June 17, 2022

Mr. Joseph Waldman
Highgates Management
119 Park Glen Avenue
Toronto, Ontario, Canada M6B2C6

C/O Mr. David Mindel
Mindel Scott & Associates, Inc.
5151 Jefferson Blvd.,
Louisville, Kentucky 40219

Reference: **Broad Run Road - Preliminary Slope Evaluation**
8000 Broad Run Road
Louisville, Jefferson County, Kentucky 40291
ECS Project No. 61-2612-A

Dear Mr. Waldman:

ECS Southeast, LLP (ECS) conducted a preliminary slope evaluation for the referenced site in accordance with ECS Proposal No. 61-P2766, dated June 14, 2022. This evaluation included the following elements: a review of provided drawings; a review of soil survey information; a review of geologic maps; a review of topographic maps: a visual reconnaissance of indicated steeper slope areas that would be disturbed by new construction; and an evaluation of the reviewed information and preparation of a report of our findings and recommendations.

Project Information

The proposed development on-site includes 242 single-family residential lots, common areas (clubhouse and picnic area/playground), and associated roadways. There is approximately 180 feet of fall across the entire site, with up to approximately 28 feet of fall across a single proposed residential development lot. The existing topography is generally flat within the central open field area but sloped down from east to west (western portion of subdivision) and south to north (northern portion of subdivision). One-hundred and seven (107) possible karst-related features were identified onsite in the previous Karst Survey (Broad Run Road – Karst Survey, ECS Project No. 61-2612, dated December 14, 2021).

The existing site consisted of approximately 192.4 acres of open grass fields, densely wooded areas, and several drainage swales toward the eastern and western wooded portions of the site. The drawing "Preliminary Plan – 8000 Broad Run Road Subdivision", provided by Kathy Linares of Mindel Scott via email, dated March 30, 2022, identified existing 20-30% slopes and >30% slopes on the property. A copy of this drawing is attached to this report.

The current LDC section 4.7.5 includes requirements for land disturbing activities on slopes greater than 20%. Item B.3 of section 4.7.5 states "Land disturbing activities on slopes greater than 20% and less than 30% shall be required to prepare a geotechnical survey report if the staff of the USDA Natural Resources Conservation Service (NRCS) determines such a study is warranted, given the site's soil and geologic characteristics. A geotechnical survey report shall be submitted for land disturbing activities on slopes greater than 30%." We understand that at present the NRCS is not making the determination of the need for a geotechnical survey report. Accordingly, ECS Southeast, LLP (ECS) was retained to conduct a limited slope evaluation along the western steep slopes onsite, specifically in areas near Lots 22-25 and planned utilities extending east through the onsite western slope.

The purpose of the reconnaissance is to observe potential conditions consistent with past or recent slope instability and/or erosion, to check for rock outcrops that would confirm the reported bedrock geology, and to check for other conditions (e.g. springs, dumping, existing structures, excavations, etc.) that could impact slope stability. Our evaluation consisted of the following tasks:

- Review the Plan
- Review USGS Geologic Quadrangle Map information
- Review USDA NRCS Soil Survey information
- Conduct a visual reconnaissance of indicated steeper slope areas that would be disturbed by new construction
- Evaluate the reviewed information and prepare a report of our findings and recommendations

Geology

The following geologic information is based on the review of the Jeffersontown, 24K Quadrangle, Geologic Map, Kentucky, published by the United States Geological Survey (USGS); information (aerial photos, geologic maps, and topographic maps, etc.) obtained from the Kentucky Geological Survey (KGS) Geologic Information Service website; and Google Earth Satellite Imaging.

The Kentucky Geologic Map Information Service website indicated that the five (5) formations reportedly underlying the site are “Louisville Limestone”, “Waldron Shale”, “Laurel Dolomite”, “Osgood and Brassfield Formations”, and “Drakes Formation”. The “knob” areas are underlain by the “Louisville Limestone” and “Waldron Shale” formations and the steep slope areas along the east and west boundaries are generally underlain by “Osgood and Brassfield Formations” and “Drakes Formation”. The observed western slope areas were reportedly underlain by the Drakes Formation, Osgood and Brassfield Dolomite, and Laurel Dolomite formations.

