TECHNICAL MEMORANDUM ADDRESSING OCCURRENCES OF RARE PLANT SPECIES OF KERSHAW AND LANCASTER COUNTIES AT HAILE GOLD MINE PROPERTIES, LANCASTER COUNTY, SOUTH CAROLINA

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Introduction

In light of permitting for proposed mining activities within an approximate 4,224-acre (ac) (1709-hectare, ha) area at Haile Gold Mine (Haile) properties in southern Lancaster County, South Carolina, surveys conducted for 42 rare plant species (Table 1). These 42 plant species are of interest since they are a part of the South Carolina Rare, Threatened & Endangered Species Inventory as reported to the South Carolina Heritage Trust Program (South Carolina Department of Natural Resources 2011).

Six of the 42 listed species also have federal status (Table 1). The six species having federal status are covered in greater detail in a separate memorandum dealing with federally listed plant species. They are included here since they are also identified and listed in South Carolina. Potential occurrences of these plant species merit botanical identification of habitat and the named species, where possible, within the project area. The species covered in Table 1 below will be discussed in greater detail later in this memorandum.

The project area is located between Charlotte, North Carolina and Columbia, South Carolina (Figure 1). The listed species have been documented in Kershaw and/or Lancaster Counties and, because of the presence of certain geographic and habitat affinities were considered as species which might be found within the project area (Table 1).

Most of the species listed below are ranked as to their rareness both globally and at the state level. Global ranking categories vary from G1 to G5. This range represents a designation from "critically imperiled" to "secure" worldwide. At the state level the S1-S5 ranking system is used in most states and covers a range with essentially the same meanings as those for the globe. The abbreviations, SH, SNR and SX refer to an historical record older than 20 years, species not ranked, and presumed extirpated, respectively (Franklin and Finnegan 2010). See APPENDIX A for a further explanation of global and state ranking systems.

Table 1. Rare plant species documented for Lancaster and Kershaw Counties as listed by the South Carolina Department of Natural Resources for South Carolina

Common Name	Scientific Name	Global Rank	State Rank	Federal Status	County Documented	Habitat Features
Southern Thimble Weed	*Anemone berlandieri* Pritzel	G4	S1		Kershaw	Thin circum-neutral soils around mafic rock
Carolina Anemone	*Anemone caroliniana* Walter	G5	SH		Kershaw Lancaster	Marshy clay; Iredell Series, Oxiaquic Vertic Hapludalfs
Missouri Rock-cress	*Boechera missouriensis* (Greene) Al-Shehbaz	G5	S1		Lancaster	Thin circum-neutral soils around mafic rock
Narrow-leaf Sedge	*Carex amphibola* Steudel	G5	SNR		Lancaster	Low mesic slopes of incised valleys; colluvium
Necklace Sedge	*Carex projecta* Mackenzie	G5	SH		Lancaster	Moist forests
Blue Cohosh	*Caulophyllum thalictroides* (Linnaeus) Michaux	G4/G5	S2		Lancaster	Rich forest; northern slopes

Table 1. Cont.

Common Name	Scientific Name	Global Rank	State Rank	Federal Status	County Documented	Habitat Features
Lowland Brittle Fern	*Cystopteris protrusa* (Weatherby) Blasdell	G5	S2		Lancaster	Rich, rocky hardwoods
Broomsedge	*Dichanthelium aciculare* (Desvaux ex Poiret) Gould & Clark	G4/G5	SNR		Lancaster	See page 307 Weakley
Open-ground Whitlow-grass	*Draba aprica* Beadle	G3	S1		Kershaw, Lancaster	Granite; amphibolite; under Juniperus virginiana; shallow soil
Smooth Coneflower	*Echinacea laevigata* (C. L Boynton & Beadle) C. F. Blake	G2/G3	S3	Endangered	Lancaster	Alfisols; maintained corridors; forest edges
Eastern Wahoo	*Euonymus atropurpureus* Jacquin	G5	S1		Lancaster	Alluvial forest; mafic or calcareous soils
Pool Sprite	*Gratiola amphiantha* D. Estes & R. L. Small	G2	S2	Threatened	Lancaster	Granite flatrocks
Schweinitz's Sunflower	*Helianthus schweinitzii*Torrey & A. Gray	G3	S3	Endangered	Lancaster	Alfisols; maintained corridors; forest margins
Black-spored Quillwort	*Isoetes melanospora* Engleman	G1	S1	Endangered	Lancaster	Granite flatrocks
Piedmont Quillwort	*Isoetes piedmontana* (N. E. Pfeiffer) C. F. Reed	G3	S2		Kershaw, Lancaster	Granite flatrock seepage; Altamaha grit
Georgia Rush	*Juncus georginus*	G4	S2		Lancaster	Granite flatrocks; seepage
White-Wicky	*Kalmia cuneata* Michaux	G3	S2		Kershaw	Stream corridor forest/sand hill ecotones
Southern Lepuropetalon	*Lepuropetalon spathulatum* Elliott	G4/G5	S2		Lancaster	Granite flatrock seepage; other disturbed wet seepage areas.
Pondspice	*Litsea aestivalis* (Linnaeus) Fernald	G3	S3		Kershaw	Stream corridor forest edges
Canada Moonseed	*Menispermum canadense* Linnaeus	G5	S2S3		Lancaster	Colluvium of nutrient-rich hardwood forests
One-flower Stitchwort	*Minuartia uniflora* (Walter) Mattfeld	G4	S3		Kershaw, Lancaster	Granite flatrocks; Altamaha grit
Piedmont Water-milfoil	*Myriophyllum laxum* Shuttleworth & Chapman	G3	S2		Kershaw	Permanent natural ponds
Nestronia	*Nestronia umbellula* Rafinesque	G4	S3		Kershaw	Upper or middle forested sand hill slopes
Georgia Beargrass	*Nolina georgiana* Michaux	G3/G5	S3		Kershaw	Middle to lower sand hill slopes
Southern Adder's-tongue	*Ophioglossum pycnostichum* (Fern.) A. & D. Löve	G5	S2		Lancaster	Loamy bottomland forests, old field forests
Hairy Sweet-cicely	*Osmorhiza claytonii* (Michaux) C. B. Clark	G5	S2		Lancaster	Rich forested coves with streams

Table 1.
(concluded)

