Cameco

CAMECO RESOURCES
Smith Ranch-Highland Operation
Mail:
P.O. Box 1210
Glenrock, WY
82637 USA

Tel: (307) 358-6541
Fax: (307) 358-4533
www.cameco.com

October 20, 2011

Mr. Lowell Spackman, District I Supervisor
Land Quality Division
Wyoming Department of Environmental Quality
122 W. 25th Street
Cheyenne, WY 82002

CERTIFIED MAIL # 7011 0470 0000 7716 1222 RETURN RECEIPT REQUESTED

RE: Excursion at Monitor Well DM-010, Plan and Compliance Schedule, 90-day Notification, Cameco Resources, Permit 603

Dear Mr. Spackman:

Power Resources, Inc. d/b/a Cameco Resources (Cameco) is herein providing a plan and compliance schedule pursuant to Chapter 11 of the Noncoal In Situ Mining, Section 12(d) (iii) for the excursion at monitor well DM-010. Cameco met with LQD on October 5, 2011 and discussed submitting a separate compliance schedule for well DM-010 to comply with the 90-day requirement, although excursion control is tied to the compliance schedule for well DM-003 on excursion. Attached is the plan and proposed compliance schedule for well DM-010.

Please contact Ken Garoutte at 307-358-6541, ext. 476 or Kenneth_Garoutte@cameco.com if you have any questions.

Respectfully,

Brent Berg
General Manager

BB/kg

Attachments: Well DM-010 Plan and Compliance Schedule

cc: File HUP: 4.3.3.1
Mr. Doug Mandeville, NRC (2copies) - CERTIFIED MAIL # 7011 0470 0000 7716 1239
Document Control Desk, NRC - CERTIFIED MAIL # 7011 0470 0000 7716 1246

ec: Cameco-Cheyenne

Excursion at Well DM-010, Plan and Compliance Schedule, 90-day Submittal

Cameco Resources, Permit 603

Introduction

Well DM-010 was confirmed to be on excursion June 6, 2011. Verbal notification to Wyoming Department of Environmental Quality-Land Quality Division (WDEQ-LQD) was given on June 7, 2011 and written notification was provided in a letter dated June 10, 2011. Guideline 8 sampling was conducted on July 11, 2011 and the results were attached to the monthly Excursion Report Summary Update letter dated August 31, 2011. Cameco contracted a consultant, Aqui-Ver, Inc., in August, 2011 to evaluate and propose recommendations to resolve excursions in Mine Unit D.

Plan to Bring DM-010 off Excursion

During a LQD site inspection on September 7 and 8, 2011, Cameco discussed that its consultant, Aqui-Ver, Inc., was preparing an excursion recovery plan as it applies to excursion events regarding wells DM-003 and DM-010. Cameco met with LQD September 29, 2011 and provided a copy of the draft recovery and prevention plan. LQD favored the recommendation to integrate restoration plans for Mine Units C, D, & E that would incorporate the excursion control and prevention.

Cameco formally submitted the Mine Unit D Excursion Recovery and Prevention Plan in the monthly Excursion Report Summary Update letter dated September 30, 2011.

Compliance Schedule

- December 2011: Cameco will submit Draft integrated restoration plan for Mine Unit D, E, and C with excursion control and prevention to resolve the excursion by the end of 2012.
- Monthly Progress Reports: Cameco will provide progress reports in the monthly Excursion Report Summary Update letters on wells DM-010 and DM-003.

AQUI-VER, INC

Hydrogeology, Water Resources & Data Services

Mr. David Moody

Cameco Resources

Smith Ranch/HUP Facility

P.O. Box 1210

Glenrock, WY 82637

September 1, 2011

Re: Mine Unit D Excursion Recovery and Prevention Plan

David:

This letter report summarizes results of our evaluation of recent excursions in Mine Unit D (MU-D) and our proposed excursion recovery and prevention plan. Our analysis included evaluation of historical groundwater quality and water level data for wells installed in the 40- and 50-Sand aquifers in MU-D, MU-C, and MU-E that are connected to underground mine workings in the area.

SUMMARY

Current and historical excursions in MU-D result from the discharge of high TDS water from underground mine workings (drifts) present in the 40-Sand production interval. The 40-Sand aquifer in MU-D is hydraulically connected to the overlying 50-Sand aquifer (production interval for MU-C and MU-E) by a series of raises and drifts connecting MU-C and MU-D, by collapsed mine workings within the MU-D footprint, and by exploration "fan" drilling during underground mine operations. The rate of discharge (and magnitude of the excursion) from underground workings is controlled by the difference in water level elevation between the 40- and 50-Sand aquifers (e.g. vertical hydraulic gradient). Although it should be possible to remediate existing excursions within MU-D by operating strategically located extraction wells, it will be necessary to improve the water quality within the underground workings if wellfield restoration and stability is to be achieved for the long-term (assuming chloride and bicarbonate restoration goals must be met to achieve wellfield closure).

Given the complexity and interconnected nature of groundwater flow between MU-C, MU-D, and MU-E, it is recommend current restoration plans for these mine units be updated and integrated to incorporate this excursion control and prevention plan. This work would include combining and updating existing independent groundwater models to account for underground mine workings that connect MU-C, MU-D, and MU-E.

BACKGROUND

Several monitor ring wells in MU-D have been on-and-off excursion status since early in the operations period, including wells DM-3, DM-9, and DM-10. These wells were placed on excursion having exceeded the Upper Control Limit (UCL) for chloride, alkalinity, and/or conductivity for at least two consecutive sampling events. Wells currently on excursion status include wells DM-3 and DM-10. Well DM-3 has been on excursion status since the fourth quarter of 2001. Well DM-10 had been off of excursion status for more than five years before returning to excursion status recently in June of 2011.

Former underground mine workings (drifts) are present in the 40-Sand production interval in Mine Unit D (**Figure 1**). The 40-Sand aquifer is hydraulically connected to the overlying 50-Sand aquifer (production interval for MU-C and MU-E) by virtue of a series of raises and drifts connecting MU-C and MU-D, by collapsed mine workings within the MU-D footprint, and by exploration "fan" drilling during underground mine operations.

