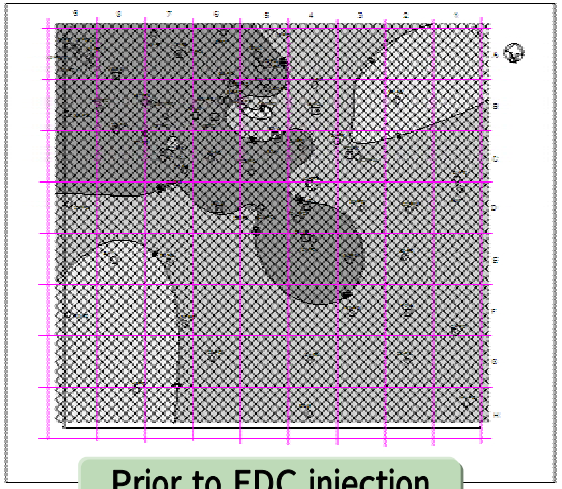
Case1

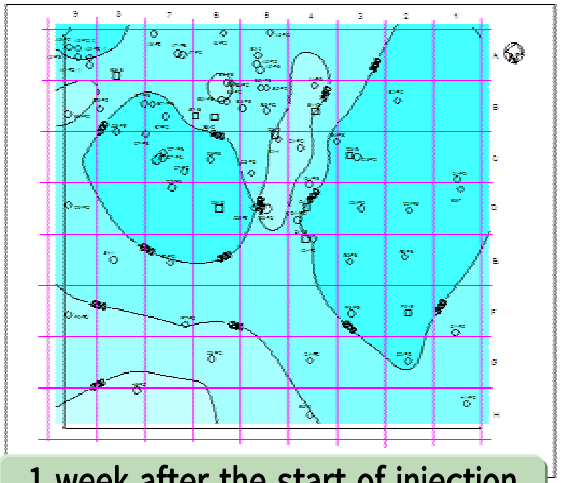
Engineering Company：Obayashi Corporation

- **Engineering company :**
  Obayashi corporation one of the largest general contractor in Japan
- **Site Location:** Nagoya, Japan
- **Site Area :** 6,780.8m^2 **Treatment Area :** 6,780.8m^2 **Depth :** 12m
- **Hydrogeology in brief :**
  Upper sandy and lower silty sand unit was separated by discontinuous silty-clay lens. Hydraulic conductivity varied between 10-3 to 10-4 cm/sec. From initial stage the groundwater was anaerobic because of high natural TOC.
- **Contamination signature :**
  Groundwater ・TCE (up to 40 times of Japanese environmental standard 0.03mg/L)
  ・*cis*-DCE(up to 190 times of Japanese environmental standard 0.04mg /L)
  Soil ・TCE (up to 19 times of Japanese environmental standard 0.03mg/L)
  ・*cis*-DCE (up to 14 times of Japanese environmental standard 0.04mg /L)
- **Treatment :** Pump and treat was done for several months. As a result the contamination concentration was reduced.
  ・TCE(up to 10 times of the environmental standard 0.03mg/L)
  ・*cis*-DCE(up to 100 times of the environmental standard 0.04mg /L))
- This is followed by injection of EDC.

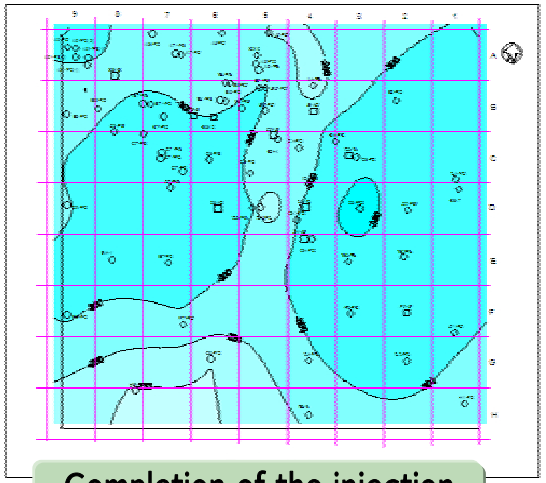
ORP contour **map showing change after injection**



