

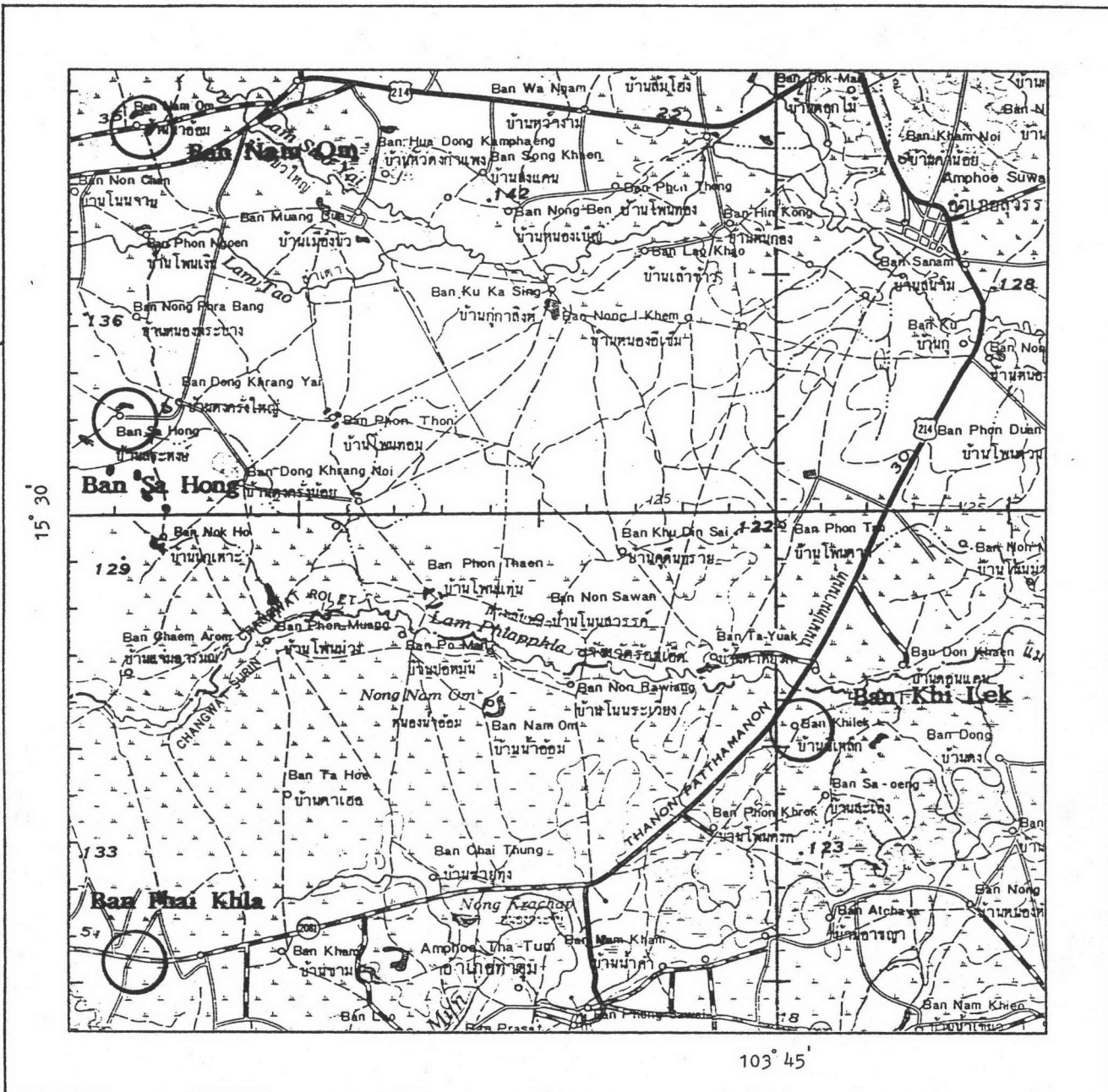
CHAPTER IV


GRAVITY SURVEY

From study of ADL in Chapter III, ADL is grouped into 5 types and 142 ADL locations are mapped within the study area. However for subsurface study by gravity survey, only four feasible sites were selected (Figure 4.1). They are Ban Nam Om Area (type 2), Ban Khi Lek Area (type 5), Ban Sra Hong Area (type 3) and Ban Phrai Khla Area (type 2).

The selected sites are ranged from 0.2-1 kilometer in width. All of them can be readily accessed by car. The gravity profiles were made with station spacing of 50 or 100 meters along the road. The line generally extends outward in the opposite direction starting from the center of the mound to about 1.5 times the width of the mound on each side. The profile length varies from 2-3 kilometers. Lacoste-Romberg gravity meter No G 620 was used for the survey. Accuracy of gravity measurement is as small as 0.1 gravity unit (gu). Totaling 143 stations extending approximately 10.3 kilometers are covered by the survey. After standard data reduction (see Appendix C), the accuracy of Bouguer gravity is in the range of ± 0.25 gu.

On interpreting gravity data, shallow salt dome concept (Seni and Jackson, 1983 ; Jackson and Talbot, 1986) is employed as a working hypothesis. Diapiric salt structure was used as an initial model (Figure B5). The salt body was approximated by $2^{1/2}$ dimension polygons. Borehole information from nearby wells as well as K-66



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

 The study area for gravity survey

Figure 4.1 Map showing classified A.D.L. distribution, circular feature and folding.

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which was drill adjacent to a salt dome as discussed earlier was used as geological constraints. Each rock type is correlated with appropriate density.

Stratigraphic sequences as well as rock thickness are adopted for the initial model construction. Hence, salt body was transform into various polygons with appropriate density that are used in computation of gravity values.

Size and shape of model are adjusted until good fit between calculated and observed gravity values are obtained. It is found that information from K-66 gave the best results. This processes is repeated for each site. The results of gravity survey are explained in detail below.

4.1 Ban Nam Om Area.

The area is situated at Ban Nam Om, Amphoe Kaset Wisai, Changwat Roi Et. It has two annular depression levels surrounding a mound and covering area about 5 square kilometers (Figure 4.2). The mound is about 1 kilometer in width. The depression area is approximately 1.6 kilometers wide.

The gravity survey line is three kilometers in length along the road which run approximately in east-west direction across the center of the mound. The gravity reading are made at 50 meters spacing on the mound and 100 meters off the mound. The observed gravity, related data as well as Bouguer gravity are shown in Appendix C (Table C1 a, b). For the purpose of making terrain correction, elevation contour was also made. The result is shown in

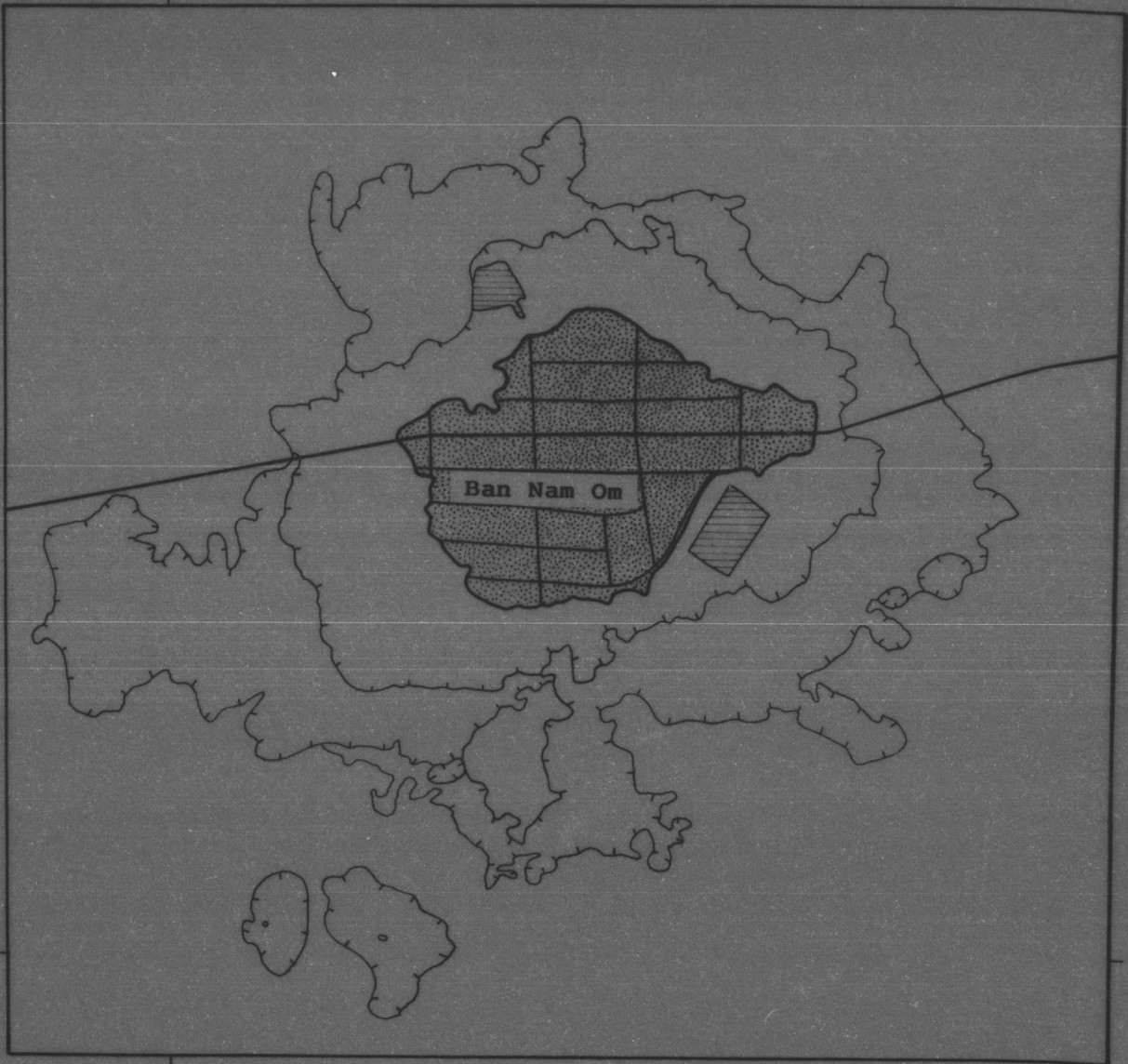




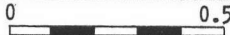
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Figure 4.2 Aerial Photograph of Ban Nam Om Area, interpretation of the landform is demonstrated on the overlay.