The MU-D excursions are "non-conventional" because the excursion source is high TDS groundwater discharged from underground mine workings. A 2001 study of MU-D excursions concluded elevated chloride concentrations in MU-D are the result of the downward migration of high TDS groundwater from underground mine workings in Mine Unit C (50-Sand) into the underlying 40-Sand aquifer in MU-D[1]. Based on our review of available information summarized below, we agree with this conclusion.

DATA ANALYSIS

Our assessment included an evaluation of certain groundwater quality and groundwater elevation data for the 40- and 50-Sand aquifers in MU-D, MU-C, and MU-E, including excursion wells DM-3 and DM-9.

Groundwater elevation data for the 40- and 50-Sand aquifers was contoured for select wells monitored over the period May 15 to May 26, 2011, as shown in **Figure 2** and **Figure 3**. Examination of these maps illustrates groundwater flow into the workings in the 50-Sand, and discharge from the workings in the 40-Sand in the MU-D area. In addition, water level elevations are shown to decrease significantly in the 40-Sand east of the mine workings due to significant withdrawl (bleed) of approximately 60-85 gpm in MU-D and D-Ext. These data support the conceptual model of groundwater flowing downward through the workings from the 50-Sand and discharging into the underlying 40-Sand in the MU-D area.

Groundwater chloride concentration data for the 40- and 50-Sand aquifers was contoured for select wells monitored over the period May 15 to May 26, 2011, as shown in **Figure 4**. Chloride concentrations were contoured for wells installed within underground mine workings (drifts and raises), as well as the surrounding aquifer. The chloride concentration within underground mine workings connecting the MU-C and MU-D areas was observed to be in excess of 70 mg/L. The distribution of chloride shown in **Figure 4** is consistent with the conceptual model of discharge of high TDS groundwater from mine workings in the MU-D area.

Water quality data for excursion wells DM-3 and DM-10 were examined for the period of record to identify any correlations between parameters and water level elevation. As expected, there is a strong correlation between water level elevation and water quality observed in both excursion wells, as shown in **Figure 5** and **Figure 6**. This correlation is most obvious over the 6-year period from approximately January of 2005 to January of 2011 observed in excursion well DM-10 (**Figure 6**). In general, increasing groundwater elevation is correlated to decreasing chloride concentrations in both excursion wells. In general, groundwater elevation greater than

---

[1] Letter from Hydro-Engineering to Leland Huffman (Cameco) dated December 14, 2001.

5085 ft-MSL promote acceptable water quality in excursion well DM-10. Although the trends in excursion well DM-3 are not quite as clear, better water quality is generally observed in when water level elevation is greater than 5110 ft-MSL. These data are also consistent with the conceptual model of decreasing downward flow through the mine workings into MU-D as 40-Sand water levels increase (decrease in downward hydraulic gradient), which results in a decrease in chloride concentration in adjacent monitoring wells.

An important conclusion of this analysis is the fact that downward flow from the mine workings into MU-D is a natural condition that can be reduced somewhat using engineering controls, but cannot be entirely prevented (even if sections of the workings could be plugged). Therefore, as long as the mine workings contain high TDS groundwater, there will be some amount of discharge of this water from the workings into MU-D. The only full-proof solution to prevent future excursions and maintain stability of MU-D restoration is to improve the quality of water within the underground mine workings.

EXCURSION MODELING

The proposed excursion recovery and prevention plan for MU-D was developed with the aid of a groundwater flow and chemical transport model previously developed for MU-D, D-Ext, and MU-E restoration planning. The model incorporates the influence of underground mine workings within the MU-D footprint, but is limited in size and does not include the MU-C area or underground mine workings that connect MU-C and MU-D.

Prior to using the groundwater flow model for excursion control and prevention, the chemical transport model (MT3D) was calibrated by reproducing the excursion currently observed in DM-3 and DM-10 in MU-D. **Figure 7** illustrates the calibrated chloride concentration in MU-D in May of 2011. The resulting chloride plume is generally consistent with observed chloride concentrations in site monitoring wells, including concentrations observed in excursion well DM-3 (approximately 25 mg/L). An exception exists in the vicinity of DM-10, where the model predicts lower chloride concentrations than observed, and instead predicts adjacent monitoring well DM-9 should be nearing excursion status. This observation is not surprising, however, since well DM-9 has been placed on excursion status in the past. Despite the small differences observed in modeled and observed chloride concentrations, the model is considered a reasonable representation of existing conditions and is further validation of the conceptual model of historical and recent excursions in MU-D.

The effectiveness of the proposed excursion recovery and prevention plan described below was tested using the calibrated groundwater flow and transport model. Results of the modeling indicate chloride concentrations in excursion wells DM-10 and DM-3 should decline to below UCL's (and removed from excursion status) within approximately 90 days of implementation of the plan, as illustrated in **Figure 8**.

EXCURSION RECOVERY AND PREVENTION PLAN

In order to improve water quality in excursion wells as quickly as possible, we recommend the following excursion recovery plan:

- Increase the overall water level elevation within MU-D by significantly reducing the existing 60 to 85 gpm bleed in MU-D and D-Ext to no more than 15 gpm across existing production pattern areas.
- Begin excursion recovery by operation of five new excursion recovery wells located in the vicinity of DM-3, DM-9, and DM-10, operating at a total pumping rate of approximately 55 gpm, as shown in **Figure 9**.
- Decrease the water level elevation in the overlying 50-Sand and underground mine workings by increasing the bleed in MU-C, ideally to include pumping from existing wells in underground workings in the vicinity of wellhouse-19 in conjunction with ongoing MU-C restoration. If an additional bleed can be taken from MU-E (Wellhouse E-12 or E-13 preferred), this would also be beneficial.

In order to improve and maintain water quality in MU-D throughout the restoration and stability monitoring period, it will be necessary to improve the water quality in underground workings within MU-D as follows:

- Inject RO permeate into underground workings using existing drift wells (up to five existing wells available), and using the workings as an injection source for the overall MU-D wellfield restoration plan (**Figure 9**). An injection rate of approximately 25 to 50 gpm from two or more MU-D drift wells is recommended. The restoration bleed in MU-D wellhouses D-2 and D-3 should be increased to approximately 50 gpm (slightly greater than the injection rate) to contain injected fluids, moderate water levels in the workings, and provide sweep of production areas adjacent to the workings.
- Improve water quality in the MU-C portion of the underground workings to assist in the long-term stability of water quality in MU-D and MU-C, as previously described. This could include pumping from existing drift wells in MU-C in Wellhouse 19 as previously described, in conjunction with MU-C restoration.

