	12.84	27.77	2.12	7.34	9.46	0.56	15.72	16.28	1.29	118	119.29	0.34	49.15	49.49	1.29	45	46.29	0.34	43	43.34
8. Wat Chompon Chao Phraya	12.24	47.23	59.47	0.65	15.44	16.09	23.61	11.27	34.88	4.53	6.29	10.82	0.79	15.72	16.51	2.75	153	155.75	0.48	49.15	49.63	2.75	81	83.75	0.48	43	43.48
9. Wat Khlong Kram	8.68	37.26	45.94	0.45	6.06	6.51	13.33	9.43	22.76	3.19	5.76	8.95	0.56	1.77	2.33	1.95	131	132.95	0.34	40.25	40.59	1.95	61	62.95	0.34	18.74	19.08
10. Wat Khao Noi	8.36	37.26	45.62	0.47	6.06	6.53	11.6	9.43	21.03	2.36	5.76	8.12	0.52	1.77	2.29	1.44	131	132.44	0.32	40.25	40.57	1.44	61	62.44	0.32	18.74	19.06
11. Wat Sri Phumpo	9.55	34.25	43.80	0.62	5.57	6.19	13.25	12.84	26.09	2.48	7.34	9.82	0.70	2.26	2.96	1.51	118	119.51	0.43	36.26	36.69	1.51	45	46.51	0.43	13.83	14.26
12. Moo 7 Ban Rawoeng, Khao Khansong Sub-district	13.42	38.01	51.43	0.61	6.19	6.80	14.57	9.43	24.00	2.75	5.76	8.51	0.66	1.77	2.43	1.68	93	94.68	0.41	28.58	28.99	1.68	42	43.68	0.41	12.91	13.32
13. Moo 5 Ban Surasak, Khao Khansong Sub-district	12.61	47.23	59.84	0.55	7.69	8.24	16.12	11.27	27.39	2.32	6.29	8.61	0.6	1.93	2.53	1.42	153	154.42	0.37	47.01	47.38	1.42	81	82.42	0.37	24.89	25.26
14. Moo 7 Ban Nong Kang Pla, Bowin Sub-district	9.32	34.25	43.57	0.64	5.57	6.21	15.70	12.84	28.54	2.71	7.34	10.05	0.72	2.26	2.98	1.65	118	119.65	0.44	36.26	36.70	1.65	45	46.65	0.44	13.83	14.27
15. Moo 3 Ban Nong Kangkao, Ta Sit Sub-district	13.13	102.63	115.76	0.55	15.44	15.99	14.87	106.91	121.78	2.76	56.06	58.82	0.6	11.26	11.86	1.69	170.86	172.55	0.37	49.15	49.52	1.69	102	103.69	0.37	33.92	34.29
16. Moo 2 Ban Khao Rakhang, Ta Sit Sub-district	8.35	37.26	45.61	0.74	6.06	6.80	12.85	9.43	22.28	2.54	5.76	8.30	0.83	1.77	2.60	1.55	131	132.55	0.51	40.25	40.76	1.55	61	62.55	0.51	18.74	19.25
17. Moo 1 Ban Khlong Kram, Ta Sit Sub-district	9.08	37.26	46.34	0.47	6.06	6.53	12.69	9.43	22.12	3.14	5.76	8.90	0.57	1.77	2.34	1.92	131	132.92	0.35	40.25	40.60	1.92	61	62.92	0.35	18.74	19.09

TABLE 5.1.1.1-18

RESULTS FROM THE ASSESSMENT ON AMBIENT AIR QUALITY USING MATHEMATICAL MODEL AERMOD COMBINED WITH THE HIGHEST VALUE FROM THE CURRENT MEASUREMENT IN NORMAL CIRCUMSTANCE (WITH NO INFLUENCE OF DOWNWASH)

SCENARIO 4: IMPACT FROM SRIRACHA POWER PLANT WHEN DIESEL IS USED AS FUEL AND OPERATED AT 100 % LOAD (Cont'd)

Unit : µg/m^3

Study Area	Highest concentration value from results of assessment, case 4																								
	NO_2 average 1 hr			NO_2 average 1 yr			SO_2 average 1 hr			SO_2 average 24 hr			SO_2 average 24 yr			TSP average 24 hr			TSP average 1 yr			PM-10 average 24 hr			PM-10 average 1 yr		
	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	total	model	monitor[2/]	Total	model	monitor[2/]	total	model	monitor[2/]	total
18. Chao Phraya Community, Chompon Chao Phraya Sub-district Municipality	12.59	31.8	44.39	0.92	5.18	6.10	17.10	11.53	28.63	4.45	6.29	10.74	1.14	1.93	3.07	2.72	129	131.72	0.70	39.64	40.34	2.72	67	69.72	0.70	20.59	21.29
19. Chompon Community, Chompon Chao Phraya Sub-district Municipality	12.62	31.8	44.42	0.94	5.18	6.12	16.05	11.53	27.58	4.15	6.29	10.44	1.13	1.93	3.06	2.54	129	131.54	0.69	39.64	40.33	2.54	67	69.54	0.69	20.59	21.28
20. The Praow Village	10.69	47.23	57.92	0.55	7.69	8.24	18.41	11.27	29.68	3.18	6.29	9.47	0.68	1.93	2.61	1.95	153	154.95	0.42	47.01	47.43	1.95	81	82.95	0.42	24.89	25.31
21. The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	12.26	31.8	44.06	0.95	5.18	6.13	15.89	11.53	27.42	4.79	6.29	11.08	1.16	1.93	3.09	2.93	129	131.93	0.71	39.64	40.35	2.93	67	69.93	0.71	20.59	21.30
Standard[2/]	320			57			780			300			100			330			100			120			50		

Remark : [1/] Reference **Table 5.1.1.1-3** Highest values from ambient air quality monitoring near the project area.

[2/] Reference **Table 5.1.1.1-4** Highest value of the current air quality monitoring used as representative at sensitive receptors.

[3/] Standard reference:

- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 24 B.E.2547 (2004)
- Ambient nitrogen dioxide standard in accordance with the notification of National Environmental Committee Vol. 33 B.E.2552 (2009)
- Ambient sulfur dioxide 1 hour standard in accordance with the notification of National Environmental Committee Vol. 12 B.E.2538 (1995)
- Ambient air quality standard in accordance with the notification of National Environmental Committee Vol. 10 B.E.2538 (1995)

Source : Team Consulting Engineering and Management Co., Ltd., 2015

2) Location: Points of sensitive area in downwind received higher concentration of air substances **than those of upwind.**

When considered the primary direction of wind of the project at AQMS at Ta Sit Sub-district Administrative Organization during 2012-2015 as shown in **Figure 5.1.1.1-4,** the study found that most of the winds were from the southwest and northeast directions which caused the sensitive receptor areas downwind to have higher values of concentration of air substances than those in other areas.

In addition, when considered worst-case scenarios (Scenario 3 and Scenario 6), the project's impact, considering both cases of using natural gas and diesel with operation at 100 % load, combined with current impact from other industrial factories that have been approved in the environmental impact assessment report but have not yet released any air substance, and from the power plants in the development plan by Gulf Group Company that are located within the radius of 15 km from the project location, the highest 1 hr average NO_2 and SO_2 concentration are found at Nam Jone Mountain and Mai Rai Mountain which are 800 m above mean sea level which comprise 3 types of forests including mixed deciduous forest at the mountain foot which changes in appearance in each season, dry evergreen forest near the brooks and tropical rain forest at the top. When combined all these with existing monitoring data, the highest values are as follows:

Air Pollutant	the highest concentration of worst scenario (Scenario 3 and Scenario 6) combined with existing concentration (µg/m^3)	
	Average 1 hr	Average 1 yr
NO_2	289.93	21.60
SO_2	223.61	20.17

When comparing the above results with the values of ambient air quality standard by US.EPA (2010) that specifies standard values to prevent damage to animals, plants and buildings as shown in **Table 5.1.1.1-19**, the study found that the highest concentrations of air substances caused by the development of the project were in line with the specified standard and did not cause impact to living creatures in the forest areas as well as in the sensitive receptor areas surrounding the project area. Therefore, the study predicted that the project operation will result in moderate impact on air quality. Accordingly, the project can reduce the impact on air quality by establishing environmental impact mitigation and preventive measures and environmental impact monitoring

measures for strict compliance which will minimize impact on air quality caused by the project as details shown in **Chapter 9**.

TABLE 5.1.1.1-19

AMBIENT AIR QUALITY STANDARD OF U.S.

Pollutant	Primary/Secondary	Average of Time	Concentration	Remark
NO_2	Primary	1 hr	100 ppb or 183 µg/m^3	98th percentile, averaged over 3 yr
	Primary/Secondary	1 yr	53 ppb or 100 µg/m^3	Annual mean
SO_2	Primary	1 hr	75 ppb or 196 µg/m^3	99th percentile of 1 hr daily maximum concentrations, average over 3 yr
	Secondary	3 hr	0.5 ppm or 1,310 µg/m^3	Not to be exceeded more then once per year

Remark : - Primary Standard provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly
- Secondary Standard provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Source: Applied from National Ambient Air Quality Standards (NAAQS) (US.EPA, 2011) http://www.3.epa.gov/tth/naaqgs/criteria.htm (find on 5 November 2015)

Mitigation Measures

(a) Construction Period

- Trucks carrying construction materials must be covered and/or having items being carried tied up to prevent the materials from falling and to reduce the amount of dispersion of suspended particulate.
- Spray water in the construction area, the soil mounds or where project construction activities causes the dispersion of suspended particulate, such as the road, the area undergoing filling and grading, etc. to reduce the dispersion of the suspended particulate, at least two times/day (morning and afternoon) and more as necessary.
- Inspect and maintain condition of engines/machines used in the construction to reduce the emission of air pollutants regularly, each month.

- Install shading nets or fences with the height of 3 meters from the ground around the project construction to prevent suspended particulate from the construction.
- Assign workers cleaning up traffic surface in the area in front of the project area after the entry or exit of the delivery trucks.
- Wash tires of the delivery trucks leaving the construction area or area related to the construction activities to prevent the debris of earth and sand from falling on the road surfaces both inside and outside the project area.
- Prohibit the burning of scrap materials or garbage in the construction area.
- Limit the speed of vehicles in the construction area not to exceed 20 kilometers/hour, not exceeding 40 kilometers/hour in the urban area and no more not exceeding 80kilometers/hour on highways.
- Limit the use of the construction area to the absolute necessities and to proceed with the construction promptly.

(b) Operation Period

- Install Continuous Emission Monitoring System; (CEMs) at the stack of the power plant in order to continuously monitoring parameters including Oxides of Nitrogen (NO_X) Sulfur Dioxide (SO_2) Suspended Particulate (TSP) Oxygen (O_2) and the flow rate, display the measurement result (NO_X, SO_2 and TSP) on the screen in the front of the project site, send the report to Hemaraj Eastern Seaboard Industrial Estate (Hemaraj ESIE) throughout the project's duration.
- Inspect and calibrate instruments for the measurement of air quality at the stack (Audit CEMS) each year throughout the project's duration
- Control the rate of emission of are pollutants from the stack not to be higher than the limit pre-set in the Environmental Impacts Assessment as follow:

Case of natural gas firing

Capacity 100% load

- SO_2 : concentration not to exceed 5.5 ppm at 7% O_2
  and emission rate not to exceed 6.17 g/s/stack
- NO_x : concentration not to exceed 24.8 ppm at 7% O_2

and emission rate not to exceed 20 g/s/stack

- Particulate : concentration not to exceed 20 mg/m^3
  and emission rate not to exceed 7.86 g/s/stack

Capacity 60% load

- SO_2 : concentration not to exceed 5.5 ppm at 7% O_2
  and emission rate and not to exceed 3.96g/s/stack
- NO_x : concentration not to exceed 24.8ppm at 7% O_2
  and emission rate not to exceed 12.84 g/s/stack
- Particulate : concentration not to exceed 20 mg/m^3
  and emission rate not to exceed 5.04 g/s/stack

Case of diesel oil

Capacity 100% load

- SO_2 : concentration not to exceed 20 ppm at 7% O_2
  and emission rate and not to exceed 18.95 g/s/stack
- NO_x : concentration not to exceed 29.4 ppm at 7% O_2
  and emission rate and not to exceed 20 g/s/stack
- Particulate : concentration not to exceed 35 mg/m^3
  and emission rate and not to exceed 11.60 g/s/stack

Capacity 69% load

- SO_2 : concentration not to exceed 20 ppm at 7% O_2
  and emission rate and not to exceed 16.02 g/s/stack
- NO_x : concentration not to exceed 29.4 ppm at 7% O_2
  and emission rate and not to exceed 16.92 g/s/stack
- Particulate : concentration not to exceed 35 mg/m^3
  and emission rate and not to exceed 9.81 g/s/stack
- If natural gas is used, control the formation of the Oxides of Nitrogen by using the Dry Low NO_x type of NO_x (DLN) control system and the system of Selective Catalytic Reduction (SCR).

- If diesel is used, control the formation of the Oxides of Nitrogen by using Water Injection type of NO_x control system and the system of Selective Catalytic Reduction (SCR)
- The concentration value of the Air pollutants as mentioned above is calculated under the normal condition at 25°C and the atmospheric pressure of 1 and volume of excessive Oxygen from combustion at 7%.
- In case of breakdown of the air pollutant control system and the rate of emission exceeds the controlled level, the project will stop the gas turbine in order to inspect the NOx control system and to take corrective action promptly.
- Provide competent personnel to control air pollutant emission rate of the Project.

5.1.1.2 Noise

The noise impacts on sound sensitive premises adjacent to Sriracha Power Plant Project's vicinity were assessed in four locations: Chumchon Borisat Namtan Tawan-aok School and The Child Development Center of Chomphon Chao Phraya Sub-district Municipality, in the northeast of the site; and, Wat Chompon Chao Phraya and The Praow Village, in the south of the site, as illustrated in **Figure 5.1.1.2-1**. The impacts of both construction period and operation period were examined with details as follows.

(1) Construction Period

Noise impacts may occur as a result of construction activities of Sriracha Power Plant in Hemaraj Eastern Seaboard Industrial Estate (Hemaraj ESIE), Chon Buri Province, including transportation of construction materials, operation of heavy equipment, pile drivers, construction of pipelines, etc. These noise levels may affect people living in the sensitive areas nearby. Data from *Environmental Impact Assessment* (Canter, 1997) show the maximum sound pressure level (L_{max}) measured during different construction stages covering land grading, foundation excavating and building, structures building, and finishing. Details are as shown in **Table 5.1.1.2-1**.

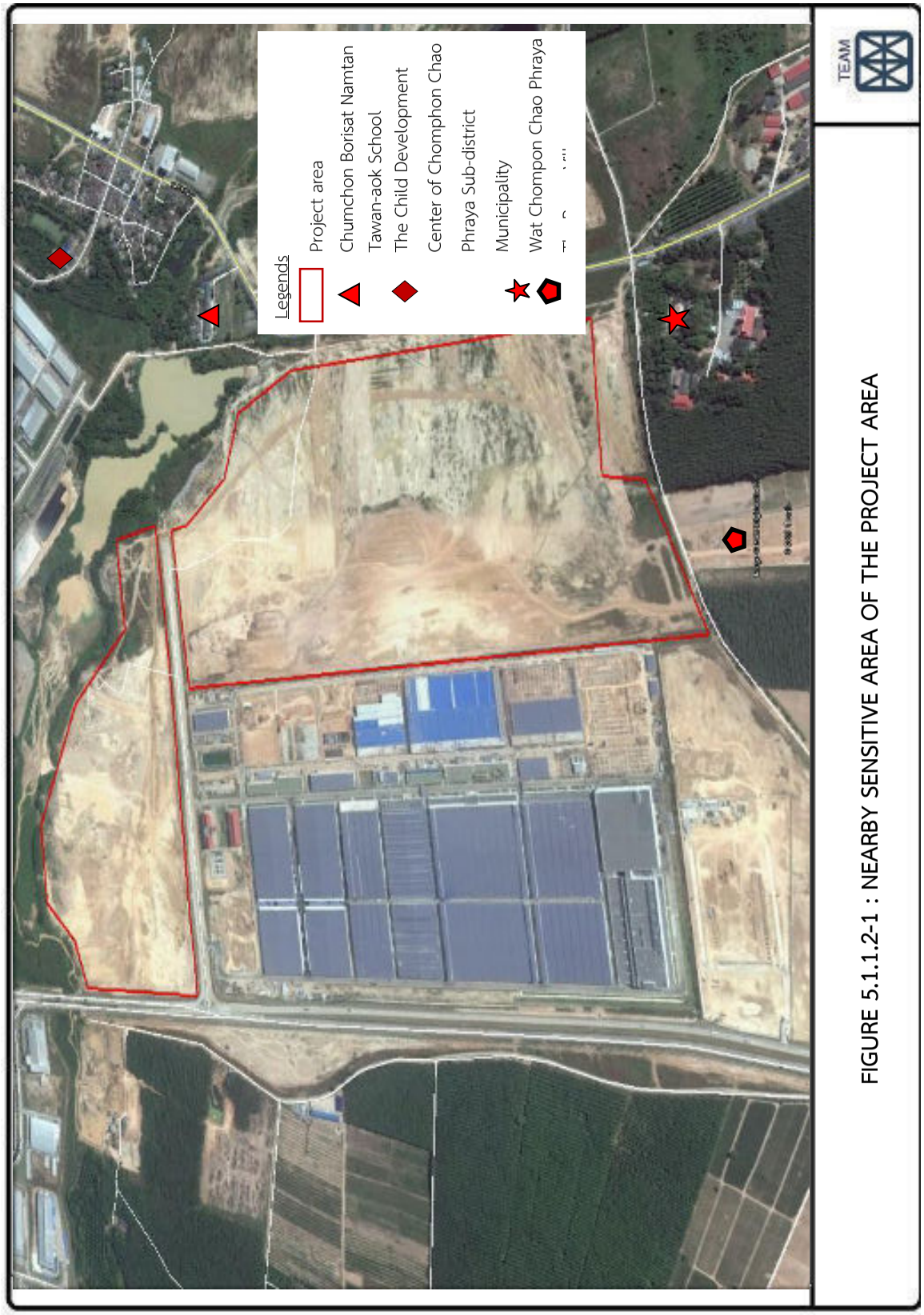


FIGURE 5.1.1.2-1 : NEARBY SENSITIVE AREA OF THE PROJECT AREA

TABLE 5.1.1.2-1

NOISE LEVELS IN EACH CONSTRUCTION STAGE OF EACH CONSTRUCTION ACTIVITY

(NOISE LEVEL AT 15 METERS FROM THE SOURCE)

Units : dB(A)

Activity	Type of Building							
	Domestic Housing		Office Building, Hotel, School, Public Works		Industrial Parking Store, Service Station		Road, Highway Sewer	
	I	II	I	II	I	II	I	II
– Ground clearing	83	83	84	84	84	83	84	84
– Excavation	88	75	89	79	89	71	88	78
– Foundation	81	81	78	78	77	77	88	88
– Structure	81	65	87	75	84	72	79	78
– Finishing	88	72	89	75	89	74	84	84

Remark : I = All Pertinent Equipment

II = Minimum Requirement

Source : Carry W. Canter, Environmental Impact Assessment, 1997

As a power plant is categorized as one of industrial buildings with the type and constructions as shown in **Table 5.1.1.2-1**, in case all machinery or pertinent equipment are operated at the same time, the machinery or equipment used in the excavation for the foundation work will generate the maximum sound pressure level at 89 dB(A) at 15 m distance. Therefore, the noise impact assessment is based on this figure as representative of noise in the worst case scenario during the construction period.

(a) Sound Pressure Level Calculation

The maximum sound pressure level at 1 m or 15 m distance from the source was calculated to obtain 1 hr, 8 hr and 24 hr equivalent sound pressure levels (Leq), including the noise level in the sensitive areas, using the following equations:

- **Equivalent Sound Pressure Level Calculation**

In calculating the sound pressure level caused by noise sources to be adjusted as the average equivalent sound pressure level at a certain duration, the equation is as follows:

$$Leq_T = Lp + 10 \log \frac{t}{T} \qquad \text{\_\_\_\_\_(1)}$$

Where Leq_T = equivalent sound pressure level at a permissible duration (T) [dB(A)]
Lp = sound pressure level caused by the sources [dB(A)]
t = the time interval of noise (in hr)
T = the measured time interval (in hr)

- **Source-to-Receiver Sound Pressure Level Calculation**

A distance of 1 m or 15 m from the sources (machinery) is frequently used to measure the impact of the sound pressure level on people living in the affected areas using the following equation (2):

$$Lp_2 = Lp_1 - 20 \log \left(\frac{r_2}{r_1}\right) \quad \text{_____(2)}$$

Where Lp_1 = the measured sound pressure level at a distance of r_1
Lp_2 = the measured sound pressure level at a distance of r_2
r_1, r_2 = the distances from the sources for the measurement of Lp1 and Lp2 respectively

- **Total Sound Pressure Level Calculation**

To calculate the sum of sound pressure levels from the Project activities and the measured values in the affected areas, the following equation for sound pressure levels is used.

$$\text{Total Lp} = 10\log\left(\sum_{i=1}^{n} 10^{Lp_i/10}\right) \quad \text{_____(3)}$$

Where Total Lp = the sum of sound pressure level [dB(A)]
Lp_i = the sound pressure level of each source [dB(A)]
n = the number of noise sources

- **Noise nuisance Level**

Apart from the estimated sound pressure level in comparison with the background noise level, the noise level in the Project's vicinity was also inspected by using the following equation:

Disturbance levels = Equivalent sound pressure level (Leq) - Background Noise Level (L_{90})

(If the disturbed level is >10 dB(A), the noise is considered to be disturbing.)

The Notification of the Pollution Control Board re: Methods for measurements of ambient noise level, unnoise nuisance level, measurement and calculation of noise nuisance level, calculation of disturbing level and record form for disturbing noise measurement, specifies a calculation method for noise level during disturbance for field measurement of noise. This method was therefore applied accordingly to measure the noise level with disturbance caused by the Project activities by using the following procedures:

(1) Subtract the estimated specific noise level (the estimated sound pressure level + the measured maximum sound pressure level) with the residual noise level. The result is the difference between the sound pressure levels.

(2) Compare the result of the noise level in (1) with the values below to find adjustment to the noise level accordingly.

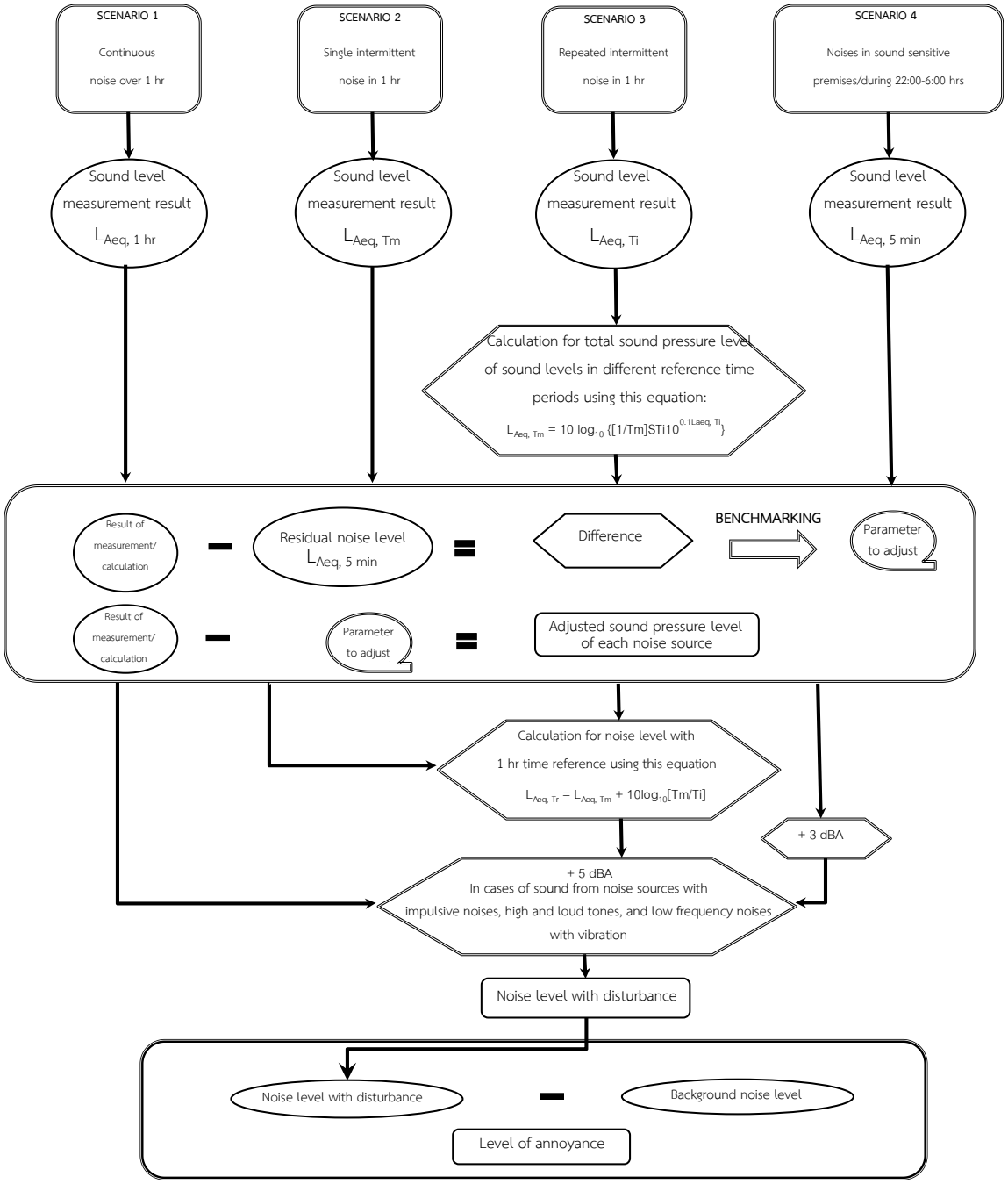
Difference Between the Sound Pressure Levels (dB(A))	Amount to Adjust the Noise Level (dB(A))
1.4 and below	7.0
1.5 - 2.4	4.5
2.5 - 3.4	3.0
3.5 - 4.4	2.0
4.5 - 6.4	1.5
6.5 - 7.4	1.0
7.5 - 12.4	0.5
12.5 and above	0

(3) Subtract the estimated specific noise level (the estimated sound pressure level + the measured maximum sound pressure level) with the amount to adjust the noise level in (2). The result is the noise level during disturbance.

In case noises are generated by the sources during 22:00 p.m. - 06:00 a.m., 3.0 dB(A) must be added. Where there are impulsive noises, 5.0 dB(A) must also be added. The sum is the noise level during disturbance.

(4) Subtract the noise level during disturbance obtained in (3) with the background noise level (L_{90}).

According to the Noise Measurement Guide developed by the Air Quality and Noise Management Bureau, Pollution Control Department, Ministry of Natural Resources and Environment (2007), the procedures for specifies a calculation method for noise level during disturbance are prescribed in four cases with different noise sources as illustrated in **Figure 5.1.1.2-2**.



Source: Air Quality and Noise Management Bureau, Pollution Control Department, Ministry of Natural Resources and Environment, 2007.

FIGURE 5.1.1.2-2: PROCEDURES OF NOISE LEVEL DURING DISTURBANCE FOR MEASUREMENT AND CALCULATION

(b) Noise Impacts During Construction Period

- **8 hr and 24 hr Average Continuous Sound Level**

The noise impact of the constructions activities of this project took into account the operation of heavy equipment during the excavation for the foundation as the maximum sound pressure level which was 89 dB(A) at 15 m distance from the sources for 8 hr continuous activities or the worst case scenario. The calculation yields the results of 1 hr, 8 hr and 24 hr average sound pressure levels as follows:

$$L_{eq,\ 1\ hr} = 89.0 + 10 \log \frac{1}{1} = 89.0 \text{ dB(A)}$$

$$L_{eq,\ 8\ hr} = 89.0 + 10 \log \frac{8}{8} = 89.0 \text{ dB(A)}$$

$$L_{eq,\ 24\ hr} = 89.0 + 10 \log \frac{8}{24} = 84.2 \text{ dB(A)}$$

In terms of the noise impacts on the workers and other employees working at the construction area, they were exposed to the 8 hr sound level of 89.0 dB(A). When combined with the 8 hr average continuous sound level measured in the current project area (52.0 dB(A)) the sound pressure level was 89.0 dB(A), meaning this is within the criteria set out in Ministry of Labour's Regulation re: Prescribing Standard for Administration and Management of Occupational Safety, Health and Environment for Work with Heat, Light and Noise, B.E. 2549, which prescribes that the 8 hr average continuous sound level shall not exceed 90 dB(A). In addition, the Project requires that those working in the areas with prolonged exposure to loud noise use personal protective equipment such as ear muff and ear plug at all time. As a result, the level of noise impacts on these workers and employees working at the construction area was low.