Common Name	Scientific Name	Global Rank	State Rank	Federal Status	County Documented	Habitat Features
American Ginseng	*Panax quinquifolius* Linnaeus	G3G4	S4		Lancaster	Rich hardwood coves and northerly slopes
Small's Purslane	*Portulaca smallii* P. Wilson	G3	S2?		Lancaster	Granite flatrocks; diabase glades; shallow soil
Wing-podded Purslane	*Portulaca umbraticola* Kunth	G5	S1		Kershaw, Lancaster	Introduced from South America or West Indies; disturbed soils; house sites and field edges
Georgia Oak	*Quercus georgiana* M. A. Curtis	G3	S1		Kershaw	Dry slopes; bluffs; granite soils
Michaux's Sumac	*Rhus michauxii* Sargent	G2G3	SX	Endangered	Kershaw	Maintained corridors; forest edges; fire
Canby Bulrush	*Schoenoplectus etuberculatus* (Steudel) Soják	G3G4	SNR		Kershaw	Beaver ponds
Granite Rock Stonecrop	*Seedum pusillum* Michaux	G3	S2		Kershaw, Lancaster	Granite flatrocks
Wire-leaved Dropseed	*Sporobolus teretifolius* R. M. Harper	G2	S1		Kershaw	Wet savannas; bogs
Georgia Aster	*Symphyotrichym georgianum* (Alexander) Nesom	G2G3	No Data	Candidate	Lancaster	Maintained corridors; field edges
Yellow Pipewort	*Syngonanthus flavidullus* (Michaux) Ruhland	G5	S2		Kershaw	Wetland savannas; pine flatwoods; ditch margins
Heart-leaved Foam Flower	*Tierella cordifolia* Linnaeus	G5	SNR		Lancaster	Moist cove forests and rock outcrops
White False-asphodel	*Tofieldia glabra* Nuttall	G4	S1S2		Kershaw	Bogs; savanna/pocosin ecotones
Chapman's Redtop	*Tridens chapmanii* (Small) Chase	G3	S1		Lancaster	Pine forest edges; loamy soils
Narrow-leaved Trillium	*Trillium lancifolium* Rafinesque	G3	S1		Kershaw	Rich forests; calcareous soils
Southern Nodding Trillium	*Trillium rugelii* Rendle	G3	S2		Lancaster	Rich woods over calcareous or mafic soils
Yellow Violet	*Viola pensylvanica* Michaux	G5	S2		Kershaw, Lancaster	Rich forests

The purpose of this memorandum is to examine the current status of the above species and relate what is known of their ecology to conditions present at the project area. Further, it will be necessary to discuss observations, methods and results of seasonal surveys made over time throughout the project area to document these and other floral elements. Important details of the species and characteristics of their local distributions and most favorable habitats will also be examined with respect to the project area.

Summary of Findings

During the course of the surveys at Haile carried out over a period of three years (2008-2011) all habitats types which might support any of the above listed plant species were investigated. Habitats were covered multiple times, during multiple seasons over multiple variations of each basic habitat type. Two state listed plant species were found. Foam Flower (*Tierella cordifolia*) was found in one habitat of limited occurrence along Camp Branch. Nestronia (*Nestronia umbellula*), is a relatively common shrub repeatedly found along upper to middle slope habitats in dry woods dominated by several species of scrub oaks (*Quercus laevis*, *Quercus marilandica*, *Quercus margarettae*) and pine (*Pinus palustris*, *Pinus taeda*). Sixteen occurrences of Nestronia were found within the project area (Figure 3).

Landscape Surveys and Methodology

Seasonal surveys have followed purchase of Haile Gold Mine by Romarco Minerals, Inc. as the prospect of mining again became feasible. Vegetation surveys began at Haile in 2008 when a portion of a section of about 1,500 ac (607 ha) of landscape that included the watershed of Haile Gold Mine Creek was the subject of initial prospecting. Surveys of Parcel A area were begun 27 May, 2008 (Figure 2). Visits were made during the periods 27-29 May, 8-10 July, 10-12 September and 22-24 October of the same year. An early spring survey, usually performed in late March, was not made. During the course of the surveys other aspects of the biophysical setting were examined. These further efforts were made to better understand overall conditions and to aid in future interpretation of site characteristics, especially with respect to rare species presence or absence.

Seasonal surveys of a second parcel, Parcel B, of about 160 ac (65 ha) began in March of 2009 and ended October, 2009 (Figure 2). Visits were made to survey this parcel 29 March 2009, 15-16 June 2009, 11-12 August 2009 and 7-8 October 2009. Survey aims and products were the same as for the above parcel.

A third set of seasonal surveys dealing with Parcel C of roughly 2,300 ac (931 ha), began during late August of 2010 (Figure 2). Visits were made over the periods of 23-26 August 2010, 5-8 October 2010, 21-24 March 2011, 16-20 May 2011, 11-14 July 2011, 29-31 August and 1 September 2011, and 17-19 October. Since there were two increments of landscape added by Haile non-concurrently to this parcel, survey times were staggered so that a final seasonal survey in the last-added portions of this parcel occurred October, 2011.

Familiarity with landscapes within the project area has been gained over multiple years and multiple seasons. Most of these lands have been covered multiple times to provide a clear picture of the total diversity of the landscape and its physical gradients and vascular plant components. Some gradients occurring over landscapes can be followed where major physical and biological factors change. Major changes in such gradients, as those for moisture, light, topography, exposure, fire and visible or inferred disturbance can be followed on foot as they occur through habitat complexes. Even though vegetation units have been defined and mapped as a part of the surveys, these units are not abrupt pencil lines with respect to their actual distributions and adjacencies. It is important to be aware of each major set of gradients as they become intertwined, overlap and otherwise vary over the landscape or across a vegetation unit.

To assess gradient variations, all work, except for some slow roadway surveys, was carried out on foot. General coverage goals were set for the day each morning. When potentially important habitat complexes were encountered, additional time was taken to review representative variation of the complex in more than one area. The direction of travel was marked and the pace was slowed. Side branches varying off the main direction of travel were followed where loops, angles and parallel traverses were employed to intercept important elements of the perceived habitat diversity. To some these methods may seem more or less arbitrary and possibly haphazard since they are never strictly random and never rote. Random, with respect to a landscape gradient, may mean little in gaining an understanding of a continuously varying habitat complex.