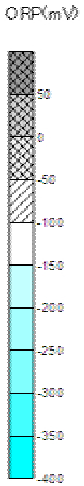
Prior to EDC injection



1 week after the start of injection



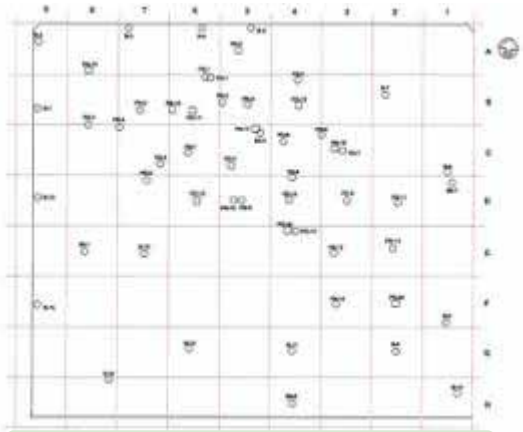
Completion of the injection



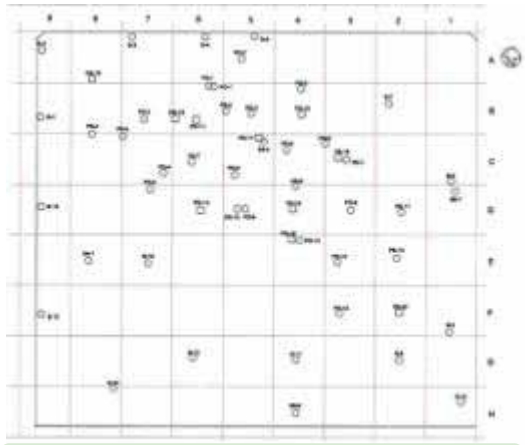
TCE concentration change

Prior to EDC injection

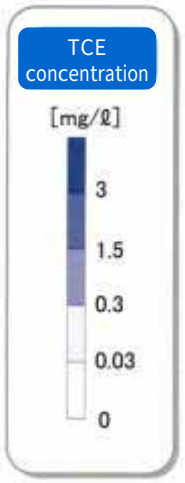
Post EDC injection



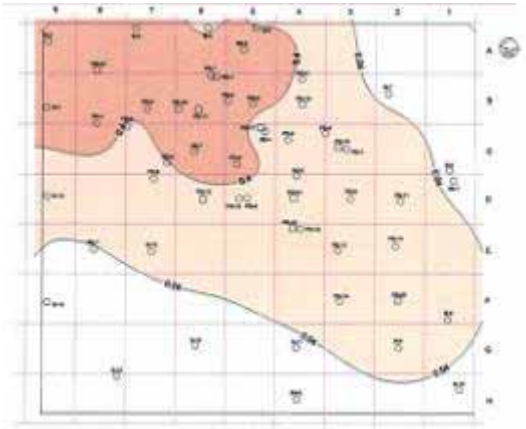
2 months after the injection



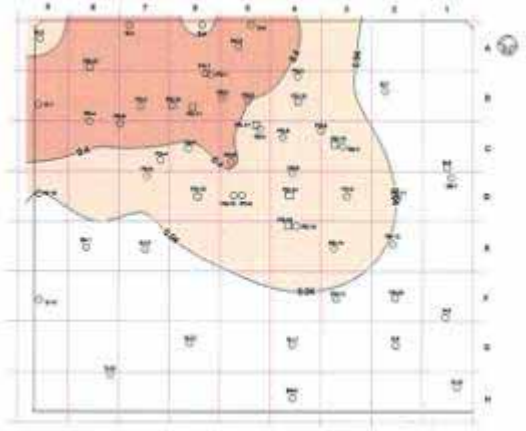
2.5 months after the injection



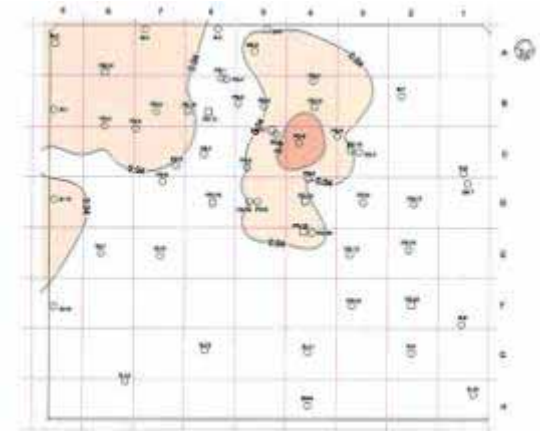
cis-DCE concentration　change



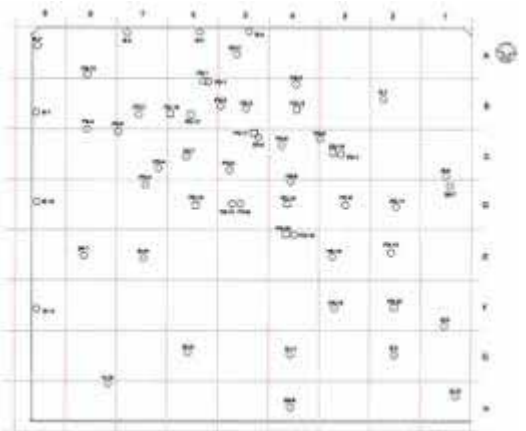
Prior to EDC injection



Post EDC injection



2 months after the injection