With regard to the noise impacts on the surrounding community, there are four noise sensitive premises. Chumchon Borisat Namtan Tawan-aok School (N2) and The Child Development Center of Chomphon Chao Phraya Sub-district Municipality, are situated in the northeast of the Project at 411 m and 666 m, respectively, from the piling work site. Located in the south are Wat Chomphon Chao Phraya (N3) and The Proud Village, with the distances of 563 m and 352 m respectively from the piling work site. By using the equation (2) to calculate the noise reduction by distance to the receivers, together with the calculation for the noise impacts of the construction activities on the noise sensitive areas and the current sound pressure level measured on 6-11 February

2014, the results are as shown in **Table 5.1.1.2-2**. It shows that all four noise sensitive area - Chumchon Borisat Namtan Tawan-aok School, The Child Development Center of Chomphon Chao Phraya Sub-district Municipality, Wat Chomphon Chao Phraya, and The Proud Village - were not affected by the noise generated by the construction activities as the 8 hr and 24 hr average continuous sound pressure levels are below the standard.

TABLE 5.1.1.2-2

ESTIMATED NOISE IMPACTS ON NOISE SENSITIVE AREA DURING CONSTRUCTION PERIOD

Noise Sensitive Area	Distance from Piling Site (m)	8 hr L_{eq} (dB(A))			24 hr L_{eq} (dB(A))		
		Construction Activities	Maximum sound pressure measured[1/]	Total L_p	Construction Activities	Maximum sound pressure measured[2/]	Total L_p
1. Chumchon Borisat Namtan Tawan-aok School (N2)	411	60.2	68.9	69.4	55.4	65.6	66.0
2. The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	666	56.1	68.9[3/]	68.9	51.3	65.6[3/]	65.8
3. Wat Chomphon Chao Phraya (N3)	563	57.5	55.1	59.5	52.7	53.7	56.2
4. The Proud Village	352	61.6	55.1[4/]	62.5	56.8	53.7[4/]	58.5
Standard		90[5/]			70[6/]		

Remarks:
1/ Maximum result of L_{eq} 8 hr of each station measured during 6-11 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.
2/ Maximum result of L_{eq} 24 hr of each station measured during 6-11 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.
3/ L_{eq} 8 hr and L_{eq} 24 hr of the nearby measuring station (Chumchon Borisat Namtan Tawan-aok School) were used as the representative.
4/ Leq, 8 hr and Leq, 24 hr of the nearby measuring station (Wat Chomphon Chao Phraya) were used as the representative.
5/ Standard as prescribed in Ministry of Labour's Regulation re: Prescribing Standard for Administration and Management of Occupational Safety, Health and Environment for Work with Heat, Light and Noise, B.E. 2549.
6/ Standard as prescribed in the National Environment Board's Notification No. 15 re: Prescribing Noise Level Standard, B.E. 2540.

- **Noise Nuisance**

The noise sensitive area adjacent to the Project site may be affected to a certain extent by both construction works and other relevant activities, including staff transportation before the working hours. However, while the Project set out the codes of practice that all construction activities must be conducted during the daytime for 8 hr daily, from 8 a.m. to 5 p.m. (except for lunch break from noon to 1 p.m.), the assessment of noise impacts on these affected areas: namely, Chumchon Borisat Namtan Tawan-aok School (N2) and The Child Development Center of Chomphon Chao Phraya Sub-district Municipality; Wat Chomphon Chao Phraya; and, The Proud Village, was consequently examined only during daytime period.

The Noise Measurement Guide (2007) created by the Air Quality and Noise Management Bureau, Pollution Control Department, Ministry of Natural Resources and Environment prescribes the procedures for disturbance levels calculation in four scenarios with different noise sources as illustrated in **Figure 5.1.1.2-2**. Based on this document, the noise sources were mainly produced by the construction activities that operate for longer than an hour. This fell into Scenario 1, meaning that, according to this Noise Measurement Guide, the 1 hr average sound pressure level will be used to represent the noise level during disturbance.

As a result, the 1 hr average sound pressure level produced by the construction activities was used to calculate for the noise reduction by distance to the receivers using the equation (2) and the sum will be the representative of the disturbance levels of the Project construction works from 8 a.m. to 5 p.m. (except for lunch break from noon to 1 p.m.). The assessment result can be concluded that **all four noise sensitive areas yielded higher level of noise during the construction period than the prescribed standard criteria**. Chumchon Borisat Namtan Tawan-aok School shows the level of 5.6 dB(A) up to 17.6 dB(A) while The Child Development Center of Chomphon Chao Phraya Sub-district Municipality had the level of 3.6 dB(A) up to 13.7 dB(A) and Wat Chophon Chao Phraya and The Proud Village shows the range of 13.2 dB(A) up to 19.2 dB(A) and 17.0 dB(A) up to 23.2 dB(A), respectively. (**Table 5.1.1.2-3** to **Table 5.1.1.2-6**)

TABLE 5.1.1.2-3

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT CHUMCHON BORISAT NAMTAN TAWAN-AOK SCHOOL (NORTHEAST OF THE PROJECT AREA) (N2)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	69.0	59.7	60.2	69.5	0.5	7.0	5.0	7.8
09:00-10:00	63.5	56.7	60.2	65.2	1.7	4.5	5.0	9.0
10:00-11:00	67.4	59.6	60.2	68.2	0.8	7.0	5.0	6.6
11:00-12:00	71.5	61.1	60.2	71.8	0.3	7.0	5.0	8.7
13:00-14:00	62.4	56.3	60.2	64.4	2.0	4.5	5.0	8.6
14:00-15:00	70.9	63.6	60.2	71.3	0.4	7.0	5.0	5.7
15:00-16:00	72.5	63.6	60.2	72.7	0.2	7.0	5.0	7.1
16:00-17:00	58.7	49.3	60.2	62.5	3.8	2.0	5.0	16.2
7 February 2014								
08:00-09:00	66.4	59.4	60.2	67.3	0.9	7.0	5.0	5.9
09:00-10:00	68.2	58.3	60.2	68.8	0.6	7.0	5.0	8.5
10:00-11:00	62.9	56.5	60.2	64.8	1.9	4.5	5.0	8.8
11:00-12:00	67.0	58.5	60.2	67.8	0.8	7.0	5.0	7.3
13:00-14:00	63.7	56.3	60.2	65.3	1.6	4.5	5.0	9.5
14:00-15:00	66.6	59.9	60.2	67.5	0.9	7.0	5.0	5.6
15:00-16:00	70.2	62.2	60.2	70.6	0.4	7.0	5.0	6.4
16:00-17:00	64.0	50.8	60.2	65.5	1.5	4.5	5.0	15.2
8 February 2014								
08:00-09:00	56.2	48.7	60.2	61.7	5.5	1.5	5.0	16.5
09:00-10:00	55.3	48.5	60.2	61.4	6.1	1.5	5.0	16.4
10:00-11:00	55.1	48.5	60.2	61.4	6.3	1.5	5.0	16.4
11:00-12:00	55.1	48.4	60.2	61.4	6.3	1.5	5.0	16.5
13:00-14:00	55.2	48	60.2	61.4	6.2	1.5	5.0	16.9
14:00-15:00	53.4	48.5	60.2	61.0	7.6	0.5	5.0	17.0
15:00-16:00	55.7	49.7	60.2	61.5	5.8	1.5	5.0	15.3
16:00-17:00	56.1	49.9	60.2	61.6	5.5	1.5	5.0	15.2
9 February 2014								
08:00-09:00	57.3	50.5	60.2	62.0	4.7	1.5	5.0	15.0
09:00-10:00	59	49.9	60.2	62.7	3.7	2.0	5.0	15.8
10:00-11:00	64.9	57.3	60.2	66.2	1.3	7.0	5.0	6.9
11:00-12:00	62.4	57.7	60.2	64.4	2.0	4.5	5.0	7.2
13:00-14:00	51.6	47.7	60.2	60.8	9.2	0.5	5.0	17.6
14:00-15:00	53.7	48.3	60.2	61.1	7.4	1.0	5.0	16.8
15:00-16:00	54.8	49.1	60.2	61.3	6.5	1.0	5.0	16.2
16:00-17:00	54.3	49.3	60.2	61.2	6.9	1.0	5.0	15.9

TABLE 5.1.1.2-3

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT CHUMCHON BORISAT NAMTAN TAWAN-AOK SCHOOL (NORTHEAST OF THE PROJECT AREA) (N2)

(Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								
08:00-09:00	67.9	55.8	60.2	68.6	0.7	7.0	5.0	10.8
09:00-10:00	64.5	57.8	60.2	65.9	1.4	7.0	5.0	6.1
10:00-11:00	62.7	57.1	60.2	64.6	1.9	4.5	5.0	8.0
11:00-12:00	65.3	57.7	60.2	66.5	1.2	7.0	5.0	6.8
13:00-14:00	61.8	56.4	60.2	64.1	2.3	4.5	5.0	8.2
14:00-15:00	65	57.6	60.2	66.2	1.2	7.0	5.0	6.6
15:00-16:00	68.4	56.6	60.2	69.0	0.6	7.0	5.0	10.4
16:00-17:00	57.2	49	60.2	62.0	4.8	1.5	5.0	16.5
Standard								**10.0**[2/]

Remark : 1/ $L_{eq,}$ 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of Chumchon Borisat Namtan Tawan-aok School station measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ Notification of NEB on disturbing noise levels

Number value on underline is higher level than standard

TABLE 5.1.1.2-4

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT

AT THE CHILD DEVELOPMENT CENTER OF CHOMPHON CHAO PHRAYA SUB-DISTRICT

MUNICIPALITY (NORTHEAST OF THE PROJECT AREA)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	69.0	59.7	56.1	69.2	0.2	7.0	5.0	7.5
09:00-10:00	63.5	56.7	56.1	64.2	0.7	7.0	5.0	5.5
10:00-11:00	67.4	59.6	56.1	67.7	0.3	7.0	5.0	6.1
11:00-12:00	71.5	61.1	56.1	71.6	0.1	7.0	5.0	8.5
13:00-14:00	62.4	56.3	56.1	63.3	0.9	7.0	5.0	5.0
14:00-15:00	70.9	63.6	56.1	71.0	0.1	7.0	5.0	5.4
15:00-16:00	72.5	63.6	56.1	72.6	0.1	7.0	5.0	7.0
16:00-17:00	58.7	49.3	56.1	60.6	1.9	4.5	5.0	11.8
7 February 2014								
08:00-09:00	66.4	59.4	56.1	66.8	0.4	7.0	5.0	5.4
09:00-10:00	68.2	58.3	56.1	68.5	0.3	7.0	5.0	8.2
10:00-11:00	62.9	56.5	56.1	63.7	0.8	7.0	5.0	5.2
11:00-12:00	67.0	58.5	56.1	67.3	0.3	7.0	5.0	6.8
13:00-14:00	63.7	56.3	56.1	64.4	0.7	7.0	5.0	6.1
14:00-15:00	66.6	59.9	56.1	67.0	0.4	7.0	5.0	5.1
15:00-16:00	70.2	62.2	56.1	70.4	0.2	7.0	5.0	6.2
16:00-17:00	64.0	50.8	56.1	64.7	0.7	7.0	5.0	11.9
8 February 2014								
08:00-09:00	56.2	48.7	56.1	59.2	3.0	3.0	5.0	12.5
09:00-10:00	55.3	48.5	56.1	58.7	3.4	3.0	5.0	12.2
10:00-11:00	55.1	48.5	56.1	58.6	3.5	2.0	5.0	13.1
11:00-12:00	55.1	48.4	56.1	58.6	3.5	2.0	5.0	13.2
13:00-14:00	55.2	48.0	56.1	58.7	3.5	2.0	5.0	13.7
14:00-15:00	53.4	48.5	56.1	58.0	4.6	1.5	5.0	13.0
15:00-16:00	55.7	49.7	56.1	58.9	3.2	3.0	5.0	11.2
16:00-17:00	56.1	49.9	56.1	59.1	3.0	3.0	5.0	11.2
9 February 2014								
08:00-09:00	57.3	50.5	56.1	59.8	2.5	3.0	5.0	11.3
09:00-10:00	59.0	49.9	56.1	60.8	1.8	4.5	5.0	11.4
10:00-11:00	64.9	57.3	56.1	65.4	0.5	7.0	5.0	6.1
11:00-12:00	62.4	57.7	56.1	63.3	0.9	7.0	5.0	3.6
13:00-14:00	51.6	47.7	56.1	57.4	5.8	1.5	5.0	13.2
14:00-15:00	53.7	48.3	56.1	58.1	4.4	2.0	5.0	12.8
15:00-16:00	54.8	49.1	56.1	58.5	3.7	2.0	5.0	12.4
16:00-17:00	54.3	49.3	56.1	58.3	4.0	2.0	5.0	12.0

TABLE 5.1.1.2-4

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT

AT THE CHILD DEVELOPMENT CENTER OF CHOMPHON CHAO PHRAYA SUB-DISTRICT

MUNICIPALITY (NORTHEAST OF THE PROJECT AREA) (Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								
08:00-09:00	67.9	55.8	56.1	68.2	0.3	7.0	5.0	10.4
09:00-10:00	64.5	57.8	56.1	65.1	0.6	7.0	5.0	5.3
10:00-11:00	62.7	57.1	56.1	63.6	0.9	7.0	5.0	4.5
11:00-12:00	65.3	57.7	56.1	65.8	0.5	7.0	5.0	6.1
13:00-14:00	61.8	56.4	56.1	62.8	1.0	7.0	5.0	4.4
14:00-15:00	65.0	57.6	56.1	65.5	0.5	7.0	5.0	5.9
15:00-16:00	68.4	56.6	56.1	68.6	0.2	7.0	5.0	10.0
16:00-17:00	57.2	49.0	56.1	59.7	2.5	3.0	5.0	12.7
Standard								**10.0[2/]**

Remark : 1/ $L_{eq,}$ 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of nearby measurement station (Chumchon Borisat Namtan Tawan-aok School station) measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ Notification of NEB on disturbing noise levels

Number value on underline is higher level than standard

TABLE 5.1.1.2-5

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT

AT WAT CHOPHON CHAO PHRAYA (SOUTH OF THE PROJECT AREA) (N3)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	53.8	47.5	57.5	59.0	5.2	1.5	5.0	15.0
09:00-10:00	53.8	47.1	57.5	59.0	5.2	1.5	5.0	15.4
10:00-11:00	54.4	47.5	57.5	59.2	4.8	1.5	5.0	15.2
11:00-12:00	56.1	49.7	57.5	59.9	3.8	2.0	5.0	13.2
13:00-14:00	53.7	47.6	57.5	59.0	5.3	1.5	5.0	14.9
14:00-15:00	55.4	48.3	57.5	59.6	4.2	2.0	5.0	14.3
15:00-16:00	54.8	47.8	57.5	59.4	4.6	1.5	5.0	15.1
16:00-17:00	55.3	49.1	57.5	59.5	4.2	2.0	5.0	13.4
7 February 2014								
08:00-09:00	55.4	48.5	57.5	59.6	4.2	2.0	5.0	14.1
09:00-10:00	55.6	46.8	57.5	59.7	4.1	2.0	5.0	15.9
10:00-11:00	54.7	47.4	57.5	59.3	4.6	1.5	5.0	15.4
11:00-12:00	53.5	46.5	57.5	59.0	5.5	1.5	5.0	16.0
13:00-14:00	54.5	47.8	57.5	59.3	4.8	1.5	5.0	15.0
14:00-15:00	54	48.2	57.5	59.1	5.1	1.5	5.0	14.4
15:00-16:00	54.4	48.6	57.5	59.2	4.8	1.5	5.0	14.1
16:00-17:00	54.3	48.5	57.5	59.2	4.9	1.5	5.0	14.2
8 February 2014								
08:00-09:00	54.7	47.3	57.5	59.3	4.6	1.5	5.0	15.5
09:00-10:00	54.3	47.4	57.5	59.2	4.9	1.5	5.0	15.3
10:00-11:00	54.1	47.7	57.5	59.1	5.0	1.5	5.0	14.9
11:00-12:00	54.4	46.7	57.5	59.2	4.8	1.5	5.0	16.0
13:00-14:00	54	45.9	57.5	59.1	5.1	1.5	5.0	16.7
14:00-15:00	52.8	46.5	57.5	58.8	6.0	1.5	5.0	15.8
15:00-16:00	54	47.4	57.5	59.1	5.1	1.5	5.0	15.2
16:00-17:00	54.4	47.9	57.5	59.2	4.8	1.5	5.0	14.8
9 February 2014								
08:00-09:00	55.2	47.7	57.5	59.5	4.3	2.0	5.0	14.8
09:00-10:00	55.1	45.8	57.5	59.5	4.4	2.0	5.0	16.7
10:00-11:00	51.9	45.0	57.5	58.6	6.7	1.0	5.0	17.6
11:00-12:00	55.0	46.6	57.5	59.4	4.4	2.0	5.0	15.8
13:00-14:00	51.6	43.3	57.5	58.5	6.9	1.0	5.0	19.2
14:00-15:00	51.5	44.6	57.5	58.5	7.0	1.0	5.0	17.9
15:00-16:00	52.2	45.4	57.5	58.6	6.4	1.5	5.0	16.7
16:00-17:00	53.5	46.0	57.5	59.0	5.5	1.5	5.0	16.5

TABLE 5.1.1.2-5

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT

AT WAT CHOPHON CHAO PHRAYA (SOUTH OF THE PROJECT AREA) (N3) (Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								-
08:00-09:00	56.2	49.4	57.5	59.9	3.7	2.0	5.0	13.5
09:00-10:00	56.0	48.2	57.5	59.8	3.8	2.0	5.0	14.6
10:00-11:00	55.8	47.6	57.5	59.7	3.9	2.0	5.0	15.1
11:00-12:00	54.4	47.0	57.5	59.2	4.8	1.5	5.0	15.7
13:00-14:00	53.4	45.7	57.5	58.9	5.5	1.5	5.0	16.7
14:00-15:00	54.6	46.9	57.5	59.3	4.7	1.5	5.0	15.9
15:00-16:00	54.5	48.1	57.5	59.3	4.8	1.5	5.0	14.7
16:00-17:00	54.9	49.2	57.5	59.4	4.5	1.5	5.0	13.7
Standard								**10.0[2/]**

Remark : 1/ $L_{eq,}$ 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of Wat Chophon Chao Phraya measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ Notification of NEB on disturbing noise levels

Number value on underline is higher level than standard

TABLE 5.1.1.2-6

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT

AT THE PROUD VILLAGE (SOUTH OF THE PROJECT AREA)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	53.8	47.5	61.6	62.3	8.5	0.5	5.0	19.3
09:00-10:00	53.8	47.1	61.6	62.3	8.5	0.5	5.0	19.7
10:00-11:00	54.4	47.5	61.6	62.4	8.0	0.5	5.0	19.4
11:00-12:00	56.1	49.7	61.6	62.7	6.6	1.0	5.0	17.0
13:00-14:00	53.7	47.6	61.6	62.3	8.6	0.5	5.0	19.2
14:00-15:00	55.4	48.3	61.6	62.5	7.1	1.0	5.0	18.2
15:00-16:00	54.8	47.8	61.6	62.4	7.6	0.5	5.0	19.1
16:00-17:00	55.3	49.1	61.6	62.5	7.2	1.0	5.0	17.4
7 February 2014								-
08:00-09:00	55.4	48.5	61.6	62.5	7.1	1.0	5.0	18.0
09:00-10:00	55.6	46.8	61.6	62.6	7.0	1.0	5.0	19.8
10:00-11:00	54.7	47.4	61.6	62.4	7.7	0.5	5.0	19.5
11:00-12:00	53.5	46.5	61.6	62.2	8.7	0.5	5.0	20.2
13:00-14:00	54.5	47.8	61.6	62.4	7.9	0.5	5.0	19.1
14:00-15:00	54	48.2	61.6	62.3	8.3	0.5	5.0	18.6
15:00-16:00	54.4	48.6	61.6	62.4	8.0	0.5	5.0	18.3
16:00-17:00	54.3	48.5	61.6	62.3	8.0	0.5	5.0	18.3
8 February 2014								-
08:00-09:00	54.7	47.3	61.6	62.4	7.7	0.5	5.0	19.6
09:00-10:00	54.3	47.4	61.6	62.3	8.0	0.5	5.0	19.4
10:00-11:00	54.1	47.7	61.6	62.3	8.2	0.5	5.0	19.1
11:00-12:00	54.4	46.7	61.6	62.4	8.0	0.5	5.0	20.2
13:00-14:00	54	45.9	61.6	62.3	8.3	0.5	5.0	20.9
14:00-15:00	52.8	46.5	61.6	62.1	9.3	0.5	5.0	20.1
15:00-16:00	54	47.4	61.6	62.3	8.3	0.5	5.0	19.4
16:00-17:00	54.4	47.9	61.6	62.4	8.0	0.5	5.0	19.0
9 February 2014								
08:00-09:00	55.2	47.7	61.6	62.5	7.3	1.0	5.0	18.8
09:00-10:00	55.1	45.8	61.6	62.5	7.4	1.0	5.0	20.7
10:00-11:00	51.9	45	61.6	62.0	10.1	0.5	5.0	21.5
11:00-12:00	55	46.6	61.6	62.5	7.5	0.5	5.0	20.4
13:00-14:00	51.6	43.3	61.6	62.0	10.4	0.5	5.0	23.2
14:00-15:00	51.5	44.6	61.6	62.0	10.5	0.5	5.0	21.9
15:00-16:00	52.2	45.4	61.6	62.1	9.9	0.5	5.0	21.2
16:00-17:00	53.5	46	61.6	62.2	8.7	0.5	5.0	20.7

TABLE 5.1.1.2-6

NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT

AT THE PROUD VILLAGE (SOUTH OF THE PROJECT AREA) (Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								-
08:00-09:00	56.2	49.4	61.6	62.7	6.5	1.0	5.0	17.3
09:00-10:00	56	48.2	61.6	62.7	6.7	1.0	5.0	18.5
10:00-11:00	55.8	47.6	61.6	62.6	6.8	1.0	5.0	19.0
11:00-12:00	54.4	47	61.6	62.4	8.0	0.5	5.0	19.9
13:00-14:00	53.4	45.7	61.6	62.2	8.8	0.5	5.0	21.0
14:00-15:00	54.6	46.9	61.6	62.4	7.8	0.5	5.0	20.0
15:00-16:00	54.5	48.1	61.6	62.4	7.9	0.5	5.0	18.8
16:00-17:00	54.9	49.2	61.6	62.4	7.5	0.5	5.0	17.7
Standard								**10.0**[2/]

Remark : 1/ $L_{eq,}$ 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of nearby measurement station (Wat Chophon Chao Phraya) measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ Notification of NEB on disturbing noise levels

Number value on underline is higher level than standard

- **Noise Impact Reduction Measures**

The estimation of 24 hr average sound pressure level and the noise nuisance as shown in **Table 5.1.1.2-2** to **Table 5.1.1.2-6** show that the affected sensitive area - Chumchon Borisat Namtan Tawan-aok School and The Child Development Center of Chomphon Chao Phraya Sub-district Municipality in the northeast of the project; and Wat Chomphon Chao Phraya and The Proud Village in the south - had higher noise nuisance level during the construction period than that prescribed in the standard criteria.

Therefore, in order to alleviate the noise impacts on the affected nearby communities caused by the construction activities, the project has established environmental impact mitigation and preventive measures. For example, contractors were requested to control the use of machinery and equipment to produce lower noises. Furthermore, a measure to reduce noise impacts during construction was also implemented. It is to install noise barriers around the piling area at a 10 m distance from the noise source in the northeast and the south of the project which are near Chumchon Borisat Namtan Tawan-aok School and The Child Development Center of Chomphon Chao Phraya Sub-district Municipality; and Wat Chomphon Chao Phraya and The Proud Village, respectively. The initial choice of materials was a metal sheet with the thickness of about 1.27 mm. (steel, 18 ga) or thicker. This resulted in the transmission loss (TL) of 25 dB(A) as shown in **Table 5.1.1.2-7**.

TABLE 5.1.1.2-7

TRANSMISSION LOSS CAUSED BY USING DIFFERENT SOUND ABSORBING MATERIALS

Material	Thickness (mm)	Surface Density (kg/m^2)	Transmission Loss* (dB)
- Concrete block 200×200×400 light weight	200	151	34
- Dense concrete	100	244	40
- Light concrete	150	244	39
- Light concrete	100	161	36
- Brick	150	288	40
- **Steel, 18 ga**	**1.27**	**9.8**	**25**
- Steel, 20 ga	0.95	7.3	22
- Steel, 22 ga	0.79	6.1	20
- Steel, 24 ga	0.64	4.9	18

Remark : *Values assuming no openings or gaps in the barriers

Source : Applied from Environmental Protection Department and Highways Department, Government of the Hong Kong SAR., 2003

- **Total Sound Pressure Level Calculation with Noise Barriers**

Regarding the calculation of the total sound pressure level after the installation of noise barriers by using steel, 18 ga plates as a temporary wall yielding the transmission loss of 25 dB(A), the sound transmitted through the barriers was calculated by using the equation (4) below. The sum, or the Fresnel number, was used to find the reduced sound pressure level from the graph illustrated in **Figure 5.1.1.2-3**. Then this reduced value will be deducted from the noise level with disturbance of the construction activities. The result was the noise level that people in the noise sensitive area will perceive after the installation of the noise barriers.

$$N_0 = \frac{2(a+b-c)}{W} \quad \text{_____(4)}$$

Where N_0 = Fresnel number

a = source to the upper edge of the barrier displacement (m)

b = the upper edge of the barrier to receiver displacement (m)

c = source to receiver displacement (m)

W = sound wavelength (m) = v/f

v = speed of sound (m/s)

= $331.4\ [1+ (T_c / 273.2)]^{1/2}$

T_c = average ambient temperature, based on Laem Chabang Weather Station's climate statistics of 22 yr period = 28.8 ℃

f = sound wave frequency = 550 Hz

The noise barriers were installed around the piling areas at a 10 m distance from the noise sources or the machinery and equipment in the northeast where Chumchon Borisat Namtan Tawan-aok School and The Child Development Center of Chomphon Chao Phraya Sub-district Municipality are situated and in the south where Wat Chomphon Chao Phraya and The Proud Village are located (**Figure 5.1.1.2-1**). The barriers in the northeast are 3 m high while those in the south are 5 m high which are higher than

the location of the receiver (1.5 m) (**Figure 5.1.1.2-4** and **Figure 5.1.1.2-5**). Details of calculation of reduced noise behind the noise barriers are as shown in **Table 5.1.1.2-8**.

