Regional Groundwater Flow and Hydrogeology and Potential PFAS Impacts to Water Supply Wells in the Areas surrounding Devens, MA

Regional groundwater flow and information available regarding geology and hydrogeology in the Devens, MA area were reviewed to assess potential impacts from PFAS to water supply wells in the surrounding areas. The results of this evaluation and information reviewed are discussed below and shown on the attached plates. Specifically, EPA has expressed concerns with potential PFAS impacts to wells within the towns of Harvard and Shirley, MA in the areas described below.

EPA has expressed concern regarding groundwater originating at Devens impacting wells located across hydraulic groundwater divides such as Cold Spring Brook and Bowers Brook in the town of Harvard, MA. Based on a review of site topography, overburden soil thickness, overburden soil characteristics, modeled groundwater flow contours, groundwater hydraulic gradients, and aquifer transmissivity, it is unlikely that potential PFAS impacts to these wells would be a result of groundwater originating from the former Fort Devens property west of Cold Spring Brook.

In the town of Shirley, MA, no PFAS impacts are expected at the Walker water supply well or the private wells located along Walker Road. Groundwater from the former Fort Devens Main Post discharges to the Nashua River and water entering the Walker Road wells is originating from an area west of the former North Post. Areas of contamination (AOCs) in the former North Post are flowing to the immediately-adjacent Nashua River, and are not flowing toward Walker Road in Shirley, MA.

The Army has identified potential wells that could be impacted (i.e., Grove Pond well, MacPherson well) and believes that no other public supply/private wells in Harvard or Shirley would be impacted by groundwater originating from the former Fort Devens.

Regional Hydrogeology

Groundwater recharge in the vicinity of Devens typically occurs in upland areas (e.g., topographic high areas within and around the former Main Post and North Post). The topographic contours are shown on the attached plate. Groundwater flow patterns in the overburden soils and underlying bedrock generally follow surface and bedrock topographies, respectively, flowing from the topographic highs to lows. Groundwater in the overburden typically upwells in the aquifer to discharge to wetlands, ponds, streams, and directly into the Nashua River. Devens is in the Nashua River drainage basin, and the Nashua River is the eventual discharge locus for surface water and groundwater flow at the installation.

The principal tributaries of the north-flowing Nashua River at Devens are Nonacoicus Brook and Walker Brook on the former North Post; and Cold Spring Brook (a tributary of Nonacoicus Brook) on the former Main Post (see attached plate). Bowers Brook is a tributary to Cold Spring Brook. Cold Spring Brook serves as a discharge area for groundwater from the east and west sides of the brook. The Nonacoicus Brook serves as a discharge boundary and groundwater divide between groundwater flow from the Shepley's Hill Landfill area and the flow from the

north of Nonacoicus Brook. There is also a lesser stream, Willow Brook that runs along Jackson Road in Devens and discharges to Nonacoicus Brook to the north. Willow Brook originates from Robbins Pond and is fed by Robbins Pond, surface water runoff, storm water discharge, and groundwater.

Glacial meltwater deposits constitute the primary overburden aquifer at Devens. The glacial units consist of till, deltaic deposits of glacial Lake Nashua, and deposits of glacial meltwater streams. Most of the surficial glacial units in the Nashua Valley are associated with deposition in glacial Lake Nashua. The glacial lake deposits consist chiefly of sand and gravelly sand. Groundwater also occurs in the underlying bedrock; however, flow is limited because regional bedrock lacks primary porosity and water moves only in fractures and dissolution voids.

The zones of highest transmissivity within the overburden are found in areas of thick glacial meltwater deposits on the former North and Main Posts at Devens, and these encompass deposits in which the Sheboken, Patton, McPherson, and Grove Pond water supply wells are screened. Due to the high transmissivity of these overburden deposits, these areas are preferential groundwater flow areas. The zones of lowest transmissivity are typically associated with exposed till and bedrock and are located on the former Main Post surrounding Shepley's Hill and between Jackson Gate and the parade ground, as well as east of the former Main Post, specifically east of Cold Spring Brook.

Zone II

As part of the permitting of water supply wells in Massachusetts, “Zone IIs” are developed. Zone II, as defined by Massachusetts regulations (30 CMR 22.02) refers to the area of an aquifer that contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation). The Zone II area is bounded by the groundwater divides that result from pumping the well and by the contact of the aquifer with less permeable materials, such as till or bedrock. In some cases, streams or lakes may act as recharge boundaries. In all cases, Zone II extend upgradient to its point of intersection with prevailing hydrogeologic boundaries (i.e., a groundwater flow divide, a contact with till or bedrock, or a recharge boundary).

Site-Specific Groundwater Flow

The identified groundwater contamination at AOC 50, 30, and 31 is located in the overburden aquifer, which flows toward and discharges into the adjacent Nashua River. The groundwater at AOC 20 and 21 flows east-northeast, and also discharges to the adjacent Nashua River. There are no residences or water supply wells located between these AOCs and the Nashua River.

