Emery & Garrett Groundwater Investigations, LLC (EGGI)
56 Main Street • P.O. Box 1578
Meredith, New Hampshire 03253
(603) 279-4425 *www.eggi.com* *Fax (603) 279-8717*

EXECUTIVE SUMMARY
OF THE PHASE II INVESTIGATION TO POTENTIALLY DEVELOP A COMMUNITY WATER SUPPLY AT THE EPPING CROSSING DEVELOPMENT SITE

Conducted for

The Town of Epping, New Hampshire

March 4, 2013

I. INTRODUCTION

Emery & Garrett Groundwater Investigations, LLC (EGGI) is pleased to present the following Executive Summary of the Phase II investigation conducted on the Epping Crossing Development Site. This investigation was conducted as a follow-up to recommendations provided in EGGI's Phase I investigation. The Phase II investigation was designed to determine if there are identifiable 'fatal flaws' that would prohibit the use of these wells for a community water supply under the New Hampshire Department of Environmental Services (NHDES) Large Groundwater Withdrawal permitting process. Furthermore, this investigation served to: 1) evaluate the potential sustainable yield from these wells, 2) assess the potential quality of the groundwater produced by these wells, 3) assess the water level recovery (recharge) after an extended pumping test, and 4) assess the potential adverse impacts (if any) to wetlands and/or nearby Piscassic and Lamprey Rivers.

A preliminary investigation of the background data, short-term pumping tests, and water quality sampling and analysis program conducted on each of the potential Production Wells (Wells A1, D2, E1, F1) and the Wheelabrator Well served to focus the remainder of the Phase II investigation on proposed Production Wells D2 and E1.

This summary provides a brief outline of the efforts conducted during this Phase II Assessment and a concluding statement with EGGI's Professional Opinion regarding the development of these wells for a Community Water Supply.

II. PUMPING TEST DESIGN FOR PROPOSED PRODUCTION WELLS D2 AND E1

- A total of 16 Monitoring Wells were sampled prior to the pumping test for Volatile Organic Compounds (VOCs), 1,4-Dioxane, and Arsenic.
- In order to monitor groundwater and surface water levels during the pumping test, 31 automated water level recorders were installed by EGGI in the proposed Production Wells and monitoring locations prior to the five-day pumping test, as follows:
  - 4 - Bedrock Wells (including Wells D2 and E1)
  - 1 - Hybrid Well (the Wheelabrator)

  - 18 - Monitoring Wells
    - 5 - Wells below the clay layer
    - 4 - Existing Monitoring Wells below the clay layer
    - 9 - Existing Monitoring Wells above the clay layer
  - 5 - Shallow Piezometers to monitor for potential impacts to surface water.
  - 3 - Surface Water Monitoring Stations including the Piscassic River, Clay Pond and the Clay Pond discharge location.
- Temporary Discharge Lines ranging in length from 500 to 1,500 feet were installed to convey the water from each well to a flowing stream.
- A Temporary Surface Water Discharge Permit was obtained from the NHDES to discharge water from Wells D2 and E1 into a nearby flowing creek during the extended pumping tests.
- No off-site wells were monitored during this pumping test program.
- Water level monitoring began approximately 28 days prior to the five-day pumping test.
- More than 60 days of water level data have been collected at each monitoring location.

III. PUMPING TEST SUMMARY/RESULTS

- Proposed Production Wells D2 and E1 were each pumped at 225 gallons per minute (gpm) [or 324,000 gallons per day (gpd) per well].
- The combined pumping rate for Wells D2 and E1 was 450 gpm (or 648,000 gpd).
- More than 3.2 million gallons of groundwater was pumped from the bedrock aquifer during the simultaneous five-day pumping period.

