CHAPTER 4

Water quality monitoring with modern information technology at Mae Ping River passing through Chiang Mai city as a study area

4.1 Background information

Mae Ping River is originated from Chiang Dao district in the northern of Chiang Mai province and flows through Chiang Mai, Lamphun, Tak, Kamphaeng Phet. Later, it joins with the Nan River to form the Chao Phraya River at Nakhon Sawan province. Along its course, it has a great influence on people and community of the north. Chiang Mai is located on the side of the Ping River where it was used in agriculture, tourism, and consumption. Due to an increase in population and tourism, large amounts of wastewater from various activities has been drained into Mae Ping River, some without any treatment. As a result. it has greatly affected water quality of the river and decelerated the river restoration and rehabilitation processes. Thus, this study is interested to apply the developed method with modern IT technology for water quality monitoring of Mae Ping River, focusing on where it flows pass the city area of Chiang Mai.

4.2 Aim of the studies

To demonstrate the water quality monitoring system employing modern information technology at Mae Ping River flowing through Chiang Mai city area.

4.3 Application of purpose

Due to the fact that Mae Ping River has been heavily polluted during flowing through the city areas of Chiang Mai, the water quality monitoring system with modern IT technology was applied to study Mae Ping River in that area. Thanks to the previous experience in water quality monitoring in the Chiang Mai moat, the operation planning process was adopted and adjusted accordingly, including staff number, monitoring time, distance and transportation. The water quality was monitored at many sampling sites along the Mea Ping riverbank. In order to choose an area of interest, the length of the river flowing through the city area was measured on Google Earth application using ruler tool (path). The chosen area of approximately 20 km long was divided into 6 zones (3-4 km. each). Also, one spot at the distance 16 km away from the first sampling point was chosen as a reference site. At each sampling zone, Google Street View was used to survey a surrounding and a sample point was assigned as shown in Figure 4.1 (b): https://www.google.co.th/maps/@18.759553,98.99637,3a,90y,115.08h,88.52t/data=!3m6!1e1!3m4!1stiQBZIQsQMthUV_ZirwW8g!2e0!7i13312!8i6656?hl=en.

Next, a mapping of water quality monitoring of Mae Ping River was created on Google Map as shown in Figure 4.2: https://www.google.co.th/maps/@18.790551,98.9871255,12z/data=!3m1!4b1!4m2!6m1!1szuV5N42p7zGU.ktKrBS6OdYm0?hl=en. The coordinate of each designated sampling point was recorded onto a GPS navigator.

In addition, the monitoring team was divided into 2 groups. The on-site team will perform water quality tests with digital probe meters and test kits for 10 parameters while the center lab team will evaluate the data as described in Section 2.2.3, Chapter 2 and display the water quality results on the website as described in Section 2.2.4, Chapter 2. The operation date was planned for 2 periods; December 2012 and April 2013.

In the monitoring process, the on-site team traveled to each designated sampling site by a car navigated using GPS on a smart phone or GPS navigator. After testing 10 parameters and taking photos, all data were uploaded to the cloud system (Picasa Web Album and Google Drive). The on-site team and the center lab could communicate with each other using a mobile application. After the evaluation process, if any outlier or abnormal result was found, the center lab would report to the on-site team to redo the test at that sampling site immediately. The water quality monitoring results was displayed on the website (https://sites.google.com/site/waterqualitymonitoringbyfbacmu/).