RECOMMENDATIONS

Results of this work should allow general excursion control and prevention to be implemented in MU-D. However, the scope of this work did not consider the impact of the plan on existing detailed groundwater restoration plans for MU-D, D-Ext, and MU-C. Current restoration plans (and supporting models) for MU-D, D-Ext, and MU-E do not adequately consider the important hydrologic influence of underground mine workings that connect MU-D and MU-C. Similarly, the restoration plan (and supporting model) for MU-C does not directly consider the influence of underground mine workings connecting MU-C and MU-D.

Given the complexity and interconnected nature of groundwater flow between MU-C, MU-D, and MU-E, it is recommend current restoration plans for these mine units be updated and integrated to incorporate this excursion control and prevention plan. This work would include combining and updating existing independent groundwater models to account for underground mine workings that connect MU-C and MU-D.

If you have any questions or comments concerning this report, please contact me directly at 720-242-9510.

Sincerely,

AQUI-VER, INC

Robert Lewis

Robert L. Lewis
Principal Hydrogeologist

FIGURES

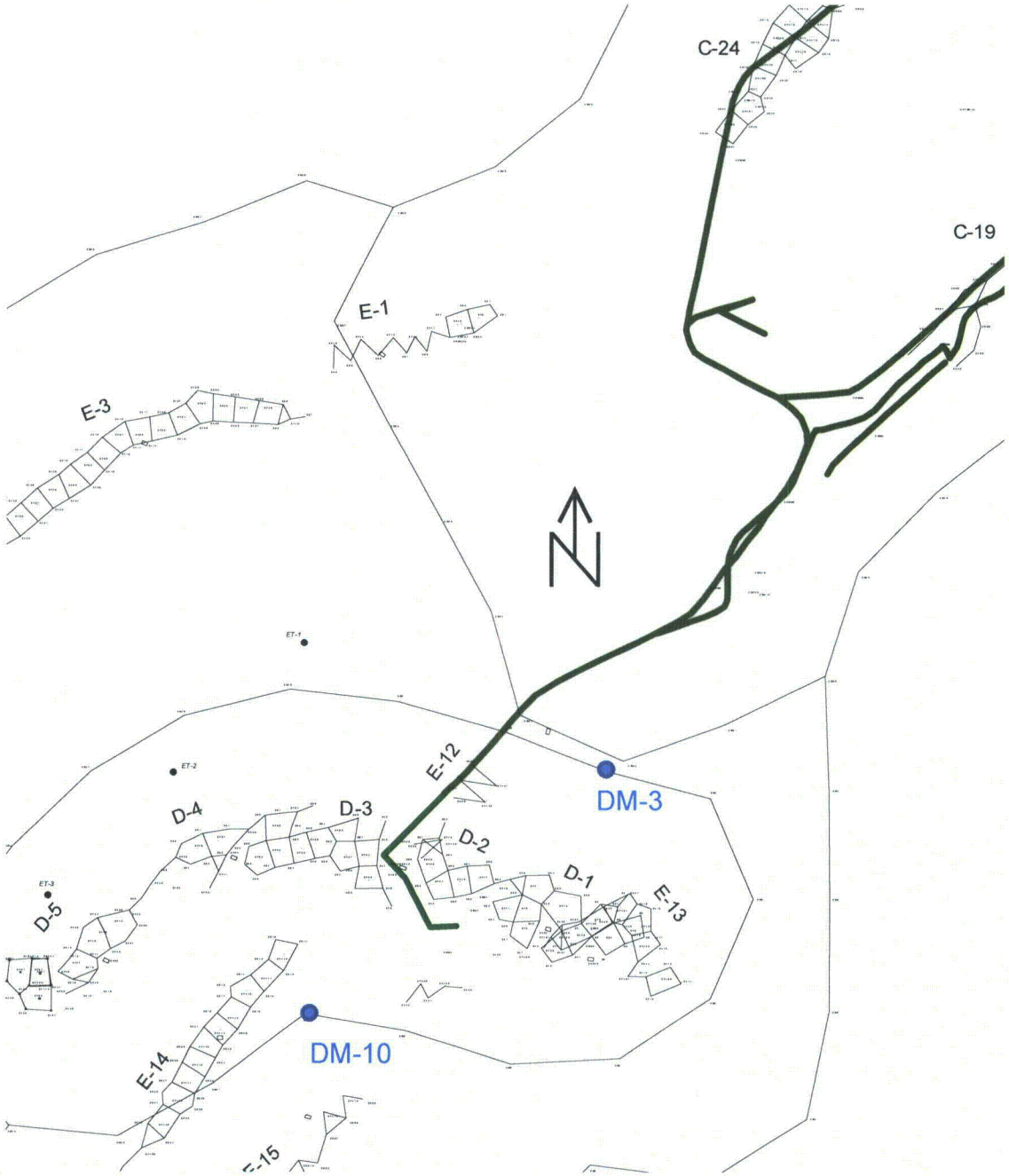

Figure 1. Location of mine workings in MU-D and MU-C. Excursion wells D-3 and D-10 also shown.

