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MEMO

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Date:
2 December 2002

ARCADIS Project No.:
NY001371.0001.00001

Subject:
GM38 Design Simulation No. 1, TT/NUS Modeling

This memo has been prepared to summarize the results of GM38 Design Modeling Simulation No.1, conducted in support of TT/NUS's design efforts for the GM38 Area. ARCADIS had previously developed a preliminary design for a 2 well remedial pumping system for the GM38 Area under contract to Northrop Grumman Corporation.

Purpose

This modeling effort was carried out to simulate several refinements to the preliminary GM38 Area design. Specifically, a modeling simulation was conducted to assess the impact of the relocation of remedial well RW-1 to the center of South Herman Street (approximately 100 ft west of its original location), and the incorporation of a recharge gallery (two injection wells screened from 50 to 100 ft bls) near the location of Vertical Profile Boring 47 (VPB-47).

Methodology

The existing groundwater model and specific GM38 model simulation was revised as follows:

- Injection wells IW-1 and IW-2 were added in the vicinity of VPB-47; the wells were screened in model layer 2 (50 to 100 feet below land surface), and were recharging at a rate of 550 gallons per minute (gpm) each.
- Remedial well RW-1 was shifted from its original location approximately 100 ft west to the center of South Herman Street.

The screen zones and pumping rates of remedial wells RW-1 and RW-2 were not changed for this assessment; the wells were simulated to pump 800 and 300 gpm, respectively.

Several simulations were conducted to complete the assessment of the affect of these changes. Initially, forward and backward particle tracking runs were conducted to determine if the capture zone developed by RW-1 and RW-2 varied significantly due to the relocation of RW-1, and the addition of injection wells south of the two remedial pumping wells. Following this determination, three solute transport simulations were performed with the GM-38 System in operation for periods of 5, 15, and 30 years. For each simulation, the movement of the impacted groundwater was tracked for a period of 30 years (i.e. 5 years of remedial pumping followed by 25 years of non-pumping).

Results:

Figures 1a and 1b show the capture zones resulting from the operation of RW-1, RW-2, and the injection wells (the pathlines from the two injection wells are not shown on Figure 1a so that the capture zones of wells RW-1 and RW-2 can be seen more easily; however, the pathlines for the injection wells are shown on Figure 1b). The pathlines are truncated to represent 10 years travel, with each arrowhead corresponding to 1 year of travel. A comparison of Figure 1a to the capture zone associated with the preliminary GM38 System shown on Figures 2 and 3 (RW-1 further east and no injection wells), indicates that no significant differences exist. Figure 1b is similar to Figure 1a, but incorporates the forward tracked pathlines representing the movement of groundwater recharged at IW-1 and IW-2; again, the lines are truncated to show 10 years travel. A review of this figure shows that some of the groundwater recharged at IW-1 and IW-2 moves to the north and is captured by RW-1.

Figures 4 through 7 superimpose the TVOC plume in the GM38 area at concentrations greater than 100 µg/L on the capture zones depicted in Figure 1. The goals of the GM38 System are to provide capture, mass removal, and treatment of VOCs in groundwater from this area of elevated concentrations (i.e. greater than 500 µg/L). As can be seen from these figures, the cumulative capture zone of RW-1 and RW-2 encompasses the area of impacted groundwater with concentrations of 100 µg/L or greater, exceeding the original design goal for the system.

Figures 8 through 12 are time versus concentration plots for this remedial scenario (including injection wells) for wells RW-1, RW-2, BWD wells 4-1, 4-2 and 5 under three pumping timeframes (5, 15, and 30 year remedial system operating periods). Figures 13 through 17 are time versus concentration plots for the same wells and pumping periods under the originally proposed remedial system (without injection wells). A comparison of the graphs show that the performance of the remedial system under the two scenarios is

essentially the same. However, under the revised remedial system TVOC concentrations in the remedial and public supply wells are generally less than under the original remedial system.

Conclusions:

The revised remedial system successfully achieves the goals of the GM38 Area system of capture and mass removal of any TVOC impacted groundwater with elevated concentrations (greater than 500 µg/L) in the vicinity of GM38.

The incorporation of injection wells in the vicinity of VPB-47 will reduce the TVOC concentrations in the remedial and public supply wells as compared to the originally proposed system.

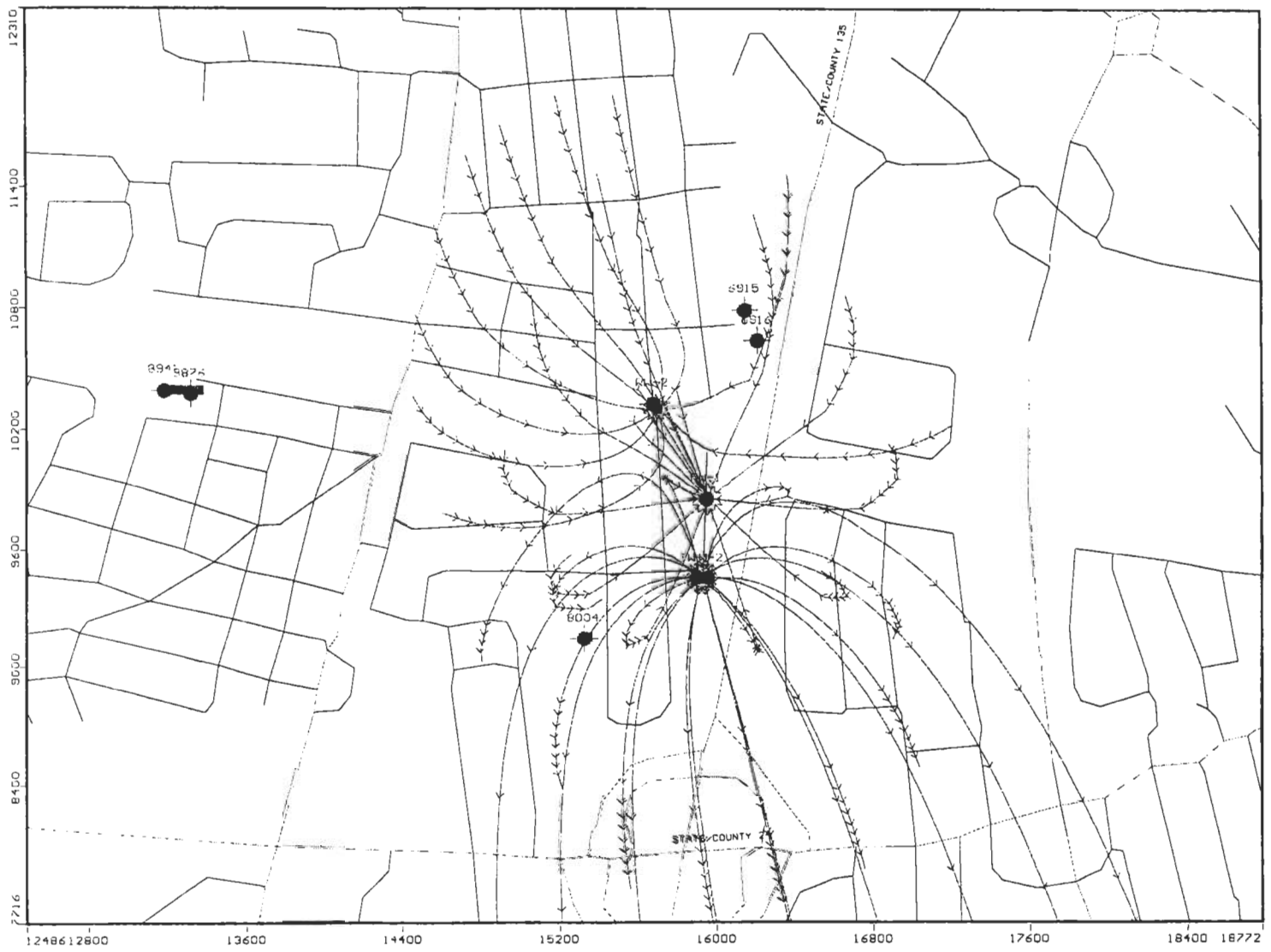
The relocation of RW-1 to the center of South Herman Street does not reduce the systems ability to fulfill its design goals.

ARCADIS
Project: Northrop Grumman Regional
Description: GM38 10-year capture zone
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995-1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 4

FIGURE 1A

Projection of RW-1 and RW-2 10-Year Capture Zones. Markers represent 1 year of travel.

