COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS

DEPARTMENT OF ENVIRONMENTAL PROTECTION

OFFICE OF APPEALS AND DISPUTE RESOLUTION

IN THE MATTER OF

MASSACHUSETTS DEPARTMENT OF CONSERVATION AND RECREATION

Docket No. WET-2009-039

DEP FILE #233-0641

NATICK, MA

TESTIMONY OF DENIS W. D'AMORE, P.E., Ph.D

I, Denis W' D'Amore, do hereby swear and affirm the following:

1. I am a self-employed consulting environmental engineer and groundwater hydrogeologist. My place of business is in Lancaster, Massachusetts. I received a Bachelor of Science from Boston University in 1967, my Masters of Arts in Geology in 1985 and my Ph.D. in Geology in 1988.

2. I have been a professional hydrogeologist for 21 years and a professional engineer in the environmental discipline for the past 15 years. I am a specialist in the areas of surface and ground water hydrogeology and subsurface contaminant transport. I became a Massachusetts Licensed Site Professional in 1993. I worked for five years at the Massachusetts Department of Environmental Protection in the Division of Water Supply where my focus was contaminated municipal ground water supplies. As a private consultant, I have continued to work with contaminated sites as well as developing new ground water supplies for municipalities and private developers.

3. I have been retained by the petitioners in this matter to determine the likelihood of migration of the pesticide diquat dibromide (a.k.a. diquat) from Lake Cochituate to ground water and the potential to reach the Evergreen wellfield, a public water supply for the Town of Natick. I have

undertaken this work on a *pro bono publico* basis. My opinions as set forth herein are stated to a reasonable degree of scientific certainty.

4. I have examined several documents pertaining to this matter. These include:

- "Pond-Aquifer Interaction at South Pond of Lake Cochituate, Natick, Massachusetts" U.S. Geological Survey Water-Resources Investigation Report 01-4040, Northborough, MA, 2001.
- "Extended Pump Test Report and Zone II Delineation for the Evergreen and Springvale Wells, Natick, Massachusetts" Tata & Howard, Inc., January 23, 2002.
- DEP Superseding Order of Conditions, DEP File # 233-0641, August 6, 2009
- Testimony of Warren J. Lyman, DEP File # 233-0641, Docket No. WET-2009-069, October 26, 2009
- Testimony of Emily Monosson, DEP File # 233-0641, Docket No. WET-2009-069, October 30, 2009

In addition to reviewing the above documents, I conducted a inspection of the site on November 1, 2009 that included walking the shoreline from the beach and boat ramp area to the culvert that passes beneath the Massachusetts Turnpike where Middle Pond discharges to North Pond as well as the peninsula where the Evergreen wells are located.

Hydrogeology of Lake Cochituate

5. Lake Cochituate is comprised of four ponds connected by shallow waterways. Surface water flows northward through the four ponds from South Pond, Carling, Middle and North Ponds before discharging to Cochituate Brook. The four ponds were formed in a bedrock valley following the last period of continental glaciation approximately 19,000 years ago when large blocks of ice that were stranded by the retreating ice sheet were surrounded and covered by stratified drift deposits consisting of silt, sand and gravel. When the ice blocks melted, the stratified drift deposits formed the banks and bottom sediments of the ponds. The bottom sediments of the ponds generally consist of thick sequences of fine-grained sediments while wave action inhibits deposition of this fine-grained material in shallower water along the pond bank meaning that the sediment along the shores of the pond are generally more permeable than the bottom sediments.

6. The Evergreen municipal wells are located on a peninsula of sand and gravel at the north end of Middle Pond immediately south of the Massachusetts Turnpike. Well # 1 and Well # 3 are gravel packed wells that are 62 feet and 59 feet deep, respectively. The wells are screened below a depth of 42 feet (Well # 1) and 44 feet (Well # 3). Well # 2 was taken out of service and replaced by Well # 3, which is located immediately adjacent to it. The DEP Division of Water Supply data base reports that Well # 1 has an approved pumping rate of 1,650 gallons per minute (gpm) and Well # 3 has an approved pumping rate of 1,805 gpm. The well field is located approximately 1,000 feet from the beach and boat ramp where the use of diquat is proposed. The nearest point of application is 900 feet while the most distant point is 1,280 feet.