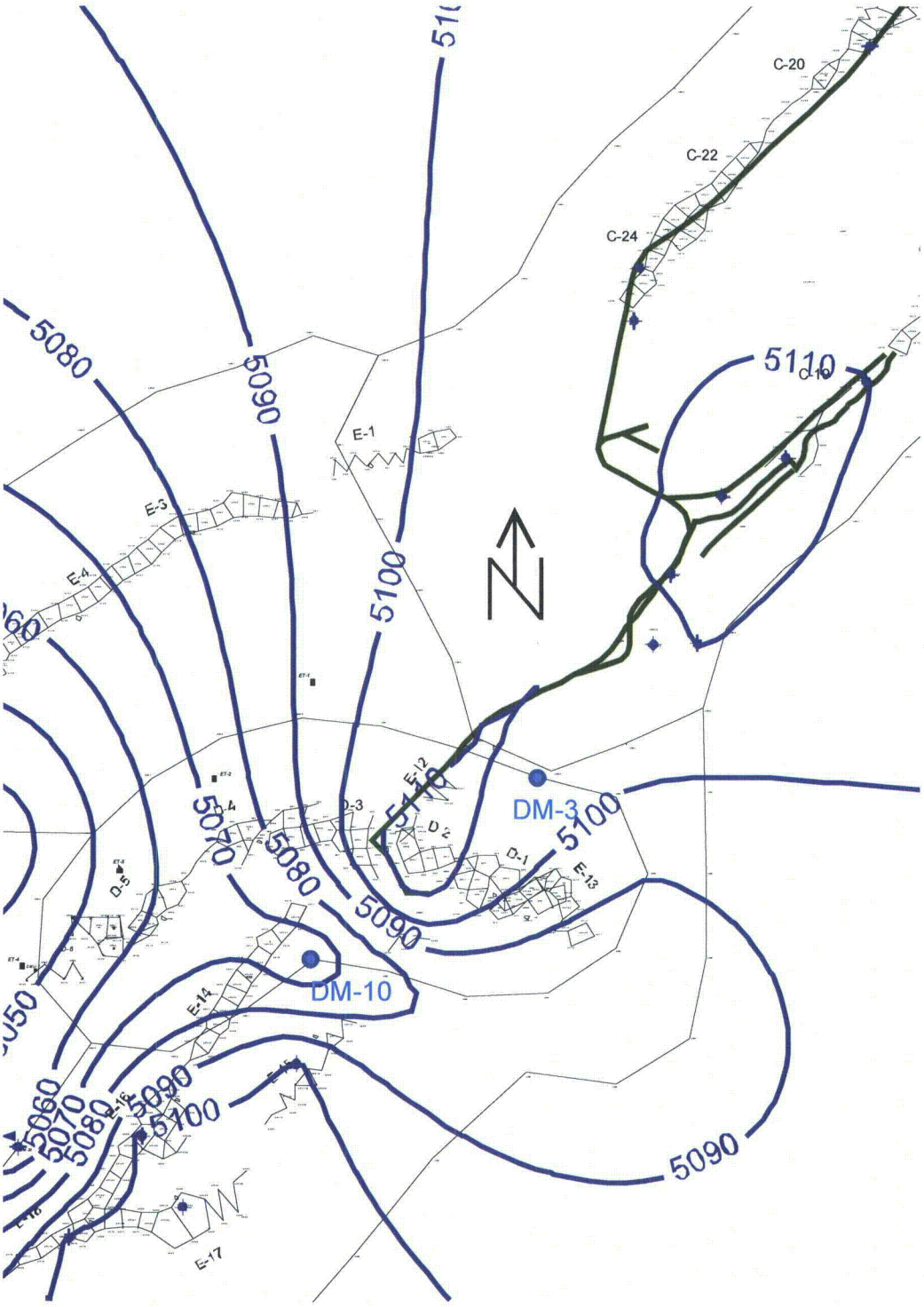

Figure 2. Water Level Elevation in the 40-Sand Aquifer, May 15-26, 2011.

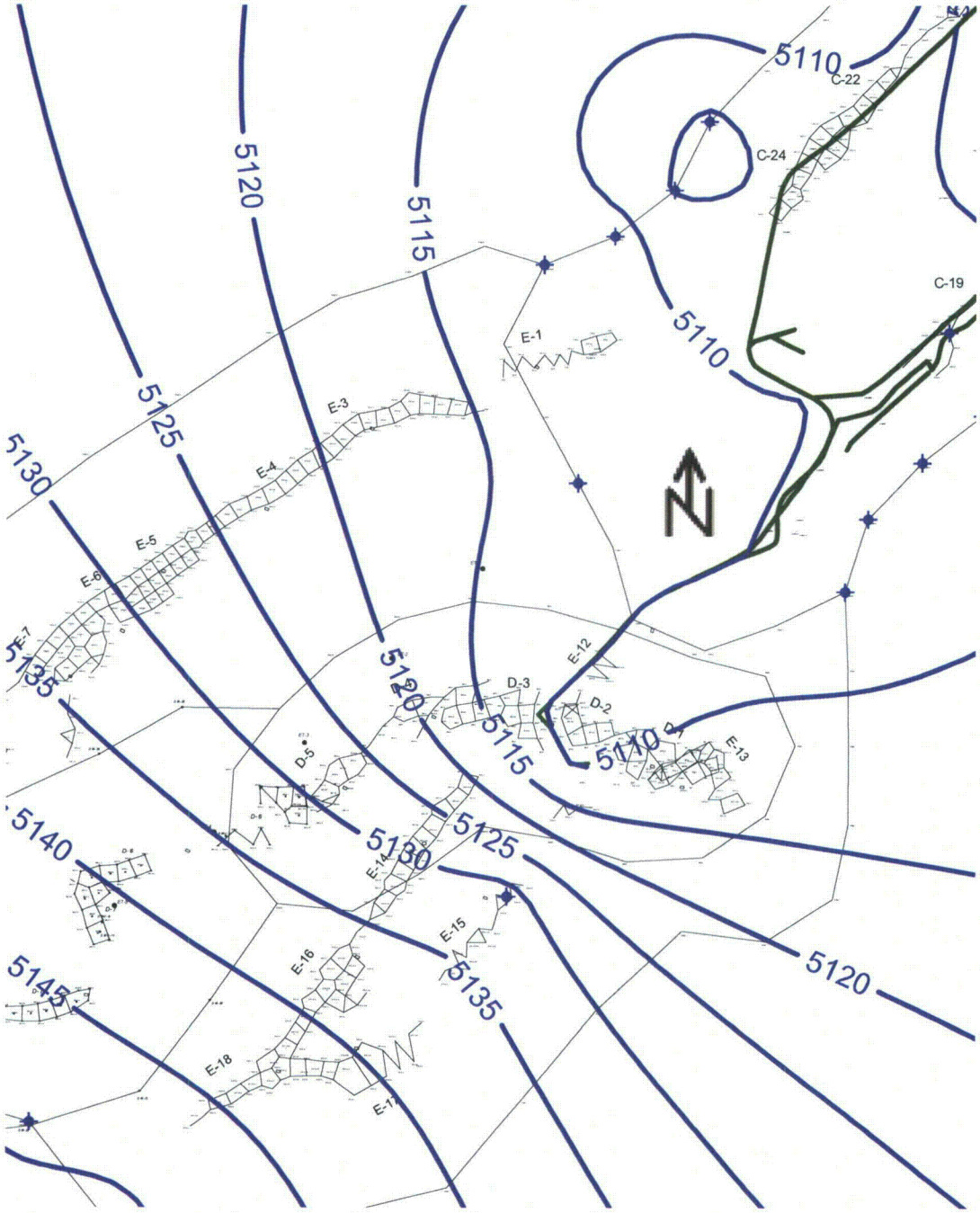

Figure 3. Water Level Elevation in the 50-Sand Aquifer, May 15-26, 2011.