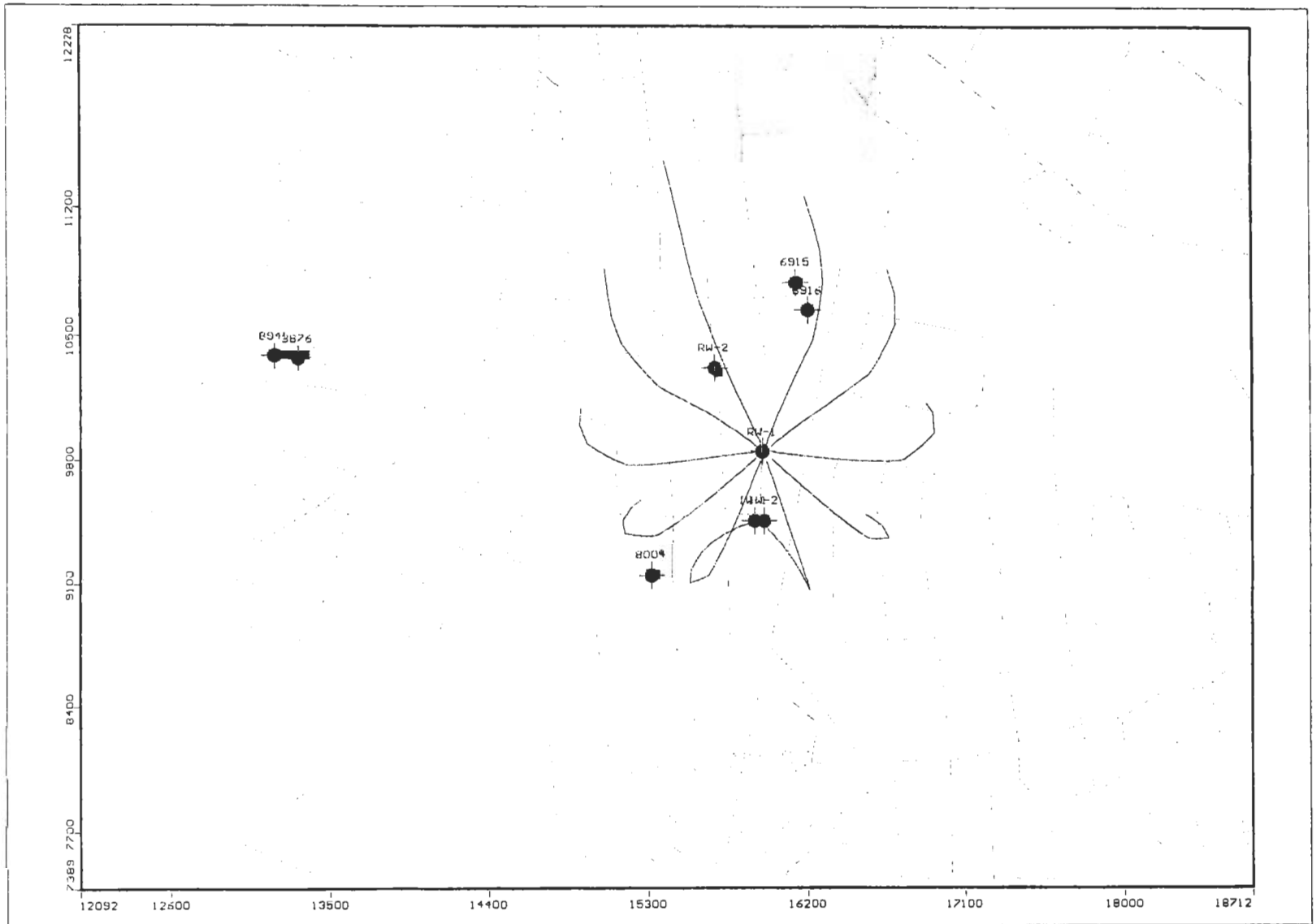


ARCADIS
Project: Northrop Grumman Regional
Description: Capture Zone and Recharge
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995-1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 2

FIGURE 1B

Projection of RW-1 and RW-2 10-Year Capture Zone and Path of Recharged Groundwater.

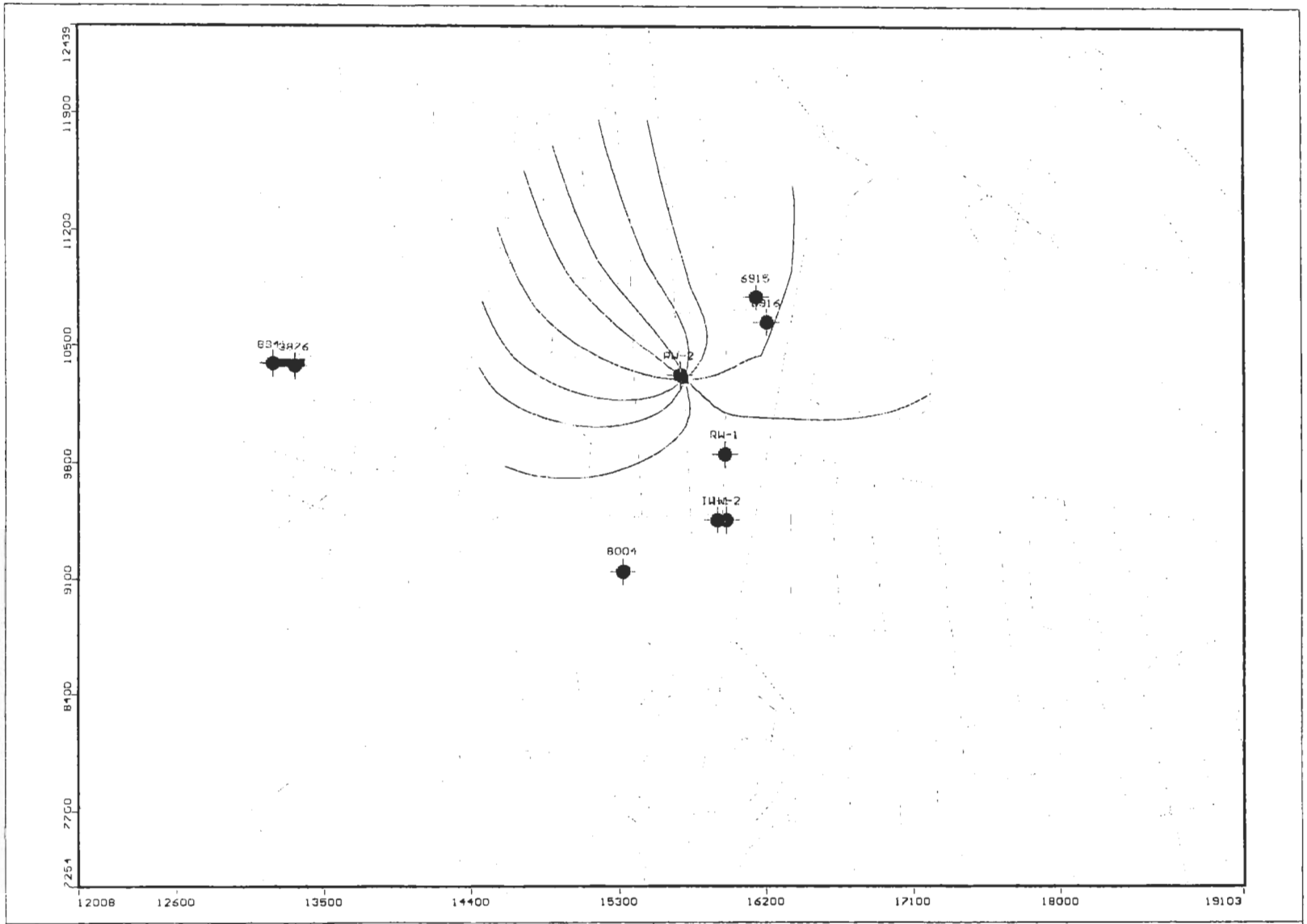


ARCADIS
Project: Northrop Grumman Regional
Description: Capture Zone
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995-1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 8

FIGURE 2

Projection of RW-1 10-Year Capture Zone.