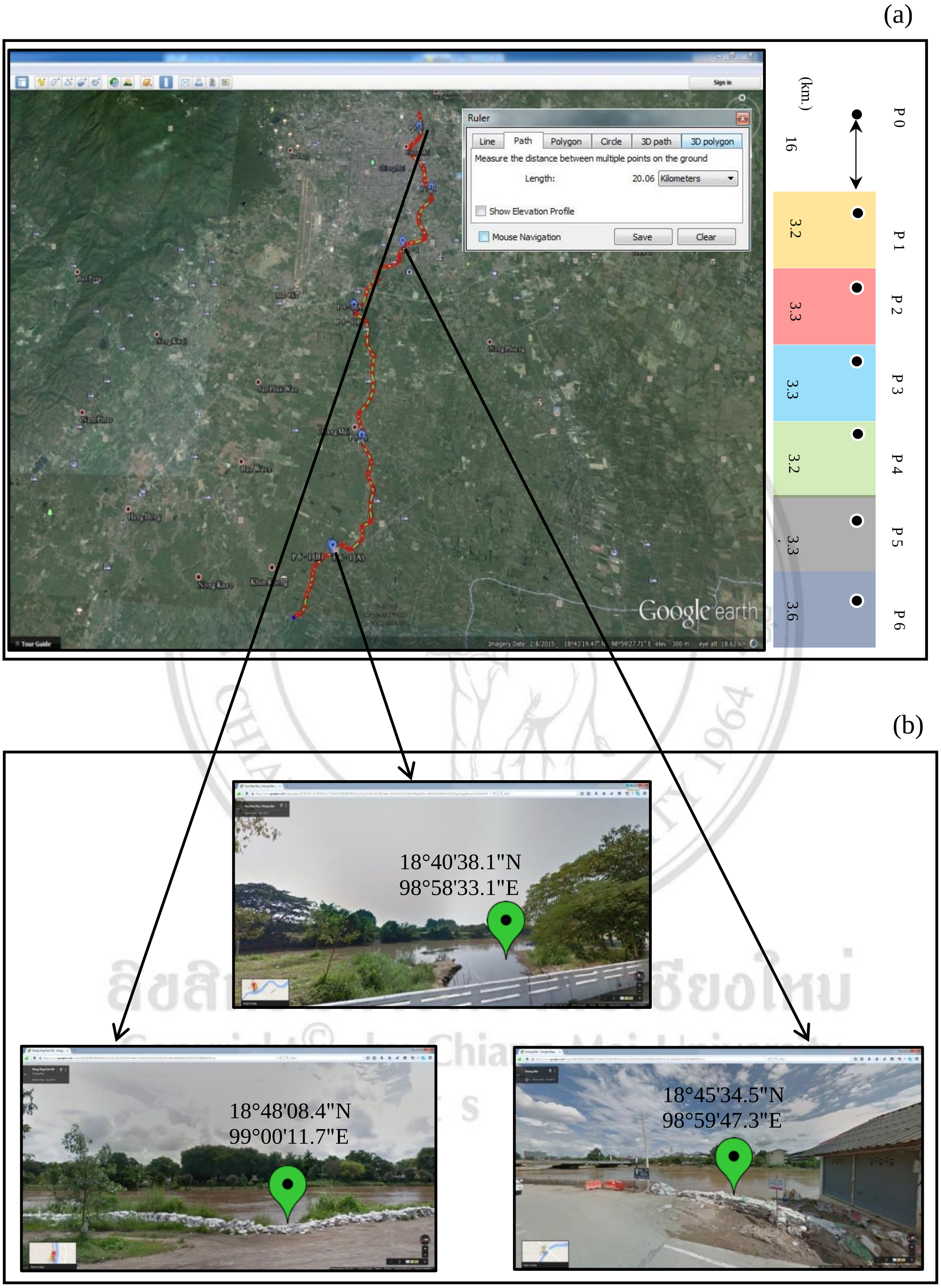

Figure 4.1 Uses of Google Earth (a) and Google Street View (b) in survey a sampling site of Mae Ping River.