-  Road
-  Depression Area
-  Pond
-  Mound

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Figure 4.3.

Figure 4.4 illustrates the Bouguer gravity curve of Ban Nam Om Area. The curve shows small negative anomaly on the top of the mound superimposed on broad positive anomaly. In Figure 4.5a, the Bouguer gravity curve is compared with the calculated curve derived from Ban Nam Om Model (Figure 4.5b). The model which is composed of 11 polygons is constructed from the modified data description of K-66 borehole (see Table 4.1a). Both curves are fairly matched which suggest that subsurface structure of this area can be represented by this model. When compared with the topography (Figure 4.5c) of this area, it is noticeable that the mound is corresponding with negative Bouguer gravity anomaly. This negative anomaly can be explained by negative density contrast in two lower polygon of the shallow salt dome body (which consist of three polygons). But the positive anomaly is caused by positive density contrast of upper most polygon which represent to upper part of salt dome that penetrated into lower density layer (soil or unconsolidated sediment. The rock salt density in salt dome is average about 2.2 gm/cc and density of unconsolidated sediment or soil are between 1.4 to 2.0 gm/cc but 1.9 gm/cc is used in this case. Thus, density contrast of this polygon is 0.3 gm/cc and positive. Nevertheless, the negative density contrast of the lower polygons in the salt dome body which cause have negative anomaly cancel the effect of positive density contrast in upper part.

In part of the adjacent layers part which consist of 8 polygons is referred to sediment layers or sedimentary rock. The adjoining contacts with salt body represent the rim syncline area. The effect of this portion is corresponding to small negative

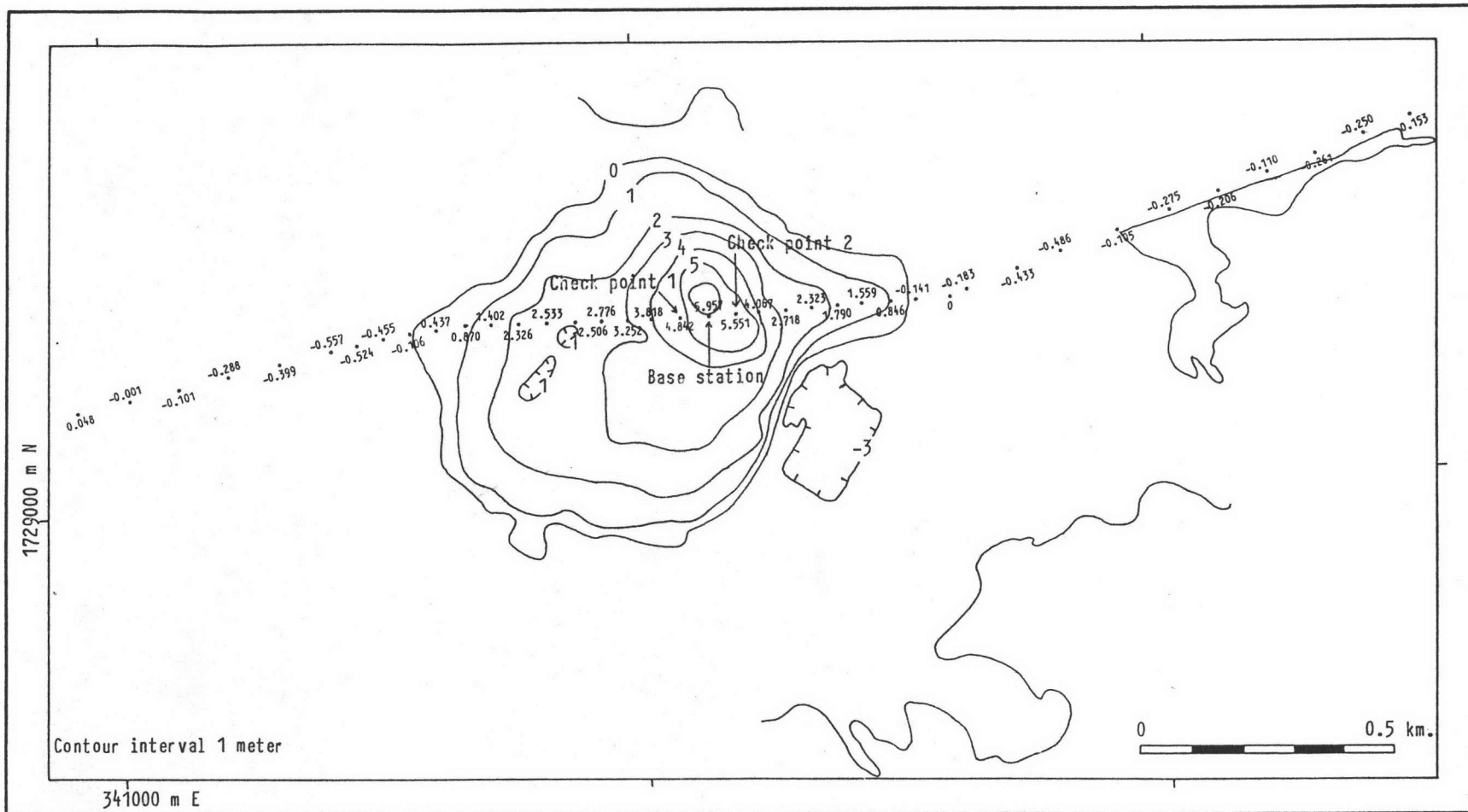


Figure 4.3 Map showing survey line, Location of station and elevation contour of Ban Nam Om Area.

Photogeology and gravity survey of the annular depression landform in parts of Changwat Surin and Roi Et

- 0.436 Gravity reading station and elevation (meter).
- Contour line

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Gravity Profile of Ban Nam Om

Amphoe Kasat Wisai Changwat Roi Et

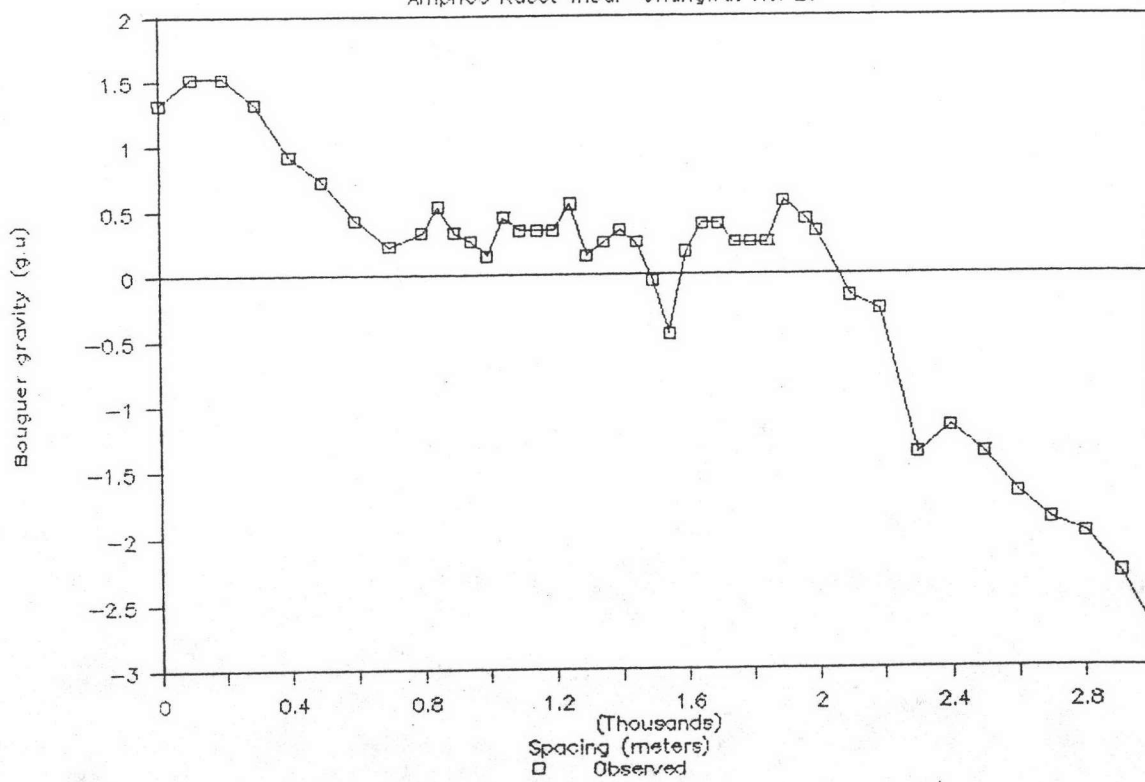


Figure 4.4 Showing Bouguer gravity curve of Ban Nam Om Area.