IV. WATER QUALITY RESULTS

- **Summary from previous investigations by others.**
  - Well A1 - Toluene was detected ranging from 0.6 to 24 parts per billion (ppb) (Spring - Summer 2005).
  - Well A1 - 2-Butanone (MEK) was detected at trace levels (Spring 2005).
  - VOCs were previously detected in shallow overburden wells include acetone, 2-Butanone (MEK), Toluene, Ethylbenzene, p-Isopropyltoluene, cis-1,2,-Dichloroethene, and Tetrachloroethene (PCE) (Spring-Summer 2005).
  - Toluene and Tetrachloroethene (PCE) are the only compounds that were previously detected above the Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs) in the shallow wells (Summer 2005).
  - Tetrachloroethene (PCE) was detected in shallow piezometer GP-3 at 20 ppb. (The EPA MCL is 5 ppb.) (Summer 2005).
  - Toluene was detected in three shallow piezometers (GP-1, GP-2, and GP-3) and Monitoring Well MW7. The levels detected ranged from non-detect to 6,100 ppb. (The EPA MCL is 1,000 ppb.) (2005- 2007).
  - ***As a result of the significant decline in the Toluene levels detected from 2005 to 2007 in the monitoring wells and the non-detection of other previously detected***

compounds (with the exception of Ethylbenzene, which was detected in Well MW7 in the summer of 2007), the NHDES issued a 'Certificate of No Further Action' on January 17, 2008 for the Epping Crossing Development Site.[1]

- **EGGI Short-Term Pumping Tests on Wells A1, D2, E1, F1, and the Wheelabrator Well *(December 17 – 20, 2012)***
  - No VOCs were detected in any of the five potential Production Wells.

- **EGGI Sampling of 16 Monitoring Wells *(prior to the five-day pumping test program)***
  - 1,4,-Dioxane was detected in Monitoring Well MWB ranging from 0.38 to 0.5 parts per billion (ppb).
  - 1,1-Dichloroethane (DCA) was detected in Monitoring Well MWB at 0.6 ppb (the laboratory's lowest ability to detect this compound).
  - Toluene was detected in Monitoring Well MW3 at 12 ppb.
  - 1,2,4-Trimethylbenzene was detected in Monitoring Well MW6 at 0.6 ppb.

- **EGGI Sampling of Production Wells D2 and E1 *(during the five-day pumping test program)***
  - The quality of the water produced by Wells D2 and E1 is generally of excellent quality. Treatment will be required to remove arsenic from both Wells D2 and E1 to meet EPA Drinking Water Standards. The manganese level in Well E1 is elevated above the EPA Secondary Drinking Water Standard and will likely require treatment; however, the treatment method chosen to remove the arsenic will likely also remove the manganese.
  - A summary of the water quality samples collected during the five-day pumping test is presented on Table I (attached).
  - MTBE was detected in one of six Volatile Organic Compound (VOC) samples collected from Well D2 during the first 24 hours of the pumping test at the laboratory's minimum detection level of 0.5 ppb. However, no other samples analyzed during the remainder of the pumping test contained MTBE.
  - Of particular note are the following: No bacteria were detected in Wells D2 or E1 and the Microscopic Particulate Analyses (MPAs) collected from each well determined that the groundwater is **not** under the direct influence of surface water.

- **EGGI Sampling of 14 Monitoring Wells *(post pumping test)***
  - No VOCs were detected.

[1] A detailed summary of the previous water quality sampling events and results conducted by others has been summarized in Emery & Garrett Groundwater, Inc. 2012 Desktop Assessment, The Epping Crossing Development Site, A Preliminary Evaluation of Potential Bedrock Water Supply Wells. Conducted for: The Town of Epping, Office of the Water & Sewer Commission, Epping, New Hampshire.

- **Range of Arsenic Levels Detected in ALL SAMPLES Collected by EGGI**
  - Shallow Overburden Wells--- Non-Detect to 0.076 mg/l.
  - Deep Overburden Wells--- 0.007 to 0.031 mg/l.
  - Bedrock Wells--- Non-Detect to 0.024 mg/l.