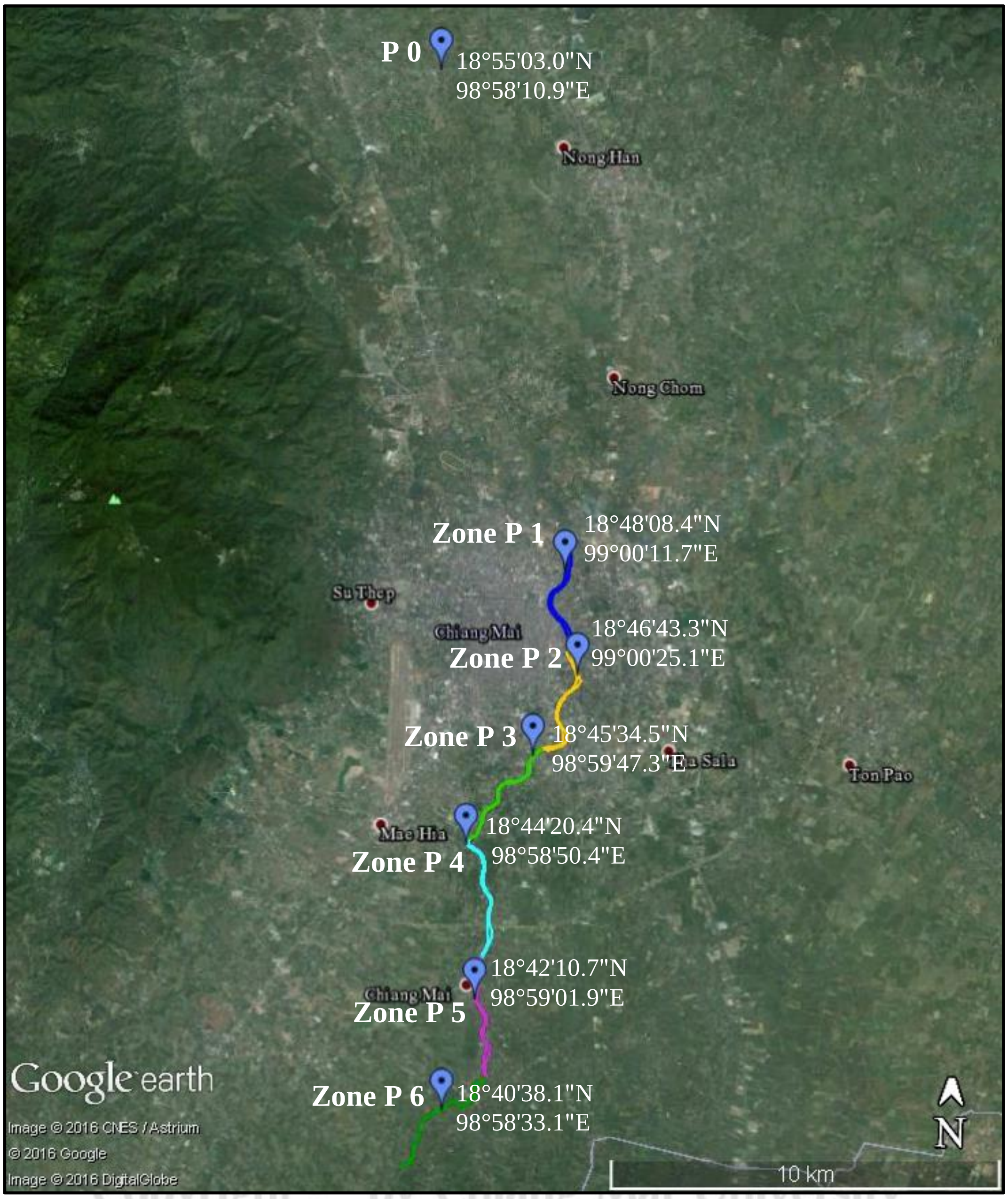

Figure 4.2 A satellite image from Google Earth showing designated sampling zones and sampling points with GPS coordinates.