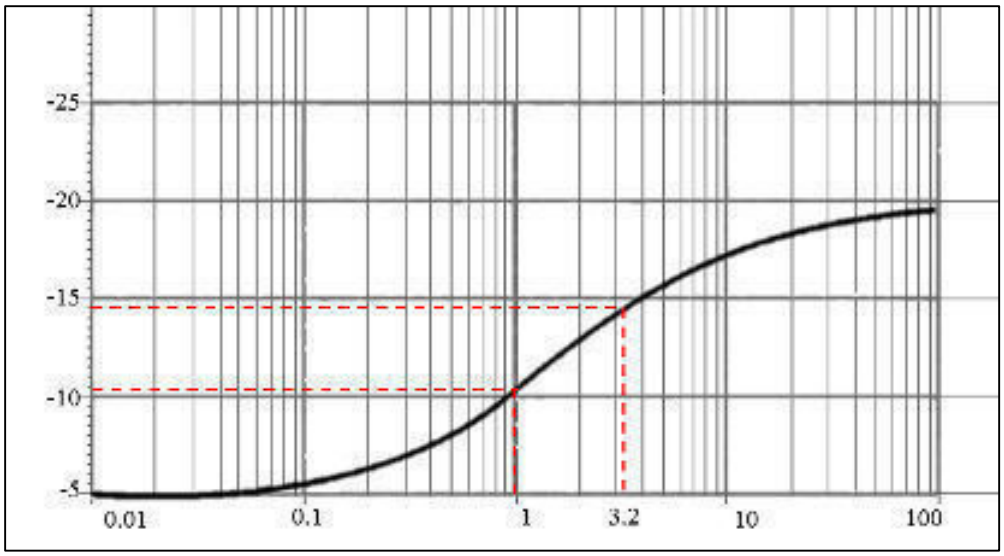


FIGURE 5.1.1.2-3 : THE GRAPH OF RELATION BETWEEN NOISE ATTENUATION AND FRESNEL NUMBER

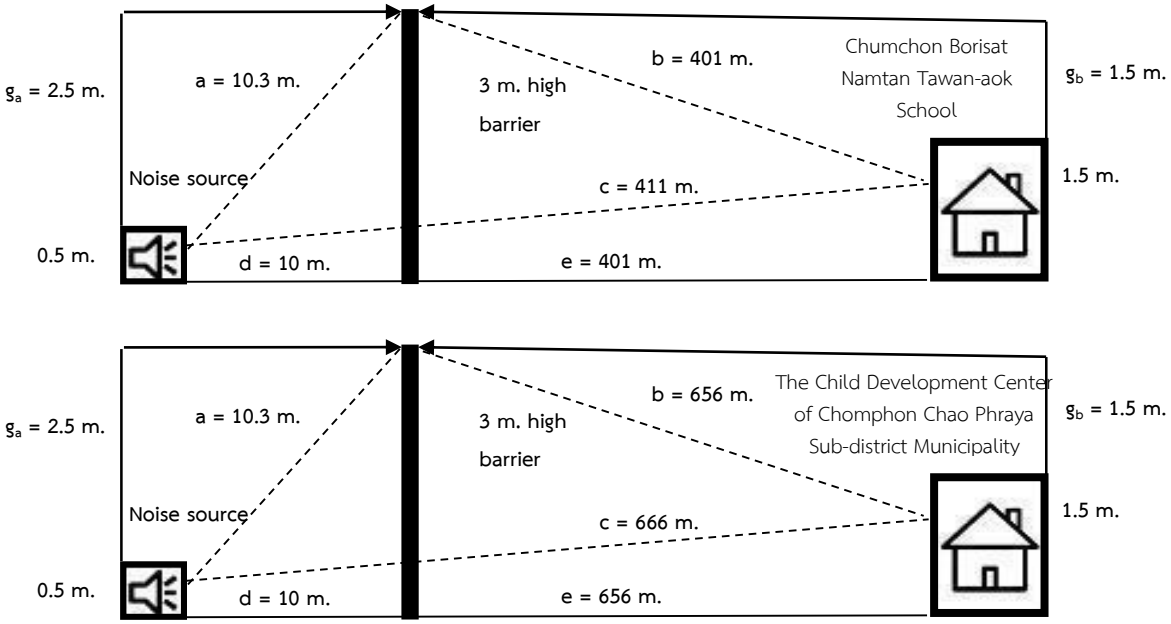


FIGURE 5.1.1.2-4 : THE DISTANCE AND DISPLACEMENT FOR THE CALCULATION ON NOISE DECREASED FROM A ACROSS THE BARRIER TEMPORARY, 3 METERS NORTHEAST OF THE PROJECT.

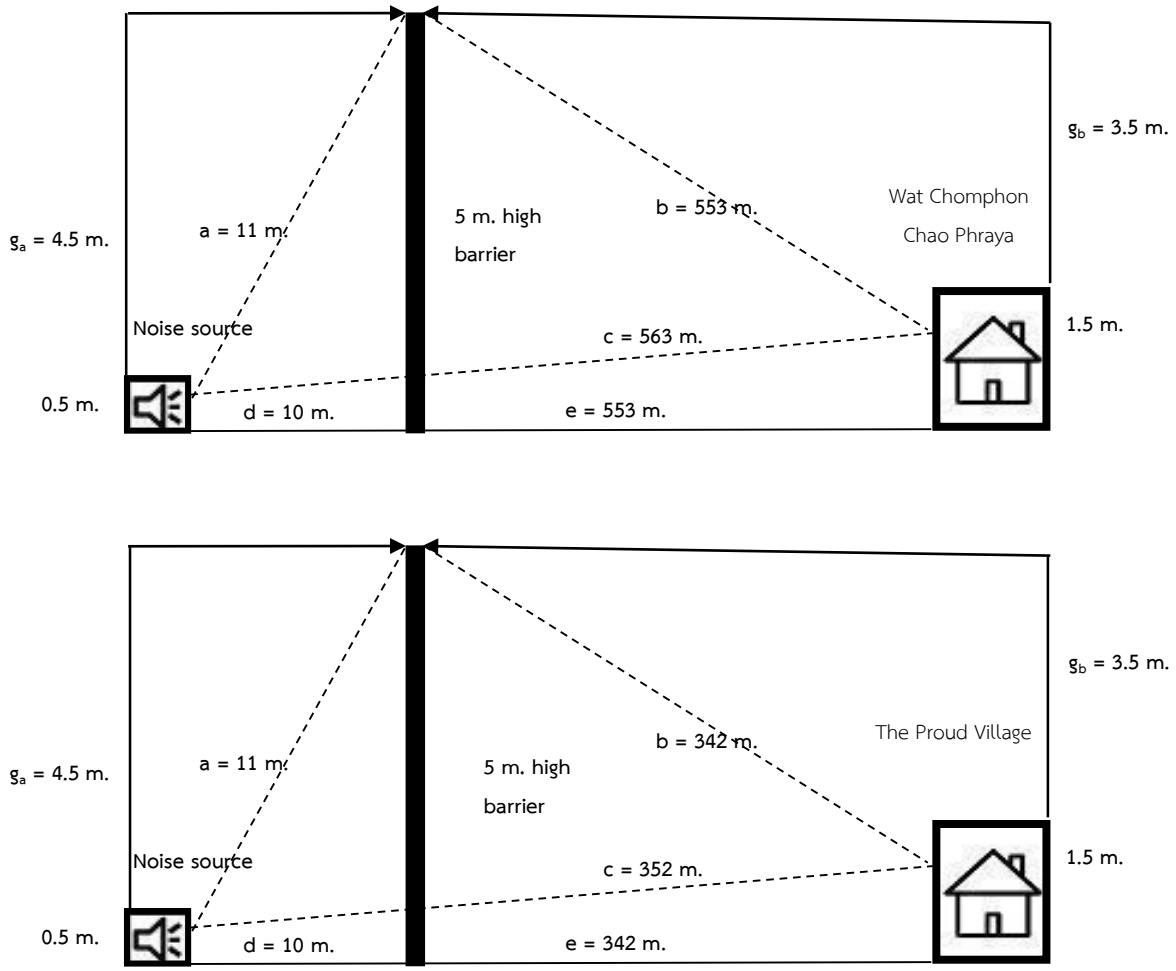


FIGURE 5.1.1.2-5 : THE DISTANCE AND DISPLACEMENT FOR THE CALCULATION ON NOISE DECREASED FROM A ACROSS THE BARRIER TEMPORARY, 5 METERS SOUTH OF THE PROJECT

TABLE 5.1.1.2-8

DETAILS OF CALCULATION OF REDUCED NOISE BEHIND THE NOISE BARRIERS

Detail		Northeast		South	
		Chumchon Borisat Namtan Tawan-aok School	The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	Wat Chomphon Chao Phraya	The Proud Village
Source to the upper edge of the barrier displacement (m)	$a=(d^2+g_a^2)^{1/2}$	10.3	10.3	11	11
The upper edge of the barrier to receiver displacement (m)	$b=(e^2+g_b^2)^{1/2}$	401	656	553	342
Source to receiver displacement (m)	c	411	666	563	352
The distance of barrier to noise receptor (m)	e	401	656	553	342
Barrier height (m)	f	3	3	5	5
The source to barrier displacement (m)	d	10	10	10	10
Source height to the upper edge of the barrier (m)	$g_a=(f-0.5)$	2.5	2.5	4.5	4.5
The height of noise receptor to the upper edge of the barrier (m)	$g_b=(f-1.5)$	1.5	1.5	3.5	3.5
average ambient temperature , based on climate statistics of 22- yr period (°C)	Tc	28.8	28.8	28.8	28.8
speed of sound (m/s)	$v=(331.4\ [1+ (Tc / 273.2)]^{1/2})$	348.43	348.43	348.43	348.43
sound wave frequency (Hz)	F	550	550	550	550
sound wavelength (m)	W =(v/F)	0.63	0.63	0.63	0.63
Fresnel number	$N_0 = 2 (a+b-c)/W$	1.0	1.0	3.2	3.2
used to find the reduced sound pressure level from the graph illustrated (dB(A)), **Figure 5.5-2**		10.5	10.5	14.5	14.5

As a result, after the installation of the sound reduction barriers around the piling areas in the northeast and the south of the Project site, with the initial materials of steel plates of 1.27 mm thickness (steel, 18 ga) or more, yielding the transmission loss of 25 dB(A) where the heights of the barriers in the northeast and the south were 3 m and 5 m respectively, the noise levels at the receiver point of Chumchon Borisat Namtan Tawan-aok School, The Child Development Center of Chomphon Chao Phraya Sub-district Municipality, Wat Chomphon Chao Phraya, and The Proud Village were reduced as follows:

Leq, 1 hr of transmitted noise at Chumchon Borisat Namtan Tawan-aok School

= 60.2 dB(A) - 10.5 dB(A)

= 49.7 dB(A)

Leq, 1 hr of transmitted noise at The Child Development Center of Chomphon Chao Phraya Sub-district Municipality

= 56.1-10.5 dB(A)

= 45.6 dB(A)

Leq 1 hr of transmitted noise at Wat Chomphon Chao Praya

= 54.5-14.5 dB(A)

= 40.0 dB(A)

Leq 1 hr of transmitted noise at The Proud Village

= 61.6-14.5 dB(A)

= 47.1 dB(A)

The installation of such barriers resulted in the reduction in the noise impacts from the construction activities on the sound sensitive area adjacent to the Project area. Therefore, the noise level at Chumchon Borisat Namtan Tawan-aok School remained unchanged up to 9.9 dB(A), while the level at The Child Development Center of Chomphon Chao Phraya Sub-district Municipality remained unchanged up to 9.8 dB(A) and the level at Wat Chomphon Chao Phraya was at the range of 3.8 dB(A) up to 7.4 dB(A), as well as from 4.4 dB(A) to 7.9 dB(A) for The Proud Village. These levels, however, were in accordance with the prescribed standard criteria. Details are as shown in **Table 5.1.1.2-9** to **Table 5.1.1.2-12**.

- **Conclusion of Estimate Noise during Construction Period**

According to the estimated noise impacts on workers and employees working at the construction site, they will be exposed to the noise level from construction activities of 89.0 dB(A). When combined with the maximum result of Leq 8 hr in the current at construction site (52.0 dB(A)), the sum was 89.0 dB(A) which was consistent with the prescribed standard criteria prescribed in Ministry of Labour's Regulation re: Prescribing Standard for Administration and Management of Occupational Safety, Health and Environment for Work with Heat, Light and Noise, B.E. 2549 which stipulates that the 8 hr average continuous sound pressure level shall not exceed 90 dB(A). So the noise impacts on the workers and employees working at the construction site was low.

TABLE 5.1.1.2-9

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT CHUMCHON BORISAT NAMTAN TAWAN-AOK SCHOOL (NORTHEAST OF THE PROJECT AREA) (N2)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	69.0	59.7	49.7	69.1	0.1	7.0	5.0	7.4
09:00-10:00	63.5	56.7	49.7	63.7	0.2	7.0	5.0	5.0
10:00-11:00	67.4	59.6	49.7	67.5	0.1	7.0	5.0	5.9
11:00-12:00	71.5	61.1	49.7	71.5	0.0	7.0	5.0	8.4
13:00-14:00	62.4	56.3	49.7	62.6	0.2	7.0	5.0	4.3
14:00-15:00	70.9	63.6	49.7	70.9	0.0	7.0	5.0	5.3
15:00-16:00	72.5	63.6	49.7	72.5	0.0	7.0	5.0	6.9
16:00-17:00	58.7	49.3	49.7	59.2	0.5	7.0	5.0	7.9
7 February 2014								
08:00-09:00	66.4	59.4	49.7	66.5	0.1	7.0	5.0	5.1
09:00-10:00	68.2	58.3	49.7	68.3	0.1	7.0	5.0	8.0
10:00-11:00	62.9	56.5	49.7	63.1	0.2	7.0	5.0	4.6
11:00-12:00	67.0	58.5	49.7	67.1	0.1	7.0	5.0	6.6
13:00-14:00	63.7	56.3	49.7	63.9	0.2	7.0	5.0	5.6
14:00-15:00	66.6	59.9	49.7	66.7	0.1	7.0	5.0	4.8
15:00-16:00	70.2	62.2	49.7	70.2	0.0	7.0	5.0	6.0
16:00-17:00	64.0	50.8	49.7	64.2	0.2	7.0	5.0	unchanged [2/]
8 February 2014								
08:00-09:00	56.2	48.7	49.7	57.1	0.9	7.0	5.0	6.4
09:00-10:00	55.3	48.5	49.7	56.4	1.1	7.0	5.0	5.9
10:00-11:00	55.1	48.5	49.7	56.2	1.1	7.0	5.0	5.7
11:00-12:00	55.1	48.4	49.7	56.2	1.1	7.0	5.0	5.8
13:00-14:00	55.2	48.0	49.7	56.3	1.1	7.0	5.0	6.3
14:00-15:00	53.4	48.5	49.7	54.9	1.5	4.5	5.0	6.9
15:00-16:00	55.7	49.7	49.7	56.7	1.0	7.0	5.0	5.0
16:00-17:00	56.1	49.9	49.7	57.0	0.9	7.0	5.0	5.1
9 February 2014								
08:00-09:00	57.3	50.5	49.7	58.0	0.7	7.0	5.0	5.5
09:00-10:00	59.0	49.9	49.7	59.5	0.5	7.0	5.0	7.6
10:00-11:00	64.9	57.3	49.7	65.0	0.1	7.0	5.0	5.7
11:00-12:00	62.4	57.7	49.7	62.6	0.2	7.0	5.0	2.9
13:00-14:00	51.6	47.7	49.7	53.8	2.2	4.5	5.0	6.6
14:00-15:00	53.7	48.3	49.7	55.2	1.5	4.5	5.0	7.4
15:00-16:00	54.8	49.1	49.7	56.0	1.2	7.0	5.0	4.9
16:00-17:00	54.3	49.3	49.7	55.6	1.3	7.0	5.0	4.3

TABLE 5.1.1.2-9

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT CHUMCHON BORISAT NAMTAN TAWAN-AOK SCHOOL (NORTHEAST OF THE PROJECT AREA) (N2) (Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								
08:00-09:00	67.9	55.8	49.7	68.0	0.1	7.0	5.0	unchanged [2/]
09:00-10:00	64.5	57.8	49.7	64.6	0.1	7.0	5.0	4.8
10:00-11:00	62.7	57.1	49.7	62.9	0.2	7.0	5.0	3.8
11:00-12:00	65.3	57.7	49.7	65.4	0.1	7.0	5.0	5.7
13:00-14:00	61.8	56.4	49.7	62.1	0.3	7.0	5.0	3.7
14:00-15:00	65.0	57.6	49.7	65.1	0.1	7.0	5.0	5.5
15:00-16:00	68.4	56.6	49.7	68.5	0.1	7.0	5.0	9.9
16:00-17:00	57.2	49.0	49.7	57.9	0.7	7.0	5.0	6.9
Standard								**10.0**[3/]

Remark : 1/ Leq, 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of Chumchon Borisat Namtan Tawan-aok School station measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ The project operation do not cause increasing of existing noise nuisance because noise level measurement shows that sometimes in the community has noise level 10 dB(A) higher than background noise (L_{90}).

3/ Notification of NEB on disturbing noise levels

TABLE 5.1.1.2-10

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT WAT CHOPHON CHAO PHRAYA (SOUTH OF THE PROJECT AREA) (N3)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	69.0	59.7	45.6	69.0	0.0	7.0	5.0	7.3
09:00-10:00	63.5	56.7	45.6	63.6	0.1	7.0	5.0	4.9
10:00-11:00	67.4	59.6	45.6	67.4	0.0	7.0	5.0	5.8
11:00-12:00	71.5	61.1	45.6	71.5	0.0	7.0	5.0	8.4
13:00-14:00	62.4	56.3	45.6	62.5	0.1	7.0	5.0	4.2
14:00-15:00	70.9	63.6	45.6	70.9	0.0	7.0	5.0	5.3
15:00-16:00	72.5	63.6	45.6	72.5	0.0	7.0	5.0	6.9
16:00-17:00	58.7	49.3	45.6	58.9	0.2	7.0	5.0	7.6
7 February 2014								
08:00-09:00	66.4	59.4	45.6	66.4	0.0	7.0	5.0	5.0
09:00-10:00	68.2	58.3	45.6	68.2	0.0	7.0	5.0	7.9
10:00-11:00	62.9	56.5	45.6	63.0	0.1	7.0	5.0	4.5
11:00-12:00	67.0	58.5	45.6	67.0	0.0	7.0	5.0	6.5
13:00-14:00	63.7	56.3	45.6	63.8	0.1	7.0	5.0	5.5
14:00-15:00	66.6	59.9	45.6	66.6	0.0	7.0	5.0	4.7
15:00-16:00	70.2	62.2	45.6	70.2	0.0	7.0	5.0	6.0
16:00-17:00	64.0	50.8	45.6	64.1	0.1	7.0	5.0	unchanged[2/]
8 February 2014								
08:00-09:00	56.2	48.7	45.6	56.6	0.4	7.0	5.0	5.9
09:00-10:00	55.3	48.5	45.6	55.7	0.4	7.0	5.0	5.2
10:00-11:00	55.1	48.5	45.6	55.6	0.5	7.0	5.0	5.1
11:00-12:00	55.1	48.4	45.6	55.6	0.5	7.0	5.0	5.2
13:00-14:00	55.2	48.0	45.6	55.7	0.5	7.0	5.0	5.7
14:00-15:00	53.4	48.5	45.6	54.1	0.7	7.0	5.0	3.6
15:00-16:00	55.7	49.7	45.6	56.1	0.4	7.0	5.0	4.4
16:00-17:00	56.1	49.9	45.6	56.5	0.4	7.0	5.0	4.6
9 February 2014								
08:00-09:00	57.3	50.5	45.6	57.6	0.3	7.0	5.0	5.1
09:00-10:00	59.0	49.9	45.6	59.2	0.2	7.0	5.0	7.3
10:00-11:00	64.9	57.3	45.6	65.0	0.1	7.0	5.0	5.7
11:00-12:00	62.4	57.7	45.6	62.5	0.1	7.0	5.0	2.8
13:00-14:00	51.6	47.7	45.6	52.6	1.0	7.0	5.0	2.9
14:00-15:00	53.7	48.3	45.6	54.3	0.6	7.0	5.0	4.0
15:00-16:00	54.8	49.1	45.6	55.3	0.5	7.0	5.0	4.2
16:00-17:00	54.3	49.3	45.6	54.8	0.5	7.0	5.0	3.5

TABLE 5.1.1.2-10

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT WAT CHOPHON CHAO PHRAYA (SOUTH OF THE PROJECT AREA) (N3) (Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								
08:00-09:00	67.9	55.8	45.6	67.9	0.0	7.0	5.0	unchanged[2/]
09:00-10:00	64.5	57.8	45.6	64.6	0.1	7.0	5.0	4.8
10:00-11:00	62.7	57.1	45.6	62.8	0.1	7.0	5.0	3.7
11:00-12:00	65.3	57.7	45.6	65.3	0.0	7.0	5.0	5.6
13:00-14:00	61.8	56.4	45.6	61.9	0.1	7.0	5.0	3.5
14:00-15:00	65.0	57.6	45.6	65.0	0.0	7.0	5.0	5.4
15:00-16:00	68.4	56.6	45.6	68.4	0.0	7.0	5.0	9.8
16:00-17:00	57.2	49.0	45.6	57.5	0.3	7.0	5.0	6.5
ค่ามาตรฐาน								**10.0**[3/]

Remark : 1/ Leq, 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of Wat Chophon Chao Phraya measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ The project operation do not cause increasing of existing noise nuisance because noise level measurement shows that sometimes in the community has noise level 10 dB(A) higher than background noise (L_{90}).

3/ Notification of NEB on disturbing noise levels

TABLE 5.1.1.2-11

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT WAT CHOPHON CHAO PHRAYA (SOUTH OF THE PROJECT AREA) (N3)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	53.8	47.5	40.0	54.0	0.2	7.0	5.0	4.5
09:00-10:00	53.8	47.1	40.0	54.0	0.2	7.0	5.0	4.9
10:00-11:00	54.4	47.5	40.0	54.6	0.2	7.0	5.0	5.1
11:00-12:00	56.1	49.7	40.0	56.2	0.1	7.0	5.0	4.5
13:00-14:00	53.7	47.6	40.0	53.9	0.2	7.0	5.0	4.3
14:00-15:00	55.4	48.3	40.0	55.5	0.1	7.0	5.0	5.2
15:00-16:00	54.8	47.8	40.0	54.9	0.1	7.0	5.0	5.1
16:00-17:00	55.3	49.1	40.0	55.4	0.1	7.0	5.0	4.3
7 February 2014								
08:00-09:00	55.4	48.5	40.0	55.5	0.1	7.0	5.0	5.0
09:00-10:00	55.6	46.8	40.0	55.7	0.1	7.0	5.0	6.9
10:00-11:00	54.7	47.4	40.0	54.8	0.1	7.0	5.0	5.4
11:00-12:00	53.5	46.5	40.0	53.7	0.2	7.0	5.0	5.2
13:00-14:00	54.5	47.8	40.0	54.7	0.2	7.0	5.0	4.9
14:00-15:00	54.0	48.2	40.0	54.2	0.2	7.0	5.0	4.0
15:00-16:00	54.4	48.6	40.0	54.6	0.2	7.0	5.0	4.0
16:00-17:00	54.3	48.5	40.0	54.5	0.2	7.0	5.0	4.0
8 February 2014								
08:00-09:00	54.7	47.3	40.0	54.8	0.1	7.0	5.0	5.5
09:00-10:00	54.3	47.4	40.0	54.5	0.2	7.0	5.0	5.1
10:00-11:00	54.1	47.7	40.0	54.3	0.2	7.0	5.0	4.6
11:00-12:00	54.4	46.7	40.0	54.6	0.2	7.0	5.0	5.9
13:00-14:00	54.0	45.9	40.0	54.2	0.2	7.0	5.0	6.3
14:00-15:00	52.8	46.5	40.0	53.0	0.2	7.0	5.0	4.5
15:00-16:00	54.0	47.4	40.0	54.2	0.2	7.0	5.0	4.8
16:00-17:00	54.4	47.9	40.0	54.6	0.2	7.0	5.0	4.7
9 February 2014								
08:00-09:00	55.2	47.7	40.0	55.3	0.1	7.0	5.0	5.6
09:00-10:00	55.1	45.8	40.0	55.2	0.1	7.0	5.0	7.4
10:00-11:00	51.9	45.0	40.0	52.2	0.3	7.0	5.0	5.2
11:00-12:00	55.0	46.6	40.0	55.1	0.1	7.0	5.0	6.5
13:00-14:00	51.6	43.3	40.0	51.9	0.3	7.0	5.0	6.6
14:00-15:00	51.5	44.6	40.0	51.8	0.3	7.0	5.0	5.2
15:00-16:00	52.2	45.4	40.0	52.5	0.3	7.0	5.0	5.1
16:00-17:00	53.5	46.0	40.0	53.7	0.2	7.0	5.0	5.7

TABLE 5.1.1.2-11

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT WAT CHOPHON CHAO PHRAYA (SOUTH OF THE PROJECT AREA) (N3) (Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								
08:00-09:00	56.2	49.4	40.0	56.3	0.1	7.0	5.0	4.9
09:00-10:00	56.0	48.2	40.0	56.1	0.1	7.0	5.0	5.9
10:00-11:00	55.8	47.6	40.0	55.9	0.1	7.0	5.0	6.3
11:00-12:00	54.4	47.0	40.0	54.6	0.2	7.0	5.0	5.6
13:00-14:00	53.4	45.7	40.0	53.6	0.2	7.0	5.0	5.9
14:00-15:00	54.6	46.9	40.0	54.7	0.1	7.0	5.0	5.8
15:00-16:00	54.5	48.1	40.0	54.7	0.2	7.0	5.0	4.6
16:00-17:00	54.9	49.2	40.0	55.0	0.1	7.0	5.0	3.8
Standard								**10.0**[2/]

Remark : 1/ $L_{eq,}$ 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of Wat Chophon Chao Phraya measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ Notification of NEB on disturbing noise levels

TABLE 5.1.1.2-12

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT THE PROUD VILLAGE (SOUTH OF THE PROJECT AREA)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
6 February 2014								
08:00-09:00	53.8	47.5	47.1	54.6	0.8	7.0	5.0	5.1
09:00-10:00	53.8	47.1	47.1	54.6	0.8	7.0	5.0	5.5
10:00-11:00	54.4	47.5	47.1	55.1	0.7	7.0	5.0	5.6
11:00-12:00	56.1	49.7	47.1	56.6	0.5	7.0	5.0	4.9
13:00-14:00	53.7	47.6	47.1	54.6	0.9	7.0	5.0	5.0
14:00-15:00	55.4	48.3	47.1	56.0	0.6	7.0	5.0	5.7
15:00-16:00	54.8	47.8	47.1	55.5	0.7	7.0	5.0	5.7
16:00-17:00	55.3	49.1	47.1	55.9	0.6	7.0	5.0	4.8
7 February 2014								
08:00-09:00	55.4	48.5	47.1	56.0	0.6	7.0	5.0	5.5
09:00-10:00	55.6	46.8	47.1	56.2	0.6	7.0	5.0	7.4
10:00-11:00	54.7	47.4	47.1	55.4	0.7	7.0	5.0	6.0
11:00-12:00	53.5	46.5	47.1	54.4	0.9	7.0	5.0	5.9
13:00-14:00	54.5	47.8	47.1	55.2	0.7	7.0	5.0	5.4
14:00-15:00	54.0	48.2	47.1	54.8	0.8	7.0	5.0	4.6
15:00-16:00	54.4	48.6	47.1	55.1	0.7	7.0	5.0	4.5
16:00-17:00	54.3	48.5	47.1	55.1	0.8	7.0	5.0	4.6
8 February 2014								
08:00-09:00	54.7	47.3	47.1	55.4	0.7	7.0	5.0	6.1
09:00-10:00	54.3	47.4	47.1	55.1	0.8	7.0	5.0	5.7
10:00-11:00	54.1	47.7	47.1	54.9	0.8	7.0	5.0	5.2
11:00-12:00	54.4	46.7	47.1	55.1	0.7	7.0	5.0	6.4
13:00-14:00	54.0	45.9	47.1	54.8	0.8	7.0	5.0	6.9
14:00-15:00	52.8	46.5	47.1	53.8	1.0	7.0	5.0	5.3
15:00-16:00	54.0	47.4	47.1	54.8	0.8	7.0	5.0	5.4
16:00-17:00	54.4	47.9	47.1	55.1	0.7	7.0	5.0	5.2
9 February 2014								
08:00-09:00	55.2	47.7	47.1	55.8	0.6	7.0	5.0	6.1
09:00-10:00	55.1	45.8	47.1	55.7	0.6	7.0	5.0	7.9
10:00-11:00	51.9	45.0	47.1	53.1	1.2	7.0	5.0	6.1
11:00-12:00	55.0	46.6	47.1	55.7	0.7	7.0	5.0	7.1
13:00-14:00	51.6	43.3	47.1	52.9	1.3	7.0	5.0	7.6
14:00-15:00	51.5	44.6	47.1	52.8	1.3	7.0	5.0	6.2
15:00-16:00	52.2	45.4	47.1	53.4	1.2	7.0	5.0	6.0
16:00-17:00	53.5	46.0	47.1	54.4	0.9	7.0	5.0	6.4

TABLE 5.1.1.2-12

AFTER INSTALLATION NOISE BARRIER, NOISE NUISANCE FROM PILE DRIVERS ACTIVITIES OF THE PROJECT AT THE PROUD VILLAGE (SOUTH OF THE PROJECT AREA) (Cont'd)

Time	Sound Pressure Level							
	Measured (Leq 1 hr)[1/]	Measured (L_{90})[1/]	Construction Activities	Total	Difference	Amount to adjust the noise level	Addition from impulsive noise	Disturbance levels of the Project construction
10 February 2014								
08:00-09:00	56.2	49.4	47.1	56.7	0.5	7.0	5.0	5.3
09:00-10:00	56.0	48.2	47.1	56.5	0.5	7.0	5.0	6.3
10:00-11:00	55.8	47.6	47.1	56.3	0.5	7.0	5.0	6.7
11:00-12:00	54.4	47.0	47.1	55.1	0.7	7.0	5.0	6.1
13:00-14:00	53.4	45.7	47.1	54.3	0.9	7.0	5.0	6.6
14:00-15:00	54.6	46.9	47.1	55.3	0.7	7.0	5.0	6.4
15:00-16:00	54.5	48.1	47.1	55.2	0.7	7.0	5.0	5.1
16:00-17:00	54.9	49.2	47.1	55.6	0.7	7.0	5.0	4.4
Standard								**10.0**[2/]

Remark : 1/ $L_{eq,}$ 1 hr and L_{90} in time 08.00 a.m. - 17.00 p.m. of The Proud Village measured during 6-10 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ Notification of NEB on disturbing noise levels

In addition, the estimated 24 hr average sound pressure levels of the four sound sensitive areas: namely, Chumchon Borisat Namtan Tawan-aok School; The Child Development Center of Chomphon Chao Phraya Sub-district Municipality; Wat Chomphon Chao Phraya; and, The Proud Village, indicated that the 24 hr average sound pressure levels of these four sensitive areas are lower than the prescribed standard criteria. On the other hand, all four sensitive areas had higher noise levels with disturbance than the prescribed standards. Therefore, the Project had the temporary noise barriers installed around the piling areas in the northeast and the south of the Project site, with the initial materials of steel plates of 1.27 mm thickness (steel, 18 ga) or more, yielding the transmission loss of 25 dB(A) with the heights of the barriers in the northeast and the south of 3 m and 5 m respectively. This resulted in the reduce in the noise levels with disturbance in all four sensitive areas to be within the prescribed standards. In conclusion, the noise impacts during the construction period are low.

