BRIERLEY ASSOCIATES
Creating Space Underground

June 29, 2016
File No. 116066-000

Community Health and Development Department
101 Main Street
Ashland, MA 01721

Attention: Mr. Nathaniel Strosberg

Subject: Blasting Impacts on Nyanza Cap and Groundwater Flow
Proposed Ashland Rail Transit Apartments
Ashland, MA

Ladies and Gentlemen:

This letter presents the results of our evaluation of potential blasting impacts at the subject site on the groundwater flow in the area, and the potential impacts of the blasting on the protective cap over the adjacent Nyanza Chemical Waste Dump site. This former superfund site is located to the east of the project area. The project site is bordered to the east and northeast by the access road to the MBTA Ashland Train station, to the northwest by residential properties on High Street, and to the southwest by the approximately 38 Acre Lot 2. Beyond Lot 2 to the southwest there are additional residential properties on Baldwin Circle, Russell Hill Road, Wilbur Drive, and Lorraine Drive.

BACKGROUND

We have visited the site and discussed the project with you and Jenn Ball, Assistant Town manager. We have received a set of project plans entitled Site Development Plans, Ashland Rail Transit Apartments, M.B.T.A. Access Road, Ashland, MA, dated September 28, 2015, prepared by Kelly Engineering Group, Inc., of Braintree, MA. The plans shows the existing and proposed grades of roadways, utilities, and buildings. We have also received an Exploration Location Plan, Jefferson at Ashland Station, dated January 28, 2002, by TGG, which shows the locations of test pits, test probes, and soil test borings performed at the site, along with refusal information which may indicate the top of bedrock.

We have also received a Draft Blast Plan-Rev. 1, dated 12 May 2016, prepared by New England Research, Inc., which outlines the areas where blasting of bedrock is anticipated, the proposed blasting procedures, the estimated peak particle velocity of vibrations at varying distances from the blast area, and the predicted elastic ground displacements at the Nyanza Superfund site.

POTENTIAL IMPACTS TO GROUNDWATER FLOW AND NYANZA SUPERFUND LINER AND CAP SYSTEM

Anticipated Blasting Areas

Based on the information received to date, we are, with one exception, in general agreement with the anticipated blasting areas noted in the Draft Blast Plan prepared by New England Research, Inc.(NER). Exhibit 1 from the NER Draft Blast Plan, indicates that the closest blasting will be over 800 ft from the closest point to the Nyanza Superfund liner. It is our opinion, based on the cut/fill information received from Mr. David Eastridge, Thorndike Development, that some blasting may be

required for construction of the proposed stormwater management pond located near the MBTA access road and the wetlands at the eastern end of the site. We estimate based on the test pit data and boring data in the area that rock cut depths will be up to about 8 ft in the area of test Pit TGG-8, which is approximately 600 ft from the closest point to the liner.

Anticipated Blasting Procedures and Potential Impacts to Nyanza Liner and Cap System and Groundwater Flow

For the assumed 8 ft rock cuts in the area of the proposed stormwater management pond, the blast hole depth would be approximately 10 ft. Based on the blast plan provided by NER, 3 inch diameter blast holes will be drilled on a plan grid of about 6 ft by 6 ft where rock is required to be excavated. Each 8 ft deep hole would be loaded with a column of explosive to about 5 to 6 ft up from the bottom, with a detonator delay blasting cap and a cast booster placed in the bottom of the explosive column. The purpose of the detonator blasting cap is to delay the detonation of each hole so they are detonated independently, in a specific sequence, to allow proper fragmentation of the rock and minimize vibrations from the blasting. The upper 2 to 3 ft of each blast hole would be filled with crushed stone stemming to confine the explosives in the blast hole.

When properly designed and detonated, the rock is fragmented between blast holes but there is very little damage to rock outside the limits of the blast holes. Our experience is that because the energy from the blast is directed upward and laterally, there is very little or no fracturing below the bottom of the blast holes. In addition, depending on a proper blast design and what controls are placed on the loading of the perimeter holes (at the exterior of the blast pattern), the fracturing outside the perimeter blast holes is limited to about ¼ to 1 times the hole depth. Thus, for 10 ft deep blast holes, there would be no damage to rock below a depth of 12 ft, and there would be no damage to the rock outside of about 10 ft laterally around the perimeter of the blast holes.

In this case, the rock is massive granitic bedrock, containing steeply dipping, relatively continuous joints and shallow dipping, relatively continuous joints. (See Photos 1 and 2 attached). If multiple hole delay blasting is utilized, the extent of fracturing around the limits of excavation would be a maximum of about 8 to 10 ft. If perimeter control measures are utilized at the limits of excavation, which would require close spacing of holes and lighter hole loading at the perimeter of the rock excavation, that damage zone is significantly reduced, to a few feet or less.

Impacts on Nyanza liner and cap system: The closest blasting is anticipated to be about 600 ft from the Nyanza liner and cap, and we agree with the NER report that the elastic deformations from the blasting should be very small. For a 10 ft deep, 3 in. diameter blast hole, loaded with 7 ft of Hydromite 880 (2 ½ inch by 16 inch sticks), the hole loading would be about 23 lbs, and if one hole per delay is assumed, the estimated peak particle velocity at the liner 600 ft away would be about 0.07 to 0.11 in/sec. For an assumed frequency of 40 Hz, the elastic displacements of the ground would be about 0.0003 to about 0.0005 in. These very small elastic ground deformations will not damage the liner or cap.