V. WHEELABRATOR WELL (EVALUATION OF SCREENED PORTION OF WELL)

- An investigation of the Wheelabrator Well was conducted to determine whether groundwater with low arsenic could be produced from the shallow overburden sediments that could be mixed with the groundwater produced from the deep bedrock wells (Wells D2 and E1) in an attempt to eliminate or reduce the need for arsenic treatment.
- A well video log was conducted to confirm the screened interval depth.
- A pneumatic well packer was installed from 60 to 63 feet below ground surface to seal off the lower bedrock portion of the Well.
- A short-term pumping test was conducted at 73 gpm to evaluate the yield of the Wheelabrator Well and to collect water quality samples.
- Two samples collected for arsenic analysis determined that the level of arsenic ranges from 0.021 to 0.022 mg/l.
- The shallow overburden aquifer will not be a potential source of low arsenic groundwater for mixing with the water withdrawn from the bedrock Production Wells. Therefore, the groundwater produced by the bedrock wells will require treatment to reduce the arsenic level.

VI. PRELIMINARY PROFESSIONAL OPINION

Emery & Garrett Groundwater, Investigations, LLC (EGGI) has conducted a preliminary but detailed investigation of the Epping Crossing Development Site for the Town of Epping's Water & Sewer Commission. This investigation was conducted under an extremely tight timeline and adverse winter weather conditions. The timeline of events to make this investigation possible is presented at the end of this summary. The result of this investigation strongly indicates that Wells D2 and E1 are capable of producing a combined yield of 450 gpm or 648,000 gpd, which is nearly double the 350,000 gpd water supply capacity that the Town of Epping desires to develop from this property.

Water level drawdown was observed in 12 monitoring wells as a result of the simultaneously pumping of proposed Production Wells D2 and E1. Water level drawdown in wells located near the property boundary ranged from no impact to 22 feet of interference drawdown. No water level drawdown was observed in any of the shallow piezometers or in the shallow monitoring wells. The quality of the water produced by Wells D2 and E1 is generally of excellent quality. Treatment will be required to remove arsenic from both Wells D2 and E1 to meet EPA Drinking Water Standards. The manganese level in Well E1 is elevated above the EPA Secondary Drinking Water Standard and will likely require treatment; however, the treatment method chosen to remove the arsenic will likely remove the manganese.

Based upon the preliminary data collected during this investigation, it does not appear that pumping of proposed Production Wells D2 and E1 will adversely impair local wetlands or the Piscassic or Lamprey Rivers. However, it is likely that the NHDES will require a more extensive water level monitoring program of the local wetlands and Rivers as part of an extended pumping test required to be performed during the Final Large Groundwater Withdrawal Permitting process. Water levels in local domestic wells and nearby public water supply wells will also need to be monitored as part of a Large Groundwater Withdrawal Permitting Process to fully assess any potential off-site water level impacts.

Based upon EGGI's Phase I Investigation and this Phase II investigation, EGGI recommends that this project move forward with a Preliminary Hydrogeologic Report and that an Application submittal be made to the NHDES to begin the process of requesting a Large Groundwater Withdrawal Permit to utilize these wells as a future water supply source for the Town of Epping.

VII. LIMITATIONS

EGGI has collected and evaluated the available technical data according to professionally accepted scientific standards. It is to be recognized that the testing program was limited to that which is presented in this report and occurred during a specific climatic period. The recommendations provided herein represent EGGI's professional opinion based upon the data collected and do not constitute a warranty written or implied.