(2) Operation Period

During the operation period, electricity generation activities are the main noise sources. The noise impacts may occur as a result of the following equipment:

- Gas Turbines
- Heat Recovery Steam Generator
- Steam Turbines
- Generators
- Cooling Tower Machines
- Circulating Water Pumps
- Heat Recovery Steam Generator Feed Water Pumps
- Electric Motors
- Air Compressors
- Control Valves and Piping System
- Gas Compressors
- Transformer Cooling Fans

The Project selected devices, machines and equipment that produce lower noise with maximum sound pressure levels not to exceed 85 dB(A) at a distance of 1 m from the source, excluding the cooling tower that produces 91.0 dB(A) at a distance of 1 m from the source as a result of water falling on the surface of the water basin.

- **8 hr and 24 hr Average Sound Pressure Level**

With regard to the noise impacts from the electricity generation on the employees working at the Project site, the devices, machines and equipment used for generating electricity are the kinds that produce lower noise. Also, the Project requires that those working in the areas with prolonged exposure to loud noise use personal protective equipment such as ear muffs and ear plugs at all time, as well as the time limit for working in the areas with the average sound pressure level of 90 dB(A) must not exceed 8 hr. As a result, the level of noise impacts on the employees of the Project was low.

In this regard, some machines are placed inside the building enclosed with metal materials of about 0.64 mm thickness (steel, 24 ga) or more, yielding the transmission loss of 18 dB(A) as shown in **Table 5.1.1.2-6**, thus reducing their sound pressure level to 67 dB(A). These machines include gas turbines, steam turbines and generators.

Regarding the noise impacts of the Project on the four noise sensitive area: namely, Chumchon Borisat Namtan Tawan-aok School; The Child Development Center of Chomphon Chao Phraya Sub-district Municipality; Wat Chomphon Chao Phraya; and, The Proud Village, with different distances from the machinery as shown in **Table 5.1.1.2-13**, it is required that the 24 hr continuous sound pressure level of the electricity generation activities must be measured in the case where all machinery operates simultaneously, except for control valves and safety relief valves. The noise level at the sources is used to calculate the transmission loss by distance to the receivers, using this equation:

$$Lp_2 = Lp_1 - 20 \log \left(\frac{r_2}{r_1} \right)$$

For example, the noise level of CT Blowdown Transfer Pump at Chumchon Borisat Namtan Tawan-aok School can be calculated as follows:

Lp_1 = measured noise level at 1 m distance (85 dB(A))

Lp_2 = noise level at sensitive areas

r_1 = distance from noise source to measurement point (1 m)

r_2 = distance from noise source to sensitive area (392.7 m from machinery to the school)

As a result, the noise level of CT Blowdown Transfer Pump at the school premise is:

$$= 85 - 20 \log \left(\frac{392.7}{1} \right) = 33.1 \text{ dB(A)}$$

TABLE 5.1.1.2-13

THE DISTANCE OF MACHINE TO SENSITIVE AREAS

Machine	Noise level of machine (dB(A))	Distance from noise source to measurement point (m)	The distance of machine to sensitive areas (m)				Forecast noise level[1/] dB(A)			
			Chumchon Borisat Namtan Tawan-aok School (N2)	The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	Wat Chophon Chao Phraya (N3)	The Proud Village	Chumchon Borisat Namtan Tawan-aok School (N2)	The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	Wat Chophon Chao Phraya (N3)	The Proud Village
1. CT Blow down Transfer Pump	85.0	1.0	392.7	744.0	837.9	789.3	33.1	27.6	26.5	27.1
2. Cooling Tower # 1	91.0	1.0	574.3	951.9	638.5	565.1	35.8	31.4	34.9	36.0
3. Cooling Tower # 2	91.0	1.0	457.2	804.0	820.2	744.6	37.8	32.9	32.7	33.6
4. Steam Turbine # 1	67.0[2/]	1.0	703.5	1,070.5	640.3	484.1	10.1	6.4	10.9	13.3
5. Steam Turbine # 2	67.0[2/]	1.0	647.1	1,002.0	717.0	572.1	10.8	7.0	9.9	11.9
6. Steam Turbine # 3	67.0[2/]	1.0	597.6	933.8	809.1	667.3	11.5	7.6	8.8	10.5
7. Steam Turbine # 4	67.0[2/]	1.0	562.1	874.9	891.7	755.8	12.0	8.2	8.0	9.4
8. Generator # 1	67.0[2/]	1.0	713.5	1,078.8	650.2	482.4	9.9	6.3	10.7	13.3
9. Generator # 2	67.0[2/]	1.0	657.9	1,010.9	727.1	570.7	10.6	6.9	9.8	11.9
10. Generator # 3	67.0[2/]	1.0	609.1	943.5	813.2	665.3	11.3	7.5	8.8	10.5
11. Generator # 4	67.0[2/]	1.0	573.8	884.6	896.1	754.6	11.8	8.1	8.0	9.4
12. Gas Turbine # 1	67.0[2/]	1.0	730.7	1,093.0	663.2	481.5	9.7	6.2	10.6	13.3
13. Gas Turbine # 2	67.0[2/]	1.0	680.0	1,028.9	740.4	569.5	10.4	6.8	9.6	11.9
14. Gas Turbine # 3	67.0[2/]	1.0	631.3	961.3	825.1	665.1	11.0	7.3	8.7	10.5
15. Gas Turbine # 4	67.0[2/]	1.0	598.5	904.7	906.7	753.9	11.5	7.9	7.9	9.5
16. HRSG # 1	85.0	1.0	764.6	1,121.6	687.1	480.7	27.3	24.0	28.3	31.4
17. HRSG # 2	85.0	1.0	716.0	1,059.2	760.7	568.1	27.9	24.5	27.4	29.9

TABLE 5.1.1.2-13

THE DISTANCE OF MACHINE TO SENSITIVE AREAS (Cont'd))

Machine	Noise level of machine (dB(A))	Distance from noise source to measurement point (m)	The distance of machine to sensitive areas (m)				Forecast noise level[1/] dB(A)			
			Chumchon Borisat Namtan Tawan-aok School (N2)	The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	Wat Chophon Chao Phraya (N3)	The Proud Village	Chumchon Borisat Namtan Tawan-aok School (N2)	The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	Wat Chophon Chao Phraya (N3)	The Proud Village
18. HRSG # 3	85.0	1.0	670.7	994.3	843.5	663.5	28.5	25.1	26.5	28.6
19. HRSG # 4	85.0	1.0	638.7	939.0	922.2	751.7	28.9	25.5	25.7	27.5
20. Air Compressor # 1	85.0	1.0	714.0	1,012.7	928.3	726.7	27.9	24.9	25.6	27.8
21. Air Compressor # 2	85.0	1.0	709.3	1,003.2	943.3	743.7	28.0	25.0	25.5	27.6
22 Gas Compressor Station # 1	85.0	1.0	693.7	960.7	1,020.1	828.8	28.2	25.3	24.8	26.6
23. Gas Compressor Station # 2	85.0	1.0	691.7	954.6	1,030.8	840.8	28.2	25.4	24.7	26.5
24. Gas Compressor Station # 3	85.0	1.0	690.4	948.8	1,042.6	853.7	28.2	25.5	24.6	26.4
25. Gas Compressor Station # 4	85.0	1.0	689.1	942.6	1,054.6	867.0	28.2	25.5	24.5	26.2
26. Gas MR Station	85.0	1.0	483.0	717.7	1,077.8	969.0	31.3	27.9	24.3	25.3
Total sound pressure level of noise source to sensitive ares[2/] (dB(A))							**43.0**	**38.9**	**39.9**	**41.4**
Standard[3/] (dB(A))							**70**			

Remark : 1/ Calculated from $Lp2 = Lp1 - 20 \log (r_2/r_1)$

2/ The machines are placed inside the building enclosed with metal materials, yielding the transmission loss of 18 dB(A) (85-18 = 67 dB(A))

3/ Calculated from Lp total = $10\log\left(\sum_{i=1}^{N} 10^{Lp_i/10}\right)$

4/ Standard as prescribed in the National Environment Board's Notification No. 15 re: Prescribing Noise Level Standard, B.E. 2540.

Then, the noise impacts of primary noise sources of electricity generation activities on the sensitive areas is combined with the current sound pressure level measurement result using the following equation:

$$Lp_{total} = 10\log\left(\sum_{i=1}^{n} 10^{Lp_i/10}\right)$$

For example, the calculation for the total sound pressure level at Chumchon Borisat Namtan Tawan-aok School can be shown as follows:

$$\begin{aligned}\text{Total Lp}_{\text{ at Chumchon Borisat Namtan Tawan-aok School}} = 10 \log (&10^{(33.1/10)} + 10^{(35.8/10)} + 10^{(37.8/10)} + \\ &10^{(10.1/10)} + 10^{(10.8/10)} + 10^{(11.5/10)} + 10^{(12.0/10)} + \\ &10^{(9.9/10)} + 10^{(10.6/10)} + 10^{(11.3/10)} + 10^{(11.8/10)} + \\ &10^{(9.7/10)} + 10^{(10.4/10)} + 10^{(11.0/10)} + 10^{(11.5/10)} + \\ &10^{(27.3/10)} + 10^{(27.9/10)} + 10^{(28.5/10)} + 10^{(28.9/10)} + \\ &10^{(27.9/10)} + 10^{(28.0/10)} + 10^{(28.2/10)} + 10^{(28.2/10)} \\ &+ 10^{(28.2/10)} + 10^{(28.2/10)} + 10^{(28.2/10)} + 10^{(31.3/10)}) \\ = \ &43.0 \text{ dB(A)}\end{aligned}$$

The 24 hr continuous sound pressure level of electricity generation activities can be used to calculate for the noise nuisance level of electricity generation activities at Chumchon Borisat Namtan Tawan-aok School as follows:

$$\text{Leq, 1 hr} = 43.0 + 10 \log \frac{1}{1} = 43.0 \text{ dB(A)}$$

$$\text{Leq, 24 hr} = 43.0 + 10 \log \frac{24}{24} = 43.0 \text{ dB(A)}$$

When combined with the maximum 24 hr average sound pressure level from the current measurement conducted on February 6-11, 2014 (Maximum of Leq 24 hr at Chumchon Borisat Namtan Tawan-aok School and Wat Chomphon Chao Phraya were 65.6 and 53.7 dB(A) respectively and were also applied as the representative of The Child Development Center of Chomphon Chao Phraya Sub-district Municipality and The Proud Village respectively), all areas are within the standards. Details are as shown in **Table 5.1.1.2-14**.

TABLE 5.1.1.2-14

ESTIMATED NOISE IMPACTS ON NOISE SENSITIVE AREA DURING OPERATION PERIOD

Noise Sensitive Area	24 hr L_{eq} (dB(A))		
	Operation Activities	Maximum sound pressure measured[1/]	Total
1. Chumchon Borisat Namtan Tawan-aok School (N2)	43.0	65.6	65.6
2. The Child Development Center of Chomphon Chao Phraya Sub-district Municipality [2/]	38.9	65.6	65.6
3. Wat Chomphon Chao Phraya (N3)	39.9	53.7	53.9
4. The Proud Village [3/]	41.4	53.7	53.9
Standard	**70[4/]**		

Remark : 1/ Maximum result of $L_{eq,}$ 24 hr of each station measured during 6-11 February 2014, by the field inspection conducted by Team Consulting Engineering and Management Co., Ltd., 2014.

2/ Leq, 24 hr of the nearby measuring station (Chumchon Borisat Namtan Tawan-aok School) were used as the representative.

3/ Leq, 24 hr of the nearby measuring station (Wat Chomphon Chaophraya) were used as the representative.

4/ Standard as prescribed in the National Environment Board's Notification No. 15 re: Prescribing Noise Level Standard, B.E. 2540.

- **Noise nuisance**

The assessment of noise impacts on the living conditions of people residing in the sensitive communities adjacent to Sriracha Power Plant Project took into account the nature of electricity generation activities in the case of 24 hr continuous operation which falls into Scenario 1 and Scenario 4 according to the Noise Measurement Guide. The 1 hr average sound pressure level is the representative of the noise nuisance level during 6 a.m. and 10 p.m., while 5-min average sound pressure level is the representative of the noise nuisance level between 10 p.m. and 6 a.m., respectively.

In this regard, the measurement results of the 5-min average sound pressure level ($L_{eq, 5\ min}$) and the background noise level (L_{90}), obtained from the maximum 24 hr average sound pressure level, conducted on February 6-11, 2014 by Team Consulting Engineering and Management Co., Ltd. were analyzed and illustrated separately for daytime period (06:01 a.m. to 22:00 p.m.) and nighttime period (22:00 p.m. to 06:00 a.m.).

It shows that, during certain periods of time, the differences of $L_{eq, 5\ min}$ and L_{90} were considerably wide (10.7-17.7 dB(A)). This indicates that the sensitive areas may be affected by the intermittent noises which were not produced by the regular noise sources.

Therefore, such intermittent noises level was excluded from this report as the incidents are not a typical circumstance.

The noise impact measurement results can be concluded as follows:

For **Chumchon Borisat Namtan Tawan-aok School (N2) located in the northeast of the project**, the estimated Leq, 24 hr was 43.0 dB(A). When combined with the maximum measured of Leq, 24 hr (65.6 dB(A)), the sum was 65.6 dB(A) (**Table 5.1.1.2-14**), which was within the prescribed standard. In terms of the estimated Leq, 1 hr for the period of 6 a.m. to 10 p.m. and the Leq, 5 min for the period of 10 p.m. to 6 a.m., the level was found to be in the range of not disturbing up to 9.0 dB(A), which did not exceed the prescribed standard.

For **The Child Development Center of Chomphon Chao Phraya Sub-district Municipality located in the northeast of the project**, the estimated Leq, 24 hr was 38.9 dB(A). When combined with the maximum measured of Leq, 24 hr (65.6 dB(A)), the sum was 65.6 dB(A) (**Table 5.1.1.2-14**), which was within the prescribed standard. In terms of the estimated Leq, 1 hr for the period of 6 a.m. to 10 p.m. and the Leq, 5 min for the period of 10 p.m. to 6 a.m., the level was found to be in the range of not disturbing up to 6.5 dB(A), which did not exceed the prescribed standard.

For **Wat Chomphon Chao Phraya (N3) located in the south of the project**, the estimated Leq, 24 hr was 39.9 dB(A). When combined with the maximum measured of Leq, 24 hr (53.7 dB(A)), the sum was 53.9 dB(A) (**Table 5.1.1.2-14**), which was consistent with the prescribed standard criteria. In terms of the estimated Leq, 1 hr for the period of 6 a.m. to 10 p.m. and the Leq, 5 min for the period of 10 p.m. to 6 a.m., the level was found to be in the range of not disturbing up to 9.0 dB(A), which did not exceed the prescribed standard.

For **The Proud Village located in the south of the project**, the estimated Leq, 24 hr was 41.4 dB(A). When combined with the maximum measured of Leq, 24 hr (53.7 dB(A)), the sum was 53.9 dB(A) (**Table 5.1.1.2-14**), which was consistent with the prescribed standard criteria. In terms of the estimated Leq, 1 hr for the period of 6 a.m. to 10 p.m. and the Leq, 5 min for the period of 10 p.m. to 6 a.m., the level was

found to be in the range of not disturbing up to 9.7 dB(A), which did not exceed the prescribed standard.

- **Conclusion of Estimate Noise Impact during the Operation Period**

The estimated noise impacts on the employees working in the Project site indicated that during the operation period the main noise sources come from electricity generation activities that utilize machinery producing sound pressure level at a 1 m distance of lower than 85 dB(A), except for the cooling towers producing 91.0 dB(A). The machinery was placed within the building installed with sound absorbing materials in accordance with the standard prescribed in the, Ministry of Labour's Regulation on the Prescribing Standard for Administration and Management of Occupational Safety, Health and Environment for Work with Heat, Light and Noise, B.E. 2549 which prescribes that the 8 hr average continuous sound pressure level shall not exceed 90 dB(A). Therefore, the level of noise impacts on the employees was low.

In addition, the estimated 24 hr average sound pressure levels and noise nuisance level during the operation period at Chumchon Borisat Namtan Tawan-aok The Child Development Center of Chomphon Chao Phraya Sub-district Municipality, Wat Chomphon Chao Phraya, and The Proud Village indicated that they were consistent with the prescribed standard. Therefore, the level of noise impacts during the operation period was low. However, Sriracha Power Plant Project has established additional mitigation measure, i.e. planting three zigzag rows of trees around the Project site, to lessen the noise impacts on these four noise sensitive areas in the neighboring communities.

Mitigation Measures

(a) Construction Period

- Use construction equipment that produce loud noise only during the day time from 08.00-17.00. If it is necessary to operate ofter working hours, the Project must obtain approvals from the related agencies and must notify the communities and factories in the vicinity, at least two weeks prior to the operation.
- Publicize the construction plan that will generate noise and the measures to control noise from the construction to the people of the communities in the vicinity at least two weeks prior to the construction.

- Inspection, maintain and repair equipment and tools in good condition at all time and follow the maintenance manual for the equipment and tools continuously.
- Install warning sign boards in the area of loud noise and provide protective equipment such as ear plugs and ear muffs for construction workers working in the area of noise exceeding 85 dB (A) and require workers to use the silencers when working in the area of loud noise.
- Ensure that the construction contractors strictly comply with the prevention and mitigation measures for noise impacts and require that they use equipment and machines which produce low level of noise.
- Install temporary noise barrier along the fence in the northeast of the project which is adjacent to the Chumchon Borisat Namtan Tawan-aok School and the Child Development Center of Chomphon Chao Phraya Sub-district Municipalityand in the south side of the project which is adjacent to Wat Chompon Chaophraya and Praow Village where the height of the barrier fence is approximately 3 meters at the northeast side and approximately 5 meters at the south side. The barriers is made of 1.27 mm metal materials (Steel 18ga) or thicker having sound transmission loss (TL) of 25 dB(A).

(b) Operation Period

- Install warning sign boards or symbols in the area of noise exceeding 85 dB (A) such as, the area at the Combustion Chamber of the Gas Turbine and that require employees and persons entering such area put on personal protective equipment such as ear plugs and ear muffs.
- Establish specifications of machines and equipment which makes loud noise, such as Gas Turbine, Steam Turbine, Fuel Gas Compressor and Cooling Tower to have the average Maximum Sound Pressure Level (L_{max}) from the machines or noise absorbent material at the distance of 1 meter of no more than 85 dB(A)
- Install noise reducing equipment such as silencer at the pipe's ends that might generate noise, construct building covering the machines in the area of the Combustion Chamber of the Gas Turbine, at the area of Power Generator, Gas Turbine, Water Pump Motor and at the Steam Producing Unit (HRSG) and use the propellers of the cooling unit that are low-noise type.

- Control the noise level at the area adjacent to the project's fence to be no more than 70 dB (A).
- Inspect efficiency of the silencer regularly.
- Prepare a Noise Mapping/Noise Contour to mark the areas of loud noise during the first year of operation and every three years thereafter.
- Educate the employees so they have knowledge, understanding, positive attitude and desirable behaviors regarding occupational hygiene and safety at work at least once a year.
- Organize a Hearing Conservation Program in the administrative management preventing the employees from prolong exposure to loud noise, such as, establishing duration of the working time to reduce the time which the employees are exposed to loud noise, rotate employees or alternate working days in the areas of loud noise and to update the information at least once a year.

5.1.1.3 Water Quality

(1) Construction Period

During project construction, the wastewater of approximately 1,377 m^3/day consisted of: (1) uncontaminated wastewater from construction activities that will be drained into the Project's wastewater holding pond for quality inspection according to Hemaraj ESIE's specified requirements prior to further discharge into Hemaraj ESIE's central wastewater treatment system; and, (2) wastewater as a result of construction workers' consumption and usage that will be drained into either the septic tank or readymade septic tank for the treatment according to the specified standards. In terms of rainwater from the construction site, rain gutter drainage system compiled water into temporary sedimentation pond for retention and sedimentation. The solid sediments are separated from the rainwater and the clear water is reused as water sprays for reducing suspended particulate levels in the Project area. The remaining volume will be drained into Hemaraj ESIE's rain gutter drainage system. Therefore, this will not cause any impacts on water quality in the areas surrounding the Project area.

(2) Operation Period

(a) Wastewater from Production Activities

After the launch of Sriracha Power Plant Project, electricity generation activities will result in some wastewater from cooling tower (cooling blowdown), water naturalization system, laboratory, and office buildings. As Sriracha Power Plant Project is situated in Hemaraj ESIE, discharged water treatment must comply with Hemaraj ESIE's environmental impact mitigation and preventive measures. Such measures require that the power plants operated in Hemaraj ESIE shall separately treat discharged water in two categories: wastewater from production activities and cooling blowdown. Wastewater from production activities includes wastewater from water naturalization system, laboratory, and office building. After the initial treatment, this type of water must be discharged into Hemaraj ESIE's central wastewater treatment system. As for the power plant's cooling blowdown, after the treatment in the Project's cooling holding pond, the water must be discharged into Hemaraj ESIE's cooling blowdown. Then these two types of water will be discharged by Hemaraj ESIE into Khlong Kram (discharged water from the central water treatment system will not be drained during dry season.), which flows to merge with Khlong Rawoeng before Ban Wang Ka Yang Weir. Therefore, the water quality impact assessment for the Project is conducted in two parts, as follows:

- **Blowdown Water**

Blowdown water has lower level of dirtiness, with higher temperature of around 34 °C, and contains total dissolved solids (TDS) derived from water quality improving chemicals, which do not have high concentrations and are commonly used for such purpose. The treatment of cooling blowdown follows the discharged water treatment measures for small power plants (SPP) and independent power plants (IPP). In this study, the Project controls the quality of blowdown in accordance with Ministry of Industry's Notification No. 2, B.E. 2539 re: Prescribing Characteristics of Effluent discharged from a Factory, as well as the requirements specified in the environmental impact mitigation and preventive measures and the environmental impact monitoring measures as appear in Environmental Impact Assessment (EIA) for Hemaraj ESIE Project (2nd Amendment). Details are as follows:

- Wastewater from electricity generation unit/other areas must be discharged into Hemaraj ESIE's central wastewater treatment system except cooling blowdown/boiler blowdown.
- SPP and IPP seeking an establishment in Hemaraj ESIE must set up 3 ponds: namely, a cooling holding pond, a boiler holding pond and emergency pond, with 1-day capacity, to receive cooling blowdown and the boiler blowdown only, then add up and discharge into discharge water holding pond of power plant provided by Hemaraj ESIE.
- SPP and IPP must install online monitoring system to monitor pH, dissolved oxygen (DO), temperature and conductivity (to convert into TDS) at their cooling blowdown and must be able to report to Hemaraj ESIE's wastewater control center/IEAT.
- SPP and IPP are required to control the characteristics of the cooling blowdown and the boiler blowdown from their cooling blowdown in compliance with Ministry of Industry's Notification No. 2, B.E. 2539 re: Prescribing Characteristics of Wastewater Effluent discharged from a Factory. TDS value must be within the standard of the Royal Irrigation Department's Standards for Wastewater Quality in Irrigation Waterways before discharging from their plants into discharge water holding pond of power plant provided by Hemaraj ESIE.
- In case the characteristics of discharged water of SPP and IPP yield higher values than the standard specified in Ministry of Industry's Notification No. 2, B.E. 2539, or where the TDS values are higher than the Royal Irrigation Department's Standards for Wastewater Quality in Irrigation Waterways, SPP and IPP must turn off the outbound valves and discharge the water into their emergency ponds.
- In case the characteristics of discharged water of SPP and IPP yield higher values than the standards, SPP and IPP should take mitigation actions to alleviate such incident promptly. Should they be unable to take such action, the SPP and IPP must suspend their operation in order to implement any mitigation measures until the cooling blowdown meets the standards.

In addition, Sriracha Power Plant Project has also studied the assessment results of the impacts on Khlong Kram, Hemaraj ESIE's effluent discharde, conducted by Hemaraj ESIE (2015), showing values of DO mixing, BOD mixing, TDS mixing,

and temperature mixing, as well as the assessment results of the impacts of Hemaraj ESIE's cooling blowdown on the water quality of Khlong Kram, Khlong Rawoeng, and Nong Pla Lai Reservoir (2015). The findings are as follows:

1. **The Study on Impacts on Water Quality of Khlong Kram from Hemaraj Eastern Seaboard Industrial Estate's Discharged Water** (2015) examined the change in values of DO mixing, BOD mixing, and TDS mixing in Kram Canal, in both wet season and dry season shows that:

- **Rainy Season:** When Khlong Kram received discharged water from Hemaraj ESIE's central wastewater treatment system and discharge water holding pond of power plant provided by Hemaraj ESIE, DO value remained unchanged at 4.0 mg/L; BOD value increased from 3.2 to 5.2 mg/L; and, TDS value also went up from 162 to 731 mg/L. However, TDS value was still less than 1,300 mg/L, which was within the Royal Irrigation Department's Standards for Wastewater Quality in Irrigation Waterways. Therefore, the impact level on water quality in Khlong Kram is low.
- **Dry Season:** When Khlong Kram received Hemaraj ESIE's discharged water sent from the discharge water holding pond of power plant provided by Hemaraj ESIE, DO value remained unchanged, at 4.0 mg/L; BOD value increased from 3.2 to 4.0 mg/L; and, TDS value also went up from 162 to 770 mg/L. However, TDS value was still less than 1,300 mg/L, which is within the Royal Irrigation Department's Standards for Wastewater Quality in Irrigation Waterways. Therefore, the impact level on water quality in Khlong Kram is also low.

In this regard, Hemaraj ESIE has established measures for the treatment of cooling blowdown for SPP and IPP.

2. **The Study on Impacts from Cooling Water of Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate (2015)** examined the impacts of cooling blowdown from power plant projects on the water quality of Khlong Kram, Khlong Rawoeng, and Nong Pla Lai Reservoir. Details are as follows:

Sriracha Power Plant Project is situated in Hemaraj Eastern Seaboard Insustrial Estate, in which two other SPPs - Tasit 3 Power Plant and Tasit 4 Power Plant - are also located. The three power plants have established similar measures for wastewater treatment. They separately treat wastewater in two categories: wastewater from production activities (including wastewater from water naturalization system,

laboratory, and office building) and cooling blowdown. After the initial treatment, wastewater from production activities must be drained into Hemaraj ESIE's wastewater treatment system. As for the cooling blowdown, after the treatment in the Project's cooling hoding pond, this water must be drained into discharge water holding pond of power plant provided by Hemaraj ESIE. Then Hemaraj ESIE will discharge the treated water into Khlong Kram (discharged water from the central water treatment system will not be drained during dry season), which flows to merge, with Khlong Rawoeng before Ban Wang Ka Yang Weir and then into Nong Pla Lai Reservoir.

2.1 Scope of the Study

⇨ To examine the impacts of cooling blowdown of Sriracha Power Plant, Tasit 3 Power Plant and Tasit 4 Power Plant, situated in Hemaraj ESIE, as well as the discharged water from Hemaraj ESIE's wastewater treatment system (with the project) in terms of BOD and TDS values on Khlong Kram, Khlong Rawoeng, and Nong Pla Lai Reservoir, in comparison with the current conditions (without the project) in both wet season and dry season.

⇨ To inspect the impacts of cooling blowdown of Sriracha Power Plant, Tasit 3 Power Plant and Tasit 4 Power Plant, located in Hemaraj ESIE, in terms of SAR value on Khlong Kram, Khlong Rawoeng, and Nong Pla Lai Reservoir.