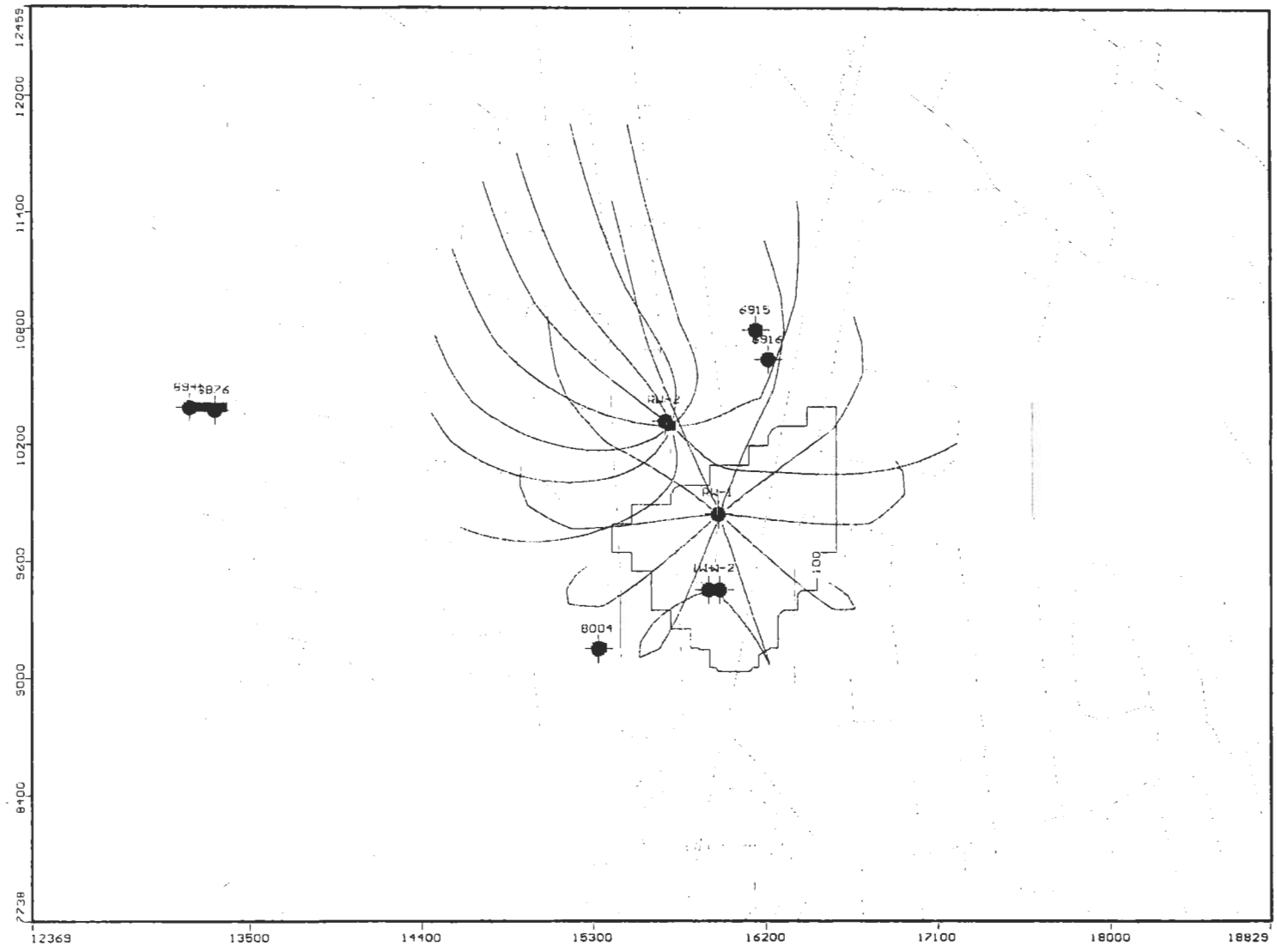


ARCADIS
Project: Northrop Grumman Regional
Description: Capture Zone
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995–1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 8

FIGURE 3

Projection of RW-2 10-Year Capture Zone.

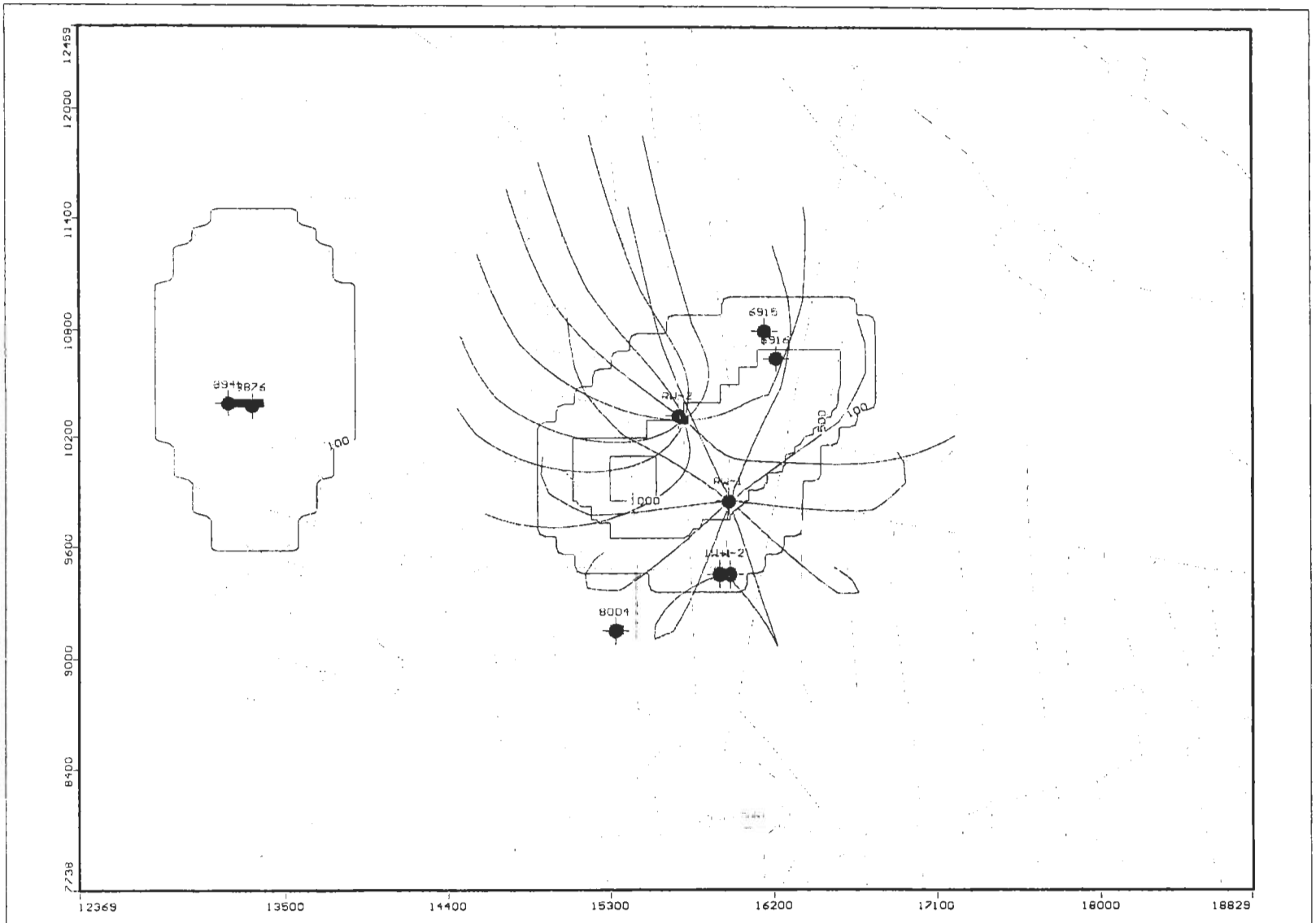


ARCADIS
Project: Northrop Grumman Regional
Description: Capture Zone and Plume
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995–1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 4

FIGURE 4

10-Year Capture Zone with TVOC Plume in Model Layer 4 (concentrations in micrograms per liter).

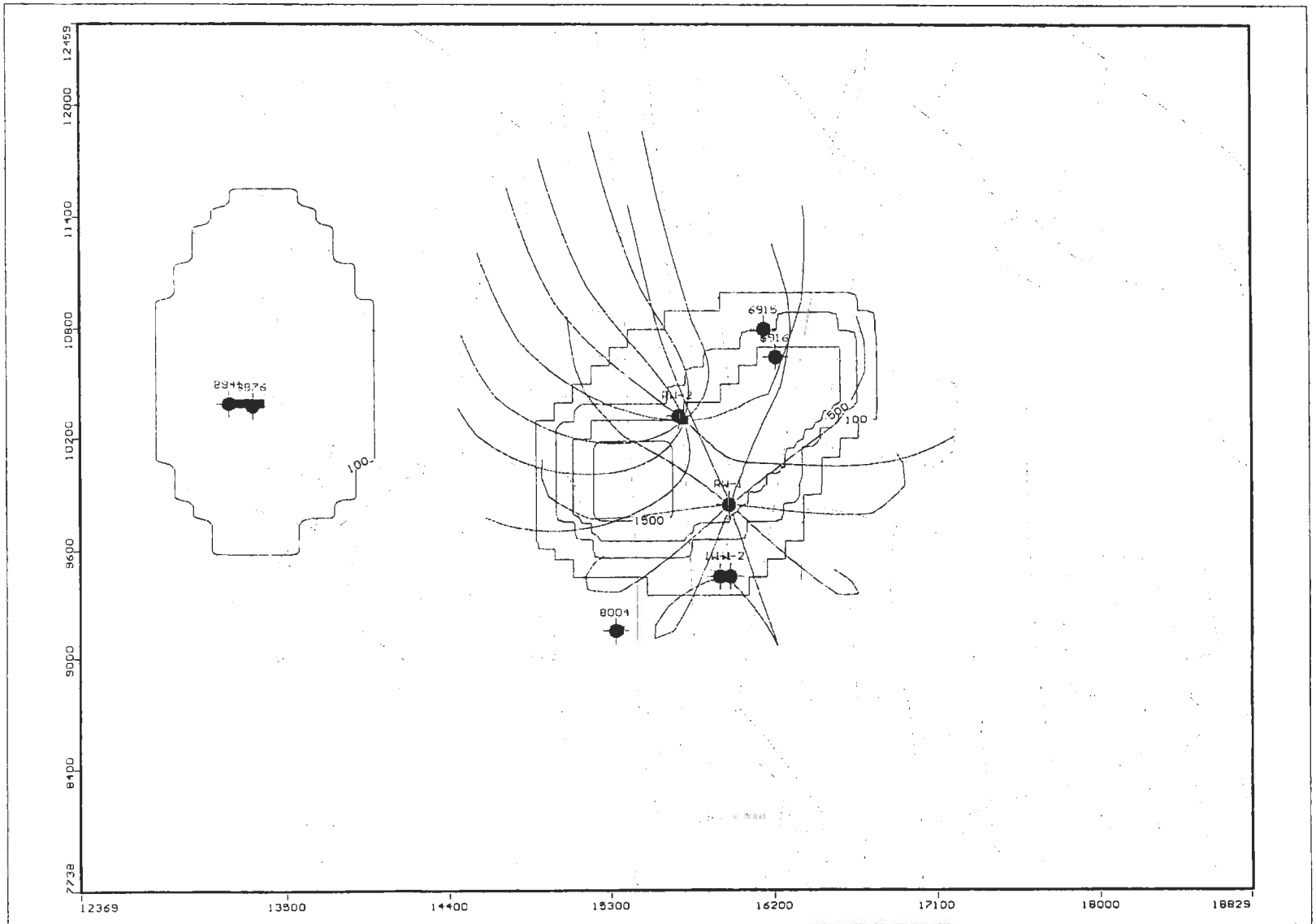


ARCADIS
Project: Northrop Grumman Regional
Description: Capture Zone and Plume
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995–1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 5

FIGURE 5

10-Year Capture Zone with TVOC Plume in Model Layer 5 (concentrations in micrograms per liter).