Specific and somewhat limited habitat complexes suspected of supporting rare species can be sought out by the above gradient methods. When such limited habitat complexes were located, such as outcroppings of mafic diabase materials suspected of supporting rare plants, these areas can be surveyed just by walking among outcrop boulders. Mafic boulder outcrops were scattered sparsely through much of the western parts of the project area (Figure 3).

Such boulders weather in response to factors subject to gravity so directing attention down-slope from the outcrops is useful.

Random surveys, grids and parallel compass headings followed in rote fashion are sometimes best for searching for plants within a previously determined set of complex or simple gradient or habitat sets (Mueller-Dombois 1974). These are useful methods with a prior understanding of a particular species' habitat limits and a reasonable estimate of its presence. They will allow occurrences of target species to be found within a restricted area. When the aim is to locate the overall habitat of the species, compass lines become a distraction, except to keep one from losing one's way. Following gradients was essential to this sort of study where known habitat characteristics for a known set of species were missing. Finding the habitat comes first if luck does not first turn up the species. Finding the rare species within the habitat must follow if the species is not, by chance, found first.

Some habitats are defined by linear rights-of-way. Woodland margins paralleling paths, roads, highways and power lines are examples. Power lines are very limited within the project area and those that are present were found to be maintained by herbicides. This method of management of power line corridors curtails recruitment and survival by most rare plant species. Road margins allowing easy access were surveyed by vehicle. Power line corridors were checked for herbicide damage and ignored or followed as warranted.

Many habitats have been modified by the construction of drilling pads and their access roads. Forest edges follow many such roads pushed through woodland habitats. Such habitat modifications are found in all parcels, but some in Parcels A and B may not have been covered since they were created after completion of the survey. However, it is doubtful that such freshly disturbed area would sustain any of the target species listed in Table 1.

Since completion of earlier surveys for Parcels A and B, there has been a gap of time during which prospecting activities at Haile have continued. These activities have been responsible for various sorts of landscape modifications. Clear-cutting activities have been responsible for removal by previous owners of many acres of loblolly pine plantation and other previously forested habitats. More recently the extent of prospecting has increased such that drilling pads now dot the landscape throughout most of Haile lands. The construction of drilling pads and supporting access roads has created much more edge habitat through the somewhat more stable, though still relatively young, habitats that previously occupied land Haile has purchased. Such an increase of new edge habitat has the effect of opening soil for recruitment of additional pioneer plant species as well as species applied for soil stabilization. Some of these new species have been accounted for where disturbed sites have been visited; others may have been missed where parcels were covered earlier. Important rare species were not found where such areas were visited.

Synopsis of Characteristics of Plant Species Listed by South Carolina

Rare plant species in South Carolina in the flora model recommended for the survey within the project area include those species listed by South Carolina for Lancaster and Kershaw Counties. These species are listed below and the major important sets of habitat factors, as currently understood, are discussed for each. Information, both ecological and taxonomic, is adapted from Weakley 2011 and Radford et al. 1968, or is considered applicable through general knowledge.

Southern Thimble Weed—This member of the buttercup or crowfoot Family (Ranunculaceae) is a spring-flowering species with white flowers and basal leaves. It is largely a species of western prairies and is occasionally found in the Carolinas where calcareous or mafic soils occur along mesic slopes. Habitat for this species is absent in the project area. Soils in the project area are inadequate for the occurrence of this species.

Carolina Anemone—is also a member of the Buttercup Family of plants, flowers in spring and can be found in soils associated with mafic rock materials. Iredell Series soils (Oxiaquic Vertic Hapludalfs) are characteristic. Soils in the project area are inadequate for the occurrence of this species.

Missouri Rock-cress—This species was once a member of the genus Arabis (a member of the crucifer or Brassicaceae family) and is typified by small, pinnately compound leaves with many leaflets and small white flowers. This genus contains small, biennial spring-flowering plants of xeric, thin soils of rocky areas, particularly

in the near vicinity of granite flatrock outcrops. Exposed or near-surface granitic materials were not seen in the project area.

Narrowleaf Sedge—This member of the sedge family (Cyperaceae) can be found along bases of mesic, low north-facing slopes where colluvium collects above stream channels. It is most apparent in spring and was one of the species sought, but not seen, in the piedmont portions of the project area.

Necklace Sedge—is another member of the Cyperaceae which may be found in rich mesic forests in colluvium. This species is known from all major physiographic provinces. It is possible that this species could be found in the project area, but it was not encountered.

Blue Cohosh—This species is a member of the barberry family of plants, Berberidaceae. The genus is characterized by ternately or biternately compound leaves with leaflets apically three lobed. Flowers are small with flower whorls in 6's. The southern species is rare in the piedmont of South Carolina and not common in the mountains. Small amounts of calcareous materials may influence soils in which this species is supported, otherwise it is most often in deep, mesic coves and along northern exposures. Soils of the project area would not seem to support this species.

Lowland Brittle Fern—Cystopteris is usually associated with rock outcrops, cliffs and boulder fields. Frequently the species are found on or about caldareous substrates. The fronds arer relatively small and born on creeping rhizomes that are often visible below light leaf litter over rocky substrate. Calcareous soils were not present in the project area.

Broomsedge—*Dichanthelium aciculare* has been separated into two subspecies, *D. aciculare* ssp. *aciculare* and *D. aciculare* ssp. *neuranthum*. The former subspecies is relatively uncommon in the Piedmont of South Carolina and the latter is rare in the southeastern Coastal Plain of that state. It is uncertain which subspecies is referenced by this element listing. The character of stiffness between the leaves of the two subspecies is difficult to define. This species was not encountered in the project area.

Open-ground Witlow Grass—This is a species of granite flatrock outcrops and occurs exclusively in open areas. This member of the crucifer family, Brassicaceae is small with cauline leaves nearly into the tiny inflorescence. This species was not encountered in the project area since granite flatrocks are not present within the project area.

Smooth Coneflower—Smooth Coneflower is listed under the Endangered Species Act of 1973 (16 U. S. C. 1531-1544, 87 Stat. 884), as amended, as endangered. This member of the sunflower family, Asteraceae, is often associated with what are thought to be historic Piedmont Prairie habitats in circum-neutral soils. Translation of that habitat preference in modern times means maintained corridors along power lines and road margins. It has been documented from an area about six miles north of the project area, but soils of the project area would not support the species.