⇨ Locations to assess BOD and TDS impacts include:

- Station 1: At Khlong Kram downstream about 10 km before Hemaraj ESIE's discharge point (and 4.5 km before entering Hemaraj ESIE area).
- Station 2: Inside Hemaraj ESIE's wastewater pond before discharging into Khlong Kram.
- Station 3: At Khlong Kram downstream about 10 km after Hemaraj ESIE's discharge point and about 500 m before the confluence with Khlong Rawoeng.
- Station 4: At Khlong Rawoeng 200 m before entering Hemaraj ESIE area.
- Station 5: At Khlong Rawoeng after Ban Wang Ka Yang Weir (after the confluence with Khlong Kram) (represent, confluence between Khlong Rawoeng with Khlong Kram).

2.2 Sources of Data in the Study

⇨ Values of BOD, DO, Na, Ca, and Mg of Khlong Kram before entering Hemaraj ESIE area and Khlong Rawoeng, as well as Hemaraj ESIE's wastewater discharge rate from report on compliance with the environmental impact mitigation and preventive measures and the environmental impact monitoring measures of Hemaraj ESIE during January to April 2013, in both wet season and dry season.

⇨ Values of TDS and Conductivity of Khlong Kram from the Khlong Kram (before entering Hemaraj ESIE area) Water Quality Monitoring Results, measured on 18 October 2014 (wet season) and 20 February 2014 (dry season) which were the results of the sample collection in this study.

⇨ Values of TDS and Conductivity of Khlong Rawoeng from the Water Quality Monitoring Results measured on 18 October 2014 (wet season).

⇨ Values of BOD, TDS and DO from the Cooling Water Quality Monitoring Results of Kaeng Khoi 2 Power Plant (2014).

⇨ Values of BOD, TDS and DO from the Cooling Water Quality Monitoring Results of Nong La Lok Power Plant (2014).

⇨ The volume flow rates of Khlong Kram and Khlong Rawoeng from the measurement results on 18 October 2014 (wet season) and 5 December 2014 (dry season), which were the results of the sample collection in this study.

⇨ Values of BOD, TDS and DO of Nong Pla Lai Reservoir from Eastern Water Resources Development and Management Plc. (2010-2012).

⇨ The inflow volume, total volume, and outflow volume of Nong Pla Lai Reservoir from the statistical data from the Royal Irrigation Department (2004-2014).

⇨ Values of BOD and TDS of Khlong Hin Loi and the volume flow rate from Khlong Hin Loi into Nong Pla Lai Reservoir, with Wang Ta Phin Power Plant, Tasit 1 Power Plant and Tasit 2 Power Plant situated in Eastern Seaboard Industrial Estate (Rayong Province) from the Drainage Monitoring Results of Wang Ta Phin Power Plant, Tasit 1 Power Plant and Tasit 2 Power Plant.

⇨ Values of Na, Ca, and Mg from the data of water quality at the pumping point of Nong Pla Lai Reservoir from Eastern Water Resources Development and Management Plc. (2015).

⇨ Values of Na, Ca, and Mg of Sriracha Power Plant, Tasit 3 Power Plant and Tasit 4 Power Plant from the calculation of the amount of chemicals used in each project.

2.3 Principles for Cooling Blowdown Impact Assessment re: BOD and TDS Values

The impact assessment of surface water quality in terms of BOD and TDS values in cooling blowdown was based on the following principles:

⇨ Cooling Blowdown: The overall analysis was based on the assumption that wastewater from three power plants was discharged into Khlong Kram, mixed water from Khlong Kram flowing into Khlong Rawoeng, and inflow water from Khlong Rawoeng into Nong Pla Lai Reservoir.

- Sriracha IPP 's cooling blowdown discharge rate was 12,232 m^3/day, equal to 0.142 m^3/s;
- Tasit 3 Power Plant 's cooling blowdown discharge rate was 1,415 m^3/day, equal to 0.016 cubic m^3/s;
- Tasit 4 Power Plant 's cooling blowdown discharge rate was 1,415 m^3/day, equal to 0.016 m^3/s;
- The total cooling blowdown discharge rate of the three power plants was 15,062 m^3/day, or equal to 0.174 m^3/s.

⇨ Discharged water generation rate of Hemaraj ESIE without the three power plants was 3,488.55 m^3/day, or 0.04 m^3/s in average. However, since the discharged water is permitted to be drained out during approximately eight months of wet season, the average wastewater discharge rate of Hemaraj ESIE is therefore 0.06 m^3/s.

⇨ The volume flow rates of Khlong Kram and Khlong Rawoeng were estimated for each season as follows:

- Khlong Kram average flow rate is 0.56 m^3/s in dry season and 1.32 m^3/s in wet season (wet season measured on 18 October 2014; dry season measured on 5 December 2014).
- Khlong Rawoeng average flow rate is 1.03 m^3/s in dry season and the average rate in wet season of 4.39 m^3/s (wet season measured on 18 October 2014; dry season measured on 5 December 2014).

⇨ Water Quality Index: The indicators used in the analysis

to assess the impacts on the quality of receiving cooling blowdown were TDS and BOD values.

⇨ Impact Analysis: The impact assessment examined the following aspects:

- TDS value for the assessment of impacts on water quality in terms of water resource use, including consumption and cultivation.
- BOD value for the assessment of impacts on surface water quality in terms of classification and objectives used of water quality and use water resources.
- The assessed TDS and BOD values were used in the analysis of the ongoing impacts on aquatic ecology, fisheries and aquaculture.

2.4 Water Quality of Khlong Rawoeng and Khlong Kram

The monitoring data as appear in report on compliance with the environmental impact mitigation and preventive measures and the environmental impact monitoring measures of Hemaraj ESIE during January to June 2013, the values of pH, DO, and BOD of Khlong Rawoeng and Khlong Kram from the measurement conducted between 2010 to 2013 can be summarized as follows:

⇨ **Khlong Rawoeng**

1) At the point before flowing in Hemaraj ESIE area

- Dry season: (measured in March and December 2010, March and December 2011, and December 2013)
  - pH ranged from 6.71 to 7.36, average of 6.92;
  - DO ranged from 5 to 7 mg/L, average of 5.69 mg/L;
  - BOD ranged from 1 to 2 mg/L, average of 1.8 mg/L;
  - TDS not measured.
- Wet season: (measured in June and September 2010, 2011, and 2013)
  - pH ranged from 6.58 to 7.46, average of 6.8;
  - DO ranged from 4 to 6 mg/L, average of 4.56 mg/L;

- BOD ranged from 1 to 2.5 mg/L, average of 1.4 mg/L;
- TDS not measured.

2) Klong Rawoeng at the point after flowing off Hemaraj ESIE area

- Dry season: (measured in March and December 2010, 2011, and 2013)
  - pH ranged from 6.95 to 7.47, average of 7.1;
  - DO ranged from 5 to 7 mg/L, average of 5.39 mg/L;
  - BOD ranged from 1 to 4 mg/L, average of 2.45 mg/L;
  - TDS not measured.
- Wet season: (measured in June and September 2010 and 2012, November 2012, and June and September 2013)
  - pH ranged from 6.3 to 7.4, average of 6.9;
  - DO ranged from 4 to 6 mg/L, average of 4.6 mg/L;
  - BOD ranged from 1 to 2.1 mg/L, average of 1.4 mg/L;
  - TDS not measured.

⇨ **Khlong Kram**

1) At the point before flowing in Hemaraj ESIE area (in the west of Hemaraj ESIE)

- Dry season: (measured in March and December 2010 and 2011, and March and December 2012 and 2013)
  - pH ranged from 6.45 to 7.36, average of 6.9;
  - DO ranged from 4 to 7.18 mg/L, average of 4.73 mg/L;
  - BOD ranged from 1 to 3.2 mg/L, average of 2.48 mg/L;
  - TDS not measured.

- Wet season: (measured in June and September 2010, 2011, and 2012, November 2012, and June 2013)
  - pH ranged from 6.6 to 7.34, average of 6.79;
  - DO ranged from 4 to 6 mg/L, average of 4.4 mg/L;
  - BOD ranged from 1 to 3.2 mg/L, average of 2.78 mg/L;
  - TDS not measured.

2) Klong Kram at the point after flowing off Hemaraj ESIE area

- Dry season: (measured in March and December 2010 and 2011, and March and December 2012 and 2013)
  - pH ranged from 6.73 to 7.65, average of 7.16;
  - DO ranged from 5 to 6.24 mg/L, average of 5.3 mg/L;
  - BOD ranged from 1 to 3 mg/L, average of 2.52 mg/L;
  - TDS not measured.
- Wet season: (measured in June and September 2010, 2011, and 2012, November 2012, and June and December 2013)
  - pH ranged from 6.9 to 7.67, average of 7.1;
  - DO ranged from 4.35 to 6 mg/L, average of 5.46 mg/L;
  - BOD ranged from 1 to 4.4 mg/L, average of 2.86 mg/L;
  - TDS not measured.

In addition, the Project also measured conductivity and TDS (which was not done by Hemaraj ESIE) in Khlong Kram (before flowing in Hemaraj ESIE) on 20 February 2014 (dry season) and on 18 October 2014 for both Khlong Kram (before flowing in Hemaraj ESIE) and Khlong Rawoeng (wet season). Details are as follows:

⇨ **Measurement Results for Khlong Kram**

1) On 18 October 2014 (wet season)

- Conductivity value of 202 µs/cm;
- TDS value of 162 mg/L.

2) On 20 February 2014 (dry season)

- Conductivity value of 243.8 µs/cm;
- TDS value of 124 mg/L.

⇨ **Measurement Results for Khlong Rawoeng**

1) On 18 October 2014 (wet season)

- Conductivity value of 168 µs/cm;
- TDS value of 108 mg/L.

In terms of the conductivity and TDS values during dry season for Khlong Rawoeng, the Project used the results for Khlong Kram water quality monitoring (before flowing in Hemaraj ESIE) of 20 February 2014 (dry season) as the representative because both canals share the same headwater and the values in Khlong Kram were likely to be higher. Thus, the conductivity and TDS values in dry season of Khlong Kram applied by Khlong Rawoeng was the worst case scenario.

Summary of Water Quality of Khlong Rawoeng and Khlong Kram to Be Used in the Assessment of BOD and TDS Impacts

The water quality values that the Project selected included the average values of pH, DO and BOD of Khlong Kram and Khlong Rawoeng derived from the results monitored by Hemaraj ESIE in both dry season and wet season. As for TDS and conductivity values of Khlong Kram and Khlong Rawoeng, the data derived from the measurement on 18 October 2014 was used as the representative of wet season while the measurement results of 20 February 2014 was used as the representative of dry season. Details are as follows:

1) Khlong Kram at the point before flowing in Hemaraj ESIE had the current water quality prior to the operation of the Project as follows:

Dry Season:

pH value = average 6.9

DO value = average 4.73 mg/L

BOD value = average 2.48 mg/L

TDS value = 124 mg/L

Conductivity value = 243.8 µs/cm

Wet Season:

pH value = average 6.79

DO value = average 4.4 mg/L

BOD value = average 2.78 mg/L

TDS value = 162 mg/L

Conductivity value = 202 µs/cm

2) Khlong Rawoeng before flowing in Hemaraj ESIE had the current water quality prior to the operation of the Project as follows:

Dry Season:

pH value = average 6.92

DO value = average 5.69 mg/L

BOD value = average 1.8 mg/L

TDS value = 124 mg/L

Conductivity value = 243.8 µs/cm

Wet Season:

pH value = average 6.8

DO value = average 4.56 mg/L

BOD value = average 1.4 mg/L

TDS value = 108 mg/L

Conductivity value = 168 µs/cm

When comparing the water quality of Khlong Rawoeng and Khlong Kram in terms of pH, DO, and BOD values in both dry and wet season with the Surface Water Quality Standards according to the National Environment Board's Notification No. 8, B.E. 2537, it can be analyzed as follows:

- Khlong Kram in dry season and in wet season is classified as Surface Water of Class 4: Fairly clean fresh surface water resources used for (1) consumption, but requires special water treatment process before using (2) industry; with specified quality standards of: pH value range 5 to 9; DO value of at least 2 mg/L; and, BOD value of not exceeding 4 mg/L (but higher than 2 mg/L).
- Khlong Rawoeng in dry season and in wet season is classified as Surface Water of Class 3: Medium clean fresh surface water resources used for : (1) consumption, but passing through an ordinary treatment process before using

(2) agriculture; with specified quality standards of: pH value range 5 to 9; DO value of at least 4 mg/L; and, BOD value of not exceeding 2 mg/L.

2.5 Quality of Discharged Water Quality from Hemaraj Eastern Seaboard Industrial Estate

The values of pH, DO, BOD and TDS of discharged water from Hemaraj ESIE were the average values from the results of water quality monitoring in Hemaraj ESIE's discharged water retention pond, measured on 18 October 2014 as well as the results of post-treatment water quality monitoring in Hemaraj ESIE's central wastewater treatment system. The summary is as follows:

pH value = average 7.5

DO value = average 2.0 mg/L

BOD value = average 7.7 mg/L

TDS value = 610 mg/L

2.6 Quality of Discharged Water From Sriracha IPP, Tasit 3 Power Plant and Tasit 4 Power Plant

2.6.1 Sriracha IPP in Hemaraj Eastern Seaboard Industrial Estate

The characteristics of cooling blowdown from Sriracha IPP was the average value derived from the results of cooling blowdown quality monitoring measured by Kaeng Khoi 2 Power Plant (2014) which was similar to the one of Sriracha Power Plant, and the data of water quality at the pumping point of Nong Pla Lai Reservoir, measured by Eastern Water Resources Development and Management Plc., as the Project's raw water resource. The summary of the discharged water characteristics used as the representative of cooling blowdown from Sriracha IPP referred to in this study is as follows:

- BOD value = average 4.6 mg/L
- TDS value = average 1,263 mg/L (roundup to 1,300 mg/L, according to the Royal Irrigation Department's Standards of Discharged Water in Irrigation Waterways)
- DO value = average 5.1 mg/L

2.6.2 Tasit 3 SPP and Tasit 4 SPP

The characteristics of cooling blowdown from Tasit 3 Power Plant and Tasit 4 Power Plant was the average value derived from the results of cooling

blowdown quality monitoring measured by Nong La Lok Power Plant, Rayong Province, which was similar to the one of Tasit 3 Power Plant and Tasit 4 Power Plant. The summary of the discharged water characteristics used as the representative of cooling blowdown from Tasit 3 Power Plant and Tasit 4 Power Plant referred to in this study is as follows:

- BOD value = average less than 2 mg/L
- TDS value = average 1,214 mg/L (roundup to 1,300 mg/L, according to the Royal Irrigation Department's Standards of Discharged Water for Irrigation Waterways)
- DO value is the same value as Sriracha Power Plant, 5.1 mg/L.

2.7 Summary of Water Quality Index to Be Used in the Assessment of BOD and TDS Impacts

The summary of water quality index to be used in the assessment of BOD and TDS impacts is as follows:

2.7.1 Khlong Kram before the point of receiving discharged water from Hemaraj ESIE

- Dry Season: average volume flow rate of 0.56 m^3/s
  DO value = average 4.37 mg/L
  BOD value = average 2.48 mg/L
  TDS value = average 124 mg/L
- Wet Season: average volume flow rate of 1.32 m^3/s
  DO value = average 4.4 mg/L
  BOD value = average 2.78 mg/L
  TDS value = average 162 mg/L

2.7.2 Khlong Rawoeng before the point of discharged water from Hemaraj ESIE (wastewater discharged into Khlong Kram and the mixed water from Khlong Kram flowing into Khlong Rawoeng)

- Dry Season: average volume flow rate of 1.03 m^3/s
  DO value = average 5.69 mg/L
  BOD value = average 1.8 mg/L
  TDS value = average 124 mg/L
- Wet Season: average volume flow rate of 4.39 m^3/s

DO value = average 4.73 mg/L

BOD value = average 1.4 mg/L

TDS value = average 108 mg/L

2.7.3 Hemaraj ESIE's wastewater was not discharged during dry season, while the discharge rate during wet season was 0.06 m^3/s. The water quality index includes:

DO value = 2 mg/L

BOD value = 7.7 mg/L

TDS value = 619 mg/L

2.7.4 Cooling blowdown from Sriracha IPP had the discharge rate of 0.142 m^3/s. The water quality index includes:

DO value = 5.1 mg/L

BOD value = 4.6 mg/L

TDS value = 1,300 mg/L

2.7.5 Cooling blowdown from Tasit 3 and Tasit 4 Power Plants was altogether at the rate of 0.032 m^3/s. The water quality index includes:

DO value = 5.1 mg/L

BOD value = 2 mg/L

TDS value = 1,300 mg/L

2.8 Analyzing Surface Water Quality for BOD and TDS Values of Khlong Kram and Khlong Rawoeng When Cooling Blowdown was discharged

The calculation of the mixing of BOD and TDS with discharged water:

$$\text{Total C} = \frac{C_1Q_1 + C_2Q_2 + C_3Q_3 + + C_4Q_4}{Q_1 + Q_2 + Q_3 + Q_4}$$

C = concentrations of BOD or TDS in Khlong Kram after mixing

C_1 = values of BOD or TDS in Khlong Kram before mixing

C_2 = values of BOD or TDS of Hemaraj ESIE's discharged water

C_3 = values of BOD or TDS of Sriracha IPP's discharged water

C_4 = values of BOD or TDS of Tasit 3 or Tasit 4 SPP's discharged water

Q_1 = volume flow rate of Khlong Kram and Khlong Rawoeng before mixing

Q_2 = volume flow rate of Hemaraj ESIE's discharged water

Q_3 = volume flow rate of Sriracha IPP's discharged water

Q_4 = volume flow rate of Tasit 3 and Tasit 4 SPP's discharged water

Total Q of Khlong Kram:

Total Q in dry season = $Q_1 + Q_2 + Q_3 + Q_4$

= 0.56 + 0 + 0.142 + 0.032

= 0.734 m^3/s

Total Q in wet season = 1.32 + 0.06 + 0.142 + 0.032

= 1.554 m^3/s

During dry season, Hemaraj ESIE did not discharge wastewater so $Q_2 = 0$.

Total BOD Value of Khlong Kram Downstream Hemaraj ESIE (Station 3)

$$\text{Total BOD in dry season} = \frac{(0.56\text{x}2.48)+(0\text{x}7.7)+(0.142\text{x}4.6)+(0.032\text{x}2)}{0.734}$$

= 2.86 mg/L

$$\text{Total BOD in wet season} = \frac{(1.32\text{x}2.78)+(0.06\text{x}7.7)+(0.142\text{x}4.6)+(0.032\text{x}2)}{1.554}$$

= 3.12 mg/L

Total TDS Value of Khlong Kram Downstream Hemaraj ESIE (Station 3)

Total TDS in dry season $= \{(0.56\text{x}124)+(0\text{x}619)+(0.142\text{x}1,300)+(0.032\text{x}1,300)\} \div 0.734$

= 402.77 mg/L

Total TDS in wet season $= \{(1.32\text{x}162)+(0.06\text{x}619)+(0.142\text{x}1,300)+(0.032\text{x}1,300)\} \div 1.554$

= 307.06 mg/L

Total Q of Khlong Rawoeng Receiving Mixed Water from Khlong Kram

Total Q of Khlong Rawoeng = $Q_K + Q_R$

Q_K = volume flow rate of Khlong Kram including the rates of discharged water of Hemaraj ESIE, Sriracha IPP, and Tasit 3 and Tasit 4 SPP, average 0.734 m^3/s during dry season and average 1.554 m^3/s during wet season.

Q_R = volume flow rate of Khlong Rawoeng before entering Hemaraj ESIE

Dry Season, Average Total Q of Khlong Rawoeng= 0.734 + 1.03

= 1.764 m^3/s

Wet Season, Average Total Q of Khlong Rawoeng= 1.554 + 4.39

= 5.94 m^3/s

Total BOD Value of Khlong Rawoeng Downstream the Conflux (Station 5)

$$\text{Total BOD in Dry Season} = \frac{(0.734 \times 2.86)+(1.03 \times 1.8)}{1.764} = 2.24 \text{ mg/L}$$

$$\text{Total BOD in Wet Season} = \frac{(1.554 \times 3.12)+(4.39 \times 1.4)}{5.944} = 1.84 \text{ mg/L}$$

Total TDS Value of Khlong Rawoeng Downstream the Conflux (Station 5)

$$\text{Total TDS in Dry Season} = \frac{(0.734 \times 402.77)+(1.03 \times 124)}{1.764} = 239.99 \text{ mg/L}$$

$$\text{Total TDS in Wet Season} = \frac{(1.554 \times 307.69)+(4.39 \times 108)}{5.944} = 160.04 \text{ mg/L}$$

2.9 Analyzing the BOD and TDS Impacts on Water Quality and Use of Khlong Kram and Khlong Rawoeng for Agriculture and Public Water Supply System

The summary of BOD and TDS values of Khlong Kram and Khlong Rawoeng without the Project and with the Project is shown in **Table 5.1.1.3-1**.

a) The Impact on Khlong Kram (see **Table 5.1.1.3-1**)

a1) Analyzing BOD and TDS Values in Dry Season

Since the BOD values, for the scenario of both with and without the Project development, were higher than 2 mg/L but not exceeding 4 mg/L (2.48-2.86 mg/L), this can be classified as the surface water of class 4. Therefore, the Project has no impact on Khlong Kram due to the fact that the Canal has already been classified as the surface water of class 4 even without the project. Moreover, the scenario with the Project did not cause it to change into the surface water of class 5. Additionally, Khlong Kram has not been used for production of potable water.

In terms of the TDS values, for the scenario without the project, the value was 124 mg/L while it was 402.77 mg/L for the scenario with the project. These values did not exceed the standard for water use for irrigation (agriculture), which

shall not exceed 450 mg/L for all kinds of plants in all soil types. However, as water is rarely used for agricultural purposes during dry season (used in pineapple plantations only) and while other plantations, including sugarcane, cassava, and rubber, rely mainly on rainfall, the project, therefore, has no impact on Khlong Kram.

TABLE 5.1.1.3-1

SUMMARY OF BOD AND TDS IMPACT ASSESSMENT AT KHLONG KRAM (STATION 3) AND KHLONG RAWOENG (STATION 5) AFTER RECEIVING DISCHARGED WATER FROM THE PROJECT AND HEMARAJ ESIE

Season and Scenario	BOD (mg/L)		TDS (mg/L)	
	Khlong Kram	Khlong Rawoeng	Khlong Kram	Khlong Rawoeng
1. Dry Season				
1.1 Without the project	2.48	1.8	124	124
1.2 With the project	2.86	2.24	402.77	239.99
2. Wet Season				
2.1 Without the project	2.78	1.4	162	108
2.2 With the project	3.12	1.84	307.06	160.04
Standards for surface water quality class 3	**Less than 2**	**Less than 2**	**Standard for water use for irrigation, applicable to all plants in all soil types, not exceeding 450**	
Standards for surface water quality class 4	**Less than 4**	**Less than 4**		

Remark : The water with TDS value that does not exceed 450 mg/L will be applicable to all kinds of plants in all soil types but the maximum standard value is 1,500 mg/L which is applicable to all plants but the soil must be of good drainage characteristics (Referring to Standard Differential. Direk Thongaram et al., 2002. Design and Irrigation Technology).

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

a2) Analyzing BOD and TDS Values in Wet Season

The BOD values, for the scenario of both with and without the Project development, were higher than 2 mg/L but not exceeding 4 mg/L (2.78-3.12 mg/L) and this can be classified as the surface water of class 4. Therefore, the Project has no impact on Khlong Kram due to the fact that even without the Project the Canal has already been classified as the surface water of class 4. Moreover, the scenario

with the Project did not cause it to change into the surface water of class 5. Additionally, Khlong Kram has not been used for production of potable water.

In terms of the TDS values, for the scenario without the project, the value was 162 mg/L while it was 307.06 mg/L for the scenario with the project. These values did not exceed the standard for water use for irrigation (agriculture) purposes, which shall not exceed 450 mg/L for all kinds of plants in all soil types. Therefore, during wet season, discharged water from the Project will not cause any impact on water untilization for such purposes. As a result, the Project has no impact on Kram Canal.

b) The Impact on Khlong Rawoeng (henceforth meaning the confluence of Khlong Rawoeng with Khlong Kram) (see also **Table 5.1.1.3-1**)

b1) Analyzing BOD and TDS Values in Dry Season

Regarding the BOD value for the scenario without the Project, the water quality is classified as the surface water of class 3 (BOD value of 1.8 mg/L). At the same time, as the BOD value for the scenario with the Project was more than 2 mg/L (2.24 mg/L), the water quality is classified as the surface water of class 4. Even though the water quality class has changed from class 3 to class 4, it can be used for production of potable water. As a result, the Project has moderate impacts on Khlong Rawoeng.

On the other hand, the TDS value for the scenario without the Project was 124 mg/L while it was 239.99 mg/L for the scenario with the Project. These values did not exceed the standard for water use for irrigation (agriculture) purposes, which shall not exceed 450 mg/L for all kinds of plants in all soil types, as well as in accordance with Department of Health's Notification B.E. 2553 re: Drinking Water standard, stipulating that TDS value shall not exceed 1,000 mg/L. Therefore, during dry season, discharged water from the Project has no impact on water use for agriculture and production of potable water.

b2) Analyzing BOD and TDS Values in Wet Season

Regarding the BOD value for the scenario with and without the Project development, the water quality is classified as the surface water of class 3 (BOD value of 1.4 and 1.84 mg/L, respectively). Since the Project did not cause the water quality class to change, the Project therefore has low impacts on Khlong Rawoeng.

On the other hand, the TDS value for the scenario with and without the Project was 108 mg/L and 160.04 mg/L, respectively. These values did

not exceed the standard for water use for irrigation (agriculture) purposes, which shall not exceed 450 mg/L for all kinds of plants in all soil types, as well as in accordance with Department of Health's Notification B.E. 2553 re: Drinking Water Standard, stipulating that TDS value shall not exceed 1,000 mg/L. Therefore, during wet season, discharged water from the Project has no impact on water use for agriculture and production of potable water.

In summary, the impacts of TDS values for the scenario with the Project on both Khlong Kram and Khlong Rawoeng can be estimated that the TDS values did not surpass 450 mg/L, which did not exceed the standard for water use for irrigation (agriculture) purposes applicable to all kinds of plants in all soil types (Referring to Standard Differential. Direk Thongaram et al., 2002. Design and Irrigation Technology). These values also did not go above 1,000 mg/L, the level not affecting production of potable water or consumption water as this is within the standard and does not make the fresh water taste brackish (Department of Health's Notification B.E. 2553 re: Drinking Water Standard; and, Kriengsak Udomsinsoj, 1994. Environmental Engineering, page 161). The summary of the impact characteristics, the affected parties, and environmental impact mitigation and preventive measures of the impacts on Khlong Kram and Khlong Rawoeng are shown in **Table 5.1.1.3-2**.

The locations of BOD and TDS impact assessment at Khlong Kram and Khlong Rawoeng in dry season are illustrated in **Figure 5.1.1.3-1** and the locations in wet season are illustrated in **Figure 5.1.1.3-2**.

2.10 Analyzing BOD and TDS Impacts on Water Quality and Use of Nong Pla Lai Reservoir

a) Current Conditions of Water Quality of Nong Pla Lai Reservoir in Terms of DO, BOD, and TDS Values

Details of the study of water quality monitoring data at the pumping point in Nong Pla Lai Reservoir conducted by Eastern Water Resources Development and Management Plc. (2010-2012) (**Table 5.1.1.3-3**) are as follows:

In terms of the DO values, during dry season (December and January to April), the average value between 2010-2012 ranged from 4.35 to 6.0 mg/L. During wet season (May to November), the average value ranged from 4.88 to 6.35 mg/L. The average annual value was at 5.52 mg/L.

Regarding the BOD values, during dry season, the average value between 2010-2012 ranged from less than 1 to 2.3 mg/L. During wet season, the average value ranged from 1.6 to 2.33 mg/L. The average annual value was 1.88 mg/L.

Regarding the TDS values, during dry season, the average value between 2010-2012 was at 111 mg/L. During wet season, the average value was at 122 mg/L. The average annual value was at 115 mg/L.