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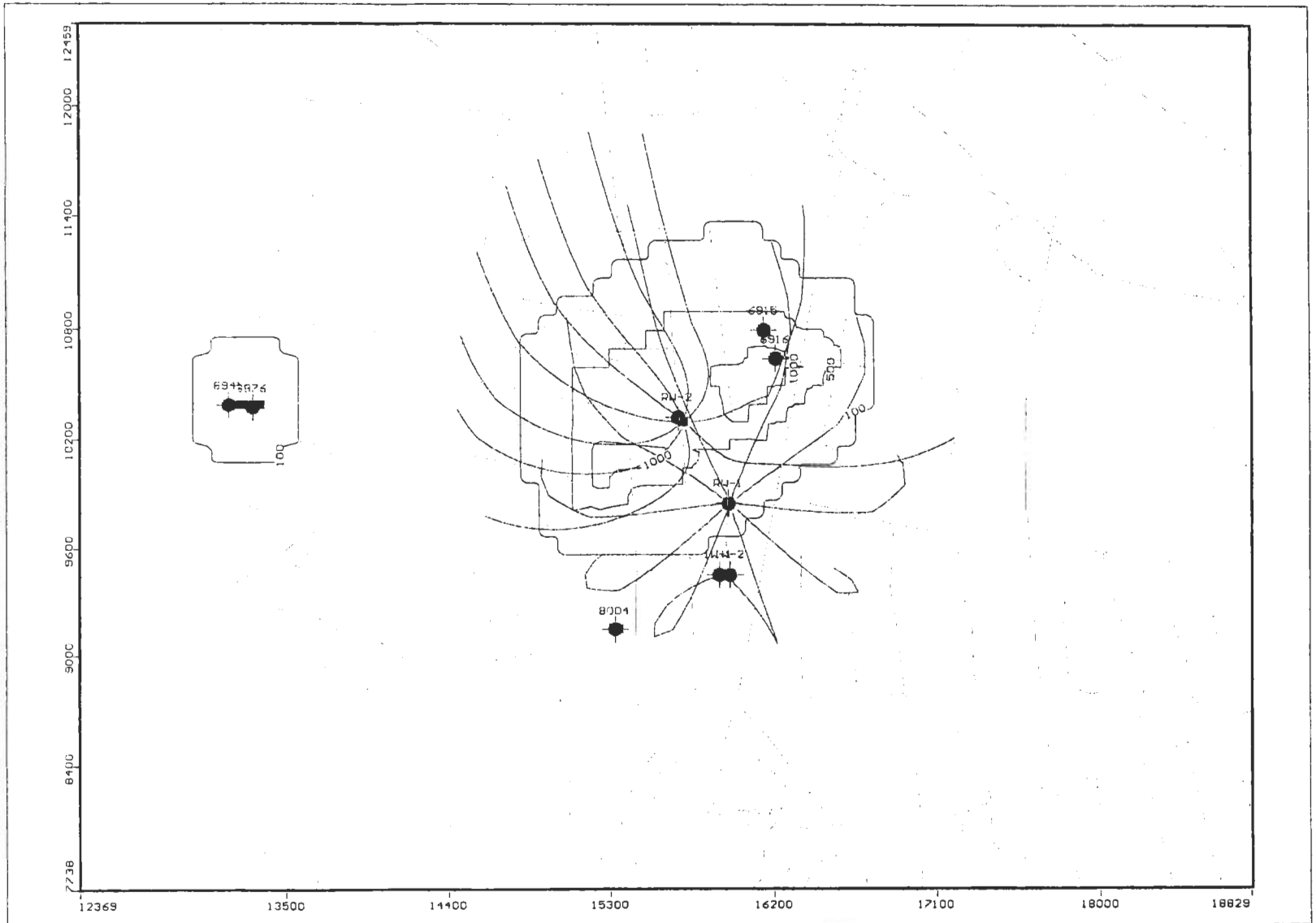
Project: Northrop Grumman Regional
Description: Capture Zone and Plume
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995-1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 6

FIGURE 6

10-Year Capture Zone with TVOC Plume in Model Layer 6 (concentrations in micrograms per liter).



ARCADIS
Project: Northrop Grumman Regional
Description: Capture Zone and Plume
2 Dec 02

Visual MODFLOW v.2.8.2, (C) 1995-1999
Waterloo Hydrogeologic, Inc.
NC: 226 NR: 280 NL: 11
Current Layer: 7

FIGURE 7.

10-Year Capture Zone with TVOC Plume in Model Layer 7 (concentrations in micrograms per liter).