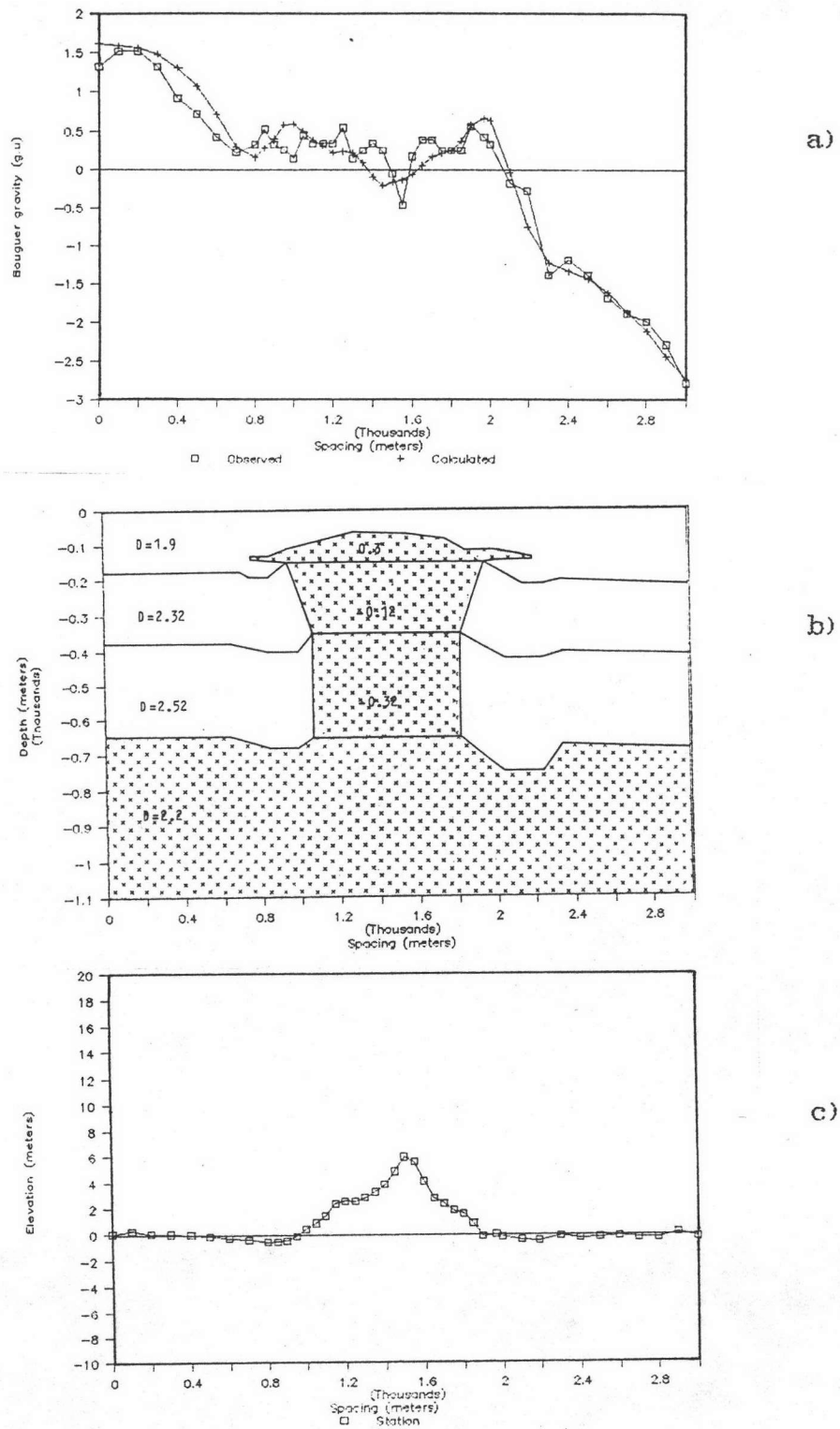


Figure 4.5 Showing a) comparison of observed versus calculated Bouguer gravity Ban Nam Om Model ; b) Ban Nam Om Model and c) elevation profile of Ban Nam Om Area along the survey line.

Table 4.1 Modified data description of K-66 borehole and Table A-2 for gravity modelling. (Modified after Thawat Japakasetr and Pakorn Suwanich, 1982).

Model	Depth	Lithology	Density
Ban Nam Om	0 - 175	unconsolidated sediment	1.9
	175 - 375	sandstone	2.32
	375 - 645	siltstone	2.52
	645 - 1010	rock salt	2.2
Ban Khi Lek	0 - 250	unconsolidated sediment	1.9
	250 - 450	sanstone	2.35
	450 - 720	siltstone	2.4
	720 - 1010	rock salt	2.2
Ban Sra Hong	0 - 62	mixed sediment	1.8
	62 - 77	clay	2.21
	77 - 115	silty clay	2.1
	115 - 136	sand and gravel	2
	136 - 348	sandstone	2.35
	348 - 823	siltstone	2.4
	823 - 959	rock salt	2.2
	959 - 1668	siltstone	2.35

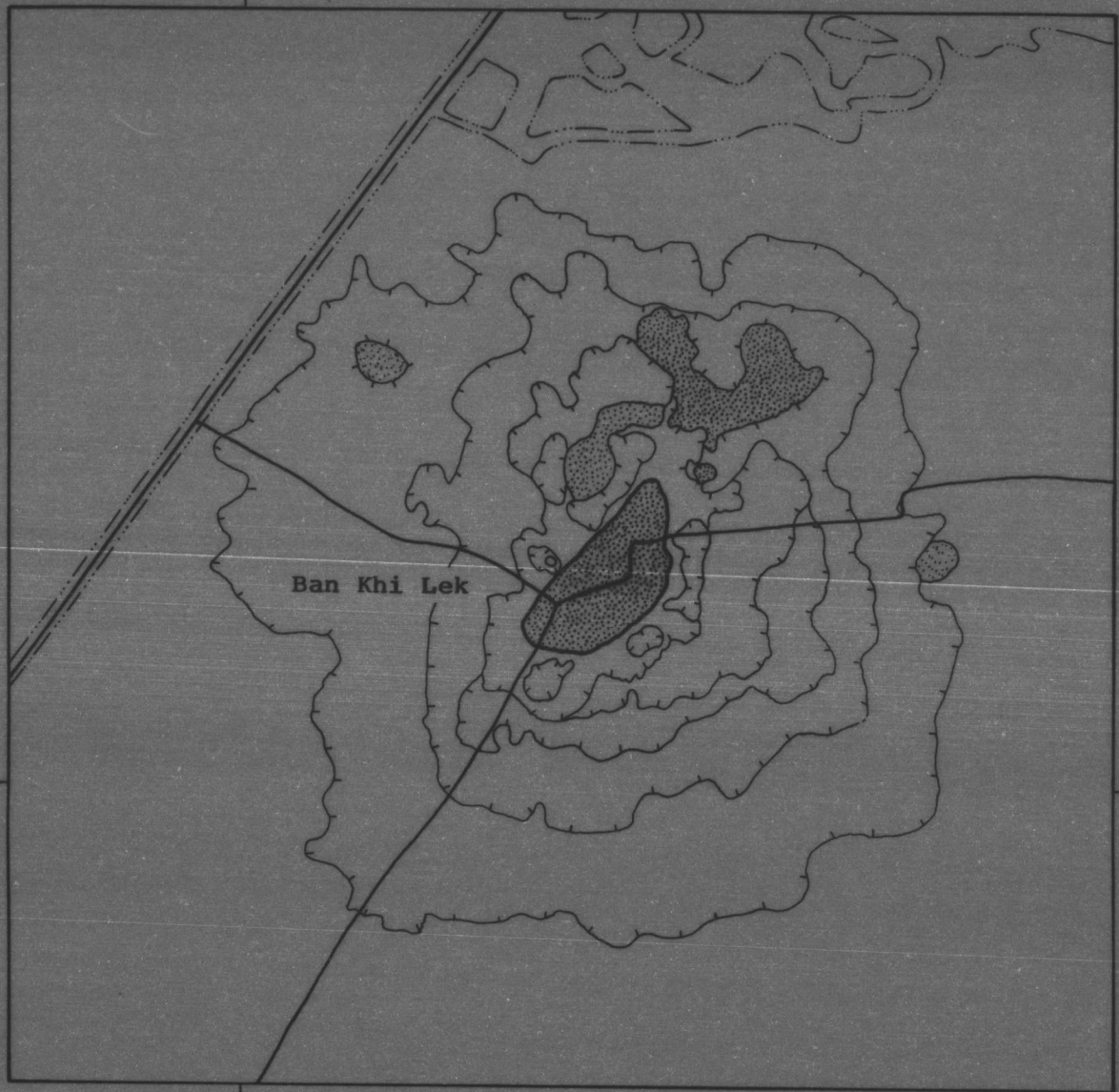
anomaly, which also reduced the effect of positive anomaly of upper most polygon. The description of polygons are summarize in Appendix D (Table D1 a, b).