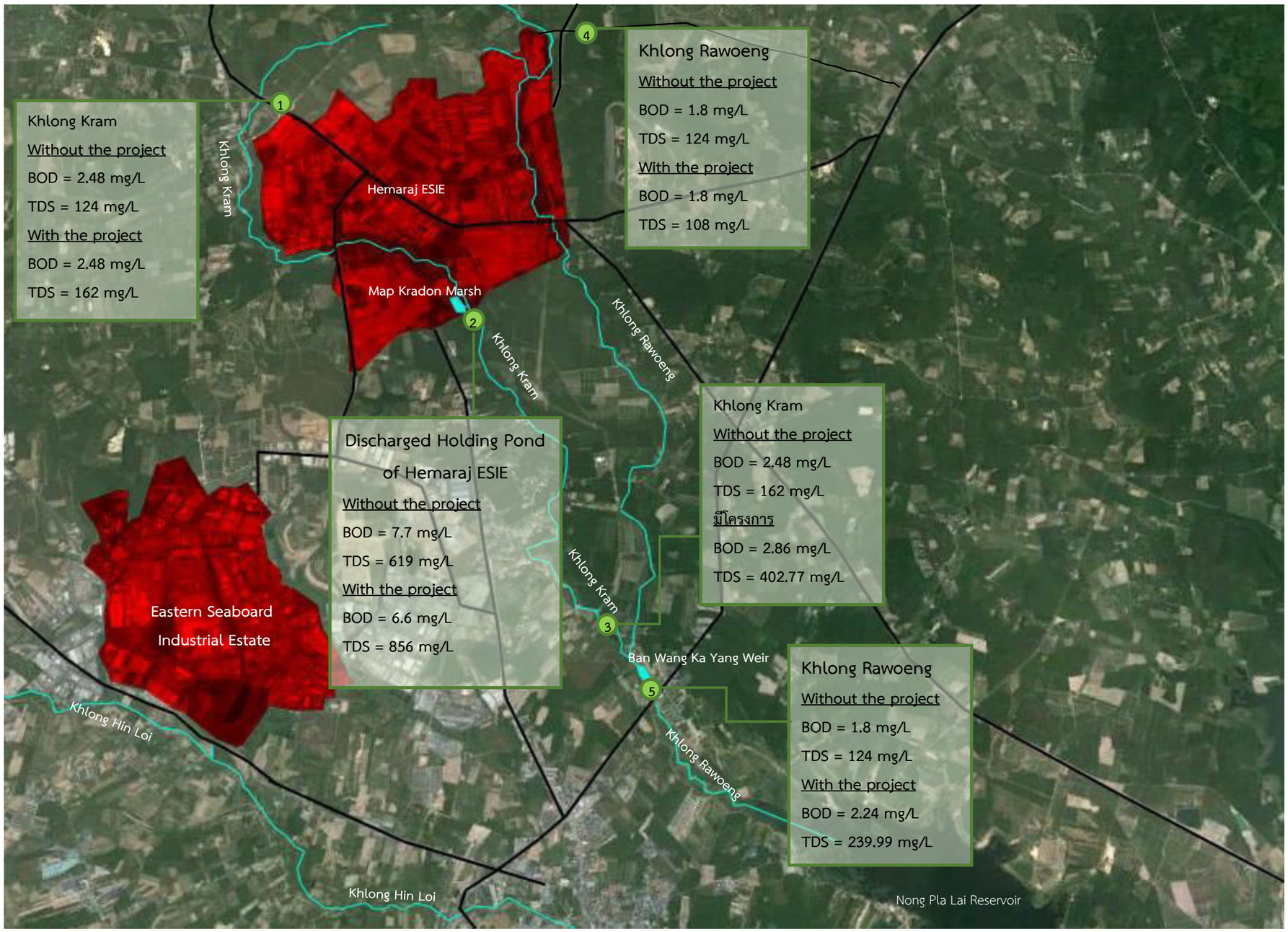
As for the BOD values, the average value did not exceed 2 mg/L in nine months, including January, February, April to July, September, and November to December. The remaining three months, including March, May and June, shows the average value of higher than 2 mg/L. As the average annual value was at 1.88 mg/L, the water quality was, therefore, classified as the surface water of class 3.

TABLE 5.1.1.3-2

SUMMARY OF IMPACT CHARACTERISTICS, POTENTIAL AFFECTED PARTIES, IMPACT LEVEL OF COOLING BLOWDOWN FROM POWER PLANTS ON KHLONG KRAM AND KHLONG RAWOENG AND THE PREVENTIVE AND MITIGATION MEASURES

Potential Impact Index	Impact Characteristics	Potential Affected Parties	Preventive and Mitigation Measures
1. Khlong Kram 1.1 BODDry season	Classified as Surface Water class 4 for scenario of with and without the Project development; no impact on water quality nor use during dry season	Not used for production of potable water; current monitoring (2015) shows no use for household consumption	-
1.2 TDS Dry season	TDS value rose from 124 to 402.77 mg/L; not exceeding 450 mg/L (the standard for values not affecting agriculture)	Rarely used; nearby plantation crops and rubber rely mainly on rainfall; surrounding soil of loam and sand types	Recirculation/reuse of discharged water in the Project area to reduce the volume during dry season
2. Khlong Kram 2.1 BODWet season	Classified as Surface Water class 4 for scenario of with and without the Project development; no impact on water quality	Not used for production of potable water; current monitoring (2015) shows no use for household consumption	-
2.2 TDS Wet season	TDS value rose from 162 to 307.06 mg/L; not exceeding 450 mg/L (the standard for values not affecting agriculture)	Direct use rarely found	-
3. Khlong Rawoeng 3.1 BOD Dry season	For scenario with the project, water quality class changed from Class 3 to Class 4; usable for production of potable water	Use for production of potable water (presently K Water Co., Ltd.)	All power plants must control DO value of cooling blowdown to be discharged at no less than 4 mg/L
3.2 TDS Dry season	TDS value rose from 162 to 307.06 mg/L; not exceeding 450 mg/L (the standard value not affecting agriculture); no impact on use for production of potable water	Moderate use for cultivation, downstream before flowing into Nong Pla Lai Reservoir	-
4. Khlong Rawoeng 4.1 BOD Wet season	For scenario with the project, water quality class remained in Class 3; production of potable water unchanged (low impact)	Use for production of potable water (presently K Water Co., Ltd.)	All power plants must control DO value of cooling blowdown to be discharged at no less than 4 mg/L
4.2 TDS Wet season	TDS value rose from 108 to 160.04 mg/L; not exceeding 450 mg/L (the standard value not affecting agriculture); no impact on use for production of potable water	Moderate use for cultivation, downstream before flowing into Nong Pla Lai Reservoir	-

Source: Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.



Legends

- Industrial Estate Boundary
- Road
- Canal

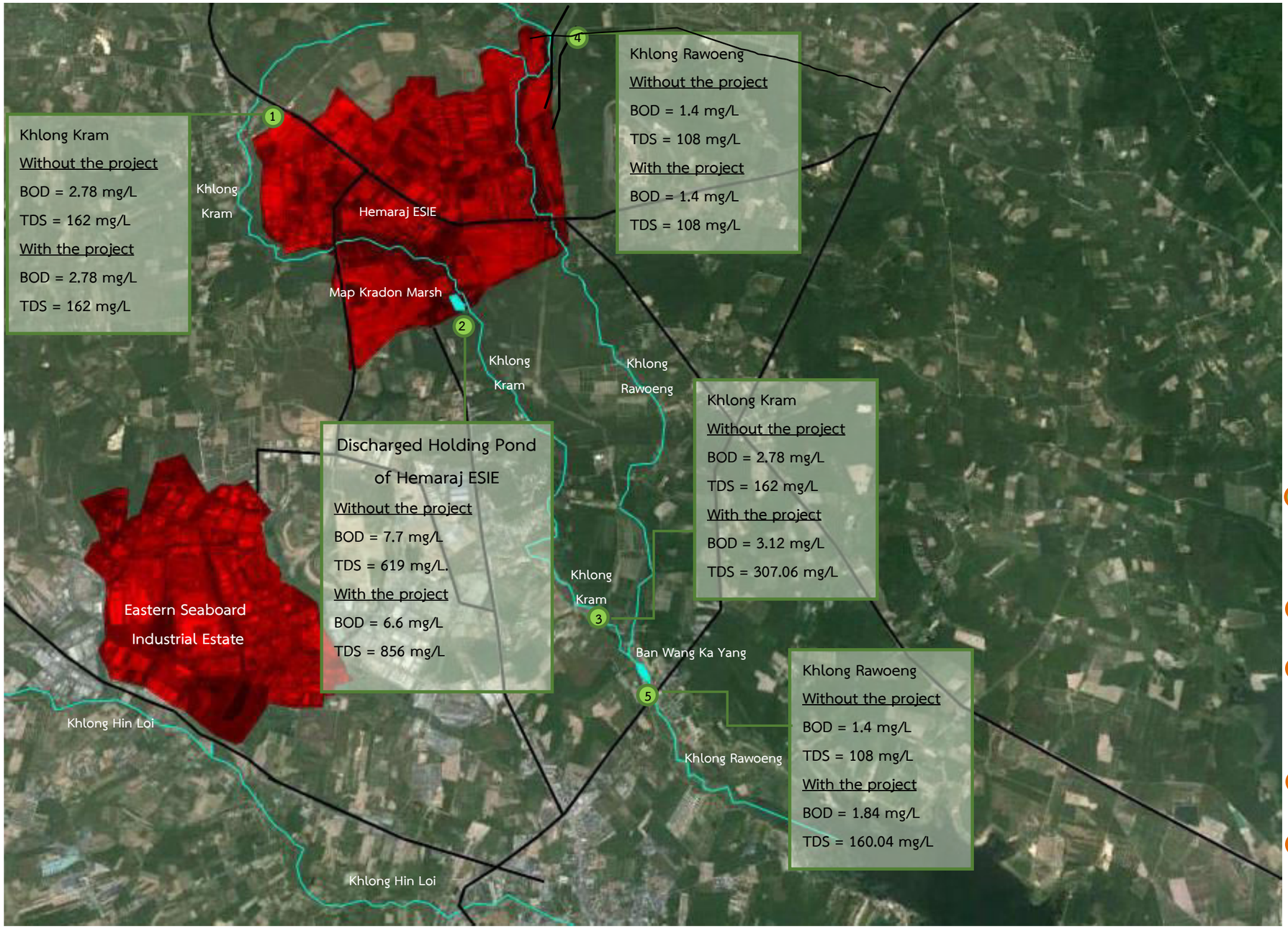
Locations to assess BOD and TDS impacts

1. At Khlong Kram downstream about 10 km before Hemaraj ESIE's discharge point (and 4.5 km before entering Hemaraj ESIE area).
2. Inside Hemaraj ESIE's wastewater pond before discharging into Khlong Kram.
3. At Khlong Kram downstream about 10 km after Hemaraj ESIE's discharge point and about 500 m before the confluence with Khlong Rawoeng.
4. At Khlong Rawoeng 200 m before entering Hemaraj ESIE area.
5. At Khlong Rawoeng after Ban Wang Ka Yang Weir (after the confluence with Khlong Kram) (represent, confluence between Khlong Rawoeng with Khlong Kram).

Scale 1 : 90,000

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

FIGURE 5.1.1.3-1 LOCATIONS TO ASSESS BOD AND TDS IMPACTS IN KHLONG KRAM AND KHLONG RAWOENG, DURING DRY SEASON.



Scale 1 : 90,000

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

FIGURE 5.1.1.3-2 LOCATIONS TO ASSESS BOD AND TDS IMPACTS IN KHLONG KRAM AND KHLONG RAWOENG, DURING WET SEASON.

TABLE 5.1.1.3-3

CURRENT CONDITIONS OF WATER QUALITY OF NONG PLA LAI RESERVOIR IN TERMS OF DO, BOD, AND TDS VALUES AT THE PUMPING POINT OF EASTERN WATER RESOURCES DEVELOPMENT AND MANAGEMENT PLC.

Year/Index	Months												Average
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2010													
DO (mg/L)	-	-	4.71	4.53	4.45	5.46	4.07	6.93	4.67	5.54	6.72	5.97	5.3
BOD (mg/L)	-	-	3.3	1.3	2.0	2.0	2.4	2.5	1.5	2.5	2.5	2.0	2.37
TDS (mg/L)	-	-	78	112	126	140	116	106	108	132	126	112	116
2011													
DO (mg/L)	-	-	-	-	-	-	-	-	5.72	7.2	6.2	5.02	6.03
BOD (mg/L)	-	-	-	-	-	-	-	-	1.6	1.8	1.7	1.6	1.67
TDS (mg/L)	-	-	-	-	-	-	-	-	108	128	90	100	106.5
2012													
DO (mg/L)	6.0	4.35	5.0	5.02	7.03	4.3	5.4	4.9	5.03	6.3	5.3	4.2	5.24
BOD (mg/L)	1.8	<1	1.3	2.0	1.9	1.2	1.6	1.8	1.5	<0.1	1.6	1.6	1.61
TDS (mg/L)	116	114	118	116	143	116	128	124	138	118	116	120	122
DO Average (mg/L)	6.0	4.35	4.85	4.77	5.74	4.88	6.16	5.91	5.14	6.35	6.07	5.06	5.52
BOD Average (mg/L)	1.8	<1	2.3	1.65	1.95	1.6	2.0	2.15	1.53	2.33	1.93	1.73	1.88
TDS Average (mg/L)	116	114	98	114	135	128	122	115	118	126	111	111	115

Remark : – = No data.

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

b) Inflow Volume, Total Volume and Outflow Volume of Nong Pla Lai Reservoir

According to the data collected by the Royal Irrigation Department between 2004 and 2014, the water volume of Nong Pla Lai Reservoir can be analyzed as follows:

b1) Monthly and Annually Inflow Volume

Table 5.1.1.3-4 shows inflow volume of Nong Pla Lai Reservoir as follows:

- Average annual flow rate of 178.84 Mm^3;
- Average annual flow rate shows that (based on the data of 2004-2013 as the yr 2014 missed data of certain months so it was excluded) the lowest rate was 127.72 Mm^3/yr and the maximum was 280.32 Mm^3/yr.

b2) Monthly and Annually Total Volume

Table 5.1.1.3-5 shows total volume of Nong Pla Lai Reservoir, monitored on the last day of each month, indicated that:

The average total volume of water in the reservoir during dry season, from December to April, was 116.15 Mm^3/month while during wet season, from May to November, the average volume was 117.66 Mm^3/month.

Based on the data of 2004-2013, the lowest volume was 10.05 Mm^3 in August 2005 while the highest volume was 168.77 Mm^3 in October 2008.

b3) River Outlet Volume for Agriculture Purposes

Table 5.1.1.3-6 shows river outlet volume for agricultural purposes as follows:

During dry season, from December to April, the average volume was 5.31 Mm^3/month while during wet season, from May to November, the average volume was 4.45 Mm^3/month.

- Average annual outflow volume of 57.31 Mm^3/yr;
- Average annual outflow volume based on the data of 2004-2013 shows that the lowest volume was 43.73 Mm^3 in 2005 while the highest volume was 78.27 Mm^3 in 2007.

TABLE 5.1.1.3-4

AVERAGE MONTHLY FLOW RATE OF NONG PLA LAI RESERVOIR

Year	Monthly Flow Rate of Nong Pla Lai Reservoir (Mm^3)												Annual (Mm^3)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2547	6.39	5.93	3.73	6.72	13.16	27.51	8.56	8.26	22.34	18.17	4.32	2.64	127.72
2548	2.53	1.64	2.34	4.86	4.63	2.02	3.50	4.64	35.34	32.38	28.35	10.25	132.50
2549	3.08	5.23	6.44	16.78	18.66	17.52	24.92	7.67	16.66	33.17	7.02	2.45	159.60
2550	3.40	2.41	8.49	8.20	25.50	27.53	21.49	13.20	17.68	10.16	3.14	2.45	143.65
2551	1.95	1.85	4.69	11.83	10.30	15.41	10.50	1.59	24.29	54.89	24.01	3.75	165.06
2552	1.97	1.24	4.87	4.48	15.00	2.17	0.85	6.40	24.07	62.91	22.02	4.39	150.38
2553	5.66	4.56	3.44	1.63	2.33	8.38	15.67	20.32	34.41	49.26	12.67	4.83	163.14
2554	0.86	0.47	3.16	34.57	16.76	14.47	7.62	33.36	57.62	95.29	14.16	1.96	280.32
2555	4.21	4.34	7.60	7.20	19.76	6.22	6.49	6.91	23.08	36.44	17.04	12.15	151.45
2556	6.84	5.63	9.43	8.30	24.93	15.59	11.43	14.01	30.39	149.33	48.95	16.34	341.17
2557	3.62	5.21	5.32	14.98	14.15	12.13	14.49	28.13	23.84	30.38	-	-	152.24
Avg.	3.68	3.50	5.41	10.87	15.02	13.54	11.41	13.14	28.16	52.03	18.17	6.12	178.84
Max.	6.84	5.93	9.43	34.57	25.50	27.53	24.92	33.36	57.62	149.33	48.95	16.34	341.17
Min.	0.86	0.47	2.34	1.63	2.33	2.02	0.85	1.59	16.66	10.16	3.14	1.96	127.72

Remark : - = No data

TABLE 5.1.1.3-5

TOTAL VOLUME OF NONG PLA LAI RESERVOIR, MONITORED ON THE LAST DAY OF EACH MONTH

Year	Monthly Flow Rate of Nong Pla Lai Reservoir (Mm^3)											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2547	131.25	123.25	107.72	95.65	90.54	99.28	92.19	87.73	100.77	110.62	107.18	94.66
2548	77.83	61.93	46.42	36.62	27.61	21.12	14.71	10.05	41.10	72.52	96.97	103.08
2549	98.29	95.65	92.68	102.75	119.86	145.57	145.57	139.04	153.24	163.54	161.34	149.73
2550	141.04	127.85	116.60	111.89	134.45	145.57	138.44	136.44	144.25	153.68	143.16	129.25
2551	114.24	101.92	87.40	80.11	81.93	88.23	103.41	110.44	138.84	168.77	162.44	149.07
2552	134.25	120.76	112.80	115.15	132.45	125.05	122.45	118.95	136.24	168.05	163.75	157.40
2553	147.76	135.65	116.96	102.91	98.46	108.27	128.05	145.35	159.15	165.90	163.10	152.14
2554	137.24	120.76	109.54	126.45	126.45	127.65	122.05	148.20	170.20	167.10	159.81	145.79
2555	136.84	121.67	103.74	88.89	94.00	81.02	72.98	69.50	108.63	159.59	165.66	158.50
2556	144.47	132.05	116.78	100.60	84.20	93.01	102.42	111.71	138.84	168.53	168.05	158.28
2557	140.84	125.65	107.91	99.94	86.78	76.92	63.28	63.28	79.50	115.33	-	-
Avg.	127.64	115.19	101.69	96.45	97.88	101.06	100.50	103.70	124.62	146.69	149.15	139.79
Max.	147.76	135.65	116.96	126.45	134.45	145.57	145.57	148.20	170.20	168.77	168.05	158.50
Min.	77.83	61.93	46.42	36.62	27.61	21.12	14.71	10.05	41.10	72.52	96.97	94.66

Remark : - = No data

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

TABLE 5.1.1.3-6

MONTHLY RIVER OUTLET VOLUME FOR AGRICULTURAL PURPOSES

Year	Monthly Flow Rate of Nong Pla Lai Reservoir (Mm^3)												Annual (Mm^3)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2547	6.98	4.89	9.75	9.22	9.37	11.61	6.53	5.61	3.15	1.18	1.25	6.30	75.84
2548	8.83	8.39	8.44	7.04	6.68	2.23	1.16	0.96	-	-	-	-	43.73
2549	-	-	-	0.53	-	1.59	19.17	7.44	4.42	13.81	1.47	2.30	50.72
2550	0.21	4.92	6.83	5.88	3.39	15.47	23.30	5.74	3.42	0.65	3.97	4.49	78.27
2551	3.41	3.14	6.45	5.65	2.00	0.84	-	-	2.63	4.09	0.74	6.32	35.28
2552	6.80	5.20	6.61	3.35	8.10	14.79	2.35	0.73	0.52	3.19	-	0.42	52.09
2553	4.80	6.35	6.87	6.46	5.39	2.02	-	3.75	17.58	8.27	2.04	4.32	67.86
2554	5.71	7.66	5.31	6.64	6.88	6.66	5.79	-	20.98	-	-	-	65.65
2555	-	7.20	9.27	9.48	5.09	6.36	3.89	5.75	1.48	0.21	0.41	3.03	52.16
2556	5.19	5.65	8.14	9.69	6.86	2.34	1.29	0.89	-	3.70	7.34	5.09	56.17
2557	7.11	8.12	7.91	6.68	7.77	4.50	6.38	3.32	0.52	0.28	-	-	52.58
เฉลี่ย	4.46	5.59	6.87	6.42	5.59	6.22	6.35	3.11	4.97	3.22	1.72	3.23	57.31
สูงสุด	8.83	8.39	9.75	9.69	9.37	15.47	23.30	7.44	20.98	13.81	7.34	6.32	78.27
ต่ำสุด	-	-	-	0.53	-	0.84	-	-	-	-	-	-	35.28

หมายเหตุ : เครื่องหมาย – หมายถึงไม่มีข้อมูล

b4) Volume used for Industrial Purposes

Table 5.1.1.3-7 shows the volume of water used for industrial purposes as follows:

- During dry season, from December to April, the average volume was 10.63 Mm^3/month while during wet season, from May to November, the average volume was 10.73 Mm^3/month.
- Average annual volume for industrial use was 126.48 Mm^3/yr.

b5) Volume for Community Consumption

Data shows that the average volume of water used for production of potable water for communities was 2 Mm^3/yr.

b6) Runoff Volume in the Flooded Lowland of Nong Pla Lai Reservoir

Data of the rainfall volume in the flooded lowland of Nong Pla Lai Reservoir in **Table 5.1.1.3-8** can be summarized as follows:

- During dry season, from December to April, the average volume was 0.89 Mm^3/month while during wet season, from May to November, the average volume was 3.03 Mm^3/month.
- Average annual volume of the runoff volume in the flooded lowland of Nong Pla Lai Reservoir was 25.53 Mm^3/yr.

b7) Evaporation Volume of Nong Pla Lai Reservoir

Data of the evaporation volume of water in Nong Pla Lai Reservoir in **Table 5.1.1.3-9** can be summarized as follows:

- During dry season, from December to April, the average volume was 2.98 Mm^3/month while during wet season, from May to November, the average volume was 2.62 Mm^3/month.
- Average annual volume of the evaporation of water in Nong Pla Lai Reservoir was 30.92 Mm^3/yr.

b8) Summary of Water Volume and BOD and TDS Values of Inflow and Outflow Water of Nong Pla Lai Reservoir

Summary of Inflow and Outflow Volume

Dry Season: The inflow volume included:

- Average inflow volume (flowing from canals and ditches into the reservoir) of 4.78 Mm^3/month (carrying along the BOD and TDS);
- Average rainfall volume of 0.89 Mm^3/month which is not increase the BOD and TDS values.

TABLE 5.1.1.3-7

MONTHLY THE VOLUME OF WATER USED FOR INDUSTRIAL PURPOSES

Year	Monthly Flow Rate of Nong Pla Lai Reservoir (Mm^3)												Annual (Mm^3)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2547	10.96	9.39	9.35	9.73	10.54	9.31	10.19	10.22	9.45	10.55	6.97	8.26	114.91
2548	9.01	8.38	8.82	7.72	7.80	6.73	9.18	8.85	5.34	4.06	5.18	6.34	87.40
2549	7.75	7.94	9.45	9.35	8.37	5.88	7.11	8.51	8.51	7.58	8.13	10.63	99.20
2550	10.86	9.92	10.43	11.19	9.63	9.54	9.62	10.13	9.43	9.59	9.59	10.64	120.57
2551	10.43	10.76	11.95	12.19	12.70	12.31	12.09	12.59	9.54	9.77	12.27	11.71	138.31
2552	11.59	10.80	12.11	11.32	10.81	9.87	10.62	12.11	11.88	10.14	7.64	9.35	128.25
2553	10.65	10.08	11.80	11.30	11.49	10.75	10.18	10.11	9.77	11.40	11.34	11.22	130.09
2554	12.62	11.16	12.53	12.20	12.49	11.46	10.95	11.87	11.78	14.22	14.18	15.17	150.65
2555	11.51	11.11	11.89	11.52	11.09	11.44	12.10	12.06	13.89	14.70	13.63	11.15	146.08
2556	12.14	10.50	12.66	12.82	19.88	13.36	10.95	10.61	10.13	14.33	9.18	8.35	144.91
2557	10.08	9.78	11.84	11.90	15.78	13.30	14.50	16.81	15.96	10.97	-	-	130.91
Avg.	10.69	9.98	11.16	11.02	11.87	10.36	10.68	11.26	10.52	10.66	9.81	10.28	126.48
Max.	12.62	11.16	12.66	12.82	19.88	13.36	14.50	16.81	15.96	14.70	14.18	15.17	150.65
Min.	7.75	7.94	8.82	7.72	7.80	5.88	7.11	8.51	5.34	4.06	5.18	6.34	87.40

Remark : - = No data

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

TABLE 5.1.1.3-8

MONTHLY RUNOFF VOLUME IN THE FLOODED LOWLAND OF NONG PLA LAI RESERVOIR

Year	Monthly Flow Rate of Nong Pla Lai Reservoir (Mm^3)												Annual (Mm^3)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2547	1.83	0.42	0.49	0.63	1.74	2.16	1.34	3.16	5.22	1.58	1.24	-	19.80
2548	0.03	-	0.97	0.85	0.77	1.13	0.44	0.84	1.81	2.82	1.47	2.11	13.25
2549	0.16	0.20	0.82	2.83	3.52	2.88	1.63	1.53	7.52	5.29	0.39	-	26.77
2550	0.23	0.08	0.10	4.00	4.31	4.96	4.15	5.28	2.58	3.00	0.02	-	28.69
2551	0.13	0.66	1.03	2.09	3.45	2.59	3.31	2.75	4.95	5.13	0.35	-	26.46
2552	-	0.49	2.68	1.48	3.84	1.58	3.08	1.78	4.97	5.15	0.57	0.05	25.68
2553	1.33	0.60	1.83	1.14	2.51	6.29	2.49	3.27	7.19	6.50	-	1.55	34.70
2554	-	0.75	1.39	2.89	1.62	4.48	4.73	4.69	6.27	4.65	-	1.54	33.00
2555	2.66	0.08	0.23	1.50	4.28	1.07	2.66	1.48	8.30	3.71	1.30	1.02	28.30
2556	0.33	0.26	2.58	1.38	1.13	2.59	2.59	2.48	4.52	8.43	2.58	0.05	28.92
2557	-	0.41	0.13	0.43	2.71	2.10	0.72	1.88	3.61	3.25	-	-	15.26
Avg.	0.61	0.36	1.11	1.75	2.72	2.89	2.47	2.65	5.18	4.50	0.79	0.63	25.53
Max.	2.66	0.75	2.68	4.00	4.31	6.29	4.73	5.28	8.30	8.43	2.58	2.11	34.70
Min.	-	-	0.10	0.43	0.77	1.07	0.44	0.84	1.81	1.58	-	-	13.25

Remark : - = No data

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

TABLE 5.1.1.3-9

MONTHLY EVAPORATION VOLUME OF NONG PLA LAI RESERVOIR

Year	Monthly Evaporation Volume of Nong Pla Lai Reservoir (Mm^3)												Annual (Mm^3)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2547	2.85	2.85	3.14	2.87	2.50	2.34	2.45	2.35	1.90	2.12	2.50	2.58	30.45
2548	-	-	-	-	-	-	-	-	-	-	-	-	-
2549	2.37	2.33	2.79	2.83	2.70	2.85	3.21	3.07	2.44	2.71	3.18	3.37	33.86
2550	2.97	2.83	3.24	3.08	3.01	2.98	3.10	2.97	2.42	2.59	3.00	3.09	35.27
2551	2.65	2.57	2.82	2.60	2.38	2.22	2.44	2.56	2.24	2.70	3.24	3.36	31.79
2552	2.92	2.75	3.17	3.10	2.92	2.80	2.84	2.75	2.23	2.70	3.23	3.43	34.82
2553	3.05	2.94	3.31	2.99	2.59	2.41	2.80	2.99	2.52	2.76	3.20	3.37	34.92
2554	2.97	2.75	3.13	3.07	3.00	2.77	2.86	2.87	2.60	2.81	3.20	3.32	35.35
2555	2.91	2.89	3.06	2.80	2.45	2.25	2.19	2.10	1.75	2.48	3.20	3.47	31.55
2556	3.04	2.90	3.30	2.97	2.48	2.24	2.47	2.57	2.20	2.79	3.23	3.46	33.65
2557	-	-	-	-	-	-	2.09	1.81	1.63	1.97	-	-	-
Avg.	2.86	2.76	3.11	2.92	2.67	2.54	2.65	2.60	2.19	2.56	3.11	3.27	33.52
Max.	3.05	2.94	3.31	3.10	3.01	2.98	3.21	3.07	2.60	2.81	3.24	3.47	35.35
Min.	2.37	2.33	2.79	2.60	2.38	2.22	2.09	1.81	1.63	1.97	2.50	2.58	30.45

Remark : - 1) = No data

2) Use data of B.E.2557 as data of B.E. of 2547 because data of B.E.2557 is not complete.

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

Dry Season: The outflow volume included:

- Volume of water used for agriculture, industry and consumption of 17.94 Mm^3/month (carrying away the BOD and TDS);
- Evaporation volume of 2.98 Mm^3/month.