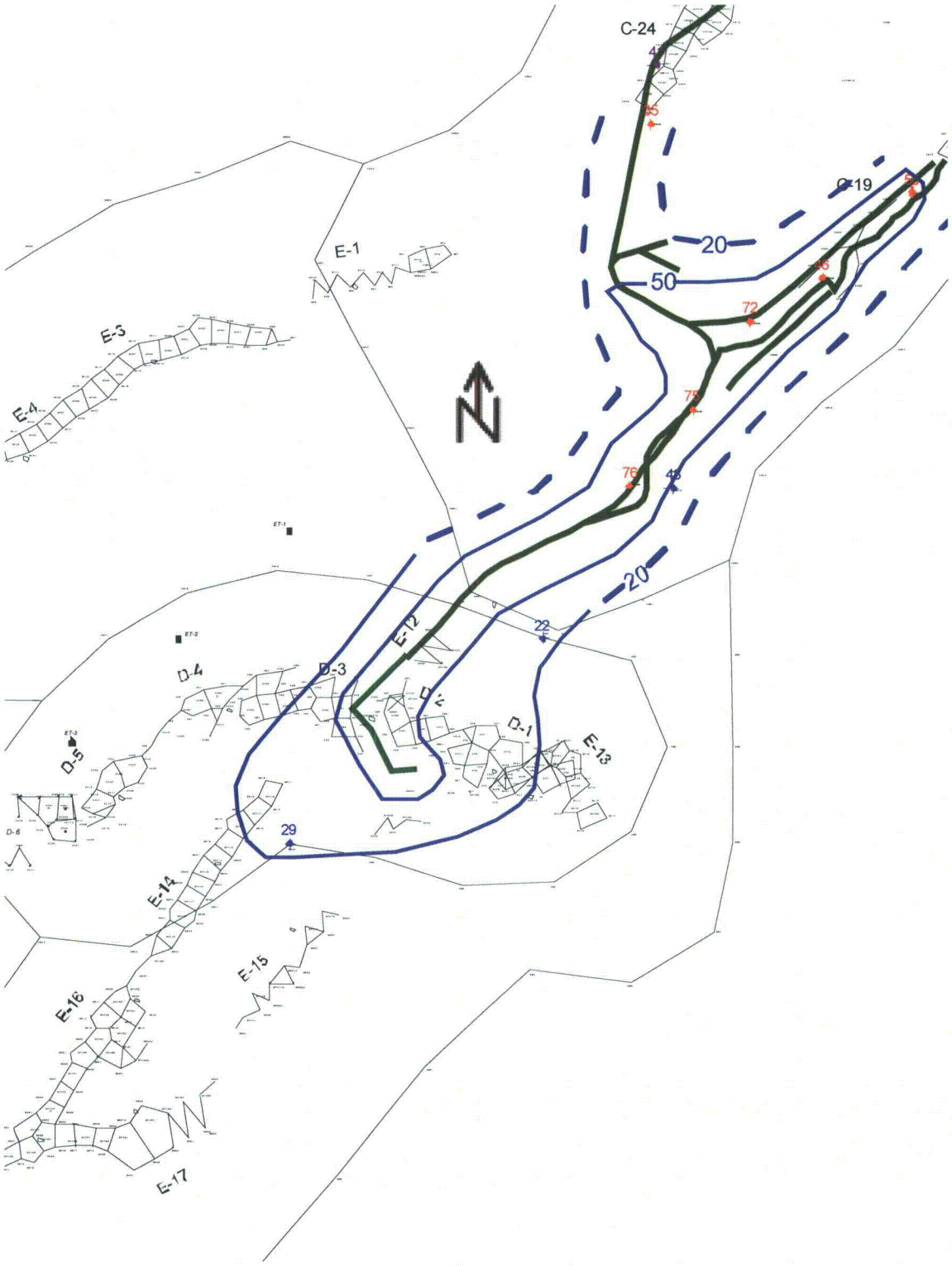

Figure 4. Chloride concentration (mg/L) in underground mine workings (red) and 40-Sand monitoring wells (blue), May 15-26, 2011.