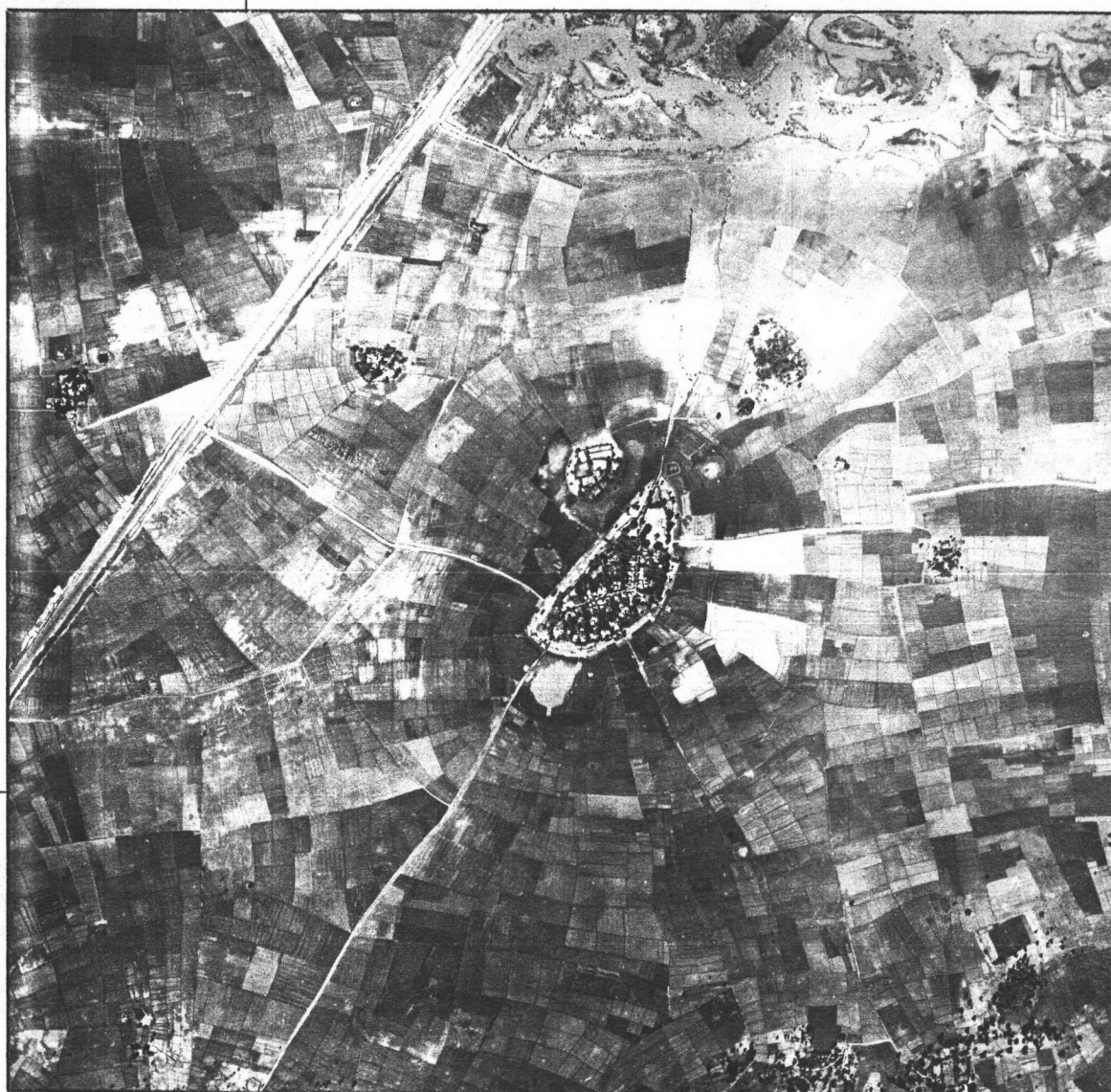
4.2 Ban Khi Lek Area.

It is located at Ban Khi Lek, Amphoe Tha Tum, Changwat Surin. It covers area of about 6 square kilometers that contains five depression levels surrounding four mounds, one large mound and three small ones (Figure 4.6). The largest mound is an oval shape of about 230 meters in width and 507 meters in length is selected for gravity survey. A survey line is 2.75 kilometers in length along the road which run approximately in east-west direction and across the central of the largest mound. Gravity measurement were made at 50 meters spacing on the mound and 100 meters off the mound. The gravity reading, related data and Bouguer gravity are shown in Appendix C (Table C2 a, b) Topographic contour was also made. the result is shown in Figure 4.7.

The Bouguer gravity curve of Ban Khi Lek Area is shown in Figure 4.8. The curve shows distinctly negative anomaly in the central part. Subsurface model of Ban Khi Lek was made by modification of data description of K-66 borehole (see Table 4.1b). Employing the concept of salt dome, The model is composed of 11 polygons. Three polygons constitute salt dome body and nine polygons represent the adjacent rock layers (Figure 4.9b).

Similarly to Ban Nam Om Model, the upper most polygon of the salt dome body of Ban Khi Lek is the cause of positive gravity anomaly due to its possible density contrast (+0.3 gm/cc) when





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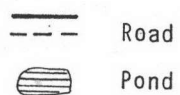
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Figure 4.6 Aerial Photograph and overlay sheet showing landform of Ban Khi Lek Area.



Road

Pond



Depression Area



Mound

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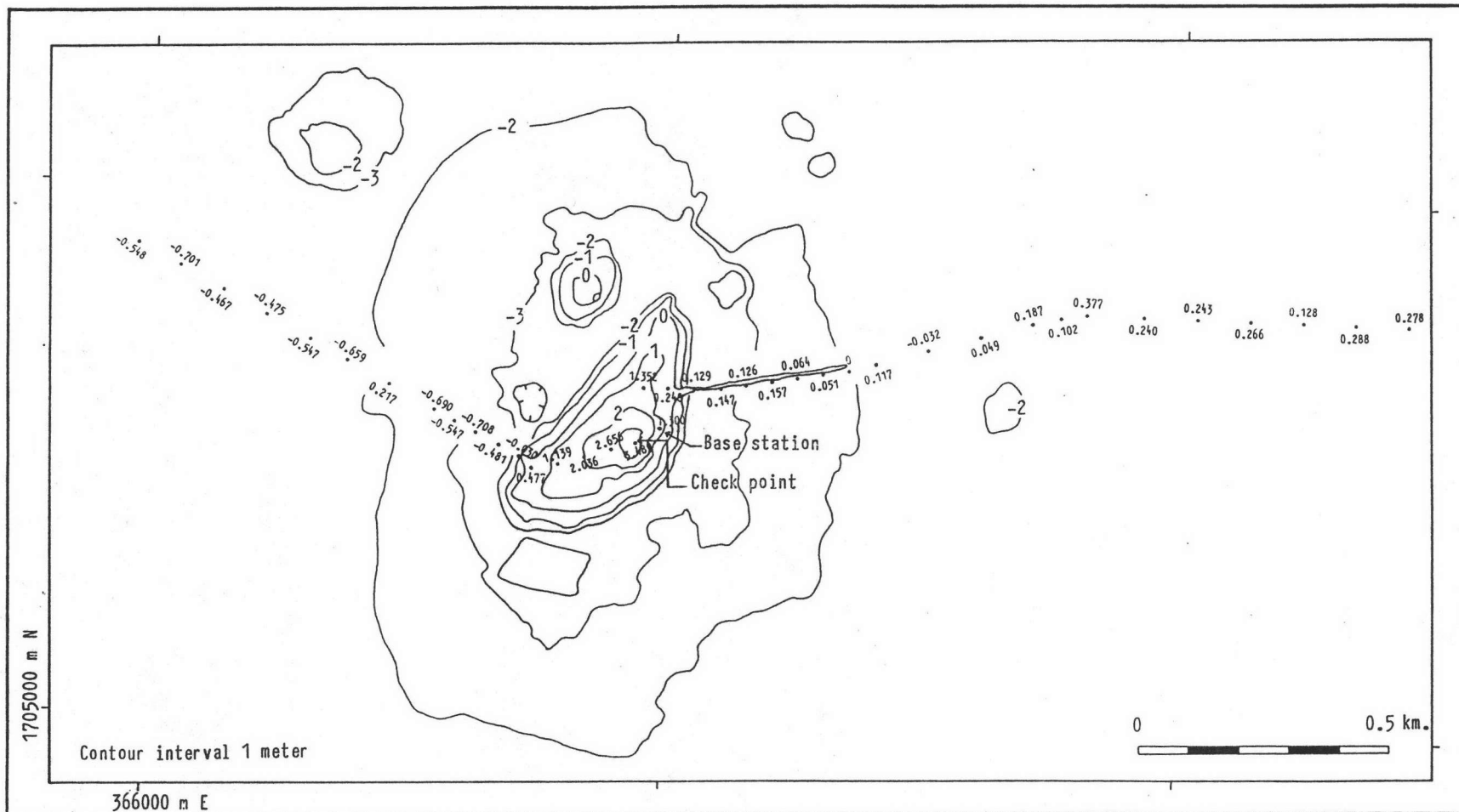


Figure 4.7 Map showing survey line, location of gravity survey station and elevation contour of Ban Khi Lek Area.

Photogeology and gravity survey of the annular depression landform in parts of Changwat Surin and Roi Et

- -0.436 Gravity reading station and elevation (meter).
- Contour line

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Gravity Profile of Ban Khi Lek