Impacts on Groundwater Flow: With respect to groundwater flow, we are not aware of any observation wells or piezometers in bedrock at the site, or any rock core borings with water observations. Some observation wells were installed within test borings and test pits which were taken to refusal, on bedrock or perhaps a large boulder in the glacial soils. In general, the borings and test pits did not encounter water, and we have not seen any observation well water levels observations over time. Based on the information available at this time, it is likely that, although

there might be some temporary water flow over the top of rock after heavy rainfall events, the groundwater levels at the site are below the top of rock, and we would expect that there will not be large inflow of groundwater upon excavating the bedrock for site development. We also conclude that the elevation of the top of groundwater, and therefore the flow direction across the site, will likely be towards the east, towards the Nyanza site, and away from the closest residences, and that the blasting will not impact any existing contaminant plume under or around the Nyanza site.

Conclusions and Recommendations

Based on the distance of the closest blasting to the to the Nyanza liner and cap (over 600 ft), the very localized fracturing of the bedrock during the blasting process (no fracturing beyond about 10 ft laterally and 2 ft below blast holes, for 10 ft deep blast holes), and the very small resulting elastic ground movements at the liner and cap (less than 0.001 inch), the required blasting will not in our opinion result in any damage to the Nyanza liner or cap.

It is also our opinion that groundwater flow at the site is generally in an easterly direction, towards the Nyanza site and away from the closest residences to the west and south. Therefore, we do not anticipate any adverse impacts to those closest residents from groundwater flow. We also do not anticipate any impacts on existing contaminant plume(s) under or around the Nyanza site. However, it is our opinion that additional groundwater observation wells should be installed prior to the start of blasting, in order to allow checks of groundwater levels, and sampling of well water, before, during and after the blasting work.

It is our further opinion that the greatest threat to the liner from the blasting operations, as well as to the health and well being of people living and working in the area, would be the throw of flyrock. A large piece of flyrock could potentially embed itself into the cover layer and damage the liner. For that reason, prevention of flyrock should be a high priority, and is addressed below.

We recommend the following:

1. Ammonium nitrate fuel oil (ANFO) should not be utilized on the project. Spillage of poured ANFO prills could result in contamination of groundwater. In addition, if ANFO is used in wet holes it may not detonate, resulting in groundwater contamination and the possibility of the throw of flyrock if several holes do not detonate properly. We understand that the intent of the blast plan is to use water resistant ANFO in wet holes, however given the nature of this project, we believe that it should not be used in any form.

2. Double matting should be used on all blasts, to ensure that there is no throw of flyrock. The NER blast plan indicates that 5 ft of 3/8 inch crushed stone stemming will be utilized in each 13 ft deep blast hole to contain the explosive energy. We concur with that recommendation, and recommend a minimum of 3 ft of stemming for 10 ft deep blast holes.

3. All blasts should be video taped, so that small problems, such as excessive movement of blast mats, can be identified prior to having bigger problems.

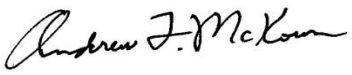
4. A minimum of four groundwater observation wells should be installed at locations near the lot lines to the northwest, west, and south where residential structures are located nearby. The

wells should be capable of sampling for groundwater testing. The water levels should be recorded at least once a week before, during, and for 3 weeks after drilling and blasting work, and groundwater sampling and testing should be done upon initial well installation and bi weekly thereafter until at least 4 weeks after completion of blasting. As a minimum, the groundwater testing program should include laboratory testing of filtered samples for D-NAPLS, L-NAPLES, nitro benzene, and heavy metals. In addition, similar sampling and testing should be performed of at least 4 existing groundwater wells to the north, northeast, and east of the site, toward the residential areas in that direction. The sampling and testing program should be reviewed and coordinated with the MA DEP.

5. Drill rigs should be equipped with dust collectors to minimize drilling dust at the site, and any trucks carrying soil or blast rock off site should be required to be sprayed with water to minimize dust. We further recommend that dust monitors be placed at a minimum of 4 locations around the perimeter of the site, in the area of residences, to ensure that dust levels off site remain at safe levels.

We hope that the above comments have addressed the concerns regarding the impacts of the blasting at the project site on the adjacent Nyanza liner and cap, potential alterations to groundwater quality or flow in the vicinity of the project, and potential impacts on people living or working in the area. If you have any questions about our evaluations, or require additional information, please feel free to contact us.

Sincerely yours,
BRIERLEY ASSOCIATES



Andrew F. McKown, P.E.
Senior Consultant

Attachments:

Photo 1, Granitic Bedrock in drainage swale near the southwest corner of the Nyanza site, looking east..
Photo 2, Looking west toward bedrock at southwest corner of Nyanza site, with access road behind.

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Photo 1, Granitic Bedrock in drainage swale near the southwest corner of the Nyanza site, looking northeast.

PHOTO 2 Looking west toward bedrock at southwest corner of Nyanza site, with access road behind.