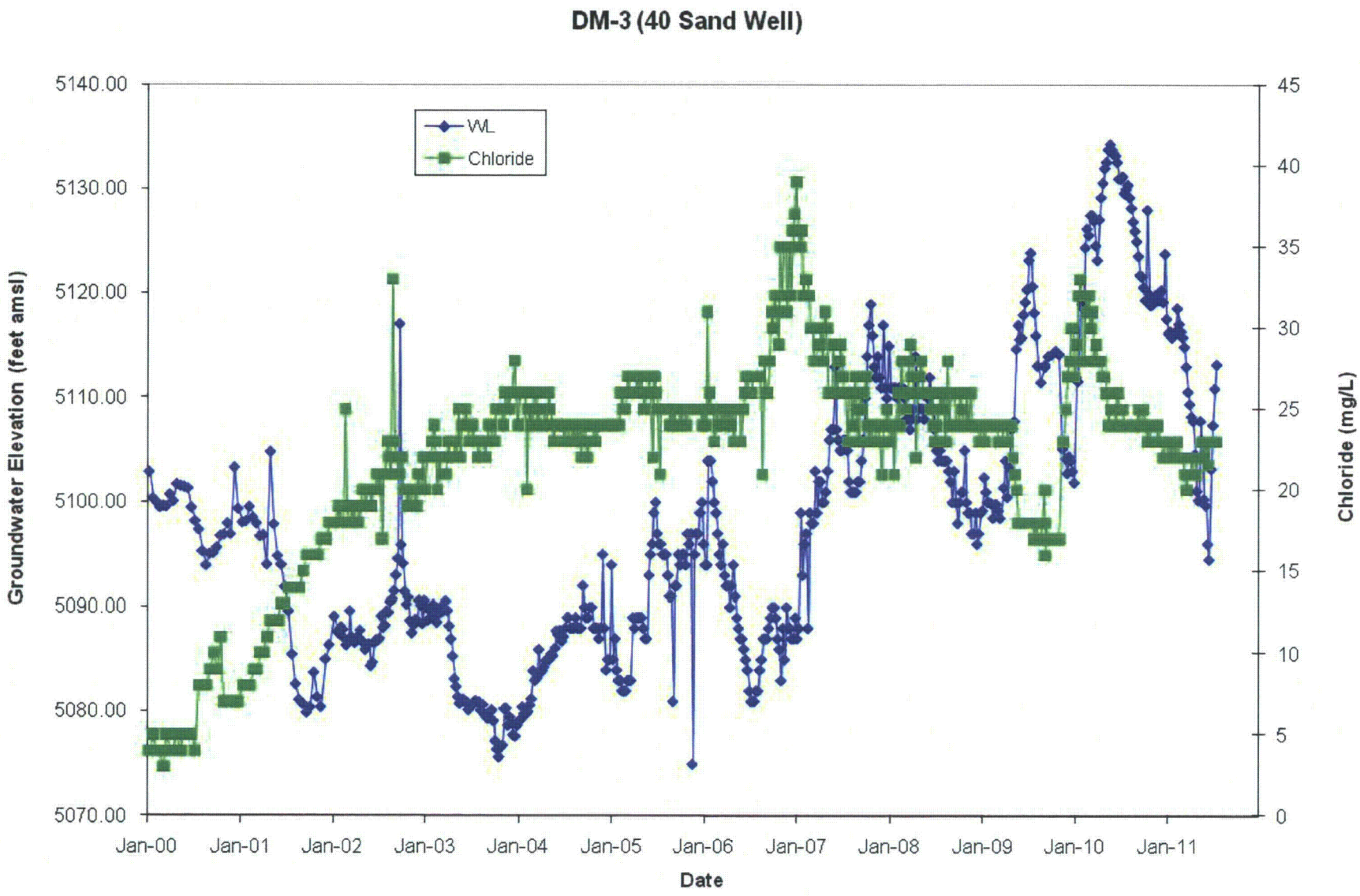

Figure 5. Chloride concentration (mg/L) in excursion well DM-3 over time.

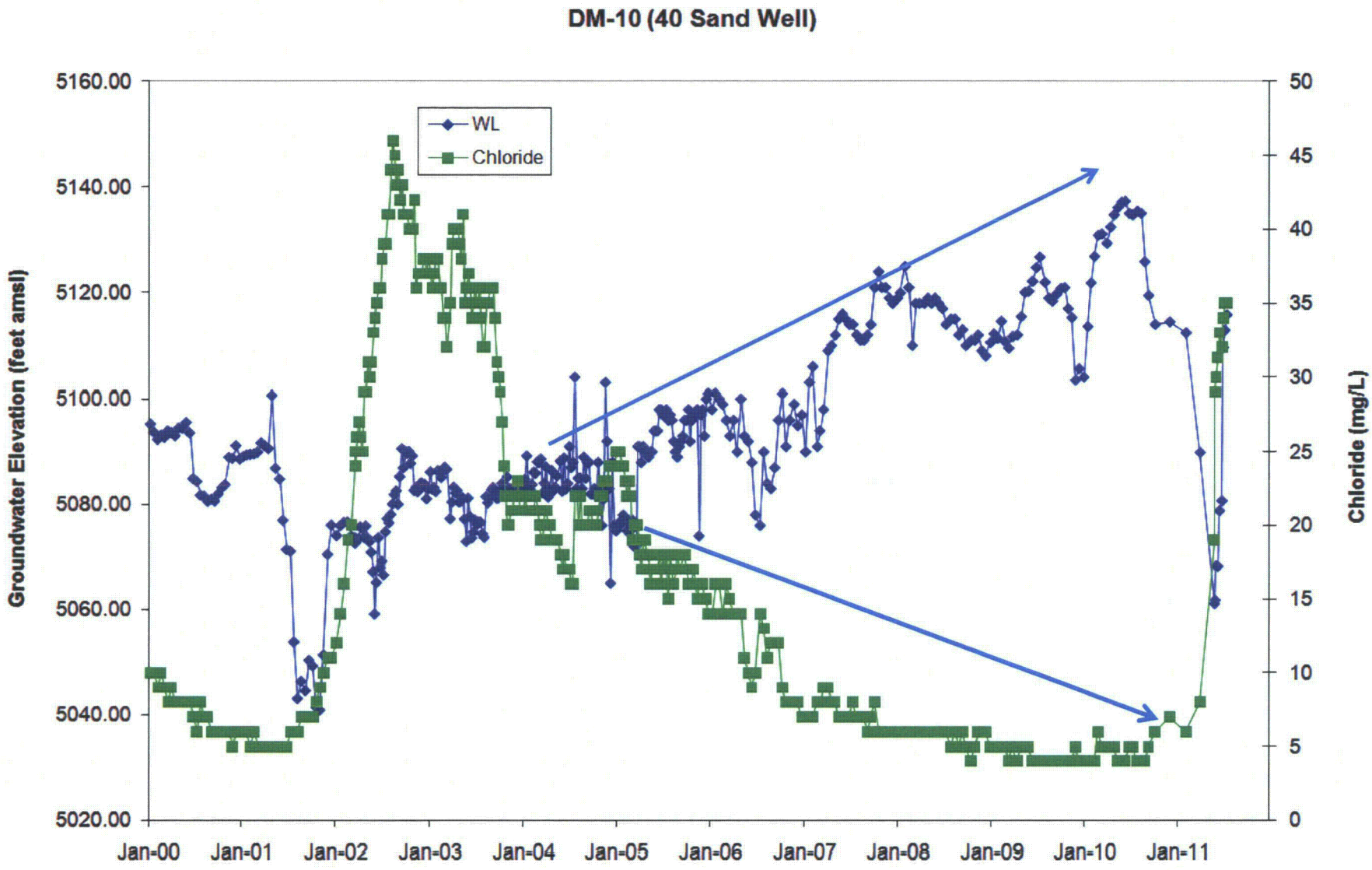

Figure 6. Chloride concentration (mg/L) in excursion well DM-10 over time. Note trend over six-year period from 2005 to 2011 indicated by arrows.