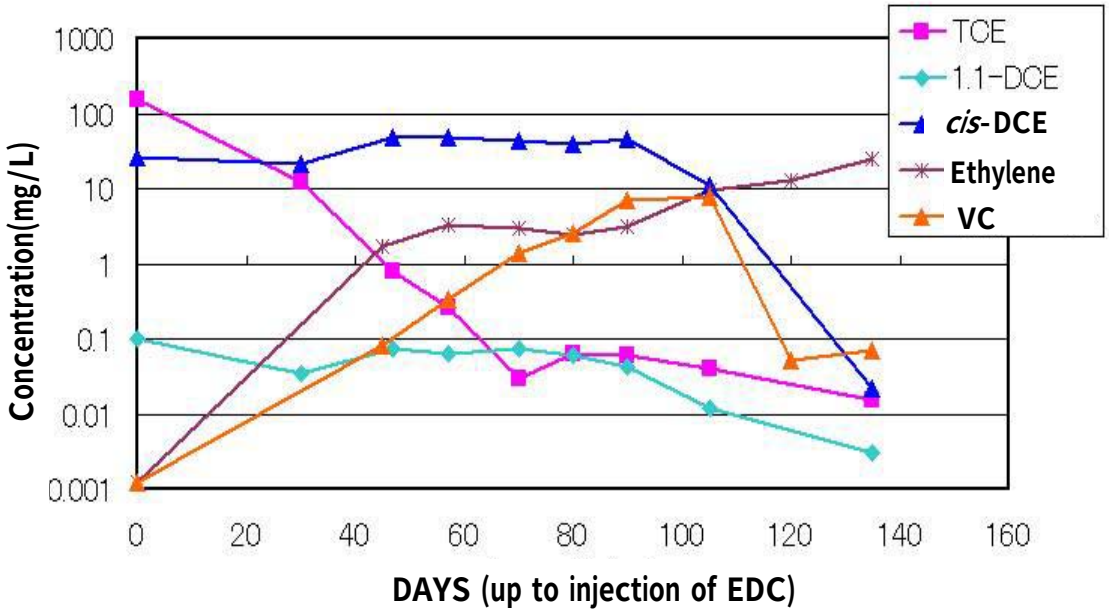
2.5 months after the injection

Case2

Engineering Company：
MITSUI MINERAL DEVELOPMENT ENGINEERING CO., LTD.

- **Site location:** Kanto region, Japan
- **Site characteristics:** The site has sandy-silt and silty units with hydraulic conductivity less than 10-4cm/sec. The contaminated depth was up to 10-15 m from GL with the concentration of TCE and *cis*-DCE varying from less than 1 mg/L to more than few hundred mg/L in the groundwater.

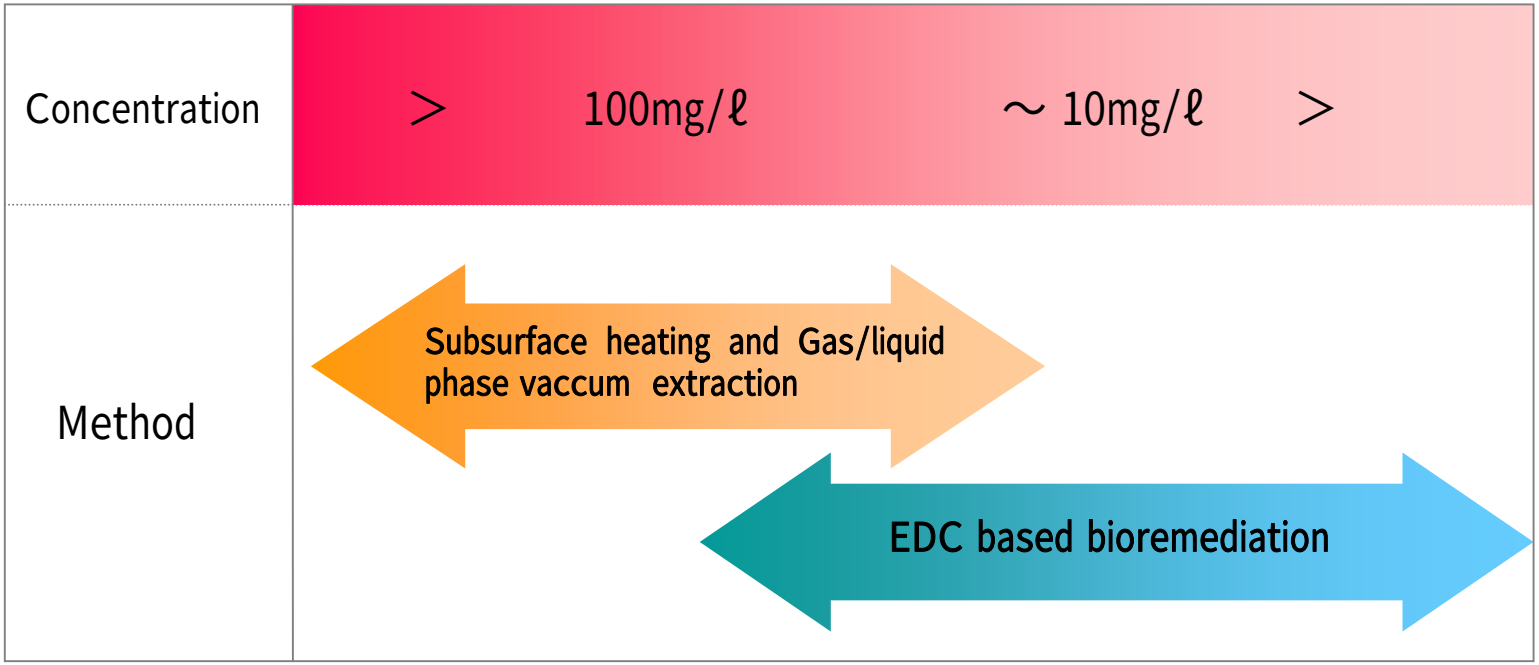
- **Treatment:** Bioremediation was directly applied without heat treatment at the locations with contamination concentration approximately 100mg/L or below.



