
GEOLOGY

Chapter Eight

GEOLOGY

Chapter Eight

A. Introduction

Subsurface conditions at the site were extensively investigated beginning in October 2008 and ending in August 2009. The purpose of these investigations was to establish the soil and bedrock characteristics of the site, as well as groundwater conditions. Particular attention was paid to areas of proposed cuts and fills, including rock cuts, retaining walls, soil/rock embankments, slopes near proposed buildings, detention basins, and areas where grade changes and/or loading is proposed.

The results of the geotechnical and hydrogeologic studies prepared by the Project geotechnical engineer, GeoDesign, Incorporated, are provided in Appendices M and N. The reader is referred to this appendix for further details.

In summary, 18 test borings were drilled and 51 test pits were excavated at the site to provide detailed subsurface data in the areas of the proposed development. See Map #28 Explorations Location Plan. Appendices M and N depict the locations of the explorations that were made during the geotechnical investigations.

Site geology consists of a thin layer of topsoil; over dense Till comprised of a well graded mixture of sands, clay, silt-clay, and cobbles/boulders; over metamorphic bedrock comprised of a blend of amphibolite, gneiss, pyroxenic amphibolite.

Depths to groundwater at the site are generally below the maximum depths explored (i.e., deeper than about 20 feet). In localized areas, such as near the smaller wetland to the southeast and in some of the proposed detention basin areas, groundwater is as shallow as about four feet.

The results of subsurface testing were used to perform geotechnical engineering analyses to confirm stability of the proposed development. Based on the results of these analyses, the applicant determined that proposed cuts and fill, and site retaining walls will be stable. In addition, it was determined that the natural site soils and bedrock (below the surficial topsoil) are suitable for support of normal shallow foundations and slab-on-grade construction.

The Putnam County Health Department files were reviewed to identify potable water wells present on the properties surrounding the site. The results of this review are included on Map #51. Several wells are present to the north of Route 312 and adjacent to the east edge of the site. Based on site topography, these wells are either up-gradient or

side gradient relative to the generalized groundwater flow direction at the site. Interstate I-84 is located to the south of the site, and provides a groundwater divide. A wetland is located adjacent to the east edge of the site. Further to the east, and downgradient of the site there are five wells along Pumphouse Road. These wells are about 2,000 feet from the closest site boundary and are separated from the site by the large wetland.

B. Existing Conditions

The site is presently undeveloped except for one single family residence, an unpaved roadway, and a relatively level staging area used to operate a firewood business. The site has a generally triangular shape with two nearly perpendicular legs parallel to Route 312 (to the west) and I-84 (to the south), and the third longer leg running along the existing Metro North Railroad tracks to the east of the site.

Site topography generally drops off from the high point near the northwest corner (Elevation 660) down to the wetlands (Elevation 440). Existing grades range from fairly steep (1.2 horizontal to 1.0 vertical [1.2H:1V] at the higher elevations) to moderately steep (6H:1V lower on the site), except at the small wetland area where grades are flat. Much of the site is wooded.

Depth to bedrock varies from exposed at the surface, to below the maximum explored depth (about 20 feet), with more typical depths ranging from about 3 to 8 feet.

The steepest slopes on the property, to the east of the wood processing area, are man-made fill slopes created to provide area for the existing commercial operation.

The site slopes are stable.

A 0.2 acre isolated area of wetland is present along the site's southeastern boundary. Many years ago, this small area of wetland was split off from the large wetland to the east as a result of railroad track construction.

C. Potential Impacts of the Proposed Project

1. Approximately 31 acres of the site will be disturbed.
2. Although the existing site soils and bedrock are eminently competent to support proposed loads from site construction and new structures, proposed site construction will create unbalanced loading due to the embankment fill and soil/rock cuts. .
3. The existing site grades (topography) will be changed. The re-grading will modify the pattern of water infiltration and run-off as it generally flows down towards the southeast (away for Route 312). This may alter the groundwater flow patterns at the site.

Increased impervious areas will tend to reduce water infiltration (as the flows are diverted into the stormwater system), while exposing bedrock and constructing rockfill or rock revetted slopes will tend to increase infiltration. Lastly, removal of trees and vegetation will reduce the evapotranspiration, which, in turn, creates more net infiltration.