Amphoe Tha Tum Changwat Surin

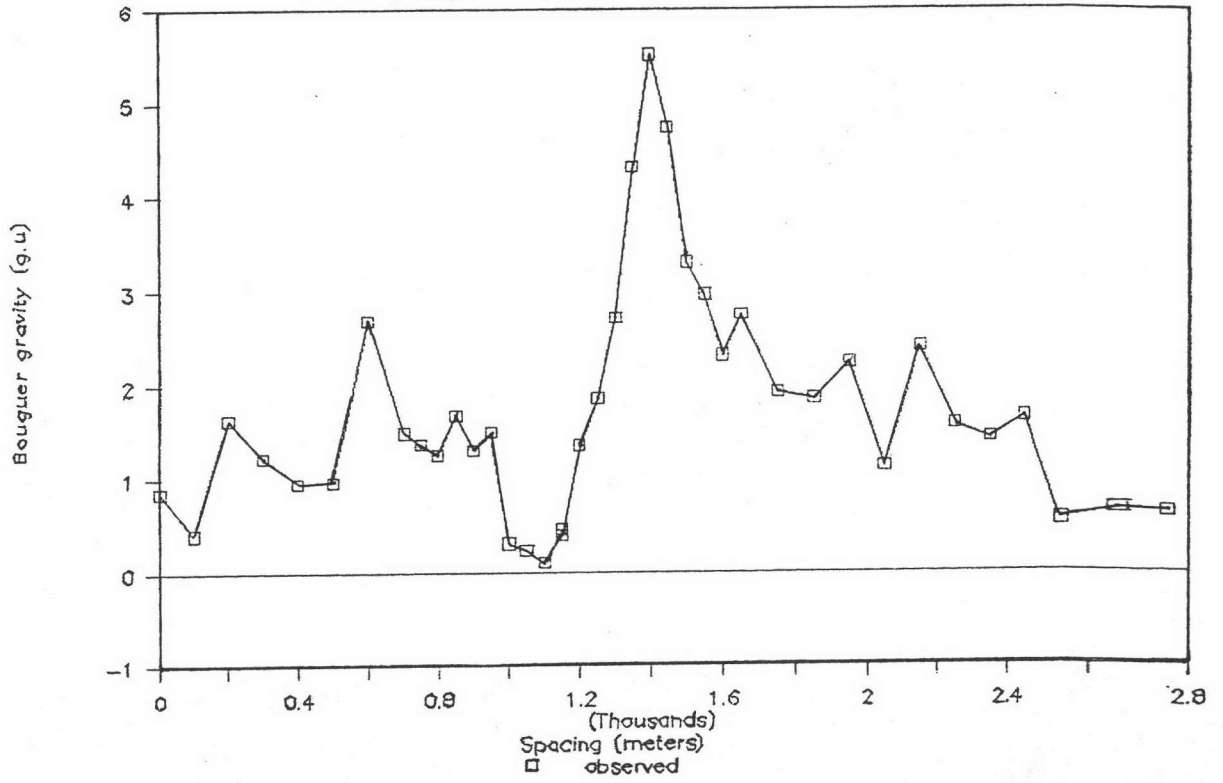


Figure 4.8 Showing Bouguer gravity curve of Ban Khi Lek Area.

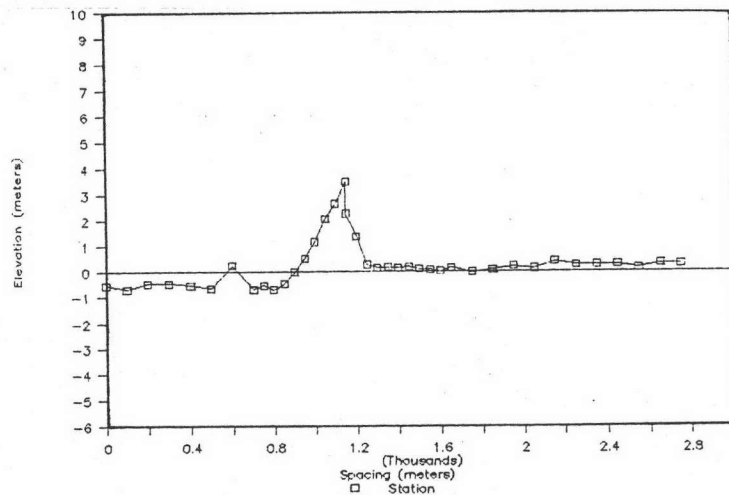
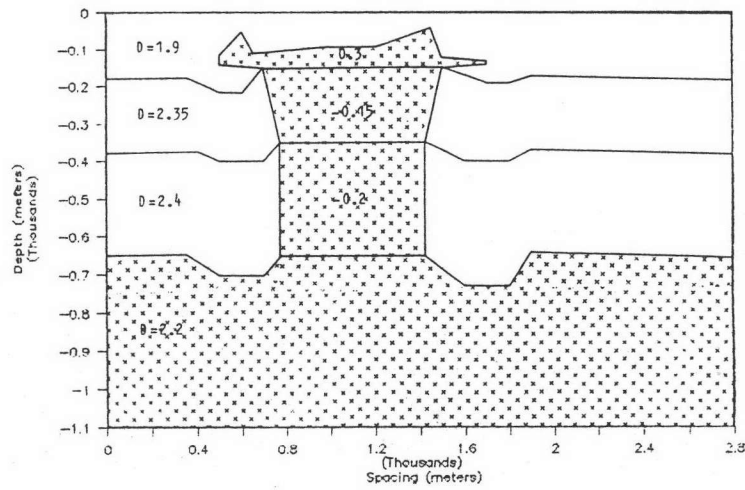
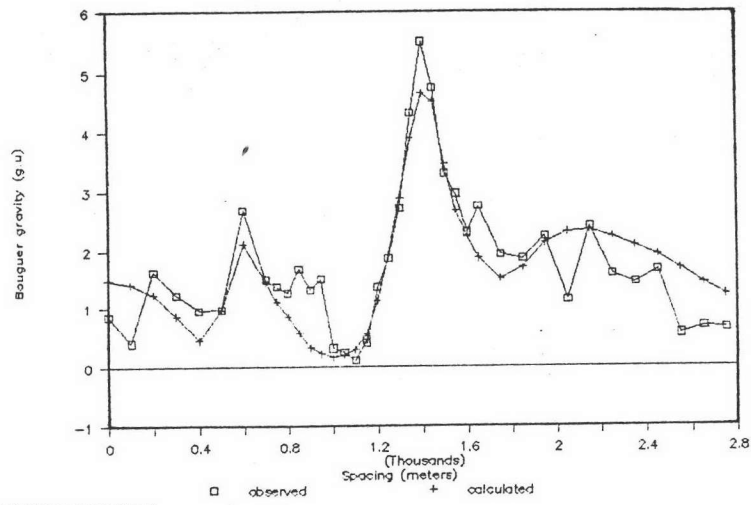


Figure 4.9 Showing a) comparison of observed versus calculated Bouguer gravity Ban Khi Lek Model ; b) Ban Khi Lek Model and c) elevation profile of Ban Khi Lek Area along the survey line.

compare with adjacent layers which is unconsolidated sediment (density = 1.9 gm/cc). The distinctive negative anomaly in the central part is effected mainly by two lower polygons (density contrast as -0.15 gm/cc and -0.2 gm/cc) The adjoining contacted between the polygons of salt dome body and the adjacent layers are the rim syncline area. The effect of this portion is correspond to small negative anomaly directly above the edge of the dome. The description of polygons are summarized in Appendix D (Table D2 a, b).

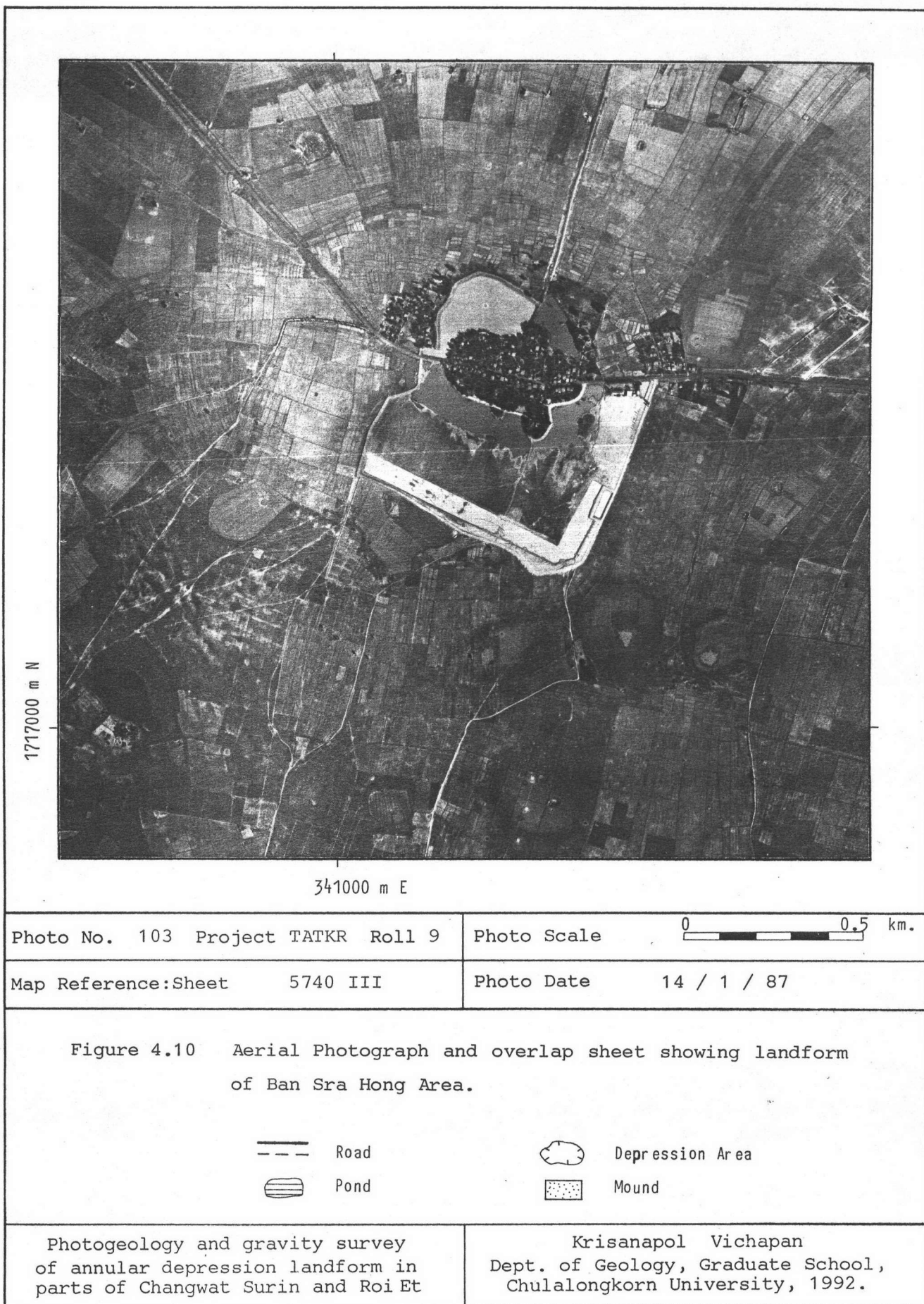
4.3 Ban Sra Hong Area.