Walker Road on the Ayer/Shirley town line is located west of Nashua River, and groundwater flow in this area is to the southeast toward the Nashua River. The former Main Post is located on the east side of the river. The groundwater from the former Main Post discharges to the Nashua River and is not anticipated to underflow the river to impact the Walker water supply well or private wells along Walker Road. The water flowing into the Walker supply well and into wells along Walker Road is coming from the northwest of these wells, based on the groundwater flow

contours in that area and the Zone II delineation for the Walker supply well. The Zone II for the Walker supply well indicates that water entering the well is originating from an area west of the former North Post at Devens. Groundwater at AOCs in the former North Post (AOC 50, 30, 31, 20, and 21) is flowing toward and discharging to the Nashua River and is not flowing toward the contribution area of the Walker supply well or residential wells located along Walker Road.

The overall groundwater flow direction at the former Main Post is to the north, with groundwater and streams ultimately discharging to the Nashua River. Closest to the Nashua River, the groundwater at Shepley's Hill Landfill and the adjacent AOC 32 flows toward the northeast and north, discharging into Plow Shop Pond and Nonacoicus Brook, which discharges to the Nashua River. Residences located between Shepley's Hill Landfill/AOC 32 and the Nonacoicus Brook are connected to the municipal water supply and do not use groundwater in this area.

Regional groundwater flow south of Grove Pond is toward the northeast (AOC 75) with groundwater discharging to Grove Pond and easterly groundwater flow along Barnum Road (AOC 57, AOC 74) with groundwater discharging to Cold Spring Brook. Shallow groundwater upwells in the aquifer to discharge to Cold Spring Brook and Grove Pond, which then discharges to Plow Shop Pond and then to Nonacoicus Brook and ultimately to the Nashua River. There is both a topographic and bedrock high east of Cold Spring Brook and northeast of Bowers Brook, in the general vicinity of Ayer Road (Route 110). Overburden deposits on these topographic high areas tend to be thin (<70 ft thick) (inferred from depths to bedrock reported in MassDEP's Well Search database) and low permeability till deposits. This topographic and bedrock high act as a hydraulic divide with overburden and bedrock groundwater west of Ayer Road flowing toward Cold Spring Brook. There is also a topographic and bedrock high between Bowers Brook and Cold Spring Brook. The recharge on this topographic and bedrock high area near Cold Spring Brook and Bowers Brook likely results in shallow groundwater flow direction toward Cold Spring Brook and Bowers Brook to the north.

Given the location of Cold Spring Brook and Bowers Brook relative to the topographic and bedrock highs to the south and east, the presence of these brooks is attributed to the convergence of flow in the overburden aquifer. Groundwater in the immediate vicinity of AOCs 57 and 74 along Barnum Road flows to the south and east (toward the brooks); shallow groundwater near Ayer Road (Route 110) and Old Mill Road in Harvard, MA presumably flows to the north and west (toward the brooks).

The topographic and bedrock highs and the drainage effect of the brooks likely provide hydraulic control and inhibit the flow of groundwater at the Barnum Road area to flow east of Cold Spring Brook; thus, there is likely no flow from the Barnum Road area to the supply wells and potential private wells to the east along Ayer Road (Route 110) in Harvard. The Zone II area for the Grove Pond supply wells encompasses Barnum Road, Cold Spring Brook, and Bowers Brook, but does not extend to Ayer Road in Harvard, further indicating the hydraulic divide between those two areas. Additionally, a review of the MassDEP Well Search database indicates that the private water supply well located to the east of Cold Spring Brook at Appleworks (ID 2125007-01G) on Ayer Road, and private wells located to the south of Cold Spring and Bowers Brooks along Old Mill Road, are screened wells within the bedrock aquifer.

North of Grove Pond, there is a topographic and bedrock high called Nonacoicus Hill. Groundwater flows from this hill to the south toward Grove Pond and Plow Shop Pond. The Grove Pond water supply wellfield is situated in an area of high transmissivity within the aquifer and there would be preferential flow within this area, and not to the less transmissive areas along and east of Cold Spring Brook.

Groundwater at AOC 43G flows east-southeast toward a small, northeasterly-flowing stream located 1,000 feet southeast of the site. The stream drains the Ammunition Storage Area and flows into Robbins Pond, located 1,500 east of the site. Based on regional groundwater flow contours, the groundwater from the area of AOC 43G likely discharges to the small stream and then to Robbins Pond to the east, and not toward the Patton supply well located to the south.

The MacPherson water supply well draws groundwater from both north and south of Nashua River from areas of high transmissivity within the aquifer. Water coming to the well from the south underlies parts of the former North Post and Main Post west of Shepley's Hill and Shepley's Hill landfill. AOC 76, Devens Fire Department, is at the southern-most extent of the MacPherson Zone II. Per the Zone II delineation for the MacPherson public water supply well, groundwater coming to the well from the north originates predominately from west of the former North Post. Groundwater from former North Post AOCs 50, 30, 31, 20, and 21 flows toward the Nashua River and not toward the MacPherson water supply well.