4. The 148,000 sf general retail building will require the creation of a pad at an elevation of 581 to 582+/- . Grades in this area range from 620 to 660 presently.
5. A 28,000 sf strip-type retail building will be constructed at an elevation of 578.8. Grades in this area range from 540 to 564 presently. Under the HC-1 and hotel alternative, a 4-story, 150-room, hotel may be constructed instead of the strip-type retail, with similar proposed site grading.
6. A 7,000 sf restaurant building will be constructed at an elevation of 578.6. Grades in this area range from 550 to 570 presently.
7. A 3,000 sf bank building will be constructed at an elevation of 581. Grades in this area range from 610 to 626 presently.
8. Along the rear (south side) of the general retail area, the cut slope required to achieve proposed site grades will be protected by three ten-foot high boulder retaining walls constructed below a 30-foot high 2H:1V slope. This slope will be partially in soil and partially in rock.
9. The easterly edge of the parking area and/or access road will be constructed in a fill area. The edge of the fill embankment will consist of an approximately 30-foot high 2H:1V soil or rock fill slope. The slope will be supported by three tiers of ten-foot high boulder retaining walls.
10. Excavated materials will consist of relatively small volumes of granular soil and large proportions of bedrock. General areas of proposed bedrock removal are depicted on Maps 38 through 41. In these areas bedrock is either very shallow or exposed at the ground surface. Bedrock excavation will require controlled drilling and blasting to provide a blend suitable for rock fill, and a mix of boulders used to construct site retaining walls with a more natural appearance than other man-made alternatives (such as modular walls or cast-in-place concrete walls).
11. The applicant is assuming that due to the history of site disturbance, the site will yield only about three inches of useable topsoil after screening; this will all be reused on-site. It is therefore anticipated that some topsoil will need to be imported for plant beds and lawns.
12. To the west of the main entrance three tiered ten-foot high boulder walls will protect the widened portion of Route 312 that will accommodate a new turning lane. These walls will be constructed using large boulders (derived from blasted rock),
13. The grades opposite the existing westbound I-84 interchange will be excavated up to about ten feet to create the main entryway. The adjacent hillside will be excavated to construct the entrance road.
14. The general retail pad is situated entirely in a cut zone. The excavated materials will be processed and moved downhill to create fill areas to support portions of the parking areas and the internal loop driveway.

15. Stormwater basins will be located in the western and eastern portions of the site in mostly side hill conditions at lower elevations compared to the developed portions of the site. They will be created in both cut and fill areas. Above maximum design water levels, in cut areas the side slopes of the proposed basins will be constructed at 3H:1V (horizontal to vertical). In fill areas, on the downhill side of the basins slopes will be constructed at 2H:1V.

D. Proposed Mitigation Measures

1. The site surface will be disturbed in limited (five acre) increments during construction as shown schematically on the Site Construction phasing plan, Maps #30 to #37. Sequential disturbance will allow the contractor to minimize soil erosion. Moreover, due to the shallow depth to bedrock, much of the exposed surface in cut areas will consist of non-erodible bedrock. Since on-site borrow materials used for fill areas will largely consist of excavated rock fill, incrementally filled areas will also be largely non-erodible (as compared to many sites requiring soil filled areas).
2. The impacts of the new loads created by the cut and fill slopes have been carefully evaluated using detailed geotechnical analyses to confirm that adverse on- or off-site effects (such as unstable slope conditions, or lack of adequate support for proposed buildings or ponds) would not occur. Specifically, results of stability analyses indicate that the proposed cut and fill slopes have adequate factors of safety against sliding based on the proposed construction materials (i.e., soil filled slopes, or steepened rock fill slopes) and methods (i.e., placement and compaction requirements).
3. The altered topography and groundwater flows will not be meaningfully impacted. Increased impervious areas will tend to reduce water infiltration (as the flows are diverted into the stormwater collection system), while exposing bedrock and constructing rock fill or rock revetted slopes will tend to increase infiltration. Removal of trees and vegetation will reduce transpiration, which in turn, generally creates more net infiltration. As the project progresses to the detailed design phases, additional geotechnical and hydrogeologic engineering may be required to develop specific measures to increase the infiltration of stormwater in the post-development site condition. Such measures may include use of pervious pavement, infiltration galleries, and routing of the discharge from stormwater basins towards wetland areas. Regarding the smaller wetland area located on the western side of the railroad tracks, potential impacts will be negligible as this wetland is hydraulically connected to the significantly larger wetland to the southeast of the tracks. As previously mentioned, one large wetland existed prior to construction of the railroad.
4. Because no cut slopes steeper than 2H:1V are proposed, bedrock cuts will be treated as if they were soil cuts. As such, they will not require rock catchment ditches at their base. Similarly, where bedrock is exposed in cut areas, the permanent (final) rock faces will not require special treatment following drilling and blasting. As the project progresses to the detailed design phases, additional geotechnical engineering will be performed to develop specific design criteria for the retaining walls and