Wet Season: The inflow volume included:

- Average inflow volume (flowing from canals and ditches into the reservoir) of 21.64 Mm^3/month (carrying along the BOD and TDS);
- Average rainfall volume of 3.03 Mm^3/month.

Wet Season: The outflow volume included:

- volume of water used for agriculture, industry and consumption of 17.18 Mm^3/month (carrying away the BOD and TDS);
- Evaporation volume of 2.62 Mm^3/month.

Since Nong Pla Lai Reservoir received water from Khlong Rawoeng and Khlong Hin Loi, the volumes of both canals were also examined.

b9) Khlong Rawoeng receives discharged water from three power plants projects and Hemaraj ESIE. The estimation of BOD and TDS values of Khlong Rawoeng in the scenario with and without the three projects was as follows:

Khlong Rawoeng During Dry Season:

BOD value

- Average 1.8 mg/L in case without the Project development.
- Average 2.24 mg/L in case with the Project development.

TDS value

- Average 124 mg/L in case without the Project development.
- Average 307.06 mg/L in case with the Project development.

The flow rate of Khlong Rawoeng in the scenario with the Project was 0.684 m^3/s, or 1.77 Mm^3/month.

Khlong Rawoeng During Wet Season:

BOD value

- Average 1.4 mg/L in case without the Project development.
- Average 1.84 mg/L in case with the Project development.

TDS value

- Average 108 mg/L incase without the Project development.
- Average 160.04 mg/L in case with the Project development.

The average flow rate of Khlong Rawoeng in the scenario with the Project was 5.944 m^3/s, or 15.40 Mm^3/month.

b10) Khlong Hin Loi receives discharged water from Eastern Seaboard Industrial Estate (Rayong Province) (including Tasit 1 Power Plant, Tasit 2 Power Plant, and Wang Ta Phin Power Plant projects). The estimation of discharged water from these three projects into Khlong Hin Loi can be summarized as follows:

- In the scenario with Wang Ta Phin Power Plant, Tasit 1 Power Plant, and Tasit 2 Power Plant projects, the average BOD value in Khlong Hin Loi before flowing into Nong Pla Lai Reservoir during dry season was 2.7 mg/L while the average value during wet season was 3.72 mg/L.
- In the scenario with Wang Ta Phin Power Plant, Tasit 1 Power Plant, and Tasit 2 Power Plant projects, the average TDS value in Khlong Hin Loi during dry season was 1,530 mg/L and the average value during wet season was 469 mg/L.
- The average flow rate of Khlong Hin Loi, for the scenario with Wang Ta Phin Power Plant, Tasit 1 Power Plant, and Tasit 2 Power Plant projects, during dry season was 0.222 m^3/s, or 0.58 Mm^3/month while during wet season the average rate was 0.432 m^3/s, or 1.12 Mm^3/month.

The assessment of BOD and TDS impacts of the mixed water from Khlong Rawoeng and Khlong Hin Loi flowing into Nong Pla Lai Reservoir for the scenario with Sriracha Power Plant, Tasit 3 Power Plant, and Tasit 4 Power Plant projects as well as other projects in the Eastern Seaboard Industrial Estate (Rayong Province):

<u>Dry Season:</u>

The monthly inflow volume of Nong Pla Lai Reservoir and the BOD and TDS values in the scenario with the Project development were as follows:

$$\text{Total BOD value} = \frac{V_1 \times BOD_1 + V_2 \times BOD_2}{V_2 + V_2}$$

V_1 = Nong Pla Lai Reservoir inflow volume from Khlong Rawoeng with the average volume during dry season of 4.57 Mm^3/month.

V_2 = Nong Pla Lai Reservoir inflow volume from Khlong Hin Loi with the average volume during dry season of 0.58 Mm^3/month.

BOD_1 = the average volume from Khlong Rawoeng of 2.24 mg/L.

BOD_2 = the average volume from Khlong Hin Loi of 2.7 mg/L.

$$\text{Total TDS value} = \frac{V_1 \times TDS_1 + V_2 \times TDS_2}{V_2 + V_2}$$

TDS_1 = the average volume from Khlong Rawoeng of 239.99 mg/L.

TDS_2 = the average volume from Khlong Hin Loi of 1,530 mg/L.

$$\text{Total BOD value during dry season} = \frac{(4.57 \times 2.24) + (0.58 \times 2.7)}{(4.57 + 0.58)}$$

$$= 2.29 \text{ mg/L}$$

$$\text{Total TDS value during dry season} = \frac{(4.57 \times 239.99) + (0.58 \times 1{,}530)}{(4.57 + 0.58)}$$

$$= 359.36 \text{ mg/L}$$

<u>During Wet Season</u>:

The monthly inflow volume of Nong Pla Lai Reservoir and the BOD and TDS values in the scenario with the Project development were as follows:

V_1 = Nong Pla Lai Reservoir inflow volume from Khlong Rawoeng with the average volume during wet season of 15.40 Mm^3/month.

V_2 = Nong Pla Lai Reservoir inflow volume from Khlong Hin Loi with the average volume during wet season of 1.12 Mm^3/month.

BOD_1 during wet season = the average volume from Khlong Rawoeng of 1.84 mg/L.

BOD_2 during wet season = the average volume from Khlong Hin Loi of 3.72 mg/L.

TDS_1 during wet season = the average volume from Khlong Rawoeng of 160.04 mg/L.

TDS_2 during wet season = the average volume from Khlong Hin Loi of 469 mg/L.

$$\text{Total BOD value during wet season} = \frac{(15.40 \times 1.84) + (1.12 \times 3.72)}{(15.40 + 1.12)}$$

$$= 1.88 \text{ mg/L}$$

$$\text{Total TDS value during wet season} = \frac{(15.40 \times 160.04) + (1.12 \times 469)}{(15.40 + 1.12)}$$

$$= 180.98 \text{ mg/L}$$

The comparison between the values of BOD and TDS of the inflow into Nong Pla Lai Reservoir and the values of BOD and TDS of the water in Nong Pla Lai Reservoir indicated that the BOD value in the scenario with the Project development remained closely similar to the value of the water in the Reservoir while during dry season, the TDS value was less than 450 mg/L, meaning the water can still be used for agriculture and production of potable water.

c) Assessment of BOD and TDS Impacts on Nong Pla Lai Reservoir

c1) The volume of inflow water carrying along BOD and TDS values into Nong Pla Lai Reservoir (Q_1): during dry season, only the volumes of Khlong Rawoeng and Khlong Hin Loi at the lowest flow rates were combined with the discharged water from all power plant projects in both Hemaraj ESIS and Eastern Seaboard Industrial Estate (Rayong Province) of the highest volume. During wet season, when the post-treatment discharged water from both estates was drained into the canals, the BOD and TDS values were also combined with the volumes from the two estates.

The volume of Q_1 during dry season was 2.35 Mm^3/month, with the average BOD volume of 2.29 mg/L and the average TDS volume of 359.36 mg/L. (See BOD and TDS values in **Table 5.1.1.3-10**.)

The volume of Q_1 during wet season was 11.63 Mm^3/month, with the average BOD volume of 1.88 mg/L and the average TDS volume of 180.98 mg/L. (See BOD and TDS values in **Table 5.1.1.3-10**.)

TABLE 5.1.1.3-10

THE COMPARISON BETWEEN THE VALUES OF BOD AND TDS OF THE INFLOW INTO NONG PLA LAI RESERVOIR (INCASE WITH THE PROJECT) AND THE CURRENT VALUES OF BOD AND TDS OF THE WATER IN NONG PLA LAI RESERVOIR.

Season	BOD (mg/L)	TDS (mg/L)
1. Dry Season		
- Canal in the scenario with project.	2.29	359.36
- Current of BOD and TDS in Nong Pla Lai Reservoir (average).	1.54	111
- The BOD and TDS values of reservoir were combined with the water of canal.	1.57	121.72
2. Wet Season		
- Canal in the scenario with project.	1.88	180.98
- Current of BOD and TDS in Nong Pla Lai Reservoir (average).	2.2	122
- The BOD and TDS values of reservoir were combined with the water of canal.	2.16	129.23

Source : Impact Assessment Report: Cooling Blowdown from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

c2) Monthly volume of the water in Nong Pla Lai Reservoir (Q_2) and the BOD and TDS values of the water in Nong Pla Lai Reservoir:

The volume of Q_2 during dry season was 116.15 Mm^3/month, with the average BOD volume of 1.54 mg/L and the average TDS volume of 111 mg/L.

The volume of Q_2 during wet season was 117.66 Mm^3/month, with the average BOD volume of 2.2 mg/L and the average TDS volume of 122 mg/L.

c3) Volume of rainfall in Nong Pla Lai Reservoir (Q_3)

volume of Q_3 during dry season was 0.89 Mm^3/month.

volume of Q_3 during wet season was 3.03 Mm^3/month.

c4) Volume of evaporation from the Reservoir (Q_4)

volume of Q_4 during dry season was 2.98 Mm^3/month.

volume of Q_4 during wet season was 2.62 Mm^3/month.

c5) Volume of water used for all activities (Q_5)

volume of Q_5 during dry season was 17.94 Mm^3/month.

volume of Q_5 during wet season was 17.18 Mm^3/month.

c6) The calculation of BOD and TDS values in the Reservoir and of the outflow water for the scenario with all power plant projects

Total BOD or TDS value in the Reservoir for the scenario with the Project development:

$$\frac{C_1Q_1 + C_2 (Q_2 + Q_3 - Q_4)}{Q_T}$$

C_1 = BOD or TDS value carried along by Q_1.

C_2 = Current BOD or TDS value in Q_2 before mixing with Q_1.

Q_1 = Inflow volume from Khlong Rawoeng and Khlong Hin Loi in the scenario with discharged water from power plant projects (m^3/month).

Q_2 = Monthly water volume in the Reservoir (m^3/month).

Q_3 = Monthly rainfall volume in the Reservoir (m^3/month).

Q_4 = Monthly evaporation volume in the Reservoir (m^3/month).

Q_T = The sum of net volumes of water $Q_1 + Q_2 + Q_3 - Q_4$

$$\text{BOD value in dry season} = \frac{(2.29 \times 5.15) + 1.54 \times (116.15 + 0.89 - 2.98)}{119.21}$$

$$= 1.57 \text{ mg/L}$$

$$\text{BOD value in wet season} = \frac{(1.88 \times 16.52) + 2.2 \times (117.66 + 3.03 - 2.62)}{134.59}$$

$$= 2.16 \text{ mg/L}$$

$$\text{TDS value in dry season} = \frac{(359.36 \times 5.15) + 111 \times (116.15 + 0.89 - 2.98)}{119.21}$$

$$= 121.72 \text{ mg/L}$$

$$\text{TDS value in wet season} = \frac{(180.98 \times 16.52) + 122 \times (117.66 + 3.03 - 2.92)}{134.59}$$

$$= 129.23 \text{ mg/L}$$

The BOD value of Nong Pla Lai Reservoir was calculated when it had mixed with the inflow from Khlong Rawoeng and Khlong Hin Loi, for the scenario with discharged water from power plant projects in both Hemaraj ESIE and Eastern Seaboard Industrial Estate (Rayong Province). It shows that the BOD value remained almost at the same level. There was a slight increase during dry season, from 1.54 to 1.57 mg/L. Likewise, during wet season, there was a slight decrease from 2.2 to 2.16 mg/L. Therefore, the water quality is within the standard for consumption water.

The TDS value of Nong Pla Lai Reservoir was calculated when it had mixed with the inflow from Khlong Rawoeng and Khlong Hin Loi, for the scenario with discharged water from power plant projects in both Hemaraj ESIS and Eastern Seaboard Industrial Estate (Rayong Province). It shows that the TDS value did not exceed 450 mg/L and still within the standard for water use for irrigation (agriculture) for all kinds of plants in all soil types (Referring to Standard Differential. Direk Thongaram et al., 2002. Design and Irrigation Technology). These values also did not go above 1,000 mg/L, the level not affecting production of potable water or for consumption because this complied

with the standard of fresh water that does not make the drinking water taste brackish (Department of Health's Notification B.E. 2553 on drinking water standard; and, Kriengsak Udomsinsoj, 1994. Environmental Engineering, page 161).

In terms of TDS accumulation (**Figure 5.1.1.3-3**), it is unlikely that the accumulation will occur because the rate of use of water in Nong Pla Lai Reservoir for all purposes (agriculture, industry, consumption) during dry season was at 17.94 Mm^3/month and at 17.18 Mm^3/month during wet season. These rates were higher than the inflow volume carrying along the BOD and TDS values into the Reservoir, increasing the existing values. As a result, the trend of TDS accumulation is unlikely. In addition, the slight increase in BOD value will not cause polluted water since the increased value is small and the DO value of inflow volume is rather high and higher than the BOD value. Therefore, the DO value, with the average of 5.52 mg/L, when mixing with the BOD value in the Reservoir should be sufficient to dissolve the BOD, preventing the condition leading to polluted water.

2.11 Assessment of Impacts of Discharged Water from the Project Regarding SAR Values in Discharged Water from all Power Plants

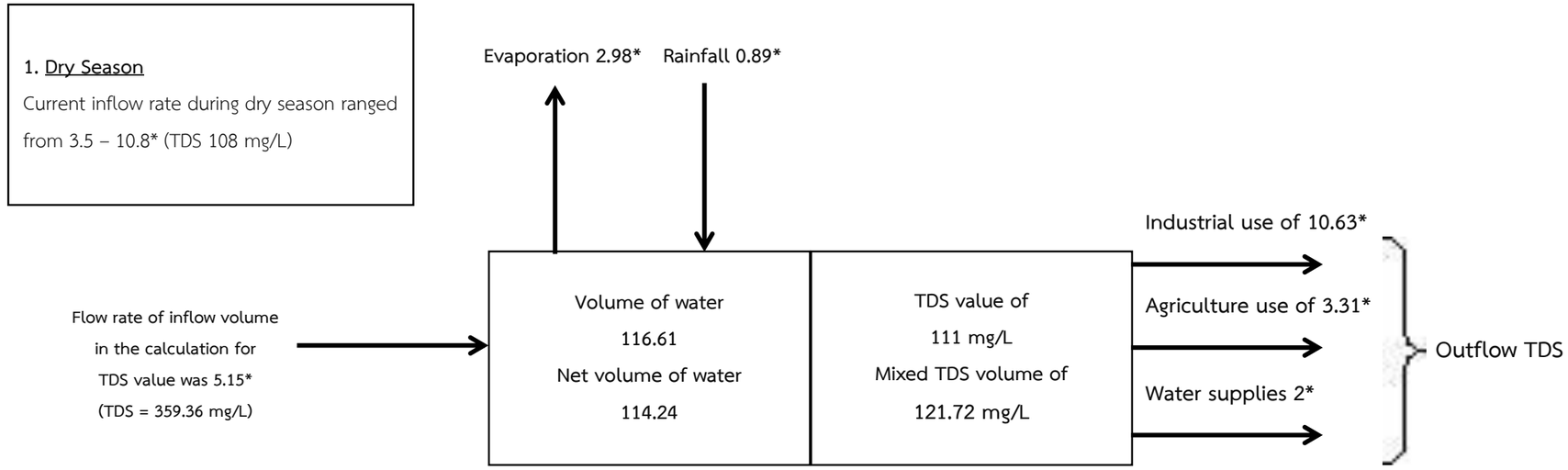
Study of Sodium Impact of Sriracha Power Plant Project

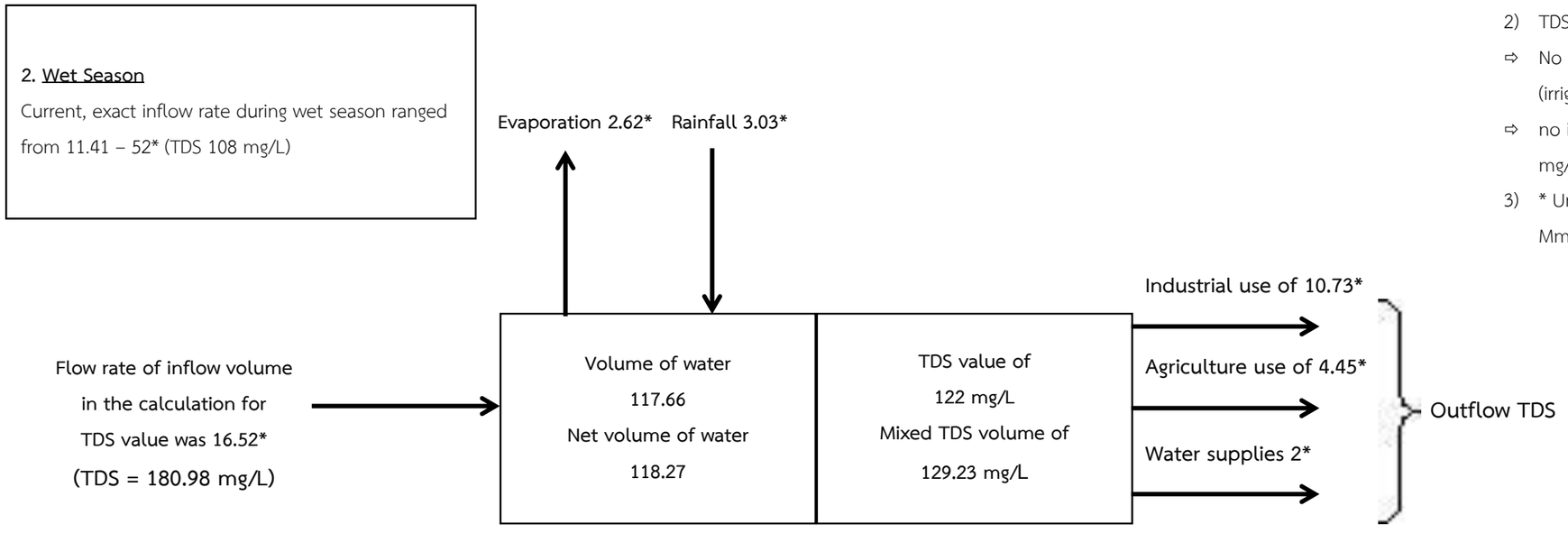
High sodium (Na) levels in water may result in a negative impact on the water quality for irrigation (plant watering). In general, the analytical methods used will be in the format of SAR (Sodium Absorption Ratio) value, i.e. the ratio of Na to the square root of the sum of Ca and Mg (unit: mmole/L).

Sriracha Power Plant Project's Use of Chemicals with Elements of Sodium (Na)

Chemicals with elements of Na used by the Project included Sodium Hydroxide, Sodium Metabisulphite, Sodium Chlorite and Trisodium Phosphate. Sodium Hydroxide Solution, 50 %, of 2,217.42 kg was used daily for the recovery of anion resin. In the chemical processing, Hydroxide Ion (OH^-) will concentrate in anion resin and sodium will attach itself with radicals Cl^-, NO^-_2, and PO^{3-}_4, and remove from Anion Resin. 2,217.42 kg of Sodium Hydroxide Solution, 50 %, contains 1,108.71 kg of Sodium Hydroxide and 637.51 kg of Sodium.

- Sodium Metabisulphite Solution, 1 %, was used to remove the residual chlorine in the water to be used for production of deionized water. Approximately 15 m^3 of this solution was used yearly, or 0.04 m^3/day. This volume contains 0.0004 kg of Sodium Metabisulphite and 0.00001 kg of Sodium, or 10 mg.





Remarks:

1) Unit of water volume is Mm^3/month
2) TDS value that does not impact
   - ⇨ No impact on plants, not exceeding 450 mg/L (irrigation)
   - ⇨ no impact on freshwater animals, from 5,000 mg/L (salinity of brackish water)
3) * Unit of flow rate and water volume is Mm^3/month

Source: Impact Assessment Report: Cooling Water from Power Plant Projects in Hemaraj Eastern Seaboard Industrial Estate, 2015.

FIGURE 5.1.1.3-3: DIAGRAM OF CONVERSION OF TDS VALUE AND TDS BALANCE IN NONG PLA LAI RESERVOIR RECEIVED FROM POWER PLANT PROJECTS IN HEMARAJ ESIE AND ESIE

- Regarding the removal of microbes and biofilm in water, the initial amount of 62,618 m^3 of both discharged water from production activities and cooling blowdown was used daily, consisting of 60,560 m^3/day of cooling blowdown and 2,058 m^3/day of service water. The calculation took into account the use of Sodium Chlorite ($NaClO_2$) Solution, 25 %, reacting with HCl to prepare ClO_2, using $NaClO_2$ of about 104.81 kg/day, containing $NaClO_2$ of 20.95 kg/day, Na of 5.32 kg and ClO_2 of 12.52 kg. This will be added into both cooling blowdown and survice water from production activities. The volume of the water is 62,618 m^3 at maximum daily, producing the concentration of ClO_2 equal to 0.2 mg/L (cooling blowdown of 60,560 m^3/day will evaporate while in use and the remaining will be discharged at maximum of 12,232 m^3 daily, producing ClO_2 of less than 1 mg/L).

- Another portion of Na that may occur was from the use of Trisodium Phosphate (Na_3PO_4), with maximum use of up to 30 m^3/yr, or 0.08 m^3/day. Trisodium Phosphate Solution of 10 % concentration was used, meaning 1-L solution contains Na_3PO_4 of 100 g, consisting of Na of 41 g (atomic weight of Na is 23, phosphorus (P) is 35, and oxygen (O) is 16; atomic weight of 3-atom Na is 69; molecular weight of Na_3PO_4 is 168). As a result, the use of Na_3PO_4 solution of 0.08 m^3 will result in Na of 3,280,000 mg (41 x 0.08 x 1,000 L x 1,000 mg). Na_3PO_4 solution was used in the boiler and the blowdown will be drained with the cooling blowdown.

Assessment of Sodium Impacts in the Worst Case Scenario

- In the discharged water from electricity generation process, potential Na may arise from Sodium Hydroxide, Sodium Metabisulphite, and Sodium Chlorite (water of 2,058 m^3/day after use will remain 792 m^3/day) of 642.83 kg/day altogether. When the lowest volume of wastewater, or 792 m^3 daily, as the worst case scenario is considered (the lower the wastewater volume, the higher the concentration of Na), the concentration of Na will be 811.65 mg/L in the boiler blowdown retention pond.

- In cooling blowdown, $NaClO_2$ is used, containing Na of about 5.15 kg, or equal to 5,150,000 mg. In addition, Na_3PO_4 solution used in the boiler will be discharged as the blowdown of 3,280,000 mg. All of them will be mixed in the cooling blowdown to be discharged at the volume of 12,232 m^3 daily, producing the concentration of 0.68 mg/L.

When combining Na volumes of both sources, the total

concentration is:

$$\text{Mixed value} = \frac{(811.65 \times 792) + (0.68 \times 12{,}232)}{(792 + 12{,}232)}$$

$$= 49.99 \text{ mg/L}$$

Based on data on quality of water compiled by Eastern Water Resources Development and Management Plc. (2015), for industrial purposes and by the project, the maximum values of Na, Ca and Mg were 20.56 mg/L, 39 mg/L, and 17 mg/L, respectively. When used in cooling blowdown, with evaporation rate of 60,562 % , a five-fold increase in the concentration of Na, Ca, and Mg in the discharged water would increase five times (60,562/12,232), producing the values of Na, Ca, and Mg of 102.8 mg/L, 195 mg/L, and 85 mg/L, respectively. When combined with chemical usage, with Na value of 49.99 mg/L, the concentration of Na, Ca, and Mg in the cooling blowdown would be 152.79 mg/L, 195 mg/L, and 85 mg/L, respectively.

Apart from Sriracha Power Plant Project, two other power plants discharging wastewater into Khlong Kram were Tasit 3 Power Plant and Tasit 4 Power Plant. The discharge rate and values of Na, Ca, and Mg used in the assessment of SAR value in Khlong Kram were as follows (discharged water from the three power plants is sent to the wastewater treatment pond of Hemaraj ESIE and the discharge will be controlled by IEAT):

- The worst case scenario of Tasit 3 Power Plant was: the total discharged water, both cooling and service water, of about 1,500 m^3/day, or equal to 0.017 m^3/s; the concentration of Na, Ca, and Mg of 100.3, 141.58, and 72.95 mg/L.
- The worst case scenario of Tasit 4 Power Plant was: the total discharged water, both cooling and service water, of about 1,500 m^3/day, or equal to 0.017 m^3/s; the concentration of Na, Ca, and Mg of 100.3, 141.58, and 72.95 mg/L.

According to the results of water quality monitoring in Khlong Kram upstream before mixing with discharged water from Hemaraj ESIE, the values of Na, Ca, and Mg were 50.94, 60.75, and 3.0 mg/L, respectively.

In calculating the SAR value, the equation used was:

$$SAR = \frac{Na}{\sqrt{Ca+Mg}}$$

1-unit weight (mmole/L) of each element = $\frac{\text{weight (mg/L)}}{\text{atomic weight}}$

Atomic weights: Na = 23; Ca = 40; Mg = 24

Calculation for the total concentration in directly discharged water from the three power plants and the water in Khlong Kram:

Na = 404.53 mg/L (100.3 x 2 SPP projects +152.79 Sriracha IPP + 50.94)

Ca = 538.16 mg/L (141.58 x 2 SPP projects + 195 Sriracha IPP + 60)

Mg = 233.9 mg/L (72.95 x 2 SPP projects + 85 Sriracha IPP + 3)

Calculation for total weight (mmole/L))

Na = $\frac{404.53}{23}$ = 17.58 mmole/L

Ca = $\frac{538.16}{40}$ = 13.45 mmole/L

Mg = $\frac{233.9}{24}$ = 9.74 mmole/L

SAR = $\frac{17.58}{\sqrt{(13.45+9.74)}}$

= 3.65

Calculation for the SAR value of discharged water from Sriracha IPP only (not discharged to Khlong Kram):

Calculation for weight (mmole/L):

Na = $\frac{152.79}{23}$ = 6.64 mmole/L

Ca = $\frac{195}{40}$ = 4.8 mmole/L

Mg = $\frac{85}{24}$ = 3.54 mmole/L

SAR = $\frac{6.64}{\sqrt{(4.8+3.54)}}$

= 2.29

Comparing with the SAR value according to the water quality standards for agriculture use set out by the Royal Irrigation Department:

Class 1: SAR values 0-10: Compatible with general soil and plants;

Class 2: SAR values 10-18: Compatible with general plants and coarse loamy soil containing high volume of organic matter;

Class 3: SAR values 18-26: Applicable to soil with good drainage capacity, containing high volume of organic matter, waterlogging is harmful to plants;

Class 4: SAR values higher than 26: Not suitable for use, except for soils with low salinity that needs amendment with gypsum.

From the SAR calculation above, it is apparent that both scenarios, discharged water into Khlong Kram from all three power plants and wastewater of Sriracha solely before discharging into Khlong Kram, produced the values in the range of 0-10, which can be used for all types of plants and soil in general. As a result, discharged water from the Project can be used for plant watering. In addition, water from Khlong Kram can also be used for agriculture purposes. Furthermore, the discharged water will not affect aquatic ecosystem of Khlong Kram since the concentration of sodium, estimated value of less than 5,000 mg/L, will not cause the salinity level of 5,000 mg/L, the salinity level of the brackish water that may cause a negative impact on fresh water aquatic lives.

Apart from the SAR value, the Project also examined whether the electrical conductivity (EC) of the discharged water from the power plant will impact aquatic ecosystem of Khlong Kram. The analytical method in assessing the EC value from the Project was as follows: the total TDS value of discharged water from the Project and other two power plants when mixed with the receiving water in Khlong Kram during dry season will be at 407.8 mg/L; this value was converted into EC value by dividing with Factor 0.64, producing EC value of 636.2 μmho/m^3. After the assessment of the discharged water from Sriracha IPP Project to comply with this criteria, the value was compared with the Royal Irrigation Department's water quality standards for agriculture use, specifying that EC value of water for agriculture use shall not exceed 2,000 μmho/m^3 (or converted into TDS value of not exceeding 1,300 mg/L). As a result, when the receiving water in Khlong Kram mixed with the discharged water from the three power plants, the water quality can still be used for agriculture.

Therefore, according to the above assessment, it can be concluded that given the use of Khlong Kram water downstream after mixing with the discharged water from Hemaraj ESIE, covering resident agricultural areas, including palm, rubber, cassava, and pineapple plantations, the water from Khlong Kram is not mainly used for agriculture while none is used for production of potable water. Regarding Khlong Rawoeng, the use of the water from the confluence with Khlong Kram includes the residences and agricultural areas in the same nature as Khlong Kram. In addition, there is a private water supply system located at Ban Wang Ka Yang Weir. Apart from that, according the assessment results of BOD and TDS values in Khlong Kram and Khlong Rawoeng Khlong Kram during wet season and dry season, the scenario with the cooling blowdown from the Project will cause a slight increase in the BOD value. However, despite a rise in the estimated BOD value, since DO in the water is also high and sufficient to dissolve organic substances, the water is unlikely to be polluted and will not affect agriculture and production of potable water. TDS value is within the water quality standard for irrigation (agriculture) purposes, which shall not exceed 450 mg/L for all kinds of plants in all soil types. Additionally, during dry season the water is rarely used for agricultural purposes (used in pineapple plantations only) while other plantations alongside the canal, including cassava, rubber, and oil palm, rely mainly on rainfall.