Eastern Wahoo—This member of the genus Euonymus has been found over rich river sediments made up of circum-neutral alluvium and along slopes associated with calcareous or mafic soils. These understory shrubs are characterized by long petioles, four-merous flowers and leaves with relatively long hairs obvious on the under sides of the leaves. It is possible that this species could be found in the project area, but it was not encountered.

Pool Sprite— Pool Sprite is listed under the Endangered Species Act of 1973 (16 U. S. C. 1531-1544, 87 Stat. 884), as amended, as threatened. It is an endemic species of open, ephemeral pools on the surfaces of granite flatrock habitats. Granite flatrock outcrops were not encountered in the project area. Granite flatrock outcrops are absent from the project area.

Schweinitz's Sunflower—Schweinitz's Sunflower is listed under the Endangered Species Act of 1973 (16 U. S. C. 1531-1544, 87 Stat. 884), as amended, as endangered. This member of the sunflower family, Asteraceae, is often associated with what are thought to be historic Piedmont Prairie habitats in circum-neutral soils. Translation of that habitat preference in modern times means maintained corridors along power lines and road margins. It is known to occur sporadically over hardpan soils of several series of Alfisols. Soils in the project area are generally unsuitable for this species.

Black-spored Quillwort-- An endemic species of open, ephemeral pools on the surfaces of granite flatrock habitats. Granite flatrock outcrops are absent from the project area.

Piedmont Quillwort-- An endemic species of open, ephemeral pools on the surfaces of granite flatrock and Altahama grit habitats. Granite flatrock outcrops are absent from the project area.

Georgia Rush-- An endemic species of open, ephemeral seepage areas over the surfaces of granite flatrock habitats. Granite flatrock outcrops are absent from the project area.

White-wicky—This shrub is a member of the Mountain Laurel family, Ericaceae, that has clusters of white, showy flowers visible in spring. It is found along pocosin or coastal plain shrub wetland and upland borders. This species could be associated with some of the eastern-most stream corridor habitats of the Haile Gold Mine Creek drainage, but it was not encountered.

Southern Lepuropetalon—This curiously small annual is found in somewhat disturbed, open, wet sandy areas, including edges of granite flatrock habitats where seepage flows maintain soil moisture and along wet ditch margins. Flowers are small, only 2-3 mm across, greenish and visible only during very early spring if precipitation/seepage regimes have favored its growth. Most apparent habitat requirements are absent from the project area.

Pondspice—This shrub, up to 8 ft in height is most visible in early spring when its small yellow flowers reach anthesis during the earliest periods of leaf growth and enlargement. It is most usually found bordering the edges of small natural ponds or dolines in Coastal Plain habitats, but can be found along the wetland edges of other open habitats. Most habitat requirements are apparently absent from the project area.

Canada Moonseed—This twining vine has peltate leaves and dark blue berries. It is most likely to be found in somewhat thick alluvial habitats or colluvial slopes adjacent to flood plains. Habitats along the lower Camp Branch and Little Lynches River might support Canada Moonseed, but the species was not encountered.

One-flowered Stitchwort—This member of the Pink family, Caryophyllaceae, occupies slightly depressional areas that accumulate small amounts of soil material on the surfaces of granite flatrock and Altahama grit habitats. Granite flatrock and Altahma girt habitats are absent from the project area.

Piedmont Water-milfoil—A member of an aquatic plant family, Myriophyllaceae, most characteristically found in natural doline and, rarely, blackwater pond habitats. Flowers, when present, appear at the immersed ends of submerged strands and may scarcely be visible above the surface of the water. The common name is misleading since it is largely a Coastal Plain species. Adequate, permanent aquatic habitat is likely missing from the project area.

Nestronia—Nestronia, a member of the Sandlewood family (Santalaceae), is a low deciduous shrub with opposite, simple leaves and branches that grows from 1.5 to 3 ft in height along upper to middle slopes in sand hill soils. This shrub species, characterized by having male and female flowers on separate plants, has not been documented from Lancaster County in the past. It is now documented at 16 clones within the project area (Figure 3). Some of these clones have become quite extensive (well over an acre) in eastern parts of the project area. The tallest stems noted were associated with an outcropping of diabase boulders along a tributary Haile Gold Mine Creek in Parcel B within the project area.

Georgia Beargrass—A member of the Ruscaceae family of plants found in xeric sand hill environments. This species may be found in upper and middle slopes in South Carolina and Georgia sand hill habitats. It has long, narrow leaves and flowers that have characteristics of members of the lily family. Georgia Beargrass was not encountered during the surveys in the eastern portions of the project area where it might be sought.

Adder's-tongue—This small species of Ophioglossum fern is one of two recently separated from O. vulgatum. It is most characteristically found along floodplains in non-wetland loamy soils and along the edges of old fields from March into July. Adder's Tongue was not seen in any of the alluvial deposits surveyed within the project area.

Hairy Sweet Cicely—This member of the carrot family, Apiaceae, is characterized by having roots that have the smell of anise. It is found in upper flood plain loamy soils and colluvium of rich cove soils. This species has ternately compound leaves and inconspicuous white flowers in spring. Historical levels of disturbance are likely to have been such that this species could not be sustained in the Piedmont cove habitats present within the project area.

American Ginseng—A long time species of commercial value, not so much in this country but in Southeast Asia where their counterparts *Panax ginseng* and other species have been all but extirpated. The species is most notable for its roots that are dug, dried and sold as a panacea. Gathering ginseng is now controlled in some states to periods following ripening of the red berries. It is doubtful that this species has been able to survive the many human influences that have operated in the project area. At best, habitat characteristics that sustain such a species are minimally present.

Small's Purslane—A succulent-leaf plant of shallow soils over granite flatrock habitats and diabase glades. This species may recruit to adjacent sandy soils of fields and lawns. Granite flatrock outcrops are absent from the project area.

Wing-podded Purslane—A succulent-leaf plant introduced from South America or the West Indies and often established or waifed in loamy soils around abandoned homes. This species was not seen.

Georgia Oak—Shallow sandy soils over granite outcrops. Leaves are similar to those of Black Oak (Quercus verutina) but unevenly lobed. Granite flatrock outcrops are absent from the project area.