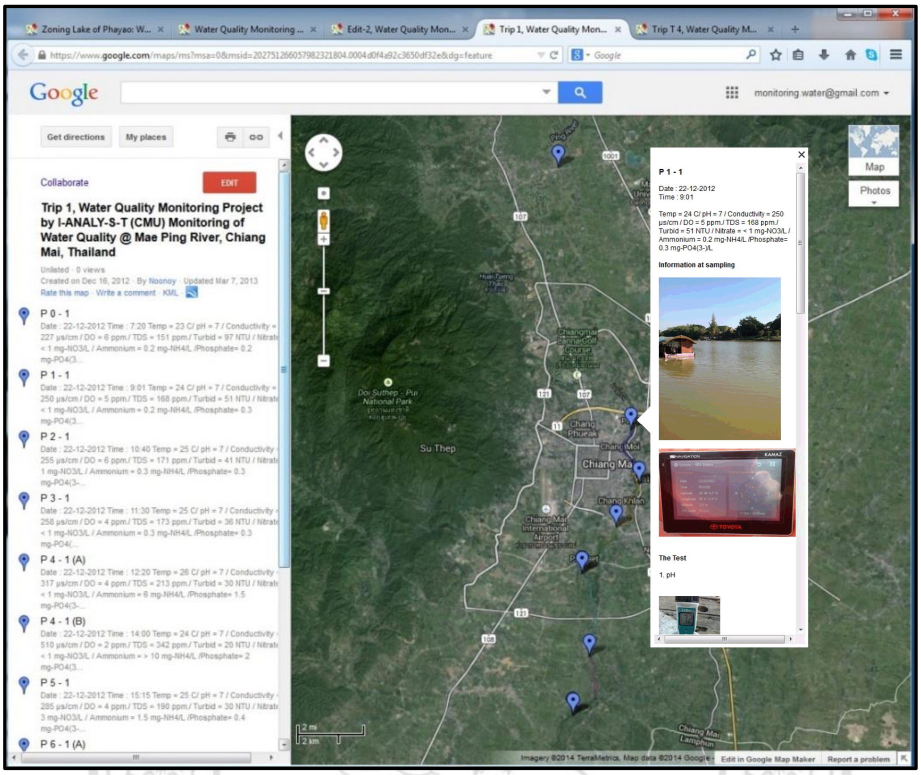

Figure 4.3 The water quality monitoring data displayed on Google Maps

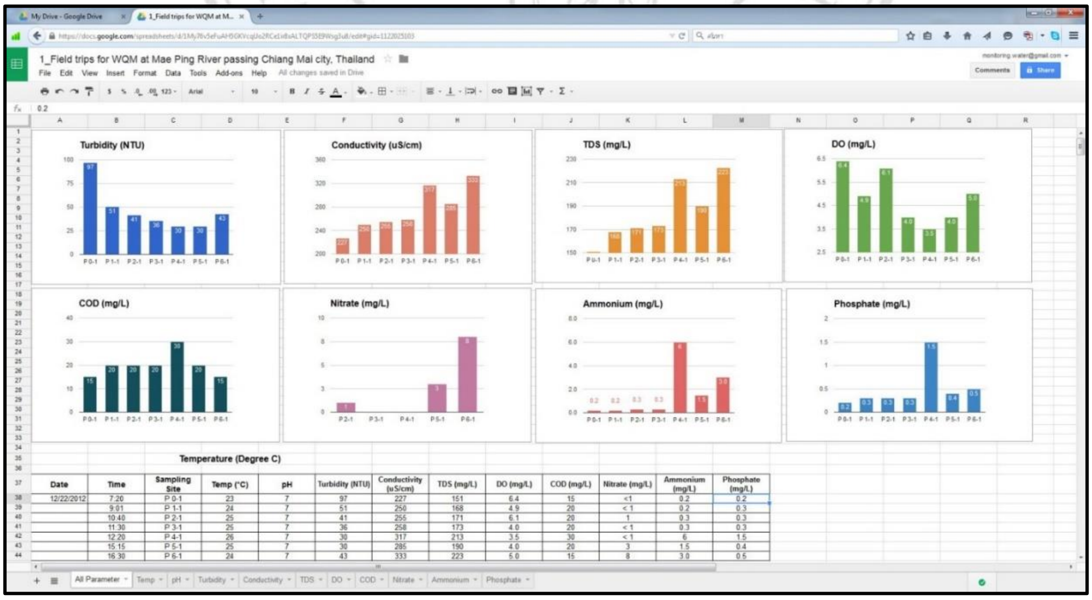

Figure 4.4 Numerical data and related graphs on Spreadsheet, Google Docs

4.4 Results and discussion of water quality monitoring of Mae Ping River passing through Chiang Mai city

According to the plan, water quality monitoring of Mae Ping River was performed on December 22, 2012 starting at reference site, P0, and moving down the river until the sampling zone, P6. It was found that some water quality parameters from zone P4 to P6 were poor compared to those from upstream zones as shown in Table 4.1.

In order to investigate the point sources of zone P4-P6, the discussion between the on-site team and the center lab was done on networking and more subzone sampling site were assigned.

Table 4.1 Results of water quality monitoring of Mae Ping River passing through Chiang Mai city on December 22, 2012

Sampling Zone-Trip	Temperature (^0C)	pH	Conductivity ($\mu s.ms^{-1}$)	DO (mg/L)	
				Measure	% DO Sat
P0-1	23	7	227	6	74
P1-1	24	7	250	5	58
P2-1	25	7	255	6	74
P3-1	25	7	258	4	49
P4-1	24	7	510	2	21
P5-1	25	7	285	4	52
P6-1	24	7	333	5	63

Table 4.1 Results of water quality monitoring of Mae Ping River passing through Chiang Mai city on December 22, 2012 (continued)

Sampling Zone-Trip	**TDS (mg/L)**	**Turbidity (mg/L)**	**Nitrate (mg/L)**	**Phosphate (mg/L)**	**Ammonium (mg/L)**	**COD (mg/L)**
P0-1	151	97	< 1	0.2	0.2	15
P1-1	168	51	< 1	0.3	0.2	20
P2-1	171	41	1	0.3	0.3	20
P3-1	173	36	< 1	0.3	0.3	20
P4-1	342	20	< 1	2	> 10	30
P5-1	190	30	3	0.4	1.5	20
P6-1	223	43	8	0.5	3	15