- **At the locations with more than 100 mg/L of contamination concentration the remediation was done in two phases. the subsurface was heated at up to 80°C and soil gas and groundwater was extracted under vacuum.**

- **Once the concentration fell below 100mg/L EDC was injected. Groundwater from the surrounding area was used as the microbial seed while diluting EDC.**

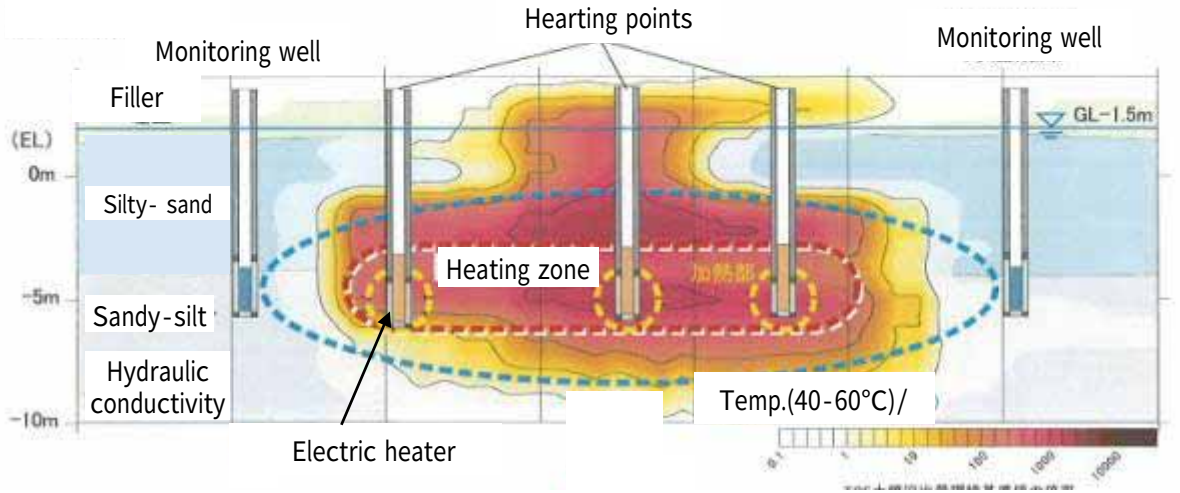
Two Phase treatment



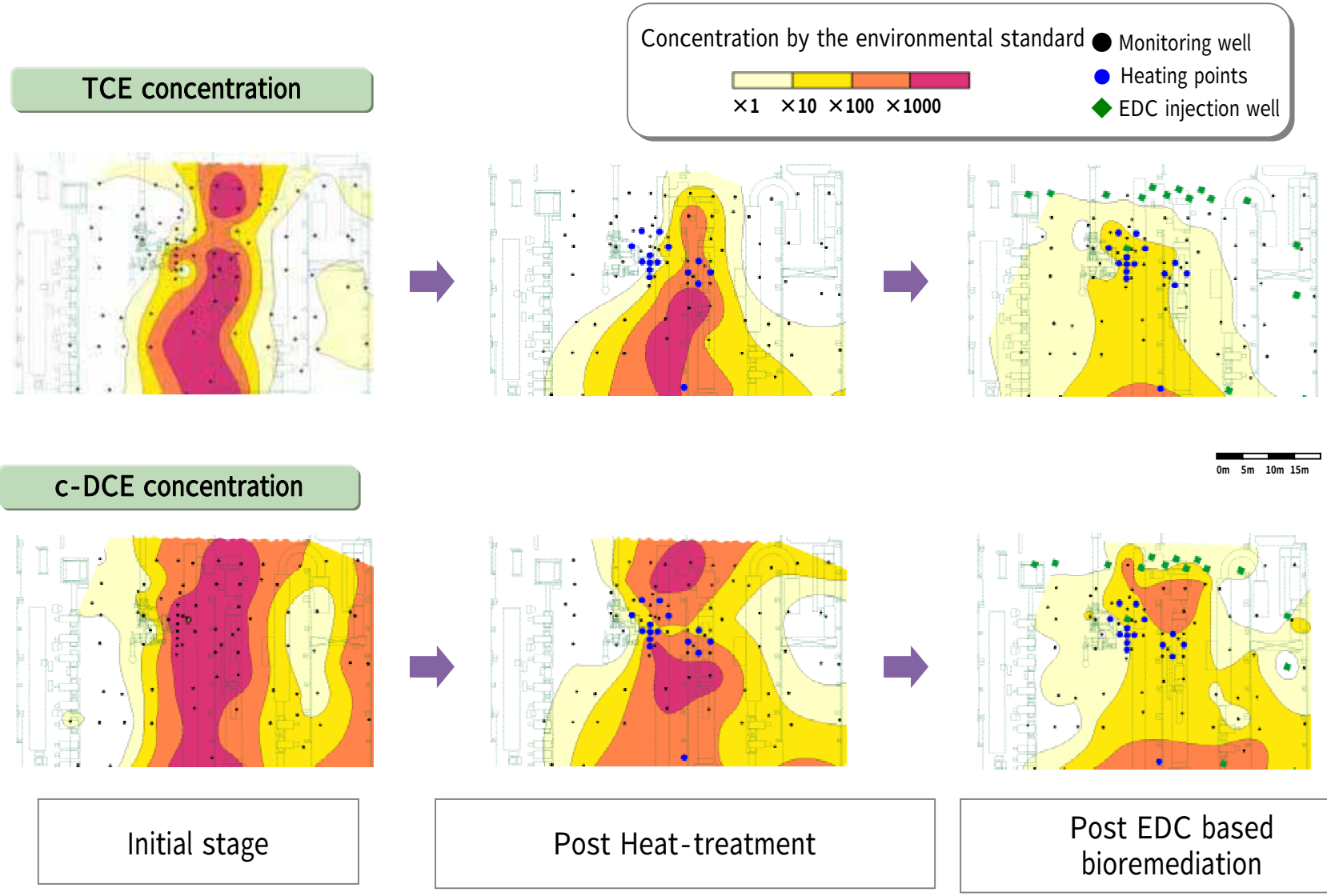
DNAPL containing zone was heated followed by vaccum extraction of soil gas and groundwater.