Michaux's Sumac—Michaux's Sumac is listed under the Endangered Species Act of 1973 (16 U. S. C. 1531-1544, 87 Stat. 884), as amended, as endangered. This member of the genus is a low hairy shrub and has pinnately compound leaves with serrate leaflets. It is known from maintained corridors, including power lines, road ways and field edges. It responds positively to fire. Lack of fire in any of the habitats surveyed has a great deal to do with the apparent absence of this species.

Canby Bulrush—This is a rare, often submersed, rush species of blackwater streams and beaver ponds in Coastal Plain wetlands. Habitats are generally inadequate within the project area to sustain this species.

Granite Rock Stonecrop—This species is a tiny, succulent annual of granite flatrocks. It often turns red in mass as it grows in shallow, gravely soils in slight granite depressions scattered over wider expanses of exposed granite. Granite flatrock outcrops are absent from the project area.

Wire-leaved Dropseed—A very fine-leaf grass species of wet pine savannas of the Coastal Plain. Savanna habitat is missing from the project area.

Georgia Aster—Georgia Aster is a candidate (C) species. This member of the composite family (Asteraceae) has compound flowers and appears very similar to a species relatively common in the project area, *Symphyotrichum patens* or Common Clasping Aster. Georgia Aster is often a robust perennial herb with blue to purple-blue rays and white disc flowers. This species was not seen and it is doubtful that the general lack of adequately maintained habitats could sustain it within the project area.

Yellow Pipewort—Syngonathus is a species of wetland savannas, ditch margins and disturbed pocosin edges. As a pipewort it has a basal set of linear leaves and a stem that rises from the rosette to produce a head of tiny yellowish flowers. Open wetland habitats of a Coastal Plain character are not readily available in the project area.

Heart-leaved Foam Flower—Heart-leaved Foam Flower of the saxafrage family (Saxifragaceae) was found in only one location within the project area (Figure 3). This Camp Branch site with rocky cliffs, Mountain Laurel (*Kalmia latifolia* Linnaeus), and American Beech (*Fagus grandifolia* Ehrhart) also supported a very small amount of Sweet Shrub (*Calycanthus floridus* Linnaeus). This herb is characteristically found in somewhat rocky rich soils, often near outcrops and produces a raceme of small white flowers that rises above the leaves in spring. The plant is somewhat hirsuit and often shows purpleish-colored vein areas on rounded, toothed, cordate leaves. Recognition of the controversial taxon *T. wherryi* seemed possible from the material examined from this locations.

White False-asphodel—A wetland area above an un-named tributary of Haile Gold Mine Creek in the eastern portion of Parcel B appeared to be a suitable habitat in which to find this white-flowered member of the asphodel family (Tofieldiaceae). The wetland area appeared unusually dry during surveys and the general area had been heavily timbered. This species was not found. The project area contains very limited habitat in which this species could be sustained.

Chapman's Redtop—This species is a tall grass about waist high with a reddish to purplish inflorescence. Hair on the swollen stem joints separates this species from the much more common Redtop seen in throughout the project area. Soil textures in the loamy class are likely lacking or not in association with other preferred habitat characteristics of this species within the project area.

Narrow-leaved Trillium—This trillium is supported in rich woods with hardwood canopies over soils derived from calcareous materials or rooted in mafic soils. Maroon deflexed petals and drooping mottled leaves help to define this species in the Coastal Plain. Soils within the project area are inappropriate for this species.

Southern Nodding Trillium—This trillium has unmottled leaves and purple anthers in a white corolla with recurved petal tips help define this species. It occupies rich slopes with a hardwood canopy and is often supported in soils that derive from calcareous or mafic parent materials. Soils are inappropriate for this species within the project area.

Yellow Violet—This species of violet with solid yellow flowers has been recently redefined to include *Viola eriocarpa* var. *leiocarpa* and is often found associated with mesic forests. Soil or moisture characteristics for this species during the surveys may have been inadequate within the project area.

Summary of Survey Findings for Threatened and Endangered Plant Species

During the course of the surveys within the Haile project area carried out over a period of three years (2008-2011) all habitats types which might support any of the above listed target plant species were investigated. Habitats were covered multiple times, during multiple seasons over multiple variations of each basic habitat type. Two state listed plant species were found within the project area. Foam Flower (*Tierella cordifolia*) was found in one habitat of limited occurrence along Camp Branch. Foam Flower (*Tierella cordifolia*) was found in one habitat of limited occurrence along Camp Branch (Foam Flower's State listing is SNR -- Unknown Not Ranked - Rank in South Carolina not yet assessed). Nestronia (*Nestronia umbellula*), is a relatively common shrub repeatedly found along upper to middle slope habitats in dry woods dominated by several species of scrub oaks (*Quercus laevis*, *Quercus marilandica*, *Quercus margarettae*) and pine (*Pinus palustris*, *Pinus taeda*). Sixteen occurrences of Nestronia were found within this project boundary (Figure 3).

Long-term and profound disturbances have been associated with habitats present within the project area. These areas have been farmed, subject to forest management and, more recently protected totally from fire. No evidence of fire either associated with controlled burning or uncontrolled wildfire was noted within the project area. No such evidence was seen. Long-term fire protection in conjunction long-term landscape disturbances largely preclude the presence of optimum habitats for most of the target species considered in this survey

Vegetation evidence indicates a history of open and confined grazing in the area. This evidence comes by way of habitats where Loblolly Pines are scattered through stands of young broadleaf hardwood forests, where a large component of Water Oak (*Quercus nigra*) is mixed with other species and where Loblolly Pine and Sweet Gum (*Liquidambar styraciflua*) dominate forested flats, ridges and slopes. Such vegetation shows where fields were abandoned. Open-range grazing and browsing were likely once used in the area to sustain various sorts of livestock. The remains of fencing materials in scattered areas throughout currently forested areas and along property lines offer more recent evidence of greater confinement for livestock. Livestock allowed to roam in confined or unconfined areas gradually creates a shallow soil layer that remains in a state of intensive or extensive pedoturbation for a time. This sort of disturbance over time will not favor growth or recruitment of any of the rare species covered.