- embankment slopes. In addition, during construction an experienced geotechnical engineer will monitor construction activities for the retaining walls and slopes and document conformance with the approved construction documents, and as needed provide additional recommendations to address conditions encountered during construction.
5. Controlled blasting will be used to provide protection of off-site improvements and to provide desired rock fragmentation. The project documents will specify that controlled blasting must be performed in compliance with the Town of Southeast Code Chapter 71. Maps #38- 41 show the anticipated rock removal areas by phase. Such procedures will require vibration and overpressure control, tight blasting patterns, and high powder factors to maximize rock fragmentation. This will maximize re-usability of the blast rock for fill material and facilitate on-site rock crushing to provide a blend suitable for rock fill. The use of blasting mats will also be required within 200 feet of Route 312, I-84 and any existing structure.
 6. The proposed site earthwork will be balanced. The proposed excavation in the general retail area will provide borrow materials to balance the site. All material excavated on-site will be reused and will remain on-site.
 - 200,000 cubic yards of soil will be cut and reused in fill areas.
 - 200,000 cubic yards of bedrock will be excavated, crushed, and used in fill slopes and retaining walls. The processed rock fill is anticipated to generate 20% more volume, compared to the volume of excavated bedrock.
 7. The applicant is assuming that due to past site disturbance, the site will yield only about three inches of topsoil after screening. All existing topsoil will be reused on-site. Due to its limited on-site volume, however, it is anticipated that some topsoil will need to be imported for planting beds and lawns.
 8. Some of the bedrock will be crushed and screened on-site to create processed stone and gravel for use below roadways, parking, and buildings. Some processed bedrock will also be segregated to provide rip-rap for use as slope cover (i.e., revetment) and long-term protection as required. Lastly, some of the blasted bedrock will be mixed with limited volumes of on-site soils to generate a rock fill. No rock or soil is planned for export or import (except topsoil).
 9. The retaining walls will be constructed using boulders (derived from blasted rock), with intentions of creating a more natural appearance compared to other man-made alternatives (such as modular walls or cast-in-place concrete walls). Maximum retaining wall heights will be limited to ten feet and constructed in a maximum of three tiers with a twelve foot (minimum width) separation bench that is slightly pitched to shed water. Site retaining walls will be constructed under the direction of the geotechnical engineer to provide required design and quality control/quality assurance.
 10. Cut areas in soil or bedrock will be stabilized using 2H:1V or flatter slopes.
 11. Fill slopes along the access road (behind the main retail area and the main parking areas) will be constructed with soil and/or rock fill that is placed and compacted in a systematic manner to allow finished slopes at 2H:1V.

12. Stormwater Pollution Prevention Plans, also called Erosion Control Plans, describe the phasing of construction operations, see Maps#30-37. The phasing of site construction and the limited, sequential disturbance areas will protect the site from erosion. All stormwater is to be contained within each disturbed area until stabilized stormwater detention/sediment basins are in place and functional. Sedimentation basins will also be established to handle design storm events. Water will be held on-site and, if necessary, treated with flocculants to remove sediment prior to discharge.
13. The Stormwater Pollution Prevention Plan will be prepared under the latest guidelines for erosion and sediment control for New York State. As shown on the Drawings, exposed areas of disturbance will be minimized; water will be contained within areas of disturbance and sent to sediment basins after the basins have been stabilized.
14. Following the Stormwater Pollution Prevention Plan guidelines and the direction of the geotechnical engineer and structural engineer, environmental impacts will be minimized during construction of the soil cut slopes, rock cut slopes, soil fill slopes and retaining walls.
15. Proposed rock excavation areas will be used as staging areas for site and building construction since they are less prone to erosion. On-site rock fill and crushed rock will be used to create erosion control check dams and rock filters.