Results

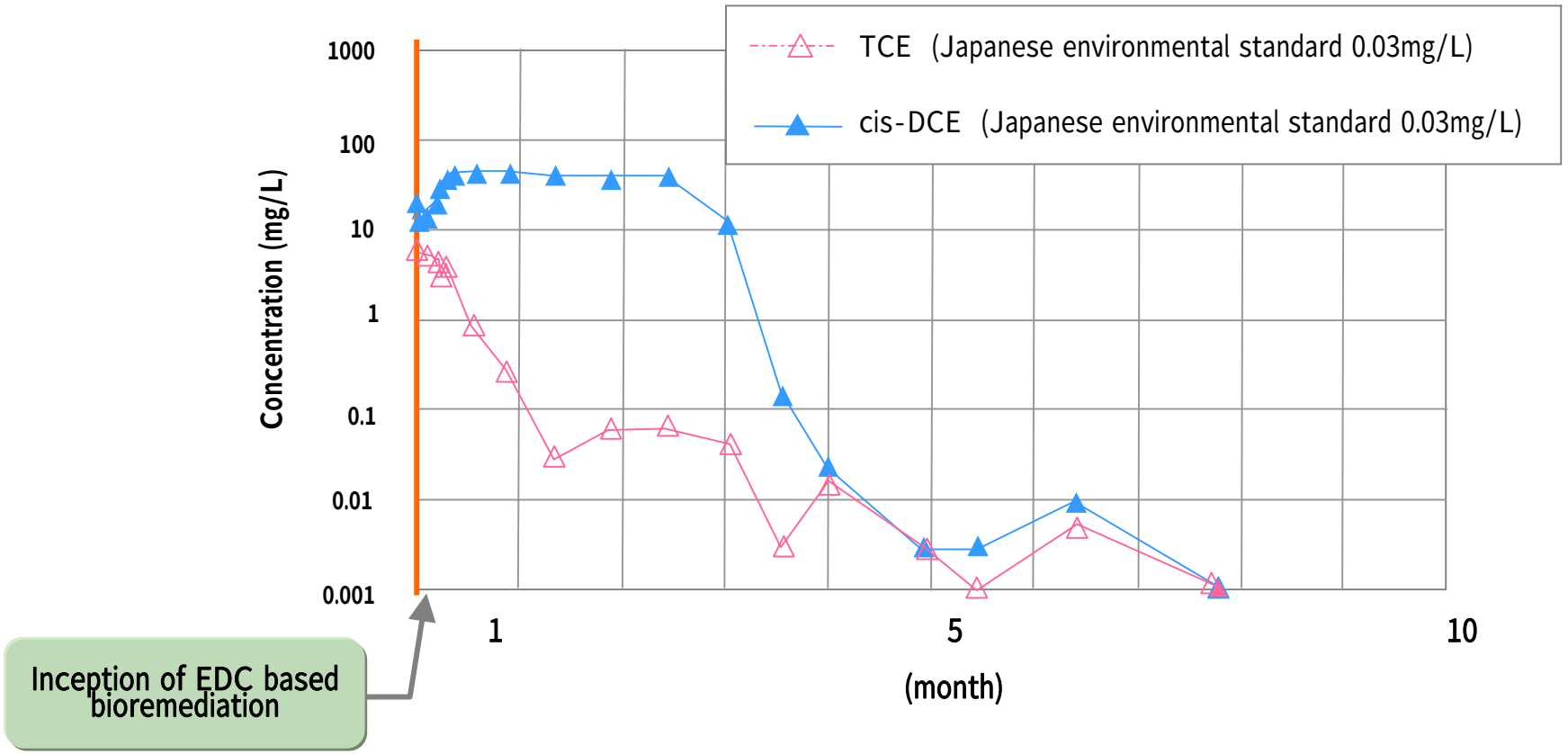
Application of heat resulted in incresed permeability of formation. Gas extraction volume increased from 20-60L/day (before heating to 100-400L/day after heating).



Results of phase 1 & 2 treatments



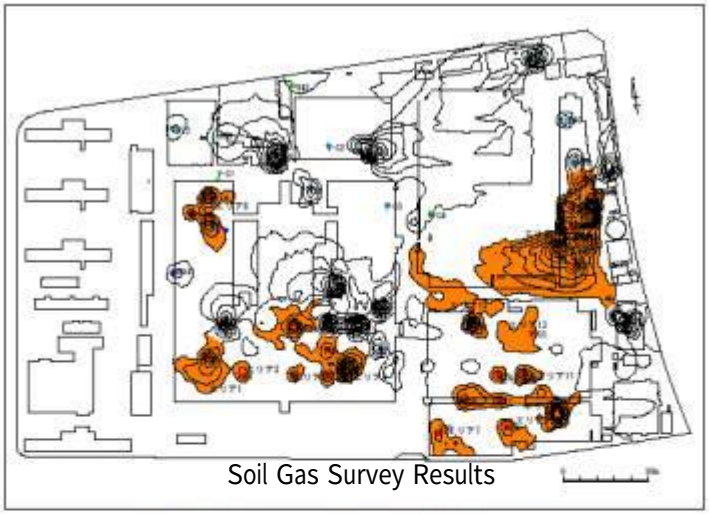
Post Heat-treatment EDC based bioremediation