7. Using isotope analyses of oxygen and hydrogen, the USGS determined the leakance of pond water into the aquifer at the Springvale well field. Their conclusion based upon this approach was that for an average pumping rate of the Springvale wells of 1.6 Mgal/day (million gallons per day), the estimate of pond water infiltrating into the aquifer and discharging to the well field is 1 Mgal/day and the estimate of water derived from ground water is 0.6 Mgal/day. In lay terms, this means that 62.5% of the water being pumped from the Springvale wells is coming from the pond.

8. In 1997, Tata & Howard conducted a seven-day pump test on Evergreen Wells # 1 and # 2. During that period, the wells were pumped at a combined rate of 4.19 Mgal/day. A total drawdown of 13.24 feet and 15.47 feet was recorded in Evergreen wells # 1 and #2, respectively. Following the replacement of Well # 2 in Fall 2001, an extended pump test was conducted on Evergreen Well # 3 for a period of six days. The replacement well was pumped at a rate of 1,800 gpm and Evergreen Well # 1 was pumped at a rate of 1,100 gpm. The combined pump rate was 4.18 Mgal/day and stabilization was reached in 5.5 days. That the two production wells could pump at such a high rate and reach a stabilized average drawdown of 14.35 feet within a seven day period speaks to the extremely high permeability of the sand and gravel that exists on the peninsula where the wells are located and the extremely high degree of hydraulic connection between the pond and the wells. The minimal drawdown produced under such a severe stress means that there is little resistance to the flow of pond water to the wells.

9. To determine the zone of capture for the Evergreen and Springvale wells (i.e., the Zone II, which, by definition, is that area of an aquifer that contributes water to a well(s) under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of maximum pumping with no recharge from precipitation), Tata & Howard constructed a three-dimensional ground water flow model that included both the aquifer and Lake Cochituate. After successfully calibrating the model, it was run under Zone II conditions and a resultant delineation of the Zone II boundary was defined and accepted by the MassDEP. Focusing strictly on that portion of the Zone II in the vicinity of the Evergreen wells, the boundary encompasses all of the peninsula where the wells are located and the embayment immediately north of the peninsula. The Zone II boundary extends to the shoreline opposite the peninsula which is immediately next to the boat ramp. The western boundary of the Zone II is approximately 300 feet from the limit of the diquat application area.

10. This embayment is the only outlet to Middle Pond. Pond water in Middle Pond flows from its southern extremity northward passing in front of the beach and boat ramp into the embayment before discharging through a box culvert that passes beneath the Massachusetts Turnpike. As water flows into the embayment, a certain percentage of it will infiltrate through the side of the penninsula that the Evergreen wells are located on and through the bottom sediments of the embayment. This pond water will enter the aquifer and be pumped into the Evergreen wells.

11. Diquat that is applied to the water in front of the beach area and boat ramp will go into solution some of which will be carried into the embayment and subsequently into the aquifer and the Evergreen wells.

Conclusion

12. It is my opinion that applying diquat along the shoreline in front of the beach and boat ramp areas will degrade the pond water that flows into the embayment immediately adjacent to the application area where significant induced infiltration under the influence of pumping the Evergreen wells occurs. Given the magnitude of pumping (4.18 Mgal/day) of the Evergreen wells and the estimated portion that comes from surface water (2.6 Mgal/day) (i.e., 62% as determined by Tata & Howard), the likelihood that diquat-contaminated water will enter the aquifer and subsequently the municipal wells is high.

Signed under the pains and penalties of perjury on this 12th day of November, 2009.

Denis D'Amore, P.E., Ph.D.