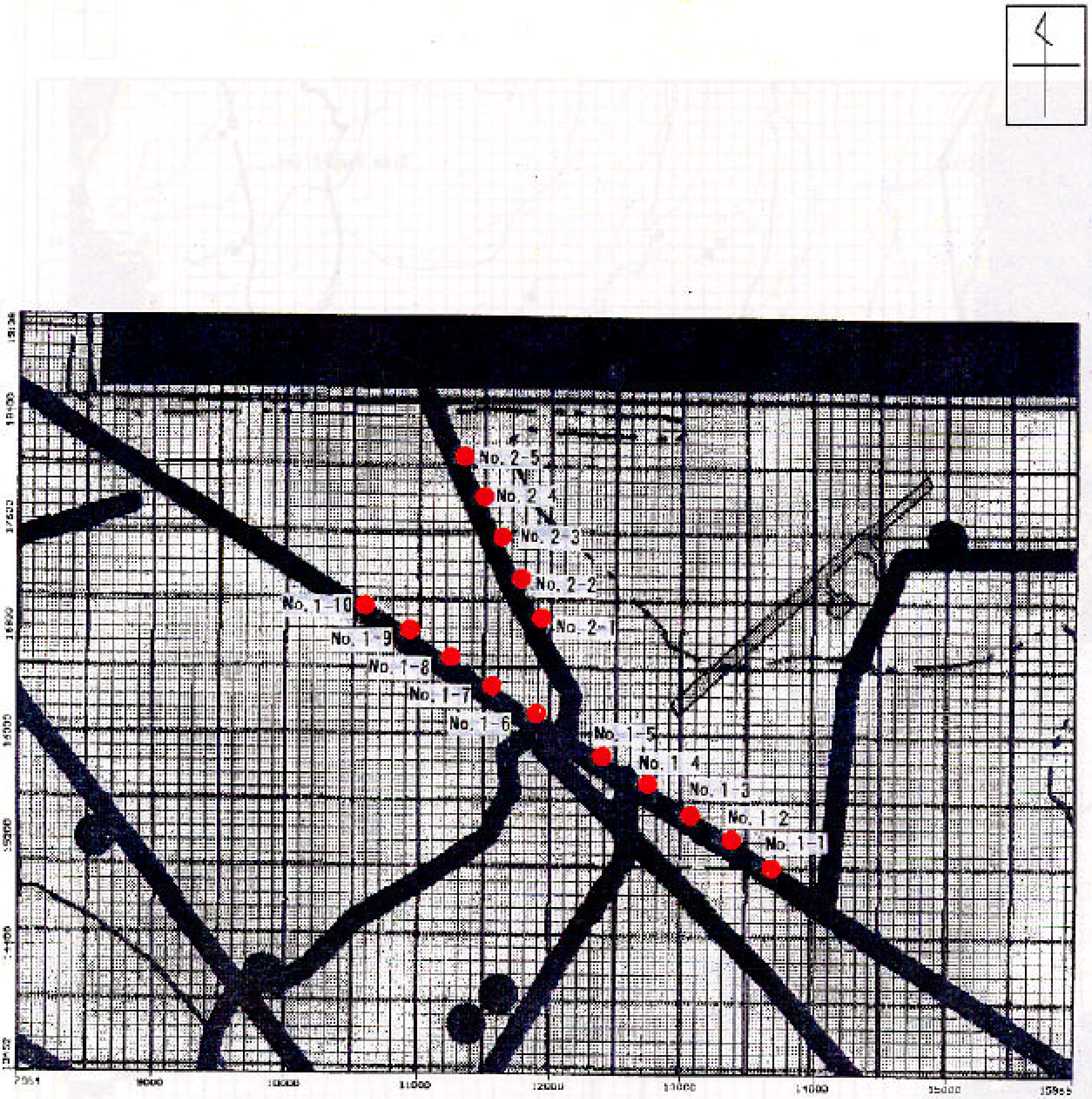


| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 4.2.12 Locations of 15 Production Wells |
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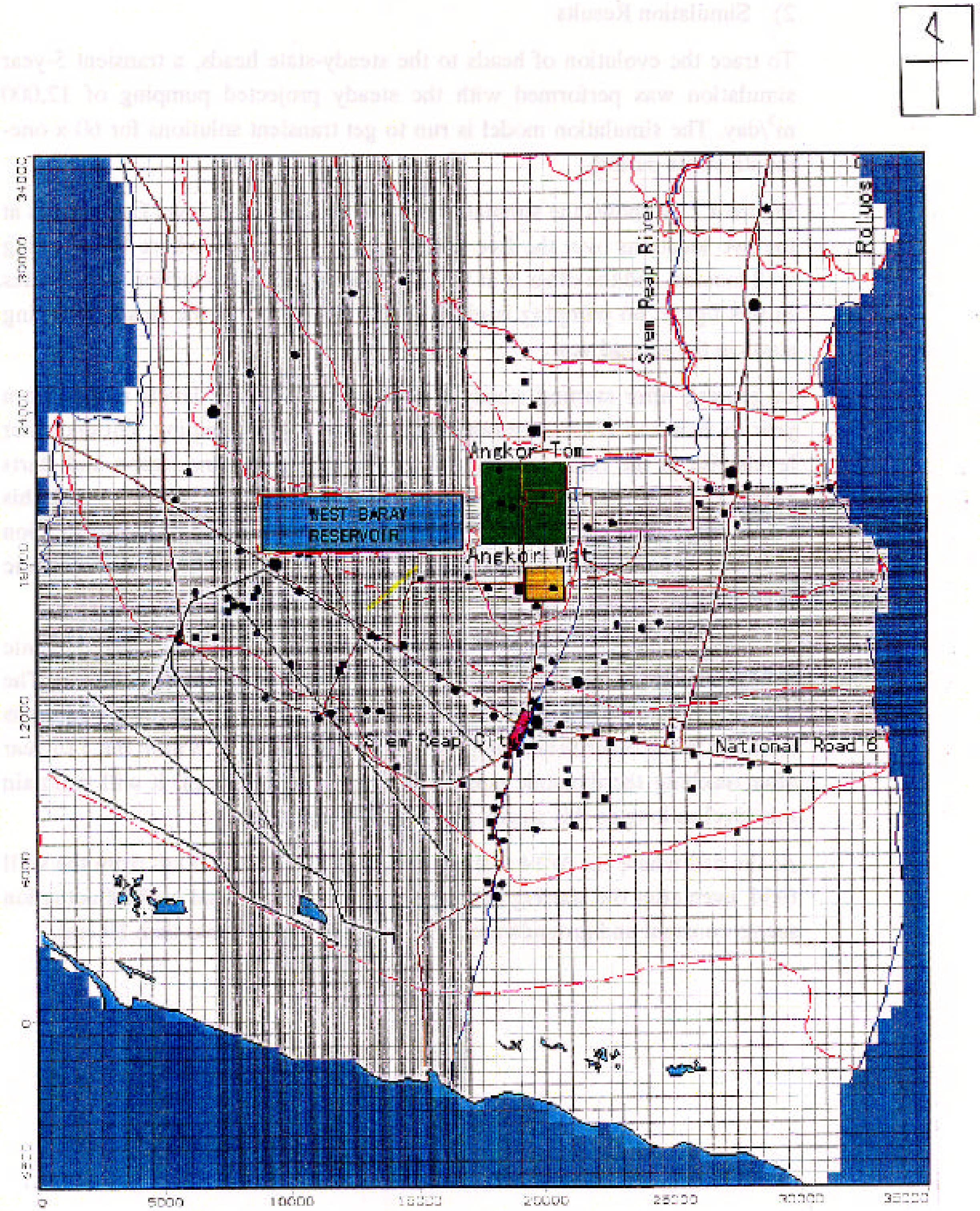
| Japan International Cooperation Agency | |




| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 4.2.13 The Well Field Discretized into 10,000 Cells |
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| Japan International Cooperation Agency | |