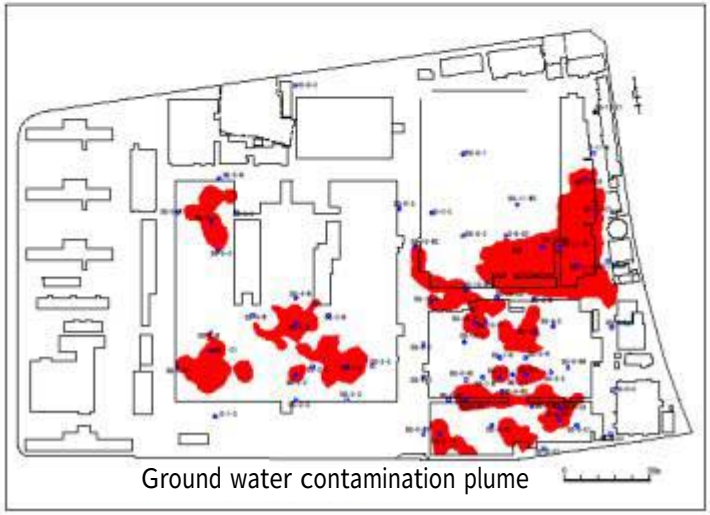
Case3

Engineering Company：KOA KAIHATSU CO., LTD

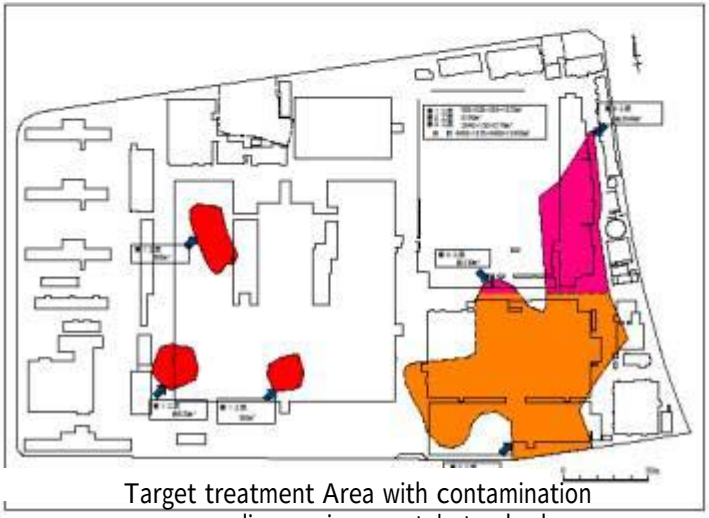
Locations



Soil Gas Survey Results

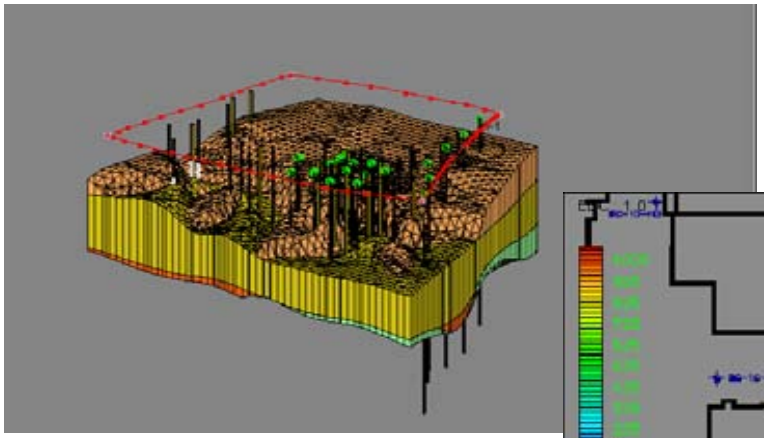


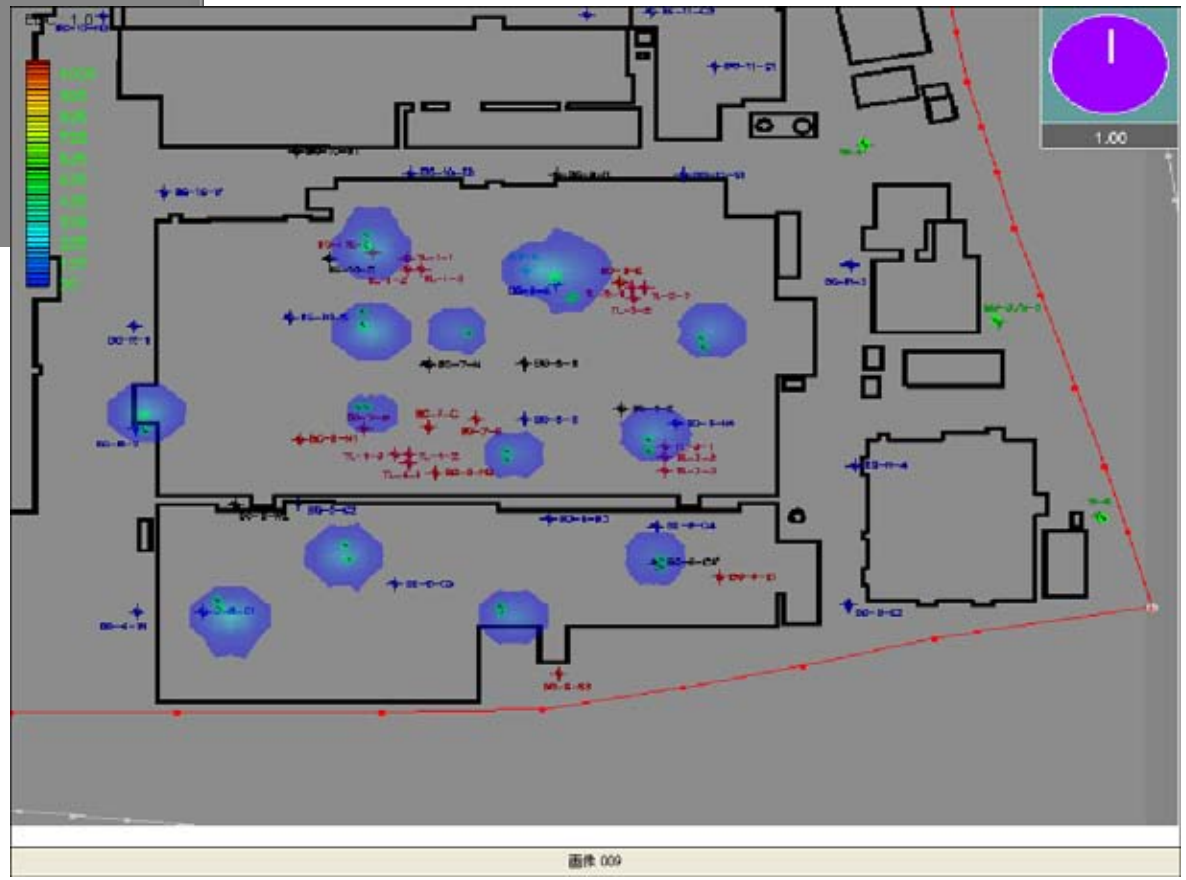
Ground water contamination plume