4.4.1 Results of water quality monitoring in the zone P4

As aforementioned, the zone P4 was divided into subzones towards the zone P3. The water quality monitoring was performed at each subzone, P4-1(A) and P4-1(B), as described in Section 2.21 – 2.2.4, Chapter 2 and the results was shown in Table C2, Appendix C. During the monitoring process, the on-site team used modern IT to make VDO conference with the center lab. It was found that wastewater was drained into Mae Ping River at location 18°44’22.0” N, 98°58’50.6” E as shown in Figure 4.6. It was observed that the wastewater causing white foaming in some parts of the river. The water quality results show that DO was low while COD, conductivity, TDS, ammonium and phosphate were high. This suggests that it could be domestic wastewater discharged from community by the river.

From this result, the water quality monitoring at the zone P4 was continued for 5 times, including monitoring at the point source at different time in a day; morning, afternoon and evening (see Table C2, Appendix C). It was found that the wastewater was drained into the river daily with varied amounts. It could be due to the amount of wastewater was in excess of the capacity of the existed wastewater treatment system, so some of them was drained directly into the river. The correlation between each parameter in the zone P4 were calculated as shown in Table C3, Appendix C. It shows that conductivity and TDS are related to COD, and highly related to ammonium and phosphate. In contrast, ammonium is inversely proportional with nitrate. It could be due to nitrification process in which ammonium is transformed into nitrate.