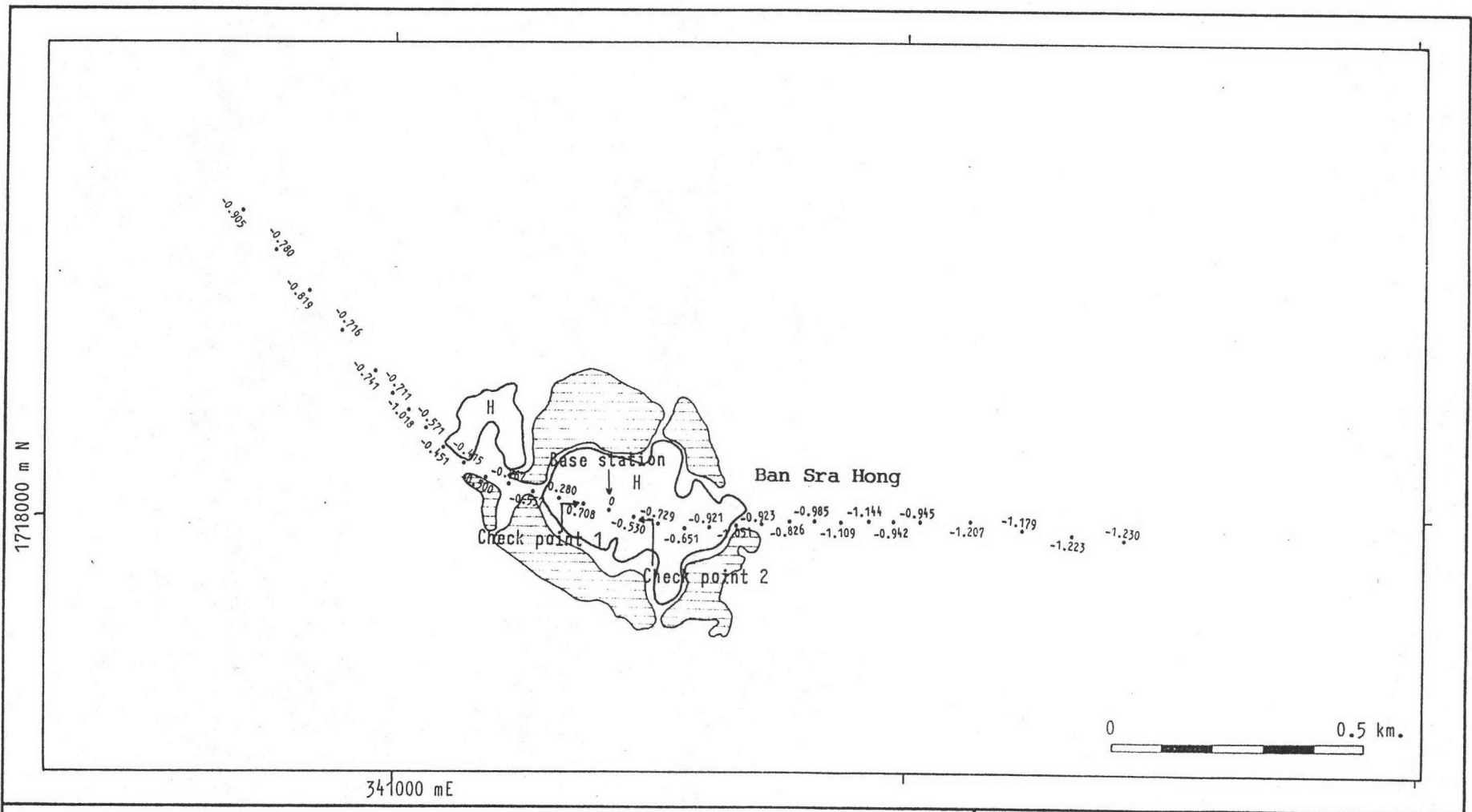
This area is located at Ban Sra Hong, Amphoe Kaset Wisai, Changwat Surin. It covers area of approximately 2 square kilometers which contain 2 depressions surrounding a mound (Figure 4.10). The mound is about 406 meters in width and the depression area is 1.06 kilometers wide.

The survey line (Figure 4.11) is two kilometers in length along the road which run approximately in east-west direction and across the center of the the mound. Station spacing of 50 meters spacing on the mound and 100 meters off the mound are used. Elevation of each station is surveyed by level transit but elevation contours are not made because this area has low relief (less than 2.0 meters over 1,100 meters distance). Hence, terrain correction is not made in this site. The gravity readings related data as well as Bouguer gravity are shown in Appendix C (Table C3 a, b).

The Bouguer gravity curve of Ban Sra Hong Area is shown in Figure 4.12. The curve shows mainly positive Bouguer anomaly. Subsurface structure of Ban Sra Hong Area is made from modification







Gravity profile of Ban Sra Hong Area

Amphoe Kaset Wisai Changwat Roi Et

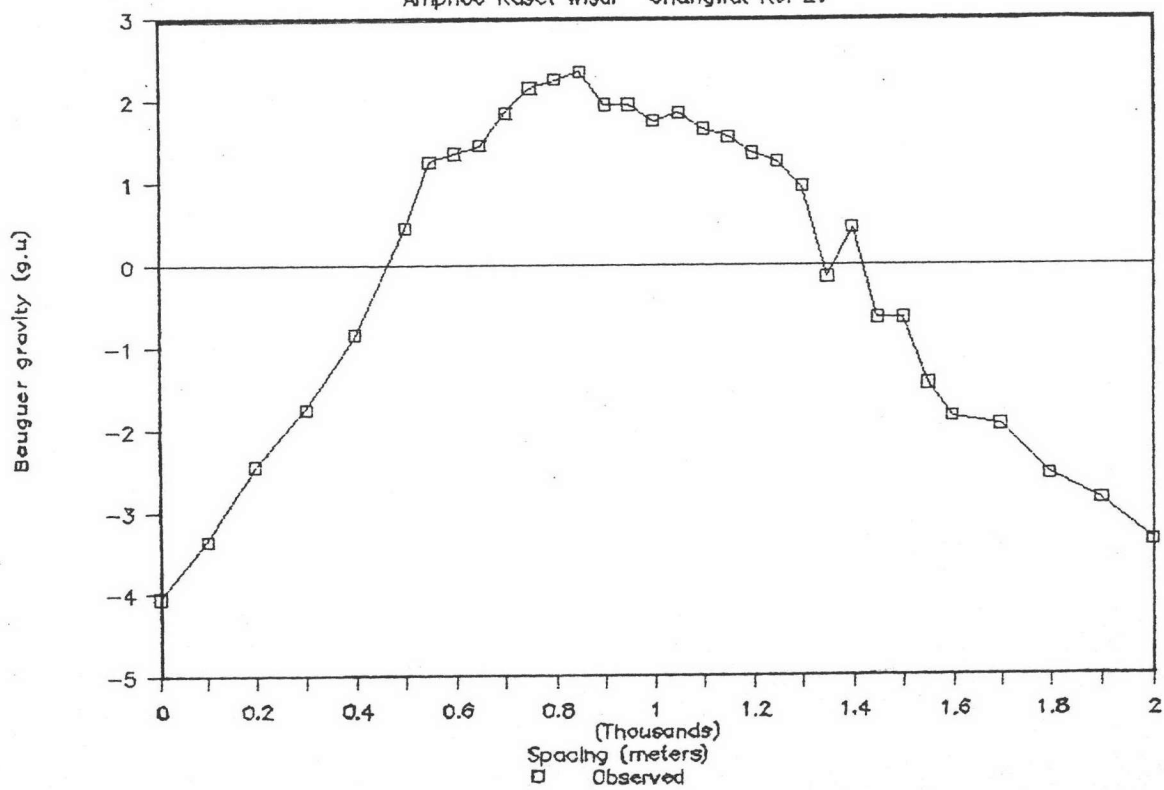


Figure 4.12 Showing Bouguer gravity curve of Ban Sra Hong Area.

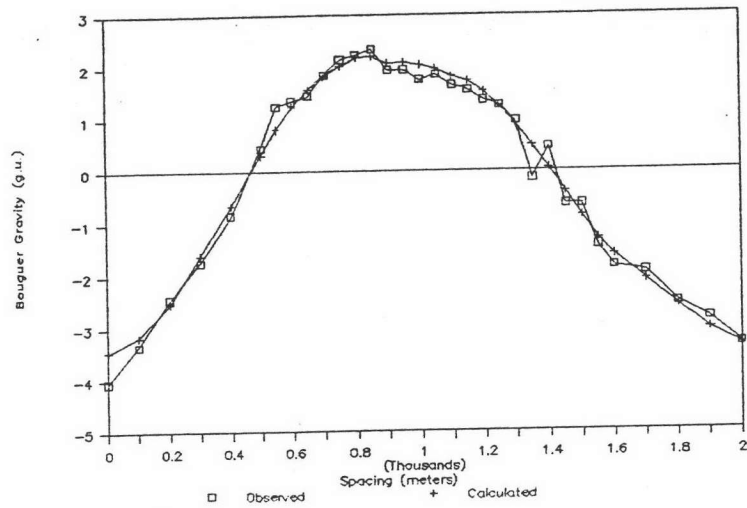
of core log description of K-66 borehole (see Table 4.1c). Employing salt dome concept, the model is composed of 15 polygons. The salt dome body consists of seven polygons (Figure 4.13b). The upper polygons have positive density contrast when compared with the sedimentary layers. They are primary cause of positive anomaly. It is noticeable that the upper most polygon of the salt dome body is only 30 meters depth. The description of polygons are summarized in Appendix D (Table D3 a, b).