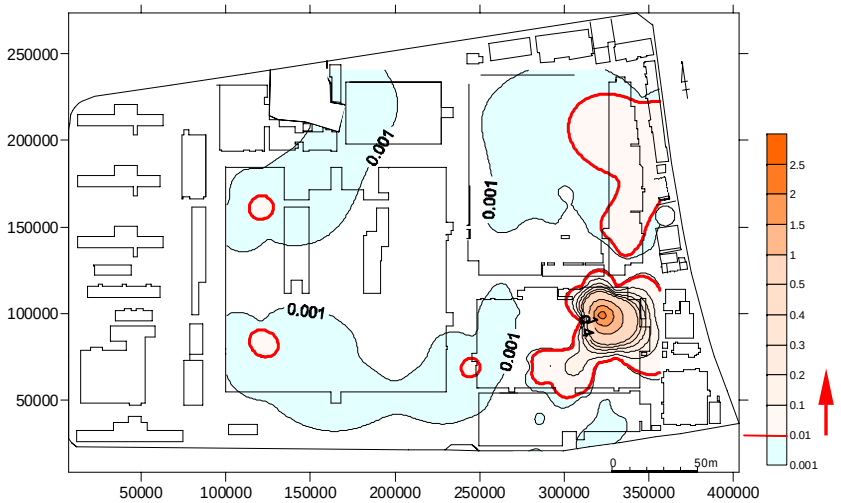
Target treatment Area with contamination exceeding environmental standard

Hydrogeological modeling **for EDC injection design**

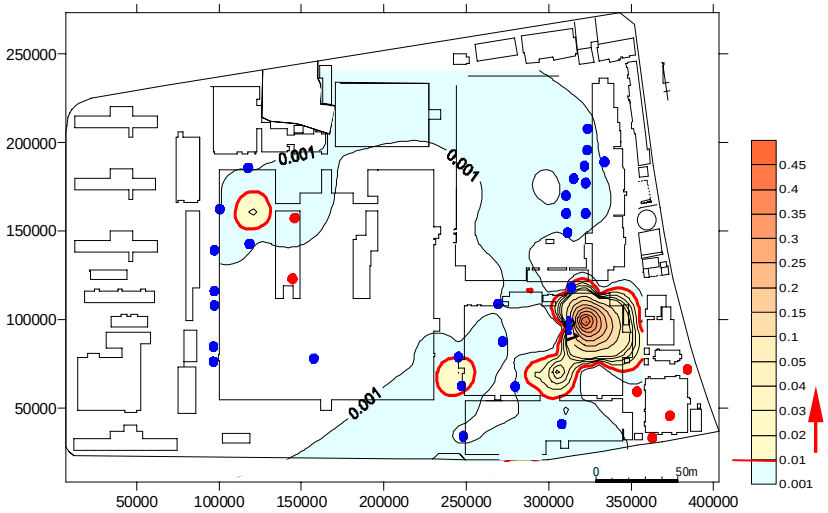




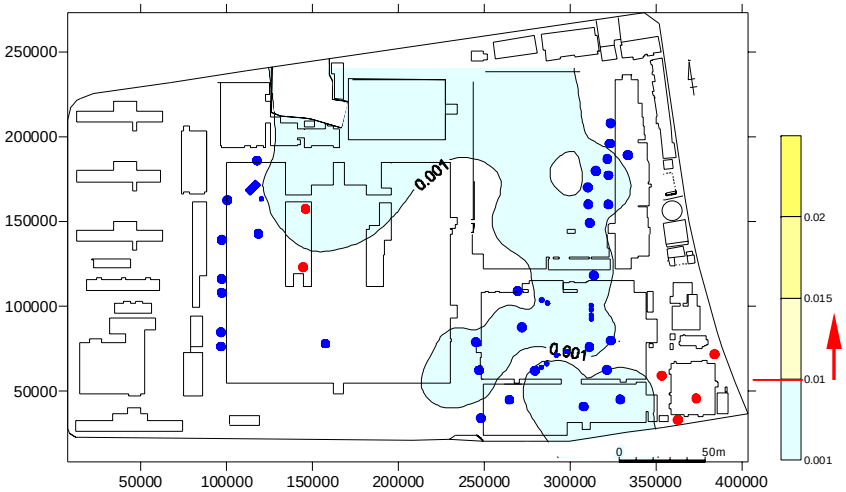
PCE concentration change



30-Jan-2004 (Prior to injection)