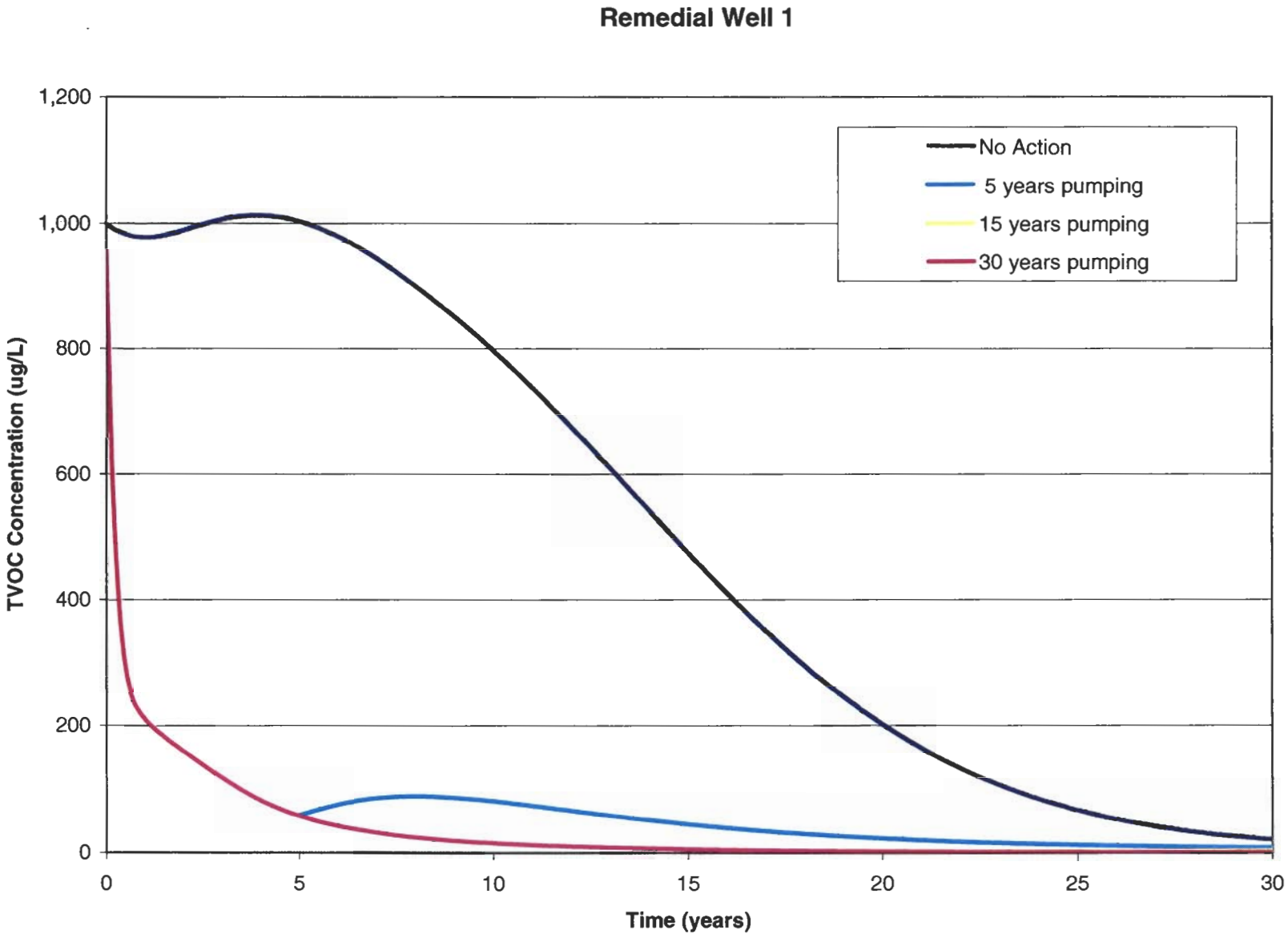


Figure No. 8
12/02/2002
Revised remedial system with injection wells

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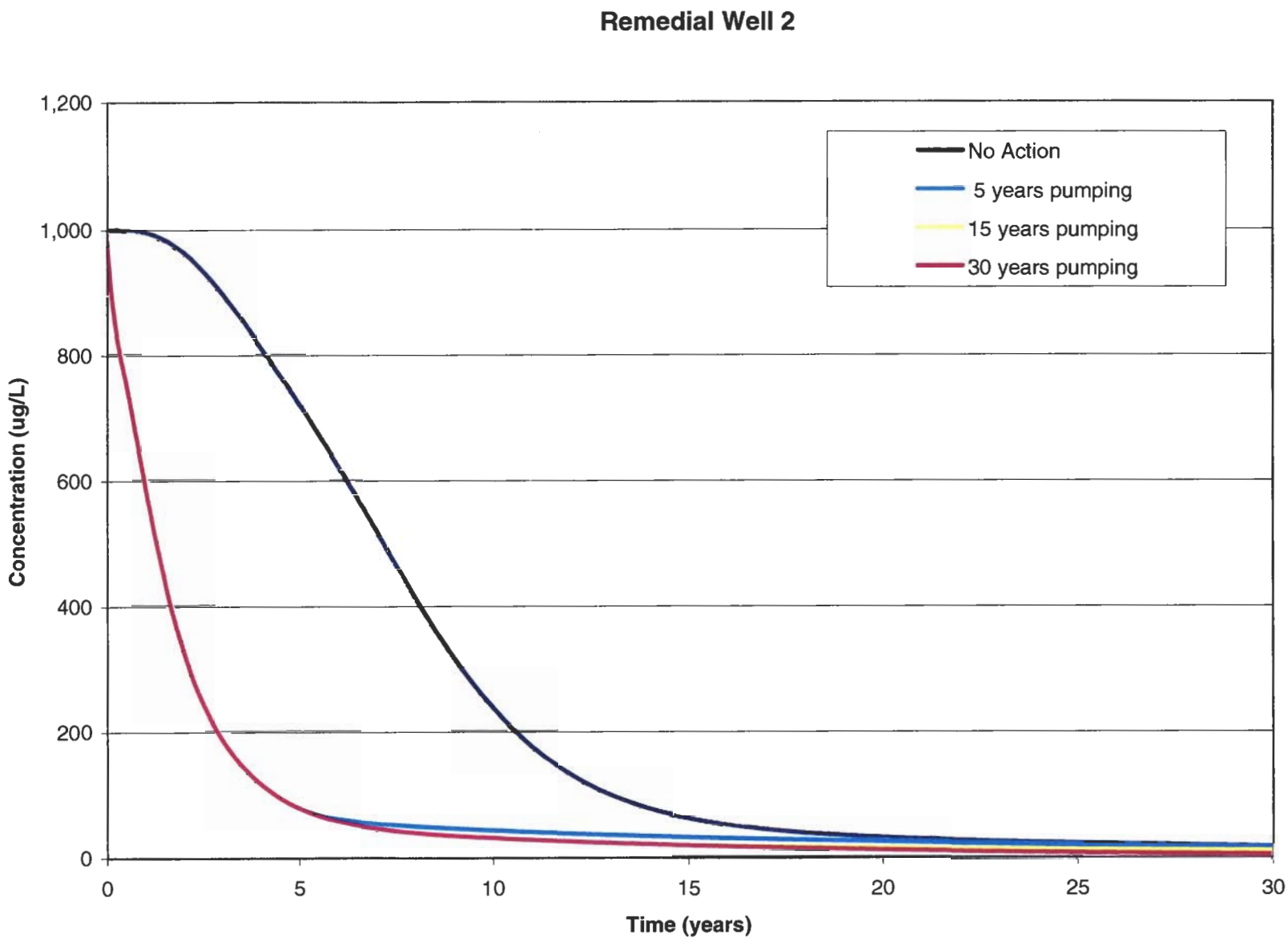

Figure No. 9
12/02/2002
Revised remedial system with injection wells

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Bethpage Water District Plant 4-1 (6915)

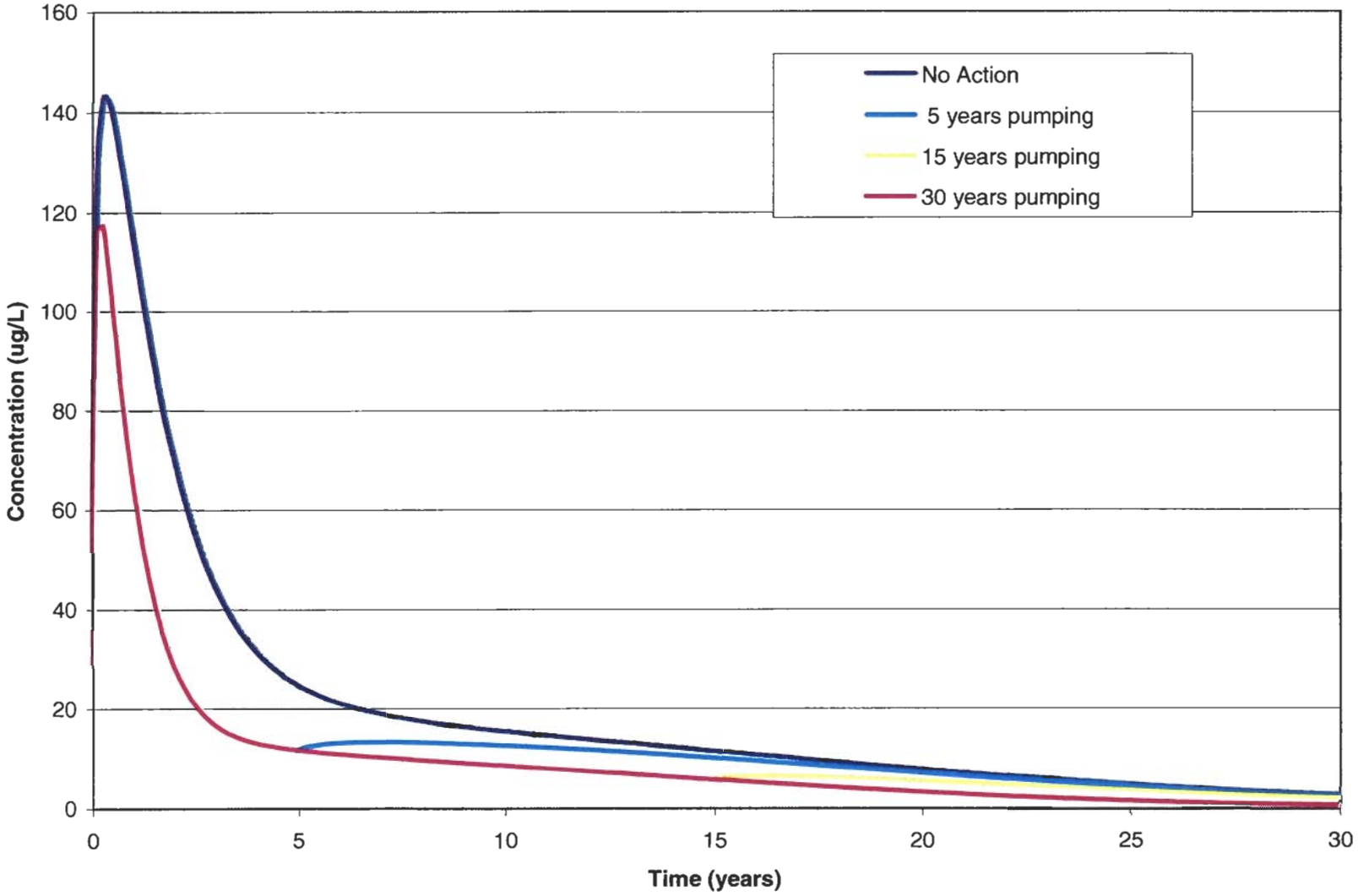

Figure No. 10
12/02/2002
Revised remedial system with injection wells

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Bethpage Water District Plant 4-2 (6916)

