



Minnesota Pollution Control Agency

**CERTIFIED MAIL
RETURN RECEIPT REQUESTED**

June 2, 2003

Mr. Douglas Hildre, P.E.
Environmental Control Manager
United Defense LP
Armament Systems Division
4800 East River Road
Minneapolis, MN 55421-1498

RE: FMC Corporation Superfund Site

Dear Mr. Hildre:

The Minnesota Pollution Control Agency (MPCA) staff has reviewed the document entitled "Results of Site Work Conducted in May 2001," ("Report") dated November 2001. The Report was submitted pursuant to the Response Order by Consent between FMC Corporation (FMC) and the MPCA, dated October 28, 1986.

The MPCA staff hereby modifies the Report pursuant to Attachment I of this letter.

If you have any questions regarding this letter, please contact me at (651) 296-7818.

Sincerely,

A handwritten signature in black ink, appearing to read "David N. Douglas".

David N. Douglas
Project Manager
Superfund Unit 2
Superfund Section
Majors and Remediation Division

DND:csa

Enclosure

cc: David Seely, U.S. Environmental Protection Agency
Dan Owens, U.S. Navy

Attachment I

Modifications to the Report Entitled "Results of Site Work Conducted in May 2001," Dated November 2001

- 1.) **Confined Aquifer**, page 5-6 – Hydraulic head data from well nest MW21, MW39 and MW43 confirms an upward vertical gradient exists in the well nest area. The deeper Bedrock Aquifer exhibits much higher hydraulic heads than the overlying Confined Quaternary and Unconfined Quaternary Aquifers. The resulting head difference results in upward ground water gradients and potentially upward ground water flow from deep to shallower zones. The well nest that includes MW11, MW12, MW13 and MW14 (all screened in the confined Quaternary Aquifer) also confirms that an upward vertical gradient exists within the Confined Quaternary Aquifer.

Hydraulic head data from well nest MW29 and MW29A show an upward gradient between the two wells. The well that is screened deeper (MW29) has a higher head than MW29A (screened in the middle of the aquifer). The hydraulic head in MW29 is most likely dominated by the higher heads that exist deeper in the screened interval. Higher hydraulic head in the Bedrock Aquifer located below the well screen likely causes the higher hydraulic head in this well.

The limited FMC Site hydraulic head information confirms that upward vertical hydraulic gradients occur at the Site in the aquifers closer to the Mississippi River. Higher hydraulic heads occur in deeper wells screened in the Bedrock Aquifer or the lower portion of the Quaternary Aquifer than in the shallow unconfined aquifer and upper portion of the Quaternary Aquifer.

The vertical hydraulic head distribution is largely influenced by higher hydraulic heads in the Bedrock Aquifer. Offsite, closer to the Mississippi River, confining layers may be absent (see cross sections) and upward gradients would allow for the relatively unimpeded upward movement of deeper ground water into shallower zones. In areas where confining units may be located between the unconfined and confined aquifers, leakage may occur. In any event, higher hydraulic head will be present in the lower confined aquifer than in the unconfined aquifer at the FMC Site.

The influence of the Prairie du Chien Aquifer on head distribution has also been noted at the NIROP Site that is located directly north of the FMC Site. Monitoring results at the NIROP Site confirm that higher hydraulic heads occur in the bedrock aquifer and the lower portion of the Quaternary Aquifer than in shallow portions of the aquifer near the river. A draft United States Geological Survey (USGS) report recently completed for the NIROP Site, evaluating capture at the NIROP Site (evaluation is in progress), indicates that upward vertical gradients exist in the Anoka County Park area downgradient of the NIROP Site near the Mississippi River.

The information from the two sites is also consistent with what has been reported by the USGS in a study entitled Characterization of Ground-Water Discharge from Bedrock Aquifers to the Mississippi and Minnesota Rivers at Three Areas, Minneapolis-St. Paul Area, Minnesota (U.S. Geological Survey Water-Resources Investigations Report 94-4163) in an area north of Interstate 694. The deeper higher hydraulic heads are also consistent with the regional observation made by the USGS and others that the Prairie du Chien Aquifer discharges to, and provides base flow to the Mississippi River.

Due to differences in the vertical hydraulic head with depth at the FMC Site, it is likely that an offsite monitoring well, screened over an entire section of the confined Quaternary Aquifer, provides a "pipe" through which ground water flow readily occurs in the vertical direction. Water in the well would tend to flow from higher hydraulic head zones in the deeper screened interval to lower hydraulic head zones higher in the screen. Vertical flow in the well annulus occurs and may dominate over horizontal flow in the aquifer due to the vertical head differential over the screened interval. Most of the downgradient monitoring wells at the FMC Site are constructed with long screens and would experience this problem.

Assuming that flow-through within the well occurs, it is not surprising that samples collected at various intervals in the well have similar contaminant concentrations. It is most likely that all samples collected in the well are samples of deeper water that has flowed upward in the well annulus seeking zones of lower head higher in the well. With this type of flow in the well, the samples would not represent samples from discrete horizontal aquifer interval and most likely do not represent the aquifer conditions in the zone in which the sample was collected. Instead, samples would be composed of water from the deeper aquifer zone that has flowed up through the well. Interactions between water in the well and the surrounding aquifer over the entire length of the screen would be impossible to predict with any acceptable degree of certainty.