Based on observations made during the course of the surveys, a large proportion of Coastal Plain acreage within the project area was clear-cut and converted to Loblolly Pine plantation after 1990. Pine plantations have been planted closely adjacent to many secondary roads. More recently much of the land has been at least selectively cut for

Loblolly and Longleaf Pine, leaving an assortment of broadleaf species in upland areas. More recent forestry practices avoid wetland areas, at least partially, allowing stream corridor and wetter forest habitats to remain somewhat undisturbed. None of the rare target species listed above are likely to be found in riparian or wetland habitats.

Power line corridors are uncommon in the project area. Most such corridors follow secondary roads or highways where at least a part of corridor is road shoulder. Evidence offered by brown, dead plants in these corridors suggests power line corridors in the area are maintained by the use of herbicides. With this sort of maintenance spray drift can impact not only plants within the corridors but plants that ordinarily thrive along and just inside corridor edges. Following spraying the most tolerant species will rebound while other species are either eliminated or considerably reduced in vigor. All of the target species would be susceptible to such herbicides.

Other edges along fields, sandy unsurfaced roads, trails and the like have been surveyed repeatedly. Two general habitat factors are always absent, soils developed from mafic rock materials such as diabase and fire. Diabase rocks occur naturally in the project area in stream valleys and along some lower slopes, where Piedmont soils have been exposed under Coastal Plain sands and ironstone lenses. Many of these areas are forested and not considered adequate habitat for the target species.

Two groups of soil parent materials are wide spread in the project area, Coastal Plain sandy materials and Piedmont Carolina Slate Belt materials derived from weathered felsic rocks. Soils formed from weathered mafic rock materials (diabase) have not been mapped for the project area and only seem to appear as inclusions generally associated with widely scattered visible outcrops of diabase (Figure 3). Plant species found at these sites offer a vague suggestion of circum-neutral soils. Examples of two such sites within the project area were also associated with old house places. It is uncertain if past human activities at these house places were a factor in formation of the apparent circum-neutral soils. These and other diabase outcrop areas within the project area were surveyed carefully over the seasons and none of the target species were found.

Conclusion

Only two of the target species listed for Kershaw and Lancaster Counties were encountered during the course of the many seasonal surveys at Haile within the project area. No other listed target species was encountered within the project area. Complete sets of optimum habitat factors for these species were apparently absent from the project area making presence of the species unlikely. Lack of appropriate substrate, long-term disturbance and long-term absence of fire are the overwhelming causes of lack of suitable habitat within the project area.

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APPENDIX A:
EXPLANATIONS OF RANKING SYSTEMS OF BIOLOGICAL SPECIES AT STATE AND GLOBAL LEVELS

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Natural Heritage Programs, Conservation Data Centers (CDCs), NatureServe, and The Nature Conservancy (TNC) have developed a consistent method for evaluating the relative imperilment of both species and ecological communities. These assessments lead to the designation of a conservation status rank. For plant and animal species these ranks provide an estimate of extinction risk. Conservation rank values have been assigned over the past 30 years by the N.C. Natural Heritage Program, NatureServe, and a large number of collaborators in government agencies, universities, natural history museums and botanical gardens, and other conservation organizations. The information has been developed primarily to help in guiding conservation and informing environmental planning and management. Conservation status ranks are based on a one to five scale, ranging from critically imperiled (S1) to demonstrably secure (S5). These status assessments are based on the best available information, considering a variety of factors such as abundance, distribution, population trends, and threats. This information is modified from Franklin and Finnegan 2010.

STATE RANK

S1-- Critically imperiled - Critically imperiled due to extreme rarity or some factor(s) making it especially vulnerable to extirpation (local extinction) from the state.

S2 -- Imperiled - Imperiled due to rarity or some factor(s) making it very vulnerable to extirpation from the state.

S3 -- Vulnerable - Vulnerable to extinction either because rare or uncommon, or found only in a restricted range (even if abundant at some locations), or due to other factors making it vulnerable to extirpation.

S4 -- Apparently secure - Apparently secure and widespread.

S5 -- Secure - Common, widespread, and abundant.

SH -- Historical - Of historical occurrence, with some expectation that it may be rediscovered. Its presence may not have been verified in the past 20 years.

SX -- Presumed extirpated -- Believed to be extirpated. Has not been located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

SU -- Unknown Unrankable - Currently unrankable due to lack of information or substantially conflicting information about status or trends. More information is needed.

SNR -- Unknown Not Ranked - Rank in North Carolina not yet assessed.

GLOBAL RANK. Similar to state ranks, global ranks are assigned by a consensus of scientific experts, Natural Heritage Programs, CDCs, NatureServe, and TNC. They apply to the status of a species throughout its range. This system is widely used by other agencies and organizations, as the best available scientific and objective assessment of a species' rarity throughout its range.

G1 -- Critically imperiled - Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction.

G2 -- Imperiled - Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction.

G3 -- Vulnerable - Vulnerable globally either because very rare throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction.

G4 -- Apparently Secure - Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery) and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for longterm concern.

G5 -- Secure - Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range.

GH -- Historical - Known from only historical occurrences, but with some expectation that it may be rediscovered. May still be extant; further searching is needed.

GX -- Presumed Extinct - Believed to be extinct throughout its range with virtually no likelihood that it will be rediscovered. Not located despite intensive searches of historical sites and other appropriate habitat.

GU ---Unknown, Unrankable - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends; need more information.

GNR -- Unknown Not Ranked - Global rank not yet assessed.

T -- The rank of a subspecies or variety. As an example, G4T1 would apply to a subspecies of a species with an overall rank of G4, but the subspecies warranting a rank of G1.

? -- Uncertain - Denotes inexact or uncertain numeric rank.

Q – Questionable taxonomy that may reduce conservation priority.

A rank involving two numbers indicates uncertainty of rank. For example, a G2G3 rank indicates that the species may be G2 or G3, but that existing data do not allow that determination to be made.