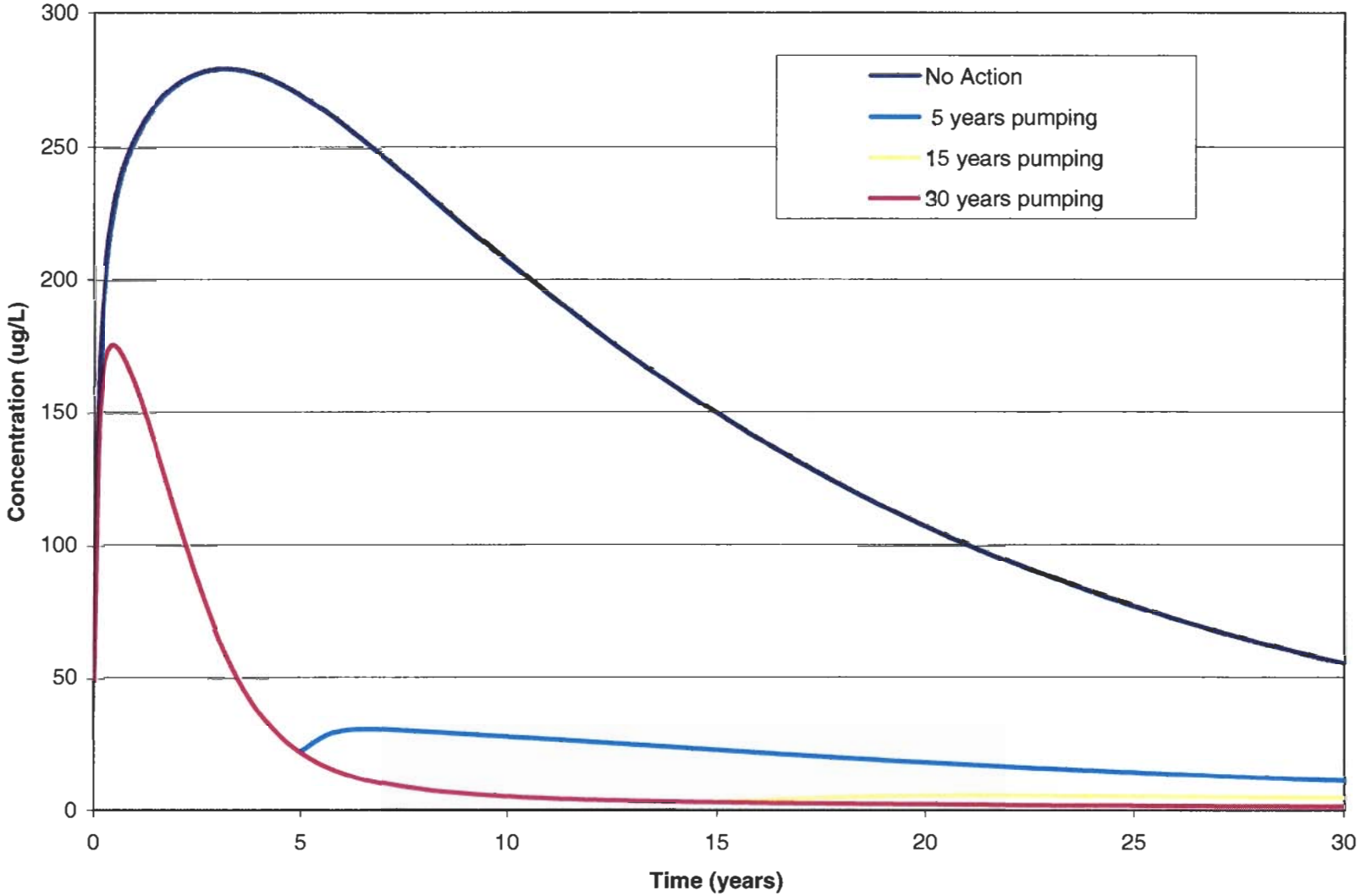

Figure No. 11
12/02/2002
Revised remedial system with injection wells

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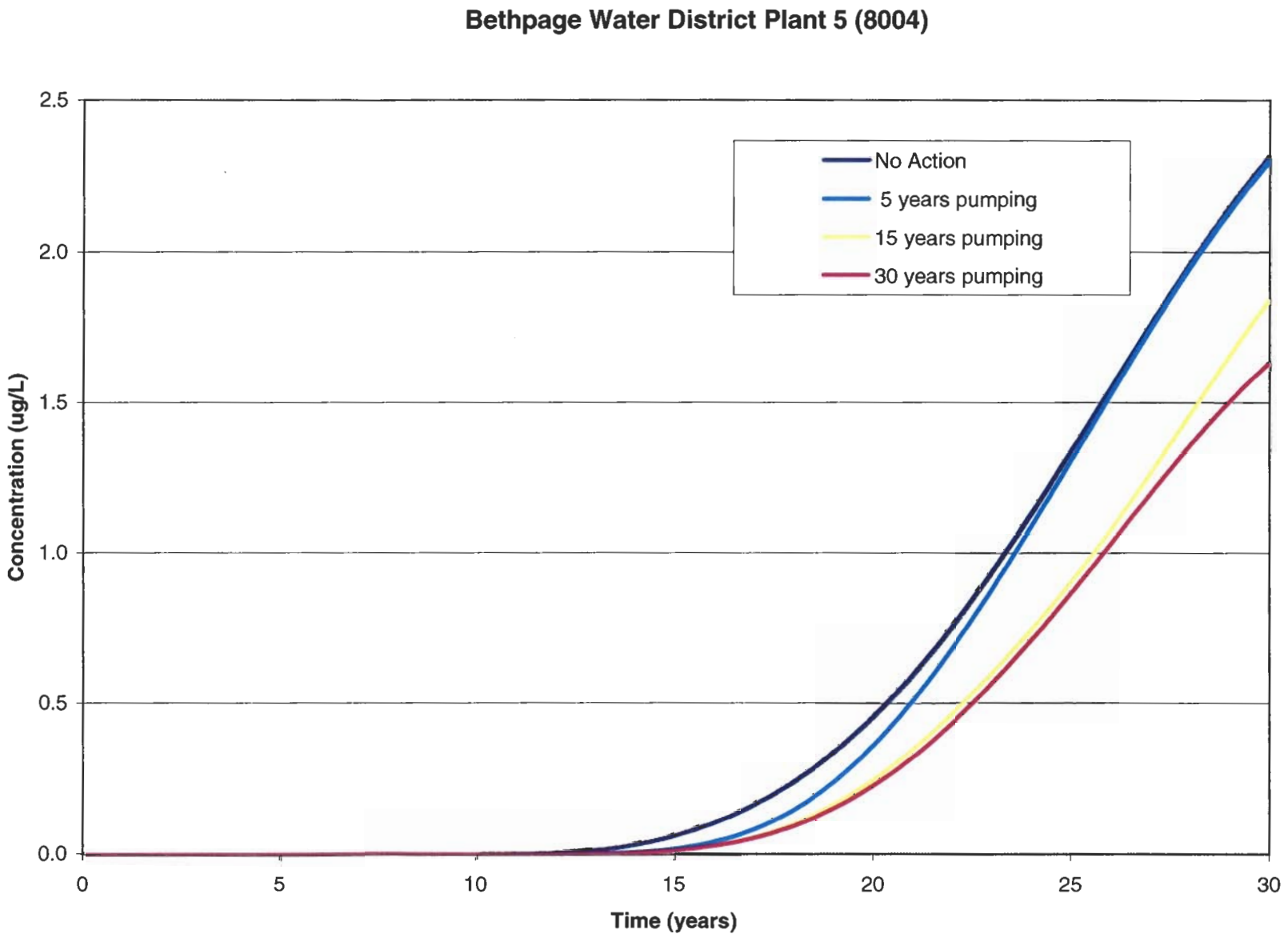