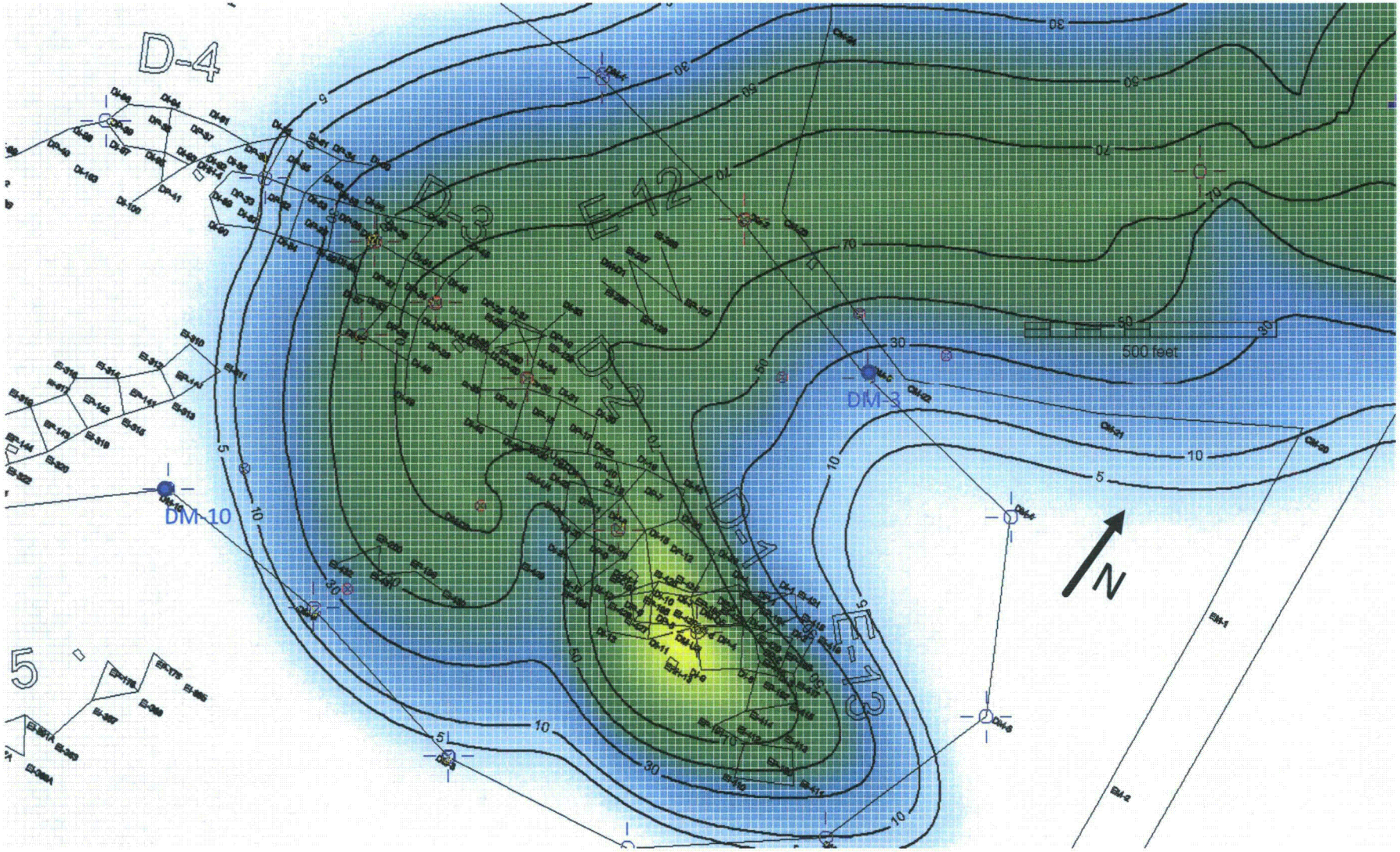

Figure 7. Model calibrated chloride concentration (mg/L) in MU-D as of May 2011.