PROJECT TIME LINE

EPPING CROSSING DEVELOPMENT SITE – TOWN OF EPPING, NEW HAMPSHIRE

- **November 15, 2012 –** EGGI submitted Final Phase I report to the Town
- **December 3, 2012 –** Board of Selectmen and Water & Sewer Commissioners met and agreed to authorize EGGI to proceed with Phase II investigation.
- **December 5, 2012 –** Stake out monitoring well locations and apply for Dig Safe clearance to drill wells.
- **December 10, 2012 –** Began drilling of Monitoring Wells.
- **December 12, 2012 –** Began Monitoring Well sampling program.
- **December 13, 2012 –** Began installation of water level monitoring equipment.
- **December 18, 2012 –** Began clearing and installation of discharge lines.
- **December 17-20, 2012 –** Conducted Short-Term Pumping Tests on Wells D2, F1, A1, and the Wheelabrator Well.
- **Late December/Holiday Period –** Regrouped and applied for surface water discharge permit, and organize pumping test plan.
- **January 7-9, 2013 --** Installed submersible pumps in Wells and completed the pumping test setup.
- **January 10-15, 2013 –** Conducted the Five-Day Pumping Test and Water Quality Sampling Program.
- **January 15-21, 2013 –** Performed preliminary water level recovery monitoring.
- **January 23-24, 2013 –** Resampled Monitoring Wells.
- **January 28, 2013 –** Conducted video log of the Wheelabrator Well and Well D2.
- **January 30, 2013 –** Performed Wheelabrator Well Packer Test and Water Quality. Sampling.
- **February 1, 2013 –** EGGI and Town Boards met to discuss project findings.
- **February 5, 2012 –** EGGI presented the findings of this groundwater investigation to the Town of Epping at the Deliberative Session.

TABLE I
Results of Laboratory Analyses of Water Quality Samples
Combined Five-Day Pumping Test of Proposed Production Well D2 and Well E1
Epping Crossing Development Site
Epping, New Hampshire

Well	Date Sampled	Lab	Iron	Manganese	Arsenic	pH	Alkalinity (mg/l)	Chloride (mg/l)	Turbidity (ntu)	Hardness (mg/l)	Total Dissolved Solids (mg/l)	Sulfate (mg/l)	Nitrate (mg/l)	VOCs (ug/l)	SOCs (mg/l)	1,4-Dioxane (mg/l)
		MCL	***0.30***	***0.05***	***0.01***	***6.5-8.5***		***250***			***500***	***250***	***10***			
Well D2	**1/11/2013**	**NTL**	0.140	**0.251**	**0.020**	7.60	76	94	0.6	100	260	19	ND	ND	ND	--
	1/11/2013	**EAI**	--	--	**0.018**	--	--	--	ND	--	--	--	--	MTBE 0.5	--	ND
	1/13/2013	**EAI**	--	--	**--**	--	--	--	--	--	--	--	--	ND	--	ND
	1/14/2013	**NTL**	0.098	**0.223**	**0.019**	7.80	80	88	0.3	90	250	19	ND	ND	ND	--
	1/14/2013	**EAI**	0.090	**0.230**	**0.018**	--	--	--	ND	--	--	--	ND	ND	ND	ND
	1/15/2013	**EAI**	--	--	**0.018**	--	--	--	--	--	--	--	--	ND	--	ND
Well E1	**1/11/2013**	**NTL**	ND	0.029	**0.016**	8.30	84	10	ND	18	140	16	ND	ND	ND	--
	1/11/2013	**EAI**	--	--	**0.014**	--	--	--	ND	--	--	--	--	ND	--	ND
	1/13/2013	**EAI**	--	--	**--**	--	--	--	--	--	--	--	--	ND	--	ND
	1/14/2013	**NTL**	ND	0.028	**0.017**	8.4	86	12	ND	18	140	16	ND	ND	ND	--
	1/14/2013	**EAI**	ND	0.027	**0.014**	--	--	--	ND	--	--	--	ND	ND	ND	ND
	1/15/2013	**EAI**	--	--	**0.013**	--	--	--	--	--	--	--	--	ND	--	ND

Well	Date Sampled	Lab	Gross Alpha	Radium 226	Radium 228	Radon
		MCL	***15 pCi/l***	***15 pCi/L combined***		***pCi/L***
Well D2	**1/14/2013**	**EAI**	1.9	0.1	0.3	1931
Well E1	**1/14/2013**	**EAI**	0.5	0.2	0.4	2310

BACTERIOLOGICAL RESULTS: Three samples taken from each well, at regular intervals, and subjected to MPN analysis.

Results are as follows: Well D2: all samples absent for total coliform bacteria and E. coli.
Well E1: all samples absent for total coliform bacteria and E. coli.

ND - no detected above the miniumum detection level.
items in bold are equal to, or exceed, primary or secondary drinking water standards
-- = Parameter not analyzed for during sampling round.
LAB CODES: NTL = National Testing Laboratories
EAI = Eastern Analytical, Inc.