Regarding the estimated SAR value, in **both scenarios, discharged water into Khlong Kram from all three power plants and discharged water of Sriracha solely before discharging into Khlong Kram, caused a slight change as shown in Figure 5.1.1.3-4, producing the values in the range of 0-10, which can be used for all types of plants and soil in general. As a result, discharged water from the Project can be used for plant watering and water from Khlong Kram can also be used for agriculture purposes. Furthermore, the discharged water did not affect aquatic ecosystem of Khlong Kram since the concentration of sodium did not cause the salinity level of 5,000 mg/L, the salinity level of the brackish water that may cause a negative impact on fresh water aquatic lives. As the estimated value was less than 5,000 mg/L, when flowing into Nong Pla Lai Reservoir, accumulation in the Reservoir would be unlikely to occur because water mass in the Reservoir will be pumped up for use in agriculture, industry, and consumption, carrying away sodium out of the Reservoir.**

Moreover, the Project has also established methods for cooling blowdown management in compliance with the measures for cooling blowdown management specified by Hemaraj ESIE as well as additional measures from relevant studies. Besides, quality control measures will also be implemented according to the Ministry of Industry's Notification No. 2, B.E. 2539 re: Prescribing Characteristics of Effluent discharged from a Factory, and the total suspended solids value prescribed in the Royal Irrigation Department's Standards for Wastewater Quality in Irrigation Waterways. The Project's cooling blowdown management methods are as follows:

1) If the water quality of the cooling blowdown and the boiler blowdown is within the specified standards, the Project will discharge it into Hemaraj ESIE's cooling blowdown as shown in **Figure 5.1.1.3-5**.

2) If the water quality of the cooling blowdown and boiler blowdown is not within the standards specified by Hemaraj ESIE, the recirculation for additional treatment will take place as shown in **Figure 5.1.1.3-6**. Details are as follows:

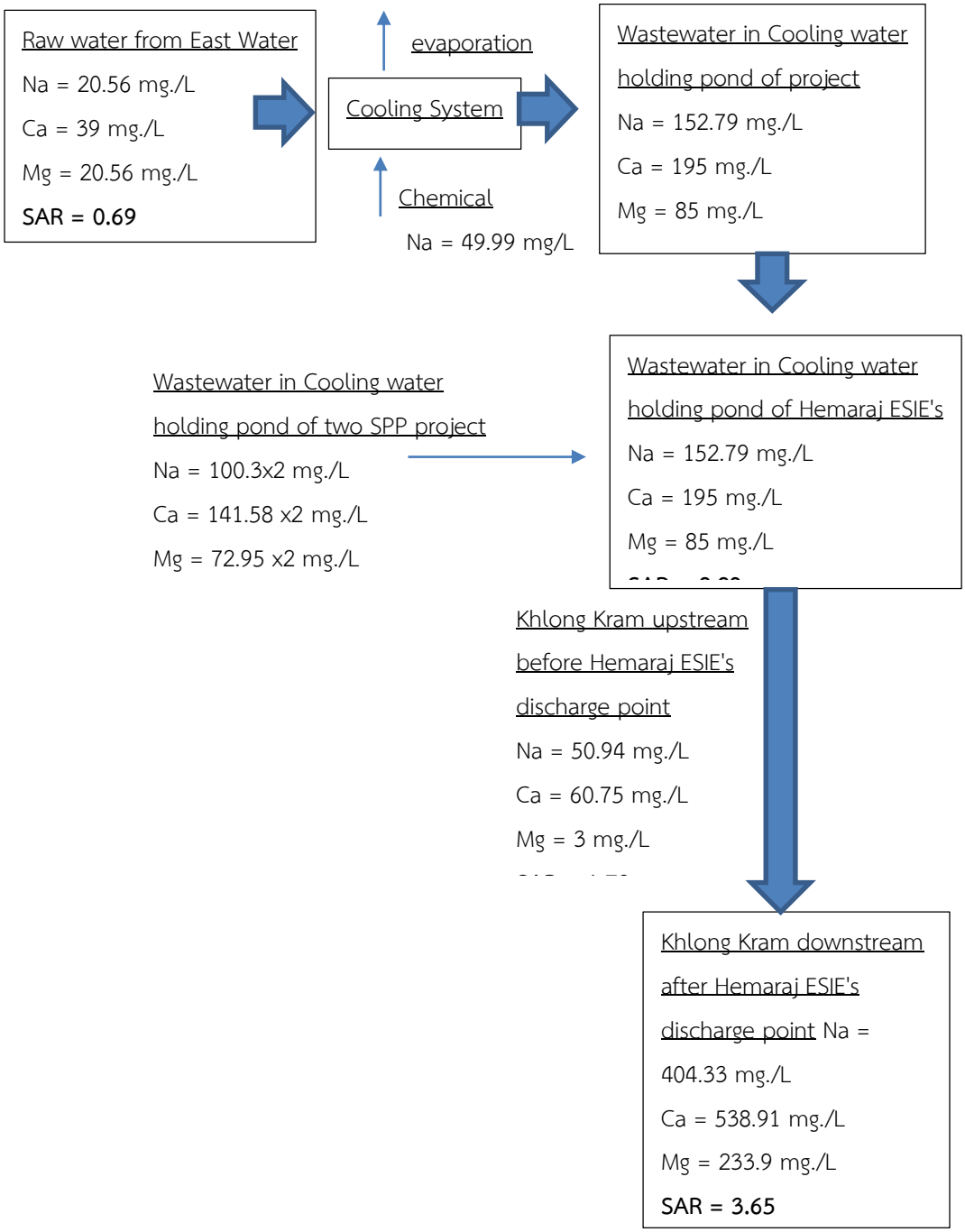


FIGURE 5.1.1.3-4 : CONVERSION OF SAR VALUE IN KHLONG KRAM (INCASE WITH THE PROJECT)

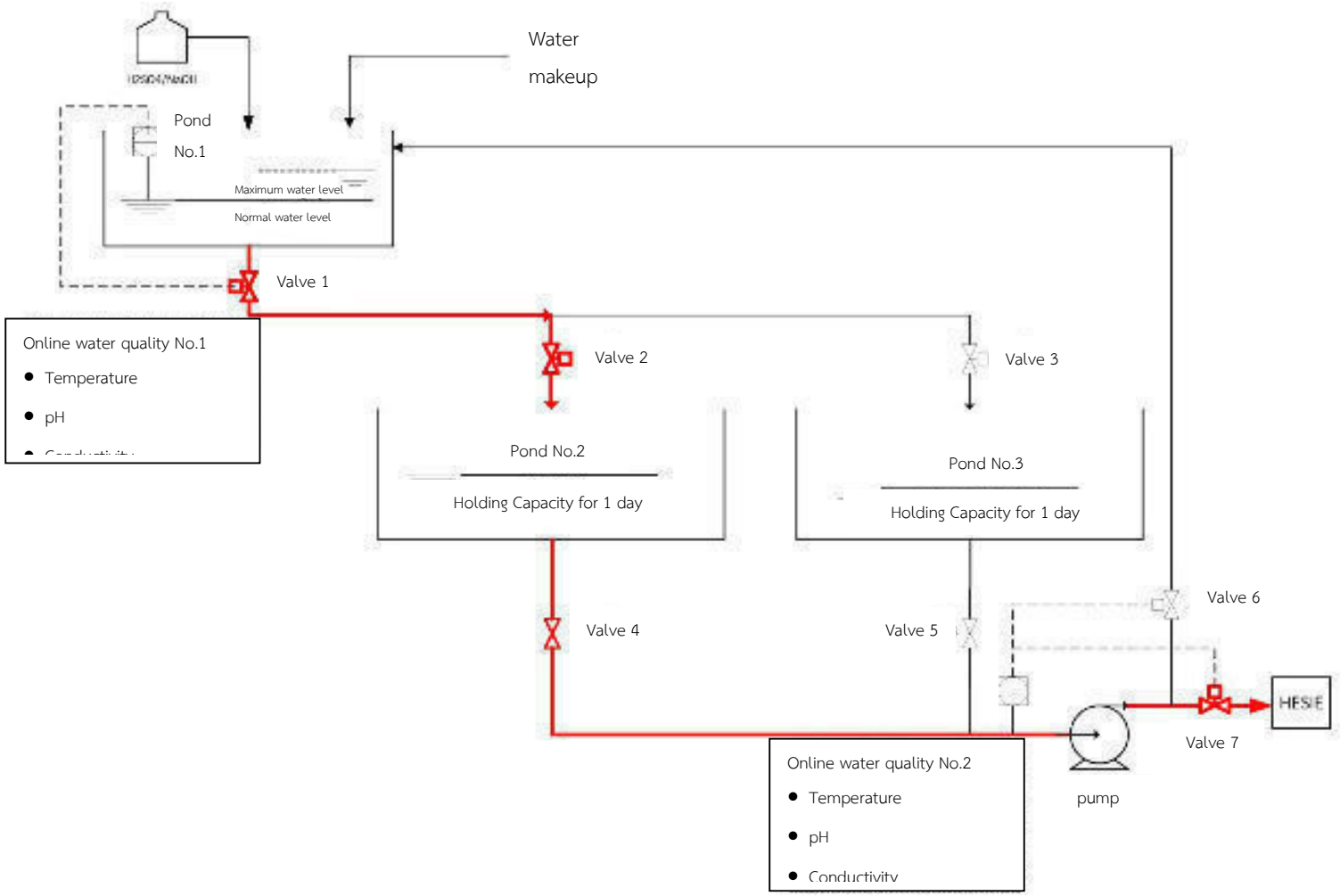


FIGURE 5.1.1.3-5 : DIAGRAM OF DISCHARGE WATER OF THE COOLING BLOWDOWN AND THE BOILER BLOWDOWN MANAGEMENT (IN SCENARIO WATER QUALITY IS WITHIN THE HEMARAJ ESIE'S STANDARDS)

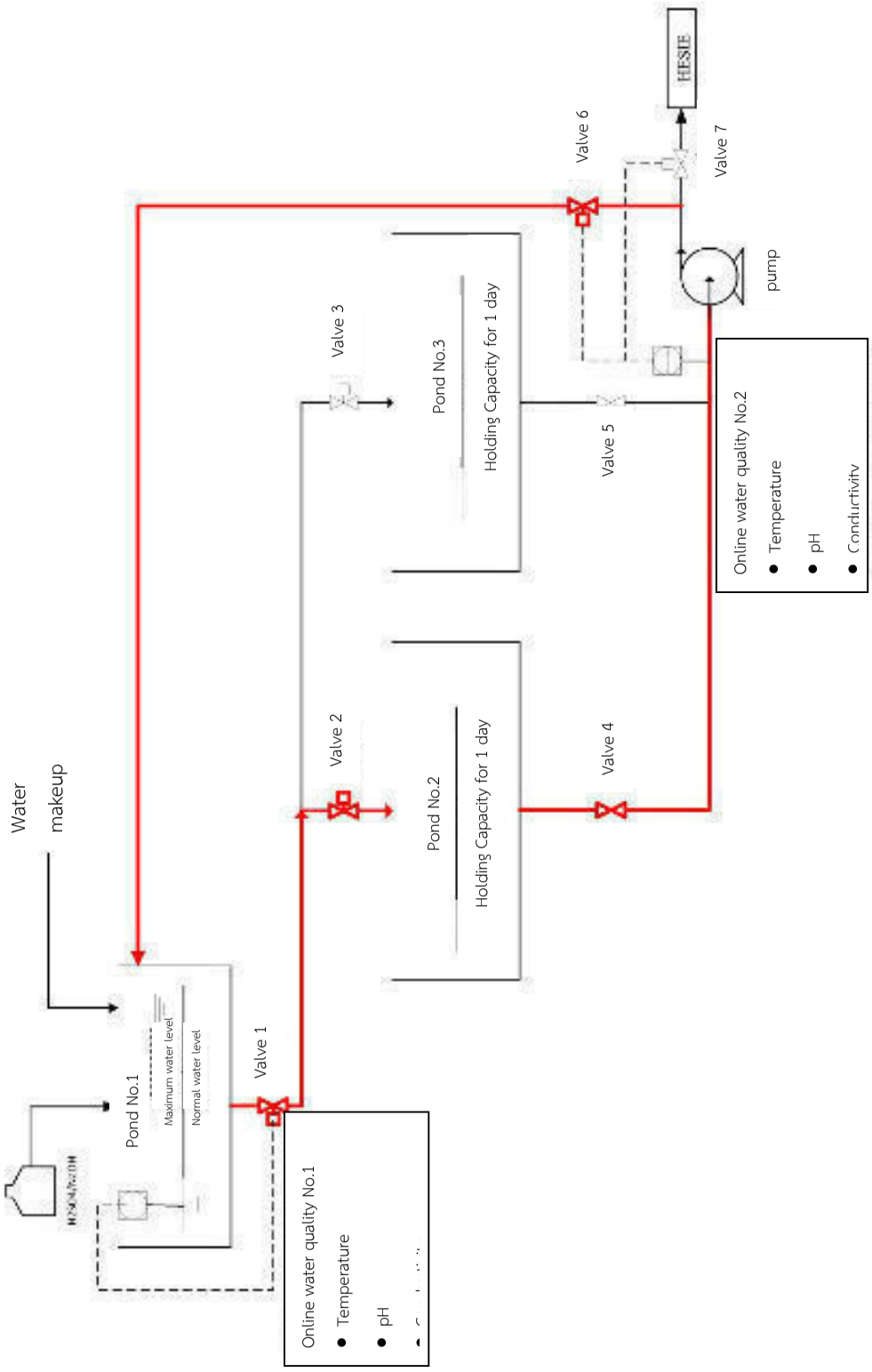


FIGURE 5.1.1.3-6 : DIAGRAM OF DISCHARGE WATER OF THE COOLING BLOWDOWN AND THE BOILER BLOWDOWN MANAGEMENT (IN SCENARIO WATER QUALITY IS NOT WITHIN THE HEMARAJ ESIE'S STANDARDS)

2.1) If the Project's cooling blowdown and boiler blowdown are not within the standards specified by Hemaraj ESIE, the monitoring device will transmit a signal to turn off the first valve instantly, preventing the water from being discharged into the holding pond. The project has established the emergency pond to receive cooling blowdown and boiler blowdown with at least 1-day capacity, which is adequate for dealing with any problem whether it be pH level or conductivity values problem. During such case, the Project can continue its operation even if cooling blowdown and boiler blowdown are not discharged. For example, if the pH of cooling blowdown is lower than the standard, the Project will conduct the neutralization in the first pond. If the discharged water contains higher conductivity value, several actions can be taken, such as change chemical used in precipitation prevention, add water in the cooling tower to reduce the concentration level, etc. The duration that the Project can continue the operation without draining the discharged water is at least 1 day.

2.2) In case the Project cannot control the incident following the methods mentioned above longer than one day, the Project will prepare the second and third holding ponds, assigning either one of them as a holding pond for poor quality wastewater or the emergency pond, and the other as the receiving pond for retreated wastewater to be drained back into the normal system, or discharged water that meets the standard. For example, if the second holding pond is assigned as the emergency pond, the cooling blowdown will be discharged into this pond through the second valve while the third valve is shut off, leaving the third pond empty and preparing to receive the retreated wastewater that meets the standard for further draining into the normal system. If the third pond is selected to receive poor quality cooling blowdown, the second pond will be treated in the same fashion. Other actions that the Project can take depend on the cause of the problem. This includes drainage into the neutralization system of the Project or outsourcing the disposal.

In addition, the Project has also established additional preventive measures for wastewater quality surveillance at the position after flowing off the second or third holding pond, in the event that the system to monitor water quality at the first point fails or is inaccurate. If the system detects that the quality of the discharged water does not meet the specified standards, it will automatically shut the

seventh valve off and turn the sixth valve on to return the poor quality discharged water back to the cooling blowdown basin for further improvement.

- **Wastewater from the process**

The wastewater water from production activities included water naturalization system discharged water of about 13 m^3/day, laboratory discharged water of about 5 m^3/day, and office building discharged water of about 30 m^3/day. This wastewater from different sources mentioned earlier will undergo the initial treatment prior to the drainage into the wastewater holding pond, in order to control the characteristics of discharged water according to the requirements of Hemaraj ESIE (**Table 5.1.1.3-11**). The wastewater holding pond has been installed with online monitoring system to measure the discharged water quality in terms of temperature, pH, and conductivity prior to the drainage into Hemaraj ESIE's central wastewater treatment system.

(b) Storm Water Drainage System

The discharged water as a result of the Project's storm water drainage system is collected and managed as follows:

- Uncontaminated rainwater, washed from the areas with no contaminants or from rooftops, will be discharged into Hemaraj ESIE's storm water drainage system.

- Oil-contaminated rainwater, washed from the area contaminated with oil such as concrete dikes surrounding diesel tanks, will be collected and stored inside the dike walls and gradually sent to oil/water separator prior to pumping into Hemaraj ESIE's central wastewater treatment system further.

(c) Capacity of Hemaraj ESIE's Central Wastewater Treatment System

After the initial treatment, discharged water from the Project will be sent to Hemaraj ESIE's central wastewater treatment system. Considering the capacity of the central wastewater treatment system, which also receives the Project's discharged water, three wastewater treatment locations have the total capacity of 22,200 m^3/day. Therefore, the discharged water from production activities from the project, with the highest volume of 48 m^3/day, when combined with the discharged water from Tasit 3 and Tasit 4 Power Plant Projects, operating simultaneously, of about 742 and 31 m^3/day, will generate the total volume of 821 m^3/day to be drained into the central wastewater treatment system. Currently, the daily volume of wastewater sent to Hemaraj ESIE's central wastewater

treatment system was 4,758 m^3/day (source: report on compliance with the Environmental Impact Mitigation and Preventive Measure Implementation Report and the Environmental Impact Monitoring Measure, Hemaraj ESIE, 2014). Therefore, after the establishment of two small power plants and the Project's power plant, the daily volume of wastewater sent to the treatment system was 5,579 m^3/day, accounting for 21.13 % of the maximum capacity of Hemaraj ESIE's central wastewater treatment system. This means the system can adequately handle the volume of wastewater resulting from the Project.

TABLE 5.1.1.3-11

PROPERTY OF WASTEWATER FROM THE INDUSTRY ALLOWING TO DISCHARGE INTO CENTRAL WASTEWATER OF HEMARAJ EASTERN SEABOARD INDUSTRIAL ESTATE

No.	Water Quality Index	Unit	Standard Index
1	Biological Oxygen Demand (BOD_5 as 20 °C)	mg/l	≤500
2	Chemical Oxygen Demand (COD)	mg/l	≤1,250
3	pH		5.5-9.0
4	Total Dissolved Solid (TDS)	mg/l	≤3,000
5	Suspended Solid (SS)	mg/l	≤200
6	Total Kjeldahl Nitrogen: TKN	mg/l	≤100
7	Heavy Metals		
	7.1 Mercury (as Hg)	mg/l	≤0.005
	7.2 Selenium (as Se)	mg/l	≤0.02
	7.3 Cadmium (as Cd)	mg/l	≤0.03
	7.4 Lead (as Pb)	mg/l	≤0.20
	7.5 Arsenic (as As)	mg/l	≤0.25
	7.6 Trivalent Chromium (Cr^{3+})	mg/l	≤0.75
	7.7 Hexavalent Chromium (Cr^{6+})	mg/l	≤0.25
	7.8 Barium (as Ba)	mg/l	≤1
	7.9 Nickel (Ni)	mg/l	≤1
	7.10 Copper (as Cu)	mg/l	≤2
	7.11 Zinc (as Zn)	mg/l	≤5
	7.12 Manganese (Mn)	mg/l	≤5
	7.13 Silver (as Ag)	mg/l	≤1
	7.14 Total Iron (as Fe)	mg/l	≤10
8	Sulphide (as H_2S)	mg/l	≤1
9	Cyanide as HCN	mg/l	≤0.2
10	Formaldehyde	mg/l	≤1
11	Phenols Compound	mg/l	≤1
12	Free Chlorine	mg/l	≤1
13	Chloride as Chlorine	mg/l	≤2,000
14	Fluoride	mg/l	≤5
15	Pesticide	mg/l	None
16	Temperature	°C	≤45 °C
17	Colour		Color is an abomination
18	Odor		Color is an abomination
19	Oil & Grease	mg/l	≤10
20	Surfactants	mg/l	≤30

Source: Notification of Industrial Estate Authority of Thailand no.78 2011 Subject : Property of wastewater from the industry allowing to discharge into central wastewater of Industrial Estate, 2014

(d) Capacity of Hemaraj ESIE's Cooling Blowdown

The Project's cooling blowdown will undertake the inspection of the characteristics of the cooling blowdown according to the Ministry of Industry's Notification No. 2, B.E. 2539 re: Prescribing of Characteristics of Effluent discharged from a Factory, before the discharge out of the SPP and IPP through the pipeline to be collected in Hemaraj ESIE's cooling water holding pond. Regarding the capacity of Hemaraj ESIE's cooling water holding pond, it has the minimum capacity of 17,830 m^3/day. Therefore, the daily volume of maximum cooling blowdown of 12,232 m^3/day from the project, when combined with the cooling blowdown from Tasit 3 and Tasit 4 Power Plant Projects, operating simultaneously, of about 2,830 m^3/day, will generate the total volume of 15,062 m^3/day, accounting for 84.48 % of the maximum capacity of Hemaraj ESIE's cooling water holding pond. This means Hemaraj ESIE's cooling water holding pond **can adequately handle the volume of cooling blowdown resulting from Sriracha Power Plant, Tasit 3 and Tasit 4 Power Plant Projects, without difficulty controlling the discharge of cooling blowdown**.

Mitigation Measures

(a) Construction Periods

Rain Water Management Measures

- Prepare gutters and temporary sedimentation pond within the project area to collect rainwater and allow it to precipitate. Solid sediments are separated from rainwater while the remaining clear water will be reused for spraying of the project area to reduce the dispersion of the suspended particulate. The remaining water will be drained into the estate's Rain Gutters.
- If any scrap material is found falling into the gutters and blocking or obstructing the flow of the water, it must be removed to allow water to flow freely.
- Forbid discarding of scrap material or dirt into the gutters.

Measures for Management of Wastewater from the Office Building and the Construction Activities.

- Provide sufficient toilets under proper hygienic principle for the construction workers as required by law and provide septic tank or ready-made wastewater treatment tanks to treat wastewater from daily consumption of the construction workers. Allocate wastewater holding pond with holding capacity for at least one day in order to

inspect the quality of the discharged water to ensure that it meets the requirement for Building Type C according to the standards prescribed in Ministry of Natural Resources and Environment's Notification re: Prescribing Standards for Discharged Water from Building of Certain Types and Sizes Prior to Draining Outside.

- Provide drainage gutter in the construction area and wastewater holding pond to hold uncontaminated discharged water from the construction activities for inspection of the quality in accordance with the requirements of Hemaraj Eastern Seaboard Industrial Estate, before draining to the estate's central wastewater treatment system.
- Control the management the contaminated wastewater such as collective wastewater from the engine oil changes in tanks for delivery to a company licensed by the government to dispose.
- Repair and maintain vehicles and machines regularly to prevent leakage of fuel provided that it is carried out in the designated area on solid surface with materials for prevention of leakage from flowing into Map Kradon Swamp.

Measures for management of wastewater from workers' camp

Provide for a ready-made wastewater treatment system in the area of the workers' living quarters including a discharged water retention pond with holding capacity for at least one day to inspect the quality of the discharged water to ensure that it meets the requirement for Building Type C according to the standards prescribed in Ministry of Natural Resources and Environment's Notification Prescribing Standards for Discharged Water from Building of Certain Types and Sizes Prior to Draining Outside.

Measures for management of wastewater from Hydrostatic Test

- Install grilles or fine mesh to trap debris or solid contaminants mixed in the water at the end of the drain of the wastewater from the hydrostatic test.
- Inspect the characteristics of the wastewater from the hydrostatic test, such as, pH value, temperature, suspended solid, oil and grease to ensure that the values are within the standard of Hemaraj Eastern Seaboard Industrial Estate.
- In case the wastewater quality is not within the standard of the estate, the project will deliver such wastewater to be disposed by the company licensed by the government for disposal.

(b) Operation Period

Measures for Management of Cooling Water

- Provide two cooling water holding ponds of the project each with capacity of 19,000 m³ with minimum holding capacity of one day per pond to collect the water drained from the cooling tower and line each pond with High Density Polyethylene (HDPE) to prevent leakage or build concrete pond.
- Install the Online Monitoring system for the inspection of the pH value, the conductivity and the Dissolved Oxygen in the area of cooling water holding pond from the power plant's cooling tower and report the values on the screen in front of the project site and to Hemaraj Eastern Seaboard Industrial Estate's Wastewater Control Centre.
- Ensure that the quality of the cooling blowdown meets the requirement of Hemaraj Eastern Seaboard Industrial Estate which specifies that the cooling blowdown must meet the requirement prescribed in Ministry of Industrial's Notification No. 2 (B.E.2539) re: Prescribing Standards of Quality of Discharged Water Drain from Factories and the level of Total Dissolved Solid must be within the standards of the quality of water discharged into the Irrigation waterway of the Department of Royal Irrigation (TDS not exceeding 1,300 mg/l and the temperature not exceeding 34 °C).
- Provide an emergency pond with the holding capacity of 19,000 m³ capable of holding water for at least one day to hold cooling blowdown. If the cooling blowdown shows the values that do not meet the requirements of Hemaraj Eastern Seaboard Industrial Estate which specifies that the quality of the cooling blowdown must meet the standard prescribed by Ministry of Industry's Notification No. 2 (B.E. 2539) re: Prescribing Standards of Quality of Discharged Water Drain from Factories and the level of Total Dissolved Solid must be under controlled the standards of the quality of water discharged into the Irrigation waterway of the Department of Royal Irrigation (TDS not exceeding 1,300 mg/l and the temperature not exceeding 34 °C). (During the normal operation, the emergency pond will be kept dry.)
- Use the aerators in the cooling water holding pond to increase the dissolved oxygen in the discharged water.

- If the Dissolved Oxygen level is under 4 milligrams/liter, the project will start the aerator to add air in the water until the Dissolved Oxygen level in the discharged water is no less than 4 milligrams/liter.
- The project will design a water dispersion system at the point where water is released into the holding pond in order to add Oxygen to the discharged water
- Control the level of Chlorite in the wastewater from the cooling tower to no more than 1 milligram/liter otherwise the project will not drain cooling blowdown to outside the project area.
- In case the project uses the wastewater from cooling tower to water the trees within the project, the SAR level must be within 0-10, conductivity must not exceed 2,000 μmhos/cm and TDS must not exceed 1,300 milligrams/liter or the quality of the discharged water must be improved to meet the standards before using it to water the trees.
- In case the quality of the water drained from the cooling tower does not meet with the specified standard, the valves will be turned off and the quality of the wastewater in cooling holding pond must be improved. If this cannot be solved, such water will be sent to the company licensed by the government for disposal.
- Inspect and maintain the condenser and the cooling tower regularly in order to help controlling the quality of cooling blowdown before draining to outside the project.

Measures to Manage Wastewater from the Process

- Ensure that the properties of the wastewater to be delivered to the central wastewater treatment system of the estate meets the requirements of Hemaraj Eastern Seaboard Industrial Estate.
- Provide Oil Separator to separate oil from wastewater that is contaminated with oil and then send the Wastewater holding pond for quality inspection before draining it to the central wastewater treatment system of Hemaraj Eastern Seaboard Industrial Estate.
- Provide sufficient toilets under proper hygienic principle for the workers as required by law. Construct septic tanks or ready-made wastewater treatment

tanks to treat wastewater from the consumption of the workers before draining it to the central wastewater treatment system of Hemaraj Eastern Seaboard Industrial Estate.

- Provide a Neutralization Pit to adjust the water condition to neutral condition before draining it to the project's wastewater holding pond and then to the central wastewater treatment system of Hemaraj Eastern Seaboard Industrial Estate.
- Provide a wastewater holding pond capable of holding wastewater for at least 24-hour in order to inspect the quality prior to draining into the central wastewater treatment system of Hemaraj Eastern Seaboard Industrial Estate.
- Install an Online Monitoring System to check temperature, pH value and conductivity at the wastewater holding pond and report the result to the Wastewater Control Centre of Hemaraj Eastern Seaboard Industrial Estate.
- Deliver the water which has passed through the quality inspection from the wastewater holding pond through the discharged water gutters for treatment at the central wastewater treatment system of Hemaraj Eastern Seaboard Industrial Estate.