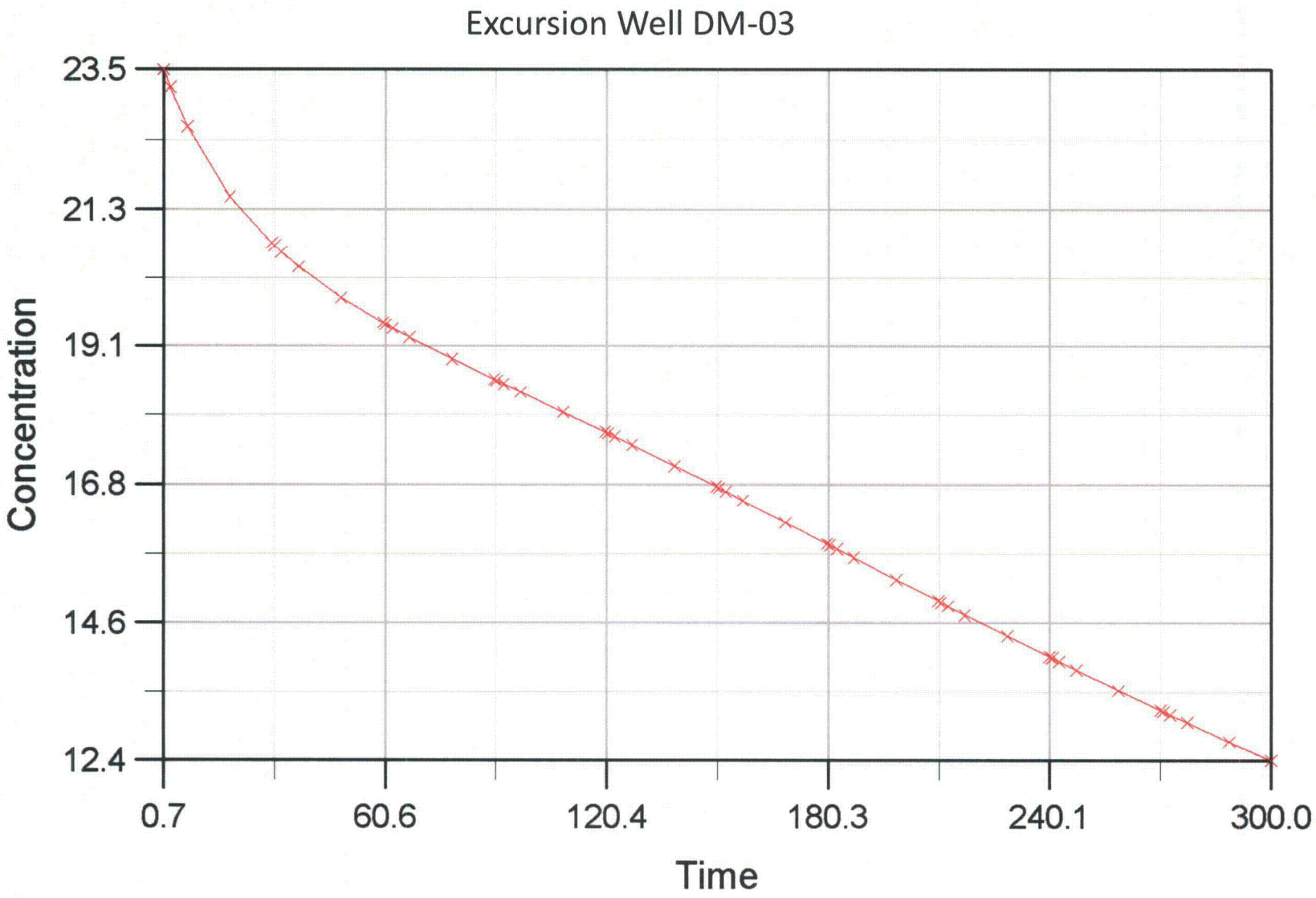

Figure 8. Model projected chloride concentration (mg/L) curve based on proposed excursion control and prevention plan.

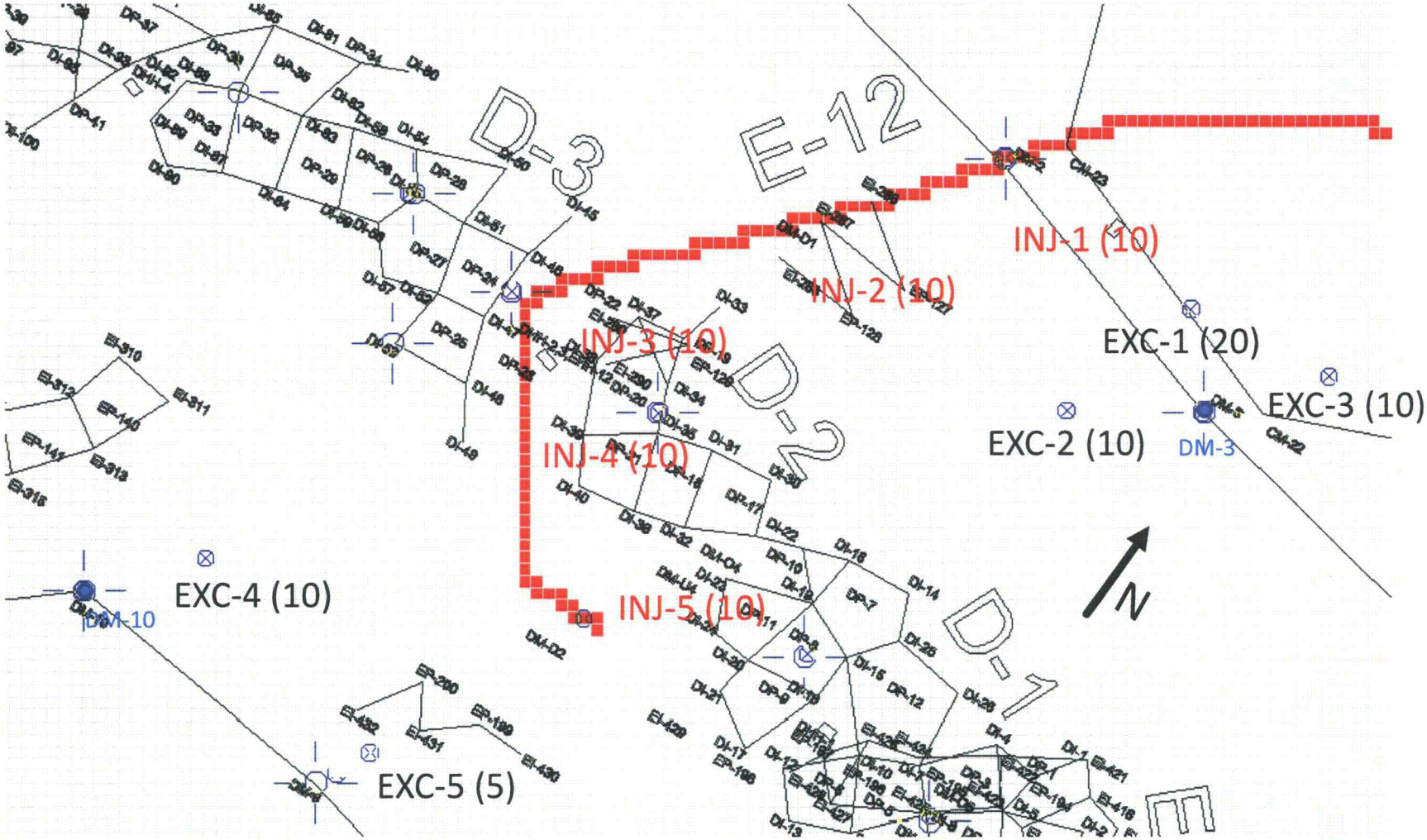

Figure 9. Excursion control and prevention plan well configuration. "EXC" wells are excursion control (and restoration) wells (to be installed). "INJ" wells are injection wells to be used for RO permeate injection (existing wells). Numbers in parentheses are approximate pumping or injection rates.