Figure No. 12
12/02/2002
Revised remedial system with injection wells

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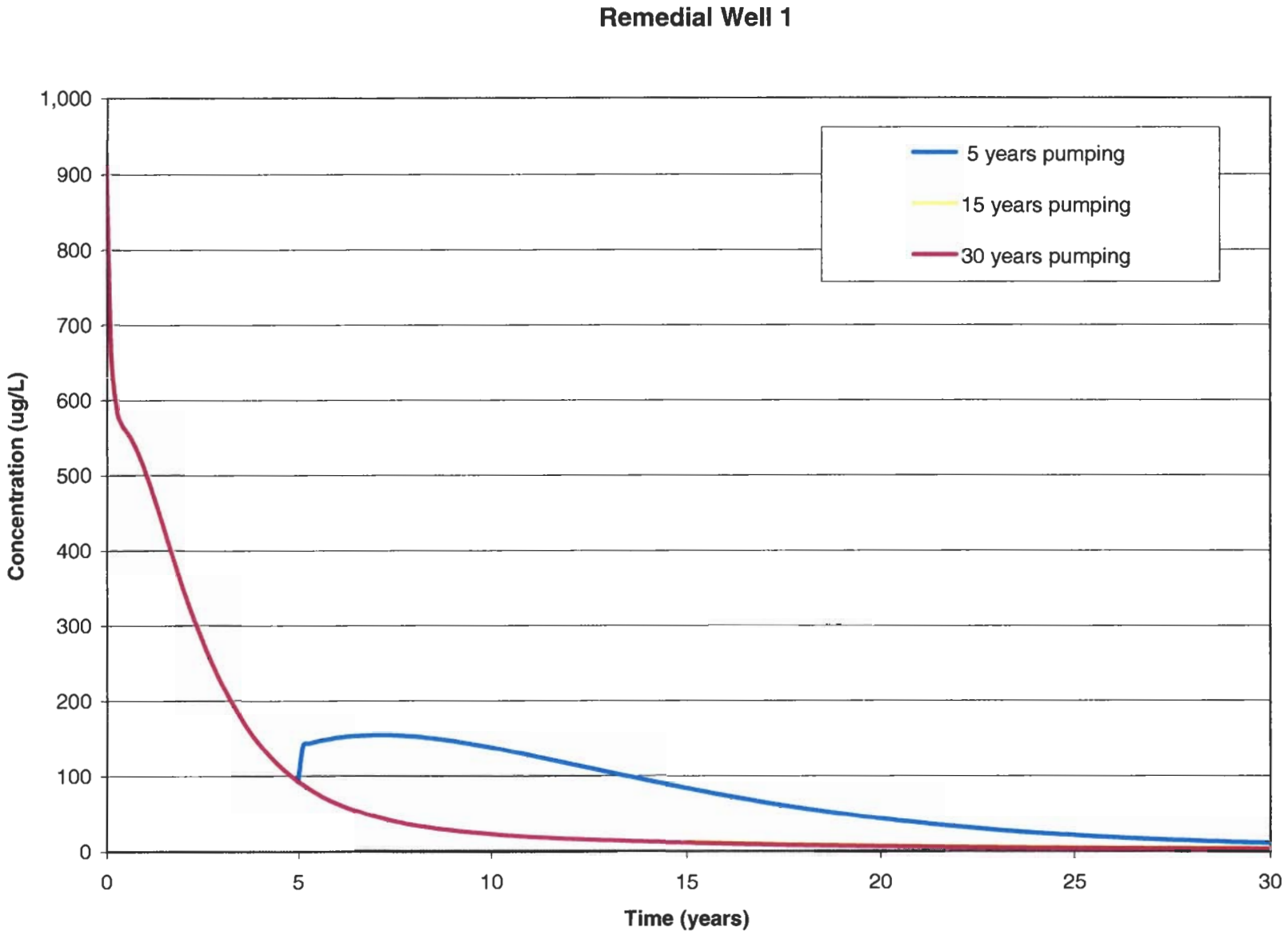

Figure No. 13
12/02/2002
Originally proposed remedial system (without injection wells)

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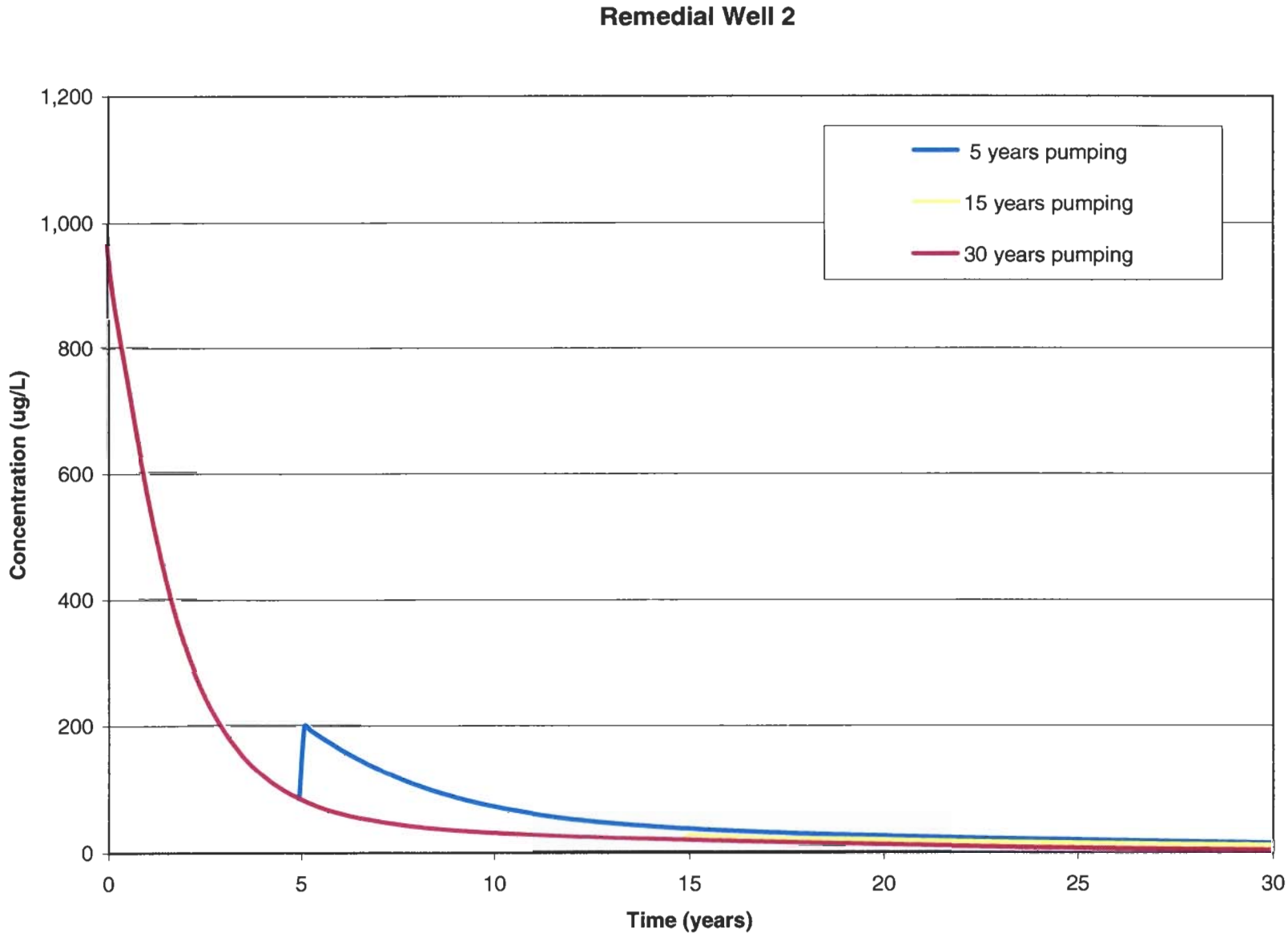

Figure No. 14
12/02/2002
Originally proposed remedial system (without injection wells)

G:\TECHNICL\Porsche\NGModel\GM38-1ppm-2\output comparison\comparison.xls- RW2

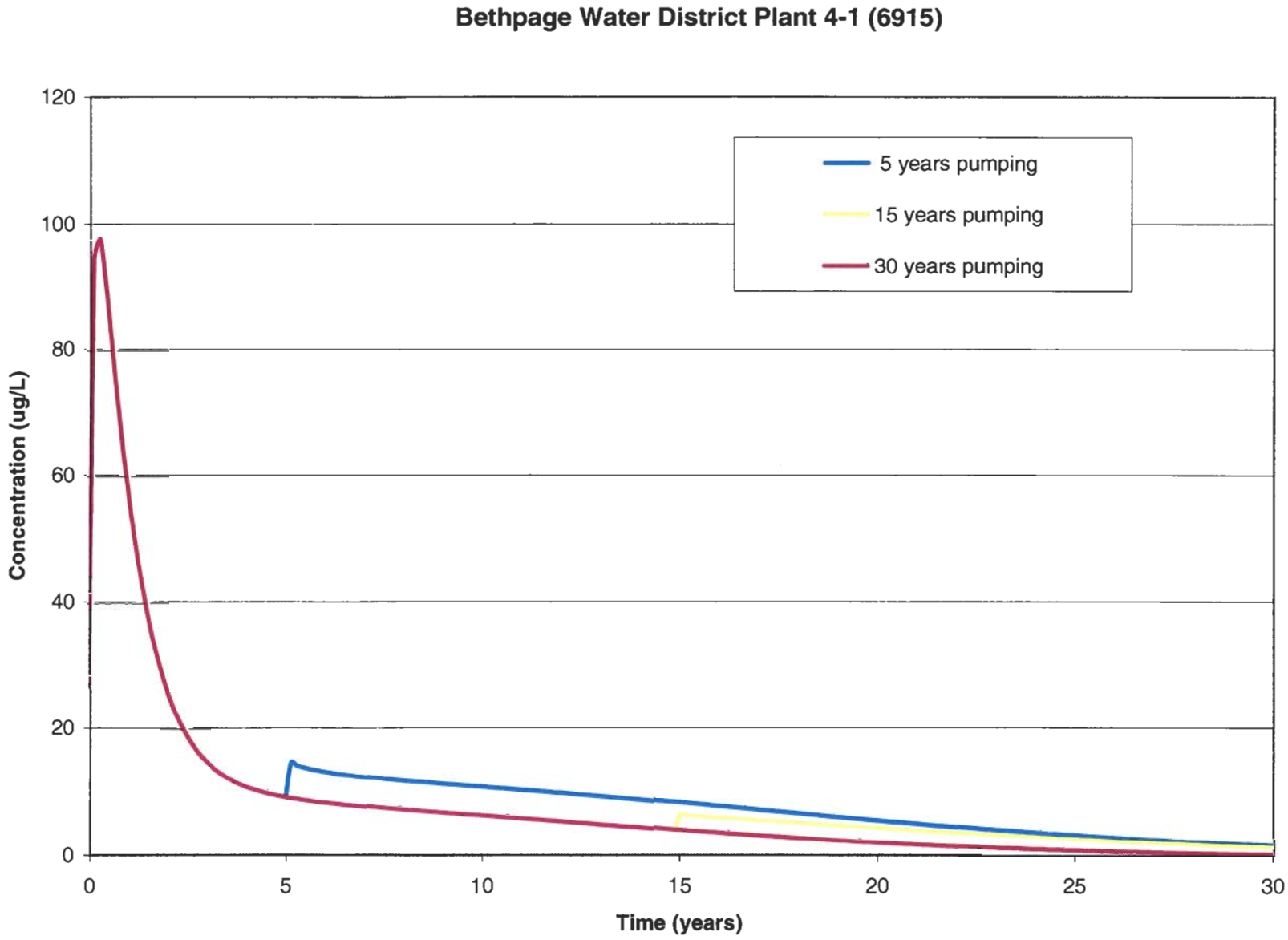

Figure No. 15
12/02/2002
Originally proposed remedial system (without injection wells)