Short circuiting of flow of deeper water out of the well into higher permeable aquifer zones (of lower head) higher in the screen is also a potential problem that would prevent collection of discrete samples. Some deep water is likely to flow upward in the well until a zone of lower head is reached. In those zones deeper water from within the well may flow out of the well into the surrounding aquifer. It is possible that contaminated water in shallower zones might be displaced by cleaner deep derived water. Collection of discrete aquifer samples from different horizons in the aquifer is not possible and prevents identification of contaminant stratification in the aquifer. The issue of cross contamination or migration of contaminants from one zone to another within the well is also a potential problem in the wells with long screen construction.

In addition, hydraulic head data, from long screened wells, is not reliable data with which to construct equipotential maps. Wells screened over long distances of aquifer, over which vertical gradients exist, do not reflect hydraulic head values for discrete aquifer intervals. Any vertical gradients which may exist are lost and cannot be evaluated. Such gradients may have an impact on the distribution and fate of contaminants.

These sampling difficulties prevent proper evaluation of the vertical distribution of the plume and the evaluation of the changes in concentration with depth. Lack of definition of the downgradient plume prevents proper mapping of the plume in a vertical and horizontal direction. The lack of proper definition of the plume makes evaluation of the effectiveness of implemented remedies in capturing the plume nearly impossible. A determination as to whether or not remedy objectives have been met cannot be made and the potential impacts of the plume cannot be evaluated. These problems have been identified in past Five-Year Reviews of the FMC Site and continue unresolved today.

The MPCA staff has determined that the data from these wells and the uncertainty of the plume distributions is unacceptable information upon which to make FMC Site decisions.

- 2.) **Conclusions – Monitoring Well Network** – page 22 - The MPCA staff rejects the conclusion of the report that the long-screened offsite monitoring wells are adequate to monitor the offsite FMC Site plume either hydraulically or chemically (see Modification 1).
- 3.) **Conclusions – Ground water Sampling and Analysis** – page 22 – The MPCA staff rejects the conclusion that long-screened wells do not need to be replaced with short-screened and/or nested short screened monitoring wells. The monitoring well results do not substantiate that trichloroethylene (TCE) concentrations show no significant vertical gradient due to the problems identified in Modification 1. The vertical distribution of TCE in the offsite plume cannot be determined from the existing long-screened wells (see Modification 1).
- 4.) The MPCA staff requests that UDLP prepare a work plan within 90 days or receipt of this letter for MPCA staff review and approval to use push-probe technology to sample ground water at discrete vertical and aerial intervals in the unconfined and confined offsite plume areas to determine the vertical and lateral distribution of offsite volatile organic contaminant (VOC) contamination and to define the FMC Site plumes. The work shall be conducted in the offsite area south of where the push probe work for the NIROP Site was terminated. The MPCA staff suggests that a meeting be scheduled to scope the effort of work prior to development of a work plan.
- 5.) The MPCA staff requests that the results be submitted in a report of findings within 90 days of approval of the work plan and that the report include text and figures that describe and show the aerial and vertical extent of the offsite unconfined and confined VOC plumes and the variation of VOC concentration vertically and horizontally. The maps shall include cross sections showing iso-concentrations that indicate the vertical distribution of the unconfined and confined plume. Any low permeability deposits that influence the flow of ground water shall be identified on the cross sections.
- 6.) Based on the report of findings, UDLP shall produce a work plan for MPCA staff review and approval for the installation of a monitoring network within 90 days of approval of the report cited in Modification 5 above. The monitoring well network shall monitor the offsite plumes and the effect of remedial measures to prevent offsite migration of the unconfined and confined plumes.

The wells shall be used to monitor the progress of the remedial measures and to monitor remedial goals. If necessary, the network may include nested monitoring wells or a mixture of nested and single monitoring wells. A review of all existing monitoring wells both on and offsite shall be included to determine which existing onsite monitoring wells should be monitored along with the new monitoring wells.

- 7.) The MPCA staff does not have confidence in the offsite ground water data presented in the Ground water Extraction System Annual Monitoring Reports (Annual Monitoring Reports) that are submitted to the MPCA staff based on concerns with the monitoring wells outlined in this letter and the lack of definition of the FMC Site plumes. The MPCA staff requests that any further ground water sampling of offsite monitoring wells be discontinued until such time that the work as requested above is completed and an appropriate monitoring network for the unconfined and confined aquifers as approved by the MPCA be installed at the FMC Site. At such time monitoring of offsite wells shall resume as well as reporting of the data in the annual monitoring reports.
- 8.) These modifications are hereby incorporated by reference for the MPCA staff modifications to report entitled Review of Ground water Extraction System Annual Monitoring Report for 2001, FMC Superfund Site, Fridley, MN, dated June 2002.