CHAPTER 1

EXECUTIVE SUMMARY

The purpose of this report is to document the results of the field investigations, yield testing, and water quality testing in the vicinity of the proposed 571-acre Sterling Forge development in Sterling Forest, Tuxedo NY. The objective of the investigation was to evaluate the potential of using the groundwater found in the former Scott Mine as a source of irrigation water for the proposed 18 hole golf course. The project site was heavily mined for the iron ore until just after World War I. The Scott Mine, which is the focus of this investigation, is one of the former vertical shaft mines in the area. The Scott Mine was worked on several levels and is believed to be connected to the nearby Cook Mine. Access to the Scott Mine was from several shafts, currently only shaft #2 and it's associated hoist building are visible from Route 84. Originally the Cook Mine had a total of four major shafts, presently three of the shafts are visible including the shaft within the fenced in area in the former NYU facility, and two shafts immediately to the south. Typically two of the shafts are filled with groundwater almost to the ground surface, while the third shaft is largely filled in. The proposed irrigation supply for the golf course is groundwater that has collected in the existing Scott Mine workings; previous studies had indicated the volume of groundwater in storage in the mine might approach 7 million gallons. It is anticipated that the proposed golf course will require irrigation approximately 200 days per year depending on weather conditions.

Based on the United States Department of Agriculture (USDA) and Soil Conservation Service (SCS) Orange County, New York soil survey maps of the area, the soils found at the Sterling Forge parcel include Erie, Swartswood, Hollis, Palms, and Alden soil series, as well as the Rock outcrop - Hollis complex. The USDA / SCS soil survey characterizes the limitations on development in these soils as serious to severe for a number of reasons including slope, wetness, and shallowness to bedrock. However these limitations can be overcome through site specific investigations and proper planning.

The topography of the site features a series of ridges and valleys that are generally oriented in a northeast-southwest direction. Land surface elevations range from approximately 1030 ft msl to 790 ft msl reaching the topographic high just west of the Scott Mine shaft #2. Wetlands and seasonal streams are abundant in the larger valleys. In general the surface water is running from the highlands in a northerly direction toward the Indian Kill. The Sterling Forest area is a component of the Reading Prong section of the Appalachian Highlands (or New England Upland) physiographic province, commonly referred to as the Hudson Highlands in this part of New York. The bedrock of the Hudson Highlands is predominantly pre-Cambrian igneous and metamorphic rock (typically granitic gneiss) of Grenville origin. The bedrock in the vicinity of

Sterling Lake, southwest of the parcel, is folded into a synform (younger rock layers in the middle of the fold with progressively older layers toward the limbs of the fold) composed entirely of Precambrian rock formations that plunge to the northeast. The rock comprising the Route 84 parcel is on the eastern edge of this syncline and is highly variable. The rock formations found on site are various assemblages of quartz-plagioclase gneiss, amphibolite-pyroxene-hornblende gneiss, hornblende granite and granitic gneiss, and leucogranitic gneiss. One of the results of the significant metamorphism that occurred in the bedrock of the area is the high density of iron ore bodies within the country rock. A total of five iron mines are found within the study area, all of the mines are within the Scott group of mines which worked two adjacent magnetite belts that trend to the north-northeast. The surficial geology at the parcel is characterized as varying amounts of till over shallow bedrock, significant areas of sand and gravel have not been identified at the parcel.

Hydrogeologic units in the Hudson Highlands can be classified as either bedrock or unconsolidated glacial and fluvial deposits. According to a groundwater supply investigation conducted for the Orange County Water Authority, fractured and jointed bedrock is the only viable source of groundwater in the study area. In general the bedrock well yields are low (1 to 5 gpm) unless highly faulted and fractured zones are found. The massive granites and granitic gneisses characteristic of this region tend to be rock that is absent of the bedding planes and high volume secondary porosity (such as in karstic terrane) where groundwater is often stored in bedrock. One important exception to this is in the case where significant subsurface mining activities have occurred. The area well inventory has identified a single active residential well within 1000 ft of the proposed well site.

The Scott Mine shaft #2 testing program involved pumping water from the open shaft #2 and observing the water level response over time at a number of locations including the shaft, wetlands, groundwater wells, and surface waters. In addition to monitoring the water levels water quality sampling and dye injection at the discharge were conducted to assist in the evaluation.

The yield test conducted on the Scott Mine shaft #2 demonstrated that the existing mine workings store a substantial quantity of water and it is feasible to pump this water from the shaft at a relatively high rate. During the yield test, a total of 2.4 million gallons of water were pumped from the mine workings at an average rate of 420 gpm. At this pumping rate, sustained over the duration of the test, no measurable changes to the water level monitoring points were noted with the exception of the monitoring location at the Cook Mine shaft. The data clearly indicated that the two mines are in direct hydraulic connection and that the Cook Mine ultimately determines how much water is stored in the mine since, above a certain elevation, the water flows out of the Cook Mine shaft. The results of the dye tracer test indicate that water was not short circuiting back into the

mine workings from the discharge location, suggesting that a hydraulic connection between the mine and the nearby downstream water courses is absent.

Once the pumping period of the yield test was completed the mine shaft was allowed to recover to pre-test levels. The mine required approximately five times longer to recover the 2.4 million gallons that were pumped. This equates to a recovery rate of 145,000 gallons per day or 101 gpm. It is not known how much of this apparent recovery rate can be attributed to groundwater and how much to surface water. Field observations would suggest that half of the recovery rate can be attributed to groundwater flow into the mine workings and half from surface water since surface water was observed entering the Cook Mine shafts at an estimated rate of 50 gpm.

The watershed immediately above the Cook Mine is approximately 40 acres. Direct runoff from this watershed area, including groundwater runoff and surface water runoff, may approach 20 million gallons per year. If the water level in the Cook Mine is maintained below 813 msl, this 20 million gallons per year would become part of the stored groundwater reservoir in the mine workings. The data suggests that overall the groundwater inflow component is similar in magnitude to direct runoff to the Cook Mine. Assuming the groundwater inflow will provide another 20 million gallons (average groundwater inflow of 38 gpm) a total of 40 million gallons per year are available for use during a typical year. Based on the results of the yield test and the historical mine maps the Scott/Cook Mine complex has a storage capacity in excess of 14 million gallons.

The groundwater samples collected during the yield test indicate that the groundwater quality at the site is suitable for use as a supply for irrigation. However, the groundwater is relatively enriched in several minerals since it is in direct contact with an ore body. Of primary concern are the high concentrations of iron, manganese and the presence of iron bacteria.

Use of the mine workings has a number of potential environmental impacts. All of the potential impacts are related to the decline in water level within the mine workings themselves. The data collected during the yield test did not indicate that using the mine workings as a source of irrigation would impact water levels within the bedrock aquifer, which is currently used as source of drinking water at the foresters cottage. The water level monitoring program did not indicate that the mine workings were hydraulically connected to the adjacent watercourses and wetlands.