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FIGURES

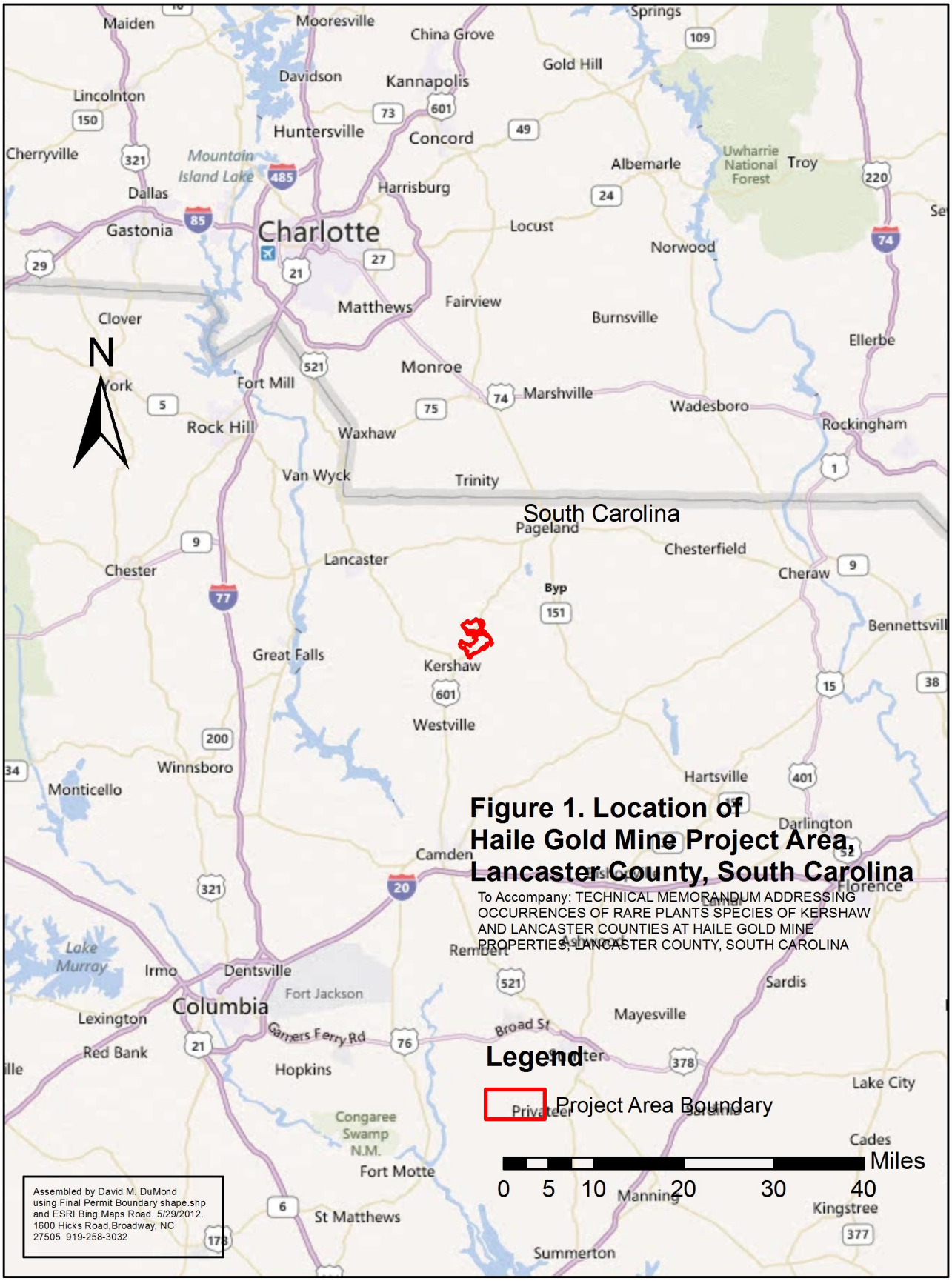

Figure 1. Location of Haile Gold Mine Project Area, Lancaster County, South Carolina

To Accompany: TECHNICAL MEMORANDUM ADDRESSING OCCURRENCES OF RARE PLANTS SPECIES OF KERSHAW AND LANCASTER COUNTIES AT HAILE GOLD MINE PROPERTIES, LANCASTER COUNTY, SOUTH CAROLINA