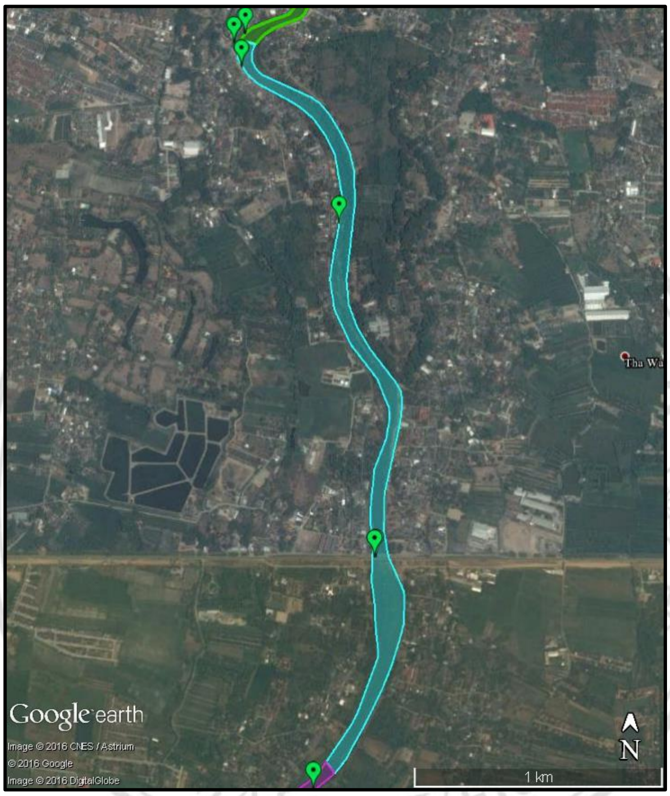

Figure 4.5 Sampling points in the subzone P4

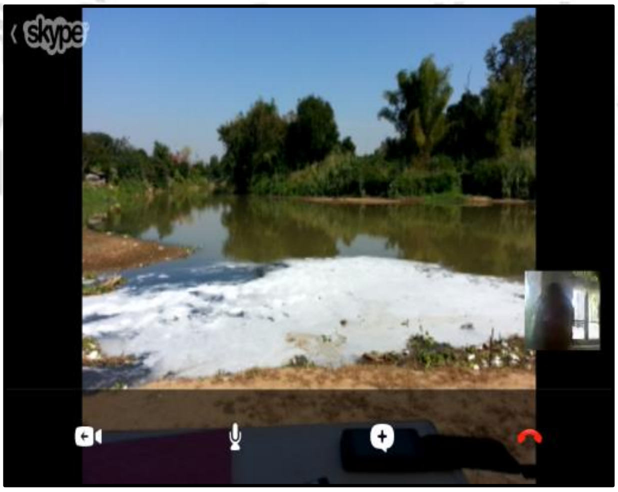

Figure 4.6 VDO conference between the onsite team at point source and the center lab at CMU

4.4.2 Results of water quality monitoring in the zone P5

Following water quality monitoring at zone P5 performed on March 9, 2013, it was found that % DO Sat (DO) was low as shown in Table C1, Appendix C. Therefore, similar to the zone P4, the zone P5 was divided into subzones for water quality monitoring as described in Section 2.21 – 2.2.4, Chapter 2 and the additional results was shown in Table C4, Appendix C. It was found that % DO Sat (DO) was low, while COD and nitrate were high. It could be a result of a weir across the river width located near the zone P5. During dry season, when monitoring was done, the water level was low and water became stagnant above the weir. Moreover, it was found that there was fish farming on Mae Ping River. The fish food mainly contains protein and fat causing an increase in COD. Also, the fat from fish food could cause hydrophobic film on water surface, blocking oxygen to dissolve into water, resulting in a decrease in DO. The observed high nitrate could be a product of microbial nitrification of ammonium from the point source in the zone P4 combine with wastewater from fish farming. Such water quality could affect aquatic life in the river and may cause fish kill.