2) Simulation Results

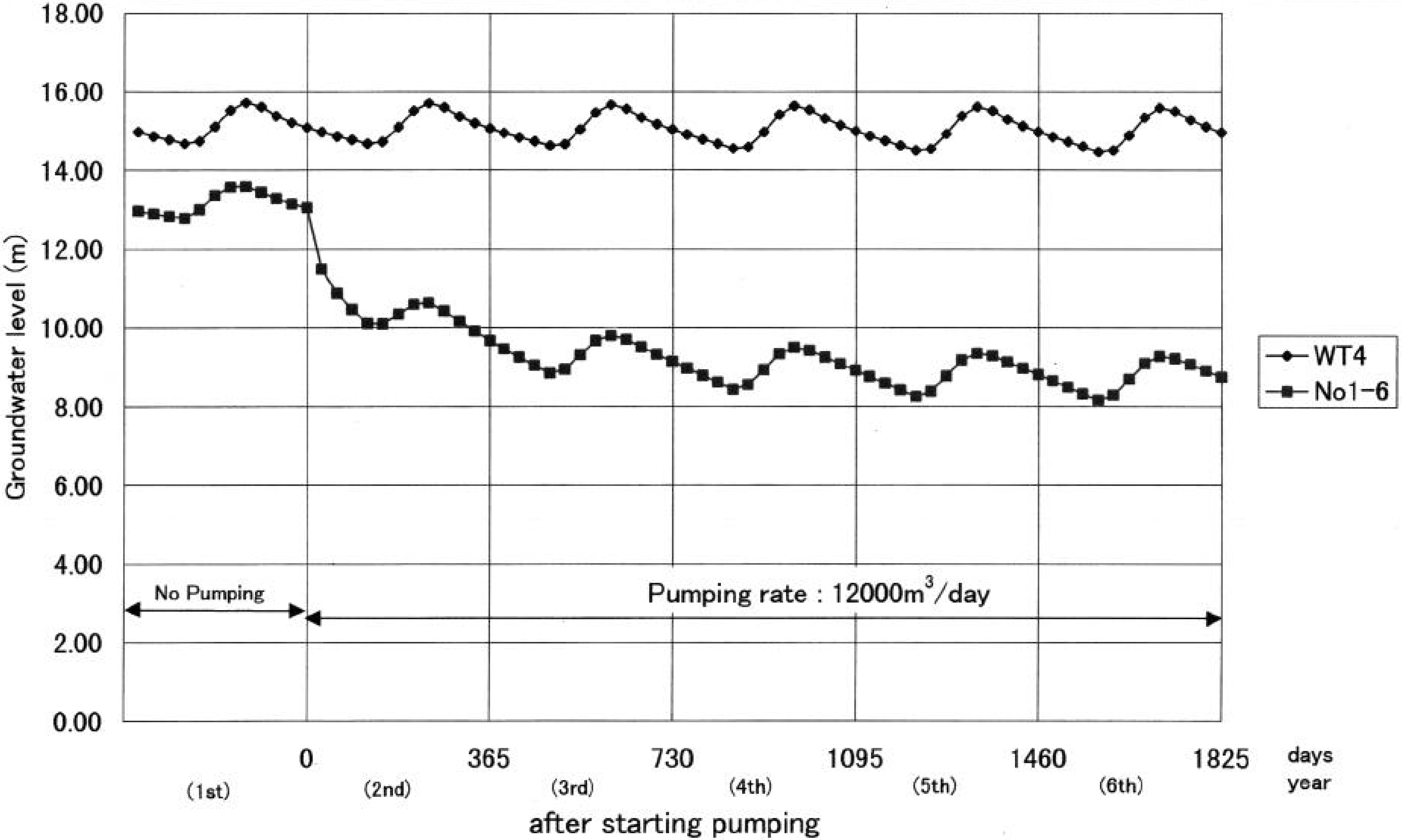
To trace the evolution of heads to the steady-state heads, a transient 5-year simulation was performed with the steady projected pumping of 12,000 $m^3$/day. The simulation model is run to get transient solutions for 60 x one-month stress period.