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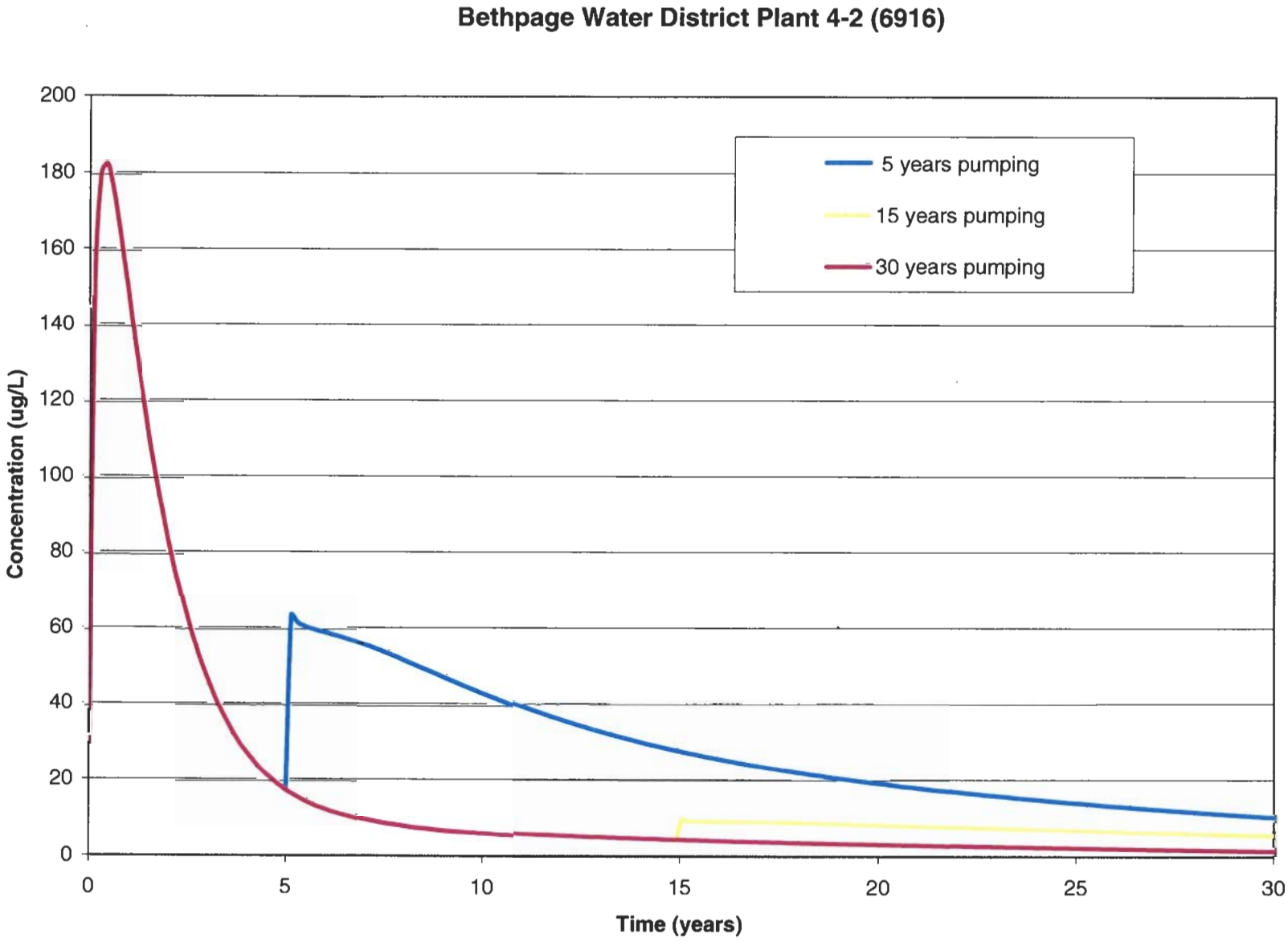

Figure No. 16
12/02/2002
Originally proposed remedial system (without injection wells)

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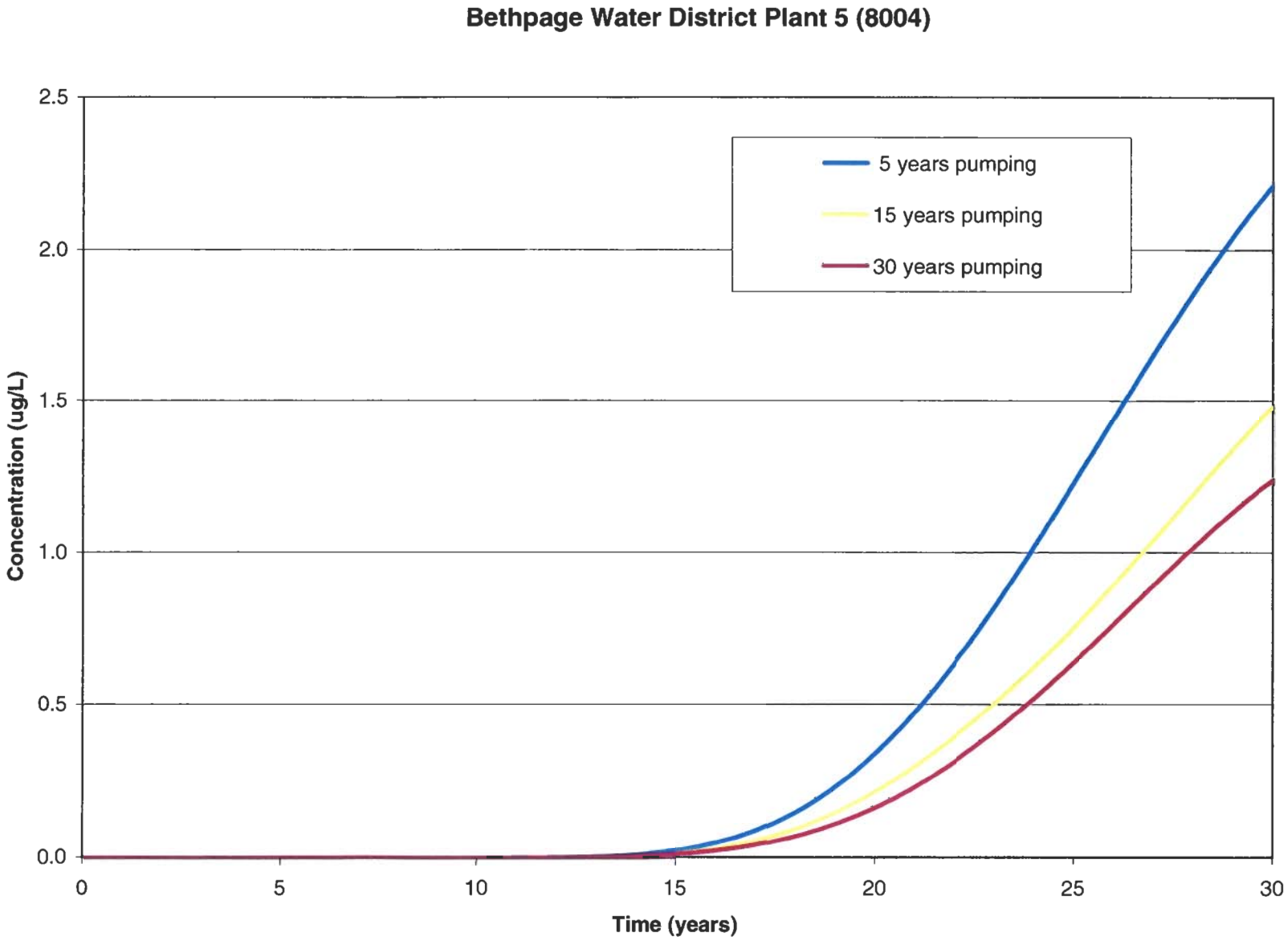

Figure No. 17
12/02/2002
Originally proposed remedial system (without injection wells)

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