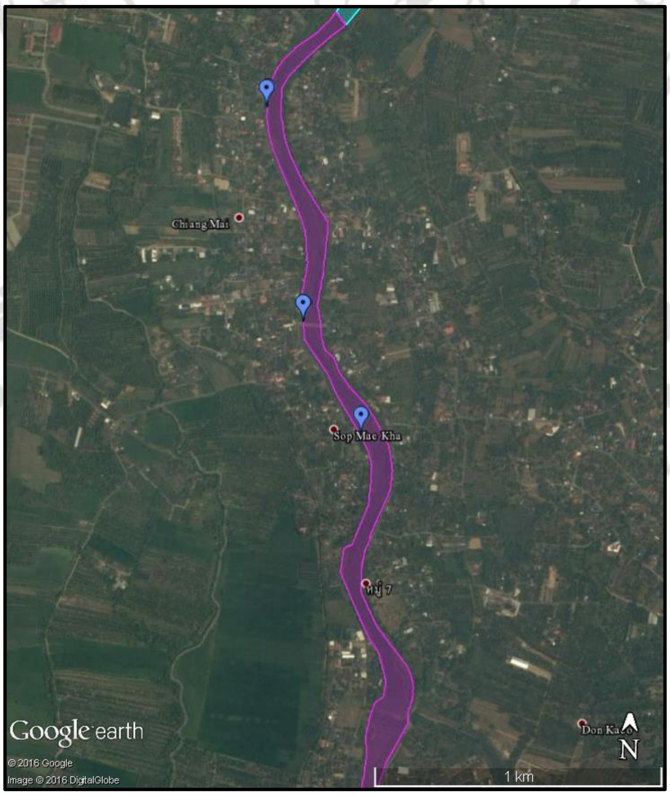

Figure 4.7 Sampling points in the subzone P5

4.4.3 Results of water quality monitoring in the zone P6

The result of water quality monitoring performed on December 22, 2012 shows nitrate in the zone P6 is significantly higher than others as shown in Table 4.1. Therefore, the zone P6 was divided into subzones for water quality monitoring as described in Section 2.21 – 2.2.4, Chapter 2 and the additional results was shown in Table C5, Appendix C. It shows that % DO Sat (DO) was slightly low, while conductivity, TDS, turbidity, COD, ammonium, nitrate และ phosphate were high at 18°40'38.1"N, 98°58'34.0"E. It was found that the water at this zone was from an irrigation canal discharged into the river. The observed pollutant could be a result of fertilizer runoff of agriculture land or household wastewater drained into the irrigation canal, which was accumulated in the river later.

The dispersion of pollutant was investigated by monitoring some water parameters at location 18°40'38.1"N, 98°58'34.0"E and surrounding (Figure 4.9). From Table C5, Appendix C, the result shows that the pollutant was distributed along the flow direction of the river.

Figure 4.8 Sampling sites of zone P 6

Figure 4.9 Water quality monitoring and pollutant distribution determination at the sub zone P6

4.5 Results of applied the water quality monitoring system employing modern information technology to Mae Ping River passing Chiang Mai city

The developed the water quality monitoring system employing modern IT was applied on the part of Mae Ping River passing through the city area of Chiang Mai, similar to the previous monitoring at the Chiang Mai moat in Chapter 3. The planning process was done by diving the area of interest into sampling zones and subzones. During water quality monitoring, modern IT was used in communication between the on-site teams and the center lab such as VDO conference and networking. The center lab teams were able to look at the site and surrounding in real-time. It helps planning and adjusting the work for each zone properly. It allowed the point source in the area to be investigated immediately without having to return to the lab. In this study, the water quality monitoring in 7 sampling zones of 36 km long was completed by 3-5 people within a day including displaying data in real-time and semi real-time. Thus, the developed system was demonstrated as a time-saving, cost-effective system for water quality monitoring.