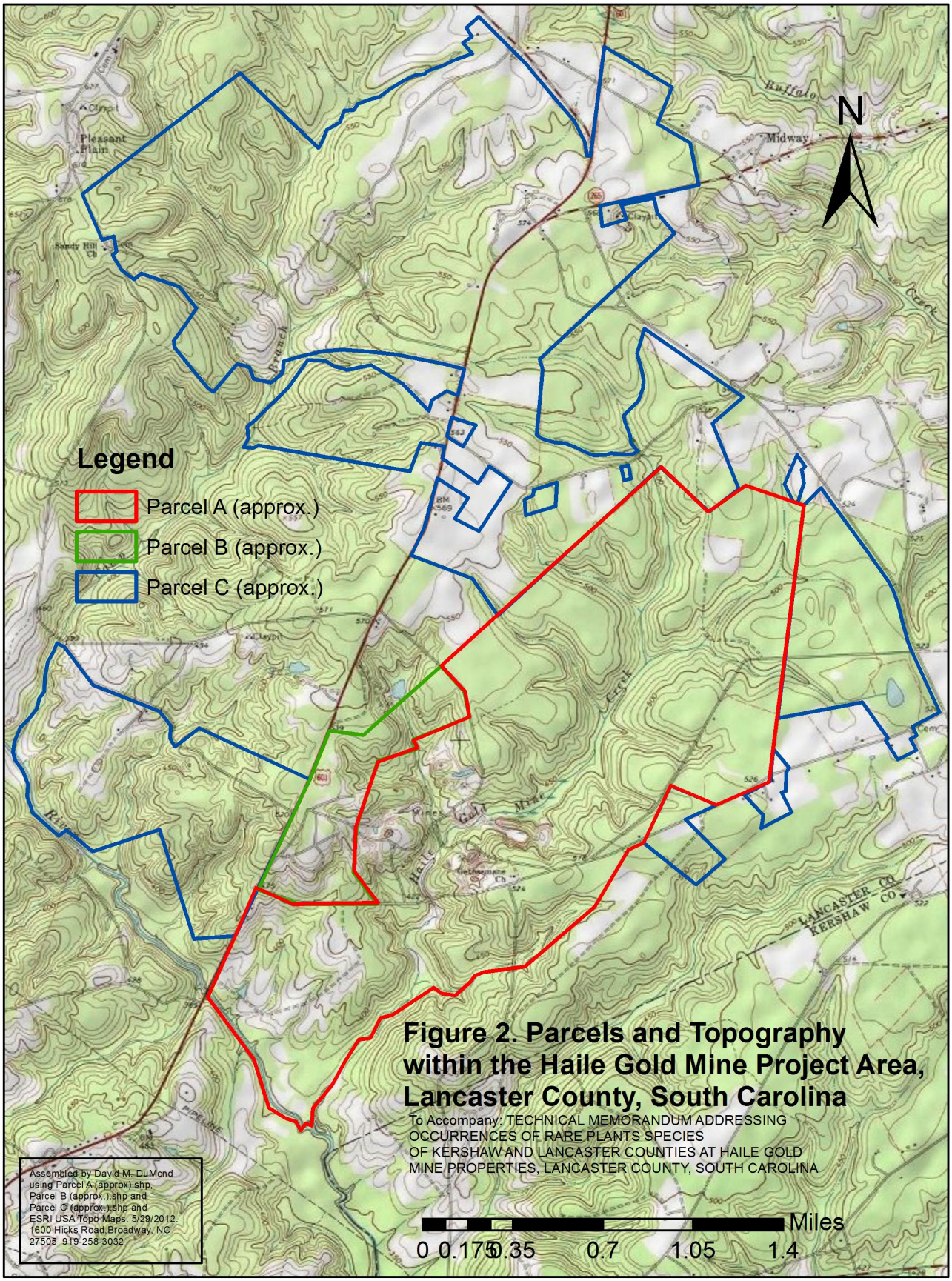

Figure 2. Parcels and Topography within the Haile Gold Mine Project Area, Lancaster County, South Carolina

To Accompany: TECHNICAL MEMORANDUM ADDRESSING OCCURRENCES OF RARE PLANTS SPECIES OF KERSHAW AND LANCASTER COUNTIES AT HAILE GOLD MINE PROPERTIES, LANCASTER COUNTY, SOUTH CAROLINA

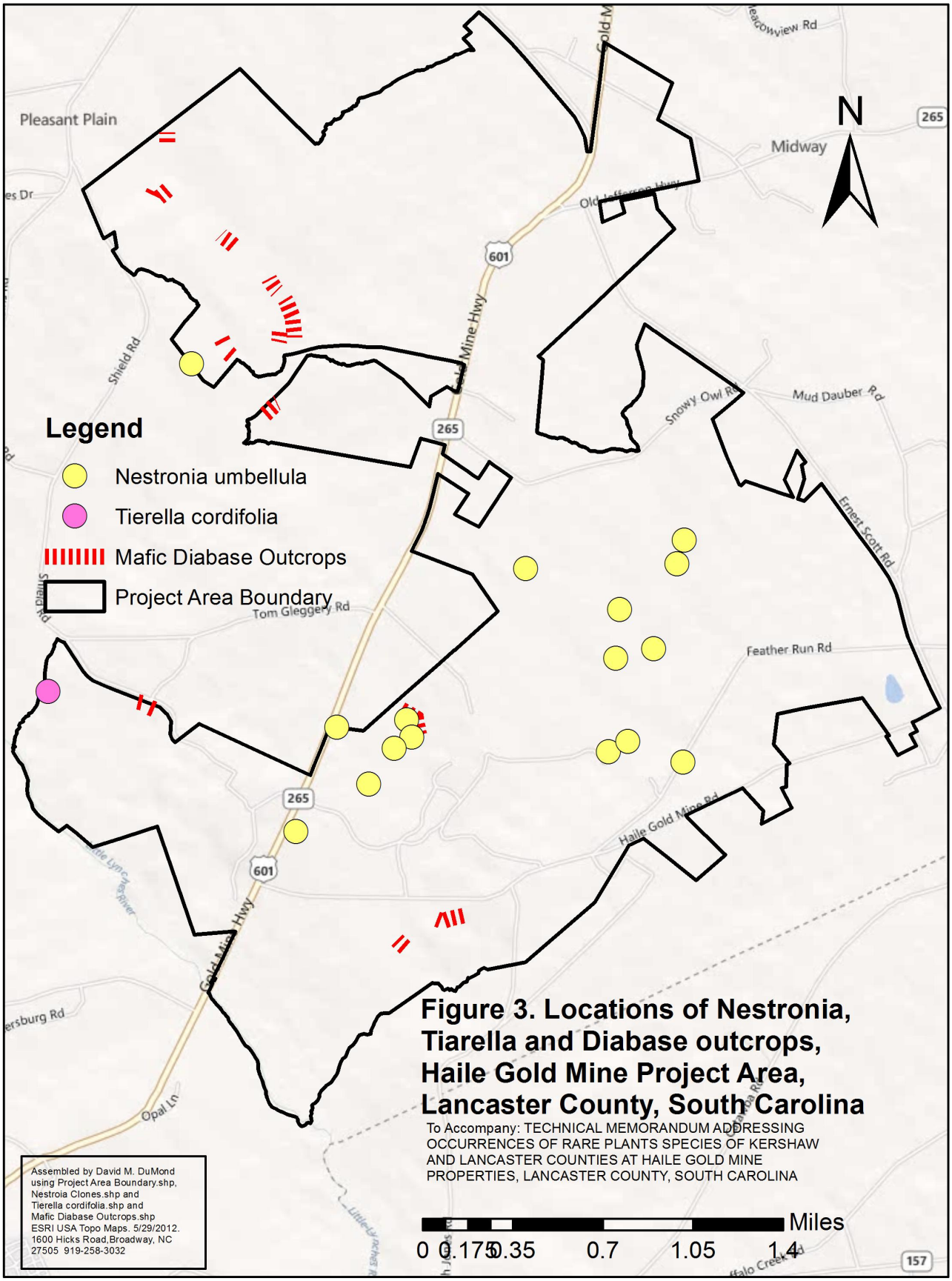

Figure 3. Locations of Nestronia, Tiarella and Diabase outcrops, Haile Gold Mine Project Area, Lancaster County, South Carolina

To Accompany: TECHNICAL MEMORANDUM ADDRESSING OCCURRENCES OF RARE PLANTS SPECIES OF KERSHAW AND LANCASTER COUNTIES AT HAILE GOLD MINE PROPERTIES, LANCASTER COUNTY, SOUTH CAROLINA