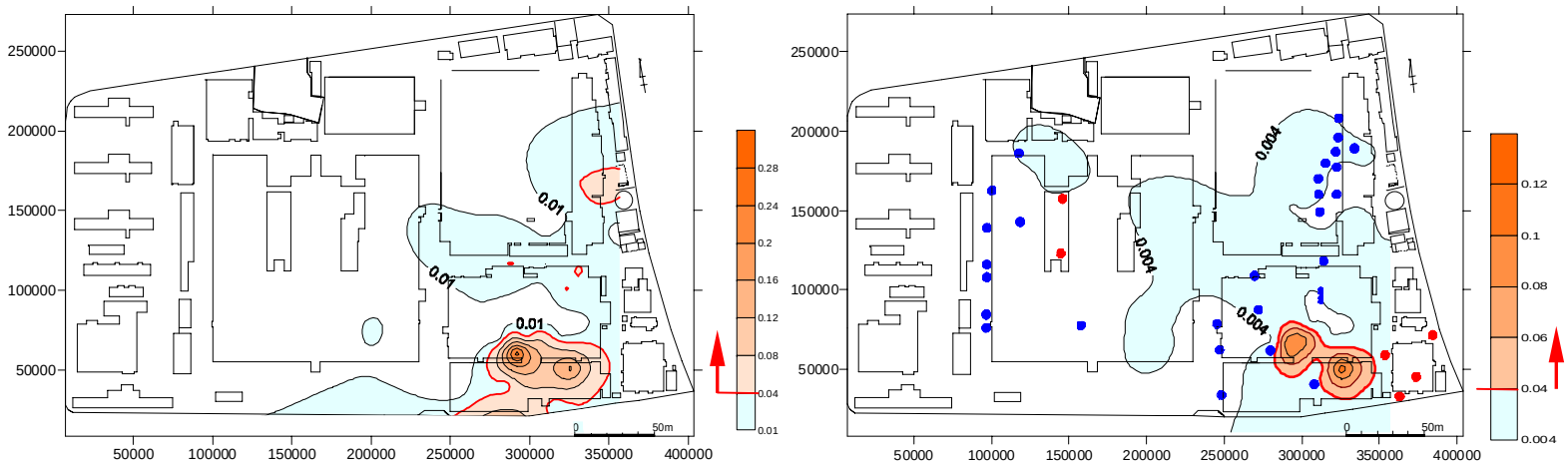


17-Dec-2004



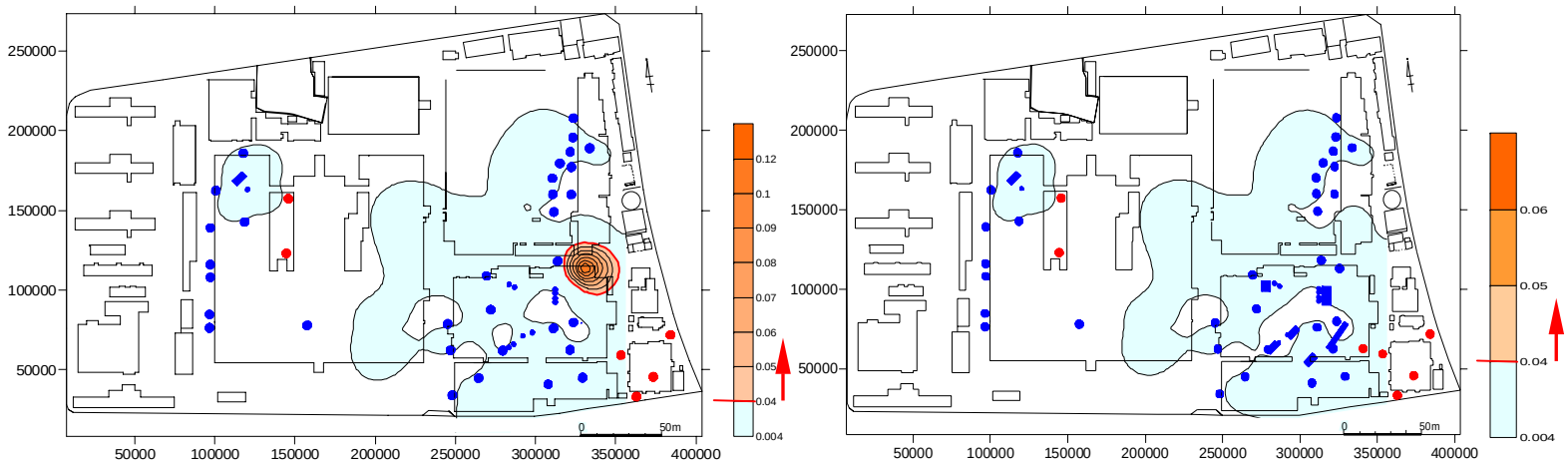
03-Oct-2005

cis-DCE concentration change



30-Jan-2004 (Prior to injection)

17-Dec-2004



03-Oct-2005

31-Jan-2006