4.4 Ban Phrai Khla Area.

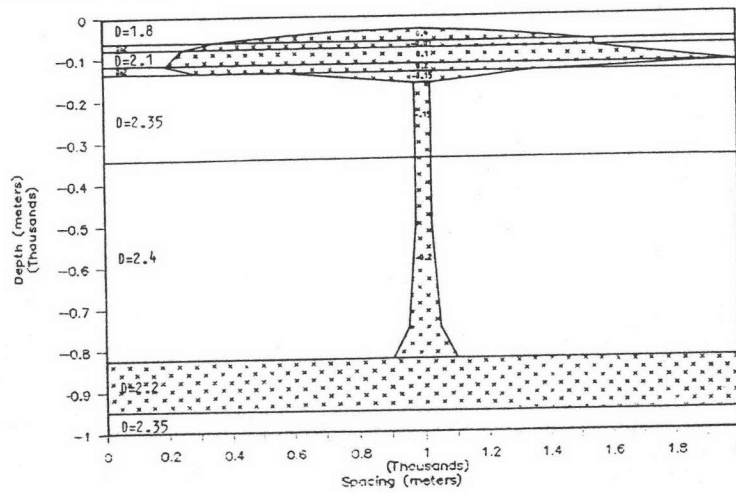
This area is located at Ban Phrai Khla, Amphoe Chumphon Buri, Changwat Surin. It covers area about 4.5 square kilometers that contains annular depression with two different levels surrounding a mound (Figure 4.14). The mound is about 651 meters in diameters. The annular depression diameters is about 2.4 kilometers.

The gravity survey line (Figure 4.15) is 2,250 meters in length along the road approximately east-west direction. It passes close to the edge of the mound not across the center of the mound. The station spacing is 100 meters. The elevation survey of each station was made by level transit but elevation contour of the area was not produced. The gravity related data of every station are shown in Appendix C (Table C4 a, b). Bouguer gravity curve of Ban Phrai Khla area is shown in Figure 4.16.

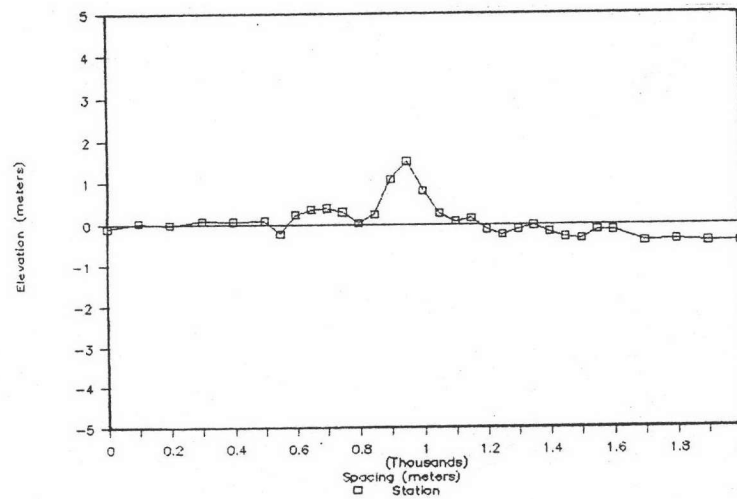
Although this area is the last one to be discussed but it is the first area that gravity survey was conducted. The survey line cut across approximately the center of the annular depression not the mound. It barely cut the edge of the mound, i.e. the underlying salt



a)

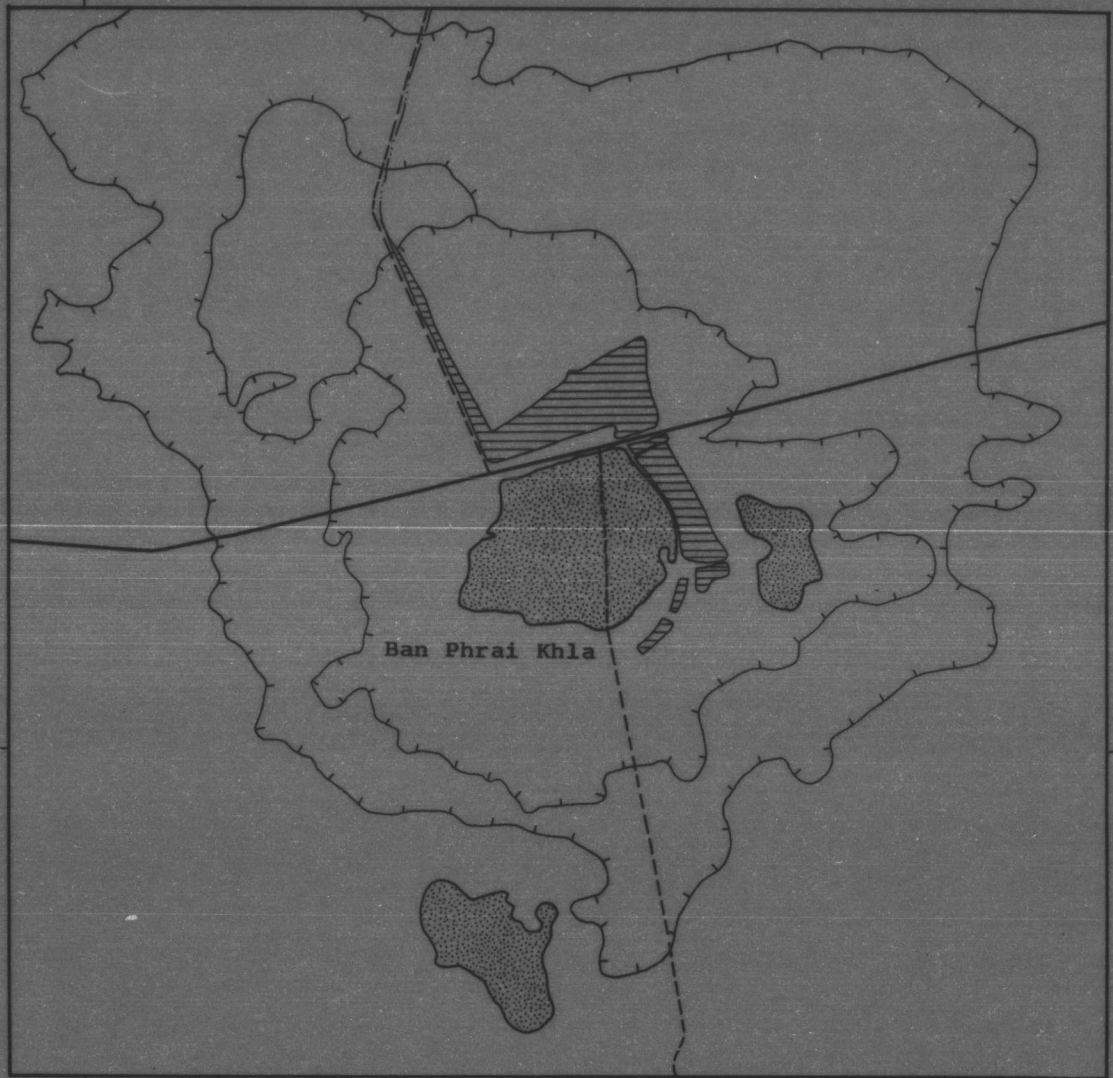


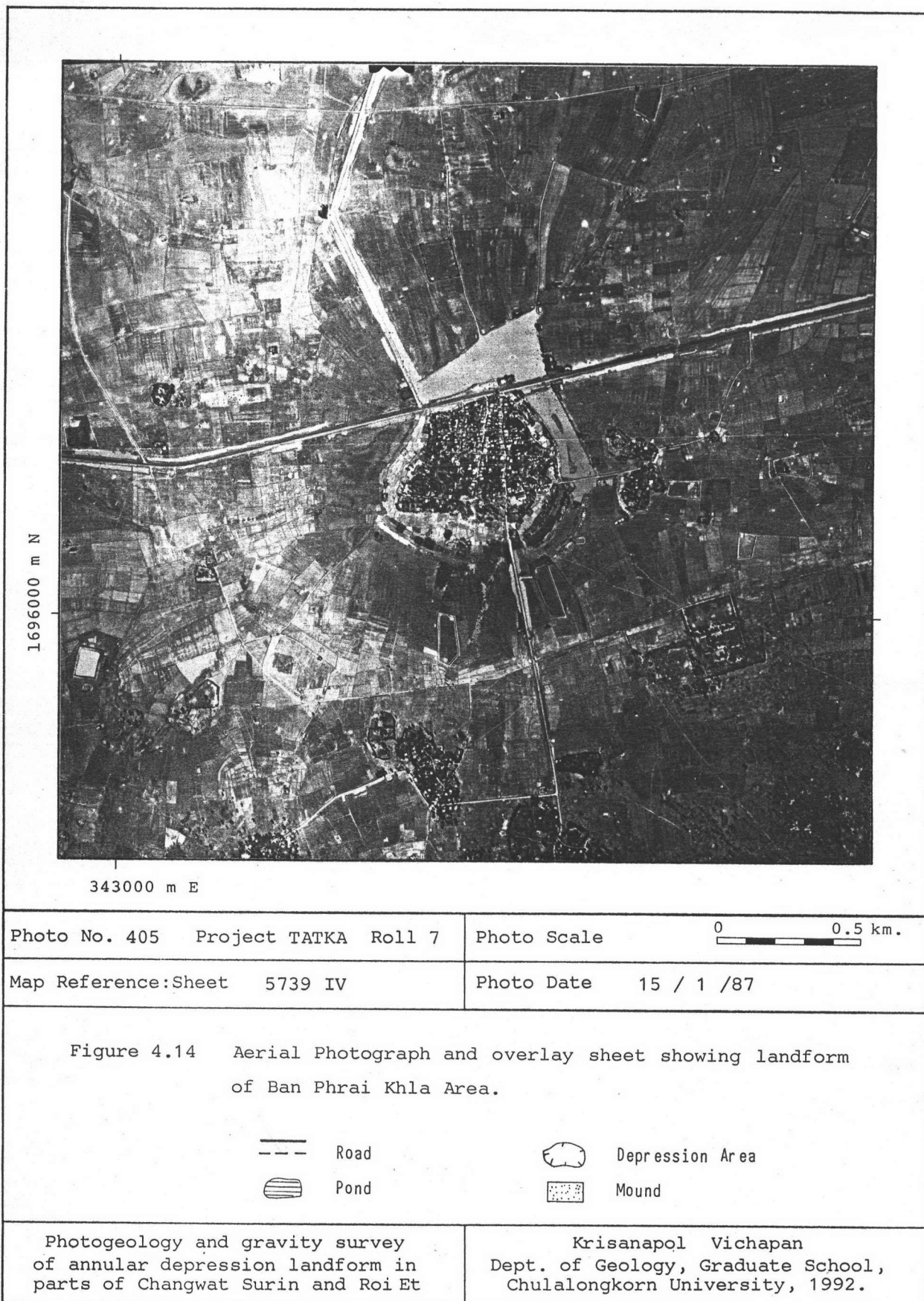
b)