Figure 4.2.14 shows the simulated monthly groundwater level fluctuations at the two locations over the five years. One is at the cell where WT4 testing well locates, and the other is at the cell where No.1-6 production well locates. In this figure, no pumping is given in the first year and the steady pumping starts in the second year.

In general, after starting steady pumping, groundwater levels recede from year to year and reach a certain level due to steady pumping. Groundwater levels rise in the rainy season and recede during the dry season and starts rising again in the following year. All the groundwater levels exhibit this cyclic fluctuation on an annual basis, the range of annual cyclic fluctuation becomes reasonably constant, and this condition is defined as "dynamic equilibrium".

At the pumping cell containing No.1-6 production well, the dynamic equilibrium seems to reach 4 years after the starting of steady pumping. The groundwater level is El. 12.60m in the first year when steady pumping is started. On the other hand, the groundwater level is El. 8.8 m in the 5 th year after reaching the dynamic equilibrium (=4.4 m lowering). It will maintain this level as long as this steady pumping is continuing.

At the cell where the WT4 testing well locates around 3.0 km from the well field, even after the starting of steady pumping, the annual cyclic fluctuation seems constant and groundwater levels slightly recede (less than 10 cm).




| The Study on Water Supply System for Siem Reap Region in Cambodia | Figure 4.2.14 The Simulated Monthly Groundwater Level Fluctuation under Project Pumping |
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| Japan International Cooperation Agency | |

3) Influence of Pumping Plan

There exist great concerns due to pumping of, a) land subsidence around the Angkor heritage area and b) stopping and less production of the existing shallow wells near the well field.

Figure 4.2.15 shows the simulated groundwater level contours in February 2011. The influence due to the steady pumping of 12,000$m^3$/day is limited in the pumping center and does not extend to the Angkor heritage. The drawdowns around the Angkor heritage and the pumping locations are less than 0.10 m and less than 4.5 m, respectively.

Based on the land subsidence monitoring near the Angkor Wat, the aquifer shows the reversible (elastic) reaction to the groundwater fluctuation, meaning the aquifer contracts due to the lowering of groundwater in the dry season, but completely recovers due to the rising of groundwater in the wet season. The aquifer deformation (contraction) is 0.56 mm to 1.0 m of groundwater lowering. Because the drawdown around Angkor heritage area is simulated less than 0.10 m, the land subsidence can be predicted to be less than 0.1 mm. On the other hand, the drawdown of more than 2.0 m due to pumping may cause stopping or less production of the shallow wells but does not extend the area where many shallow wells exist. Therefore, it is considered that this pumping plan will not cause the land subsidence problem around the Angkor heritage and stopping or less production of the shallow wells.

(5) Effects by Changing the Spatial Distribution of Hydraulic Conductivity

The first model and the second model used in this Study were formulated under the different spatial distributions of hydraulic conductivity around the well field. The spatial distribution of hydraulic conductivity in the first model was determined based on the value at WT4 testing well where the hydraulic conductivity seems to be relatively high, judging from the geological condition. In the mean time, that in the second model was determined based on pumping test results at the well field. In general, under the spatial distribution of higher hydraulic conductivity, the influence by extraction extends to wider area but the drawdown at the pumping center can be smaller than under the spatial distribution of lower hydraulic conductivity. Therefore, another concern due to the uncertainty of spatial distribution of hydraulic conductivity is how far and how much the influence by the same quantity of extraction extends under the spatial distribution of higher hydraulic conductivity. To solve this question, the second model was also run under the spatial distribution of higher hydraulic conductivity, determined by the pumping test result at WT4. In this model, the values of hydraulic