c)

Figure 4.13 Showing a) comparison of observed versus calculated Bouguer gravity Ban Sra Hong Model ; b) Ban Sra Hong Model and c) elevation profile of Ban Sra Hong Area along the survey line.





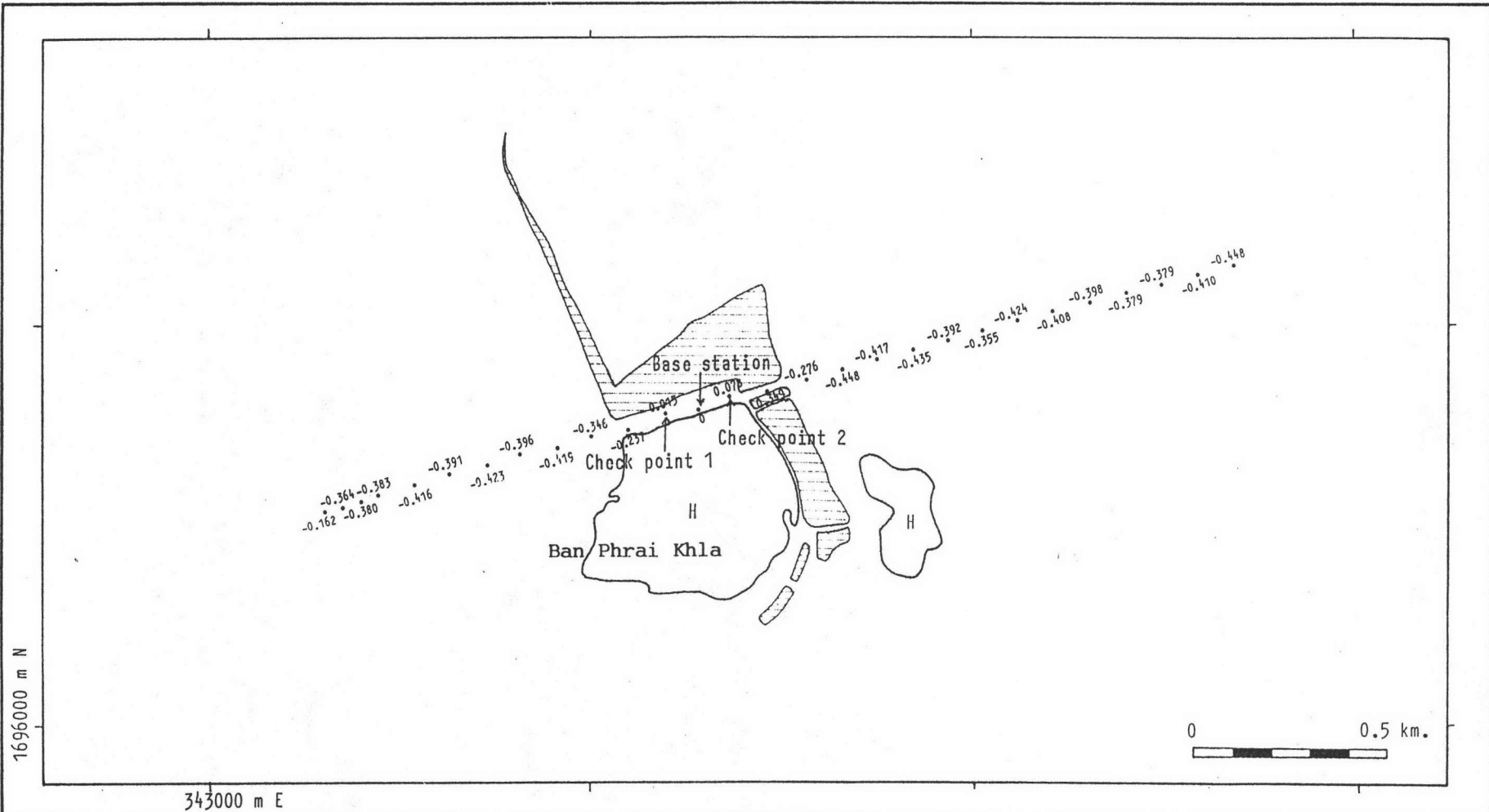




Figure 4.15 Map showing survey line and location of gravity survey station of Ban Phrai Khla Area.

- 0.436 Gravity reading station and elevation (meter).
-  Pond
-  Mound

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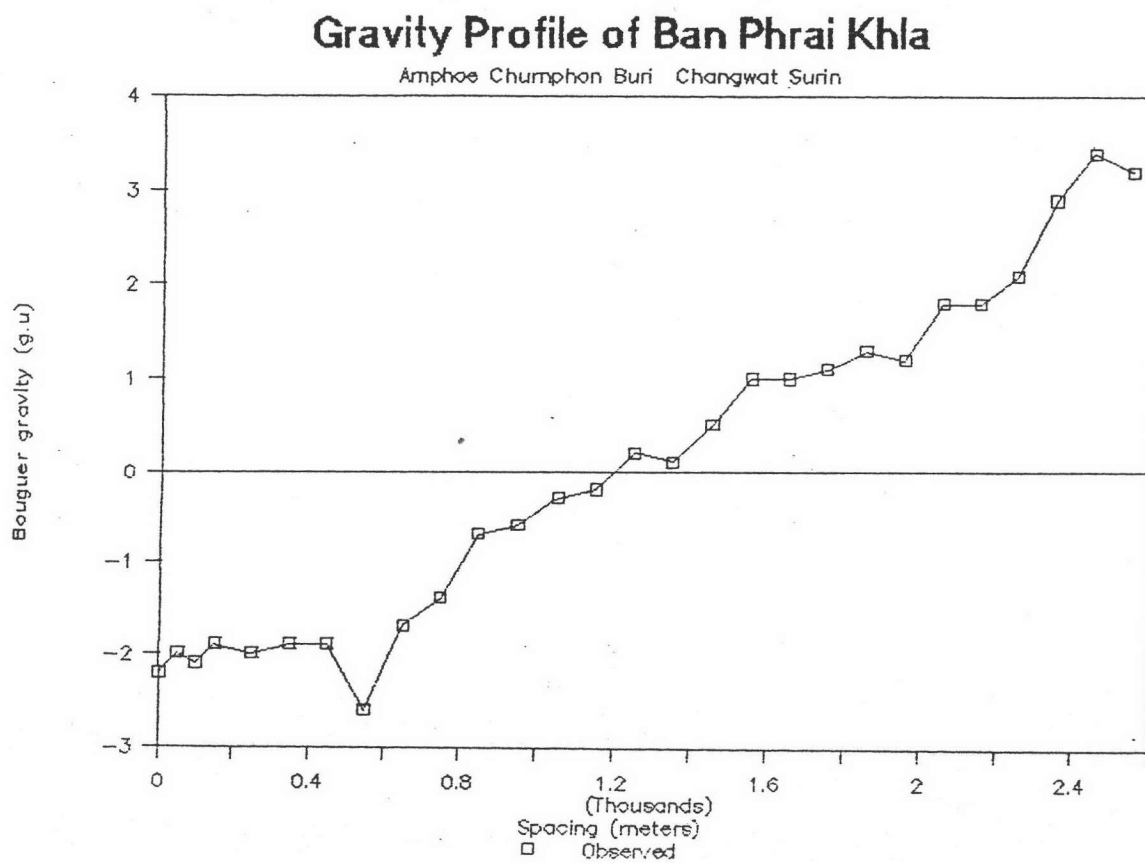


Figure 4.16 Bouguer gravity curve of Ban Phrai Khla showing regional gravity

body. As expected, Bouguer gravity curve (Figure 4.16) shows only small broad negative anomaly due to the fact that the profile is along the edge not over the center of the causative salt body. Since the polygon construction method that is used in for interpreting gravity data in this study is $2\frac{1}{2}$ dimension, not 3-dimension, subsurface model by this method will not be appropriated for this case. Therefore, quantitative interpretation of gravity data was not attempted. But qualitative interpretation still suggest negative density contrast nature of subsurface body, i.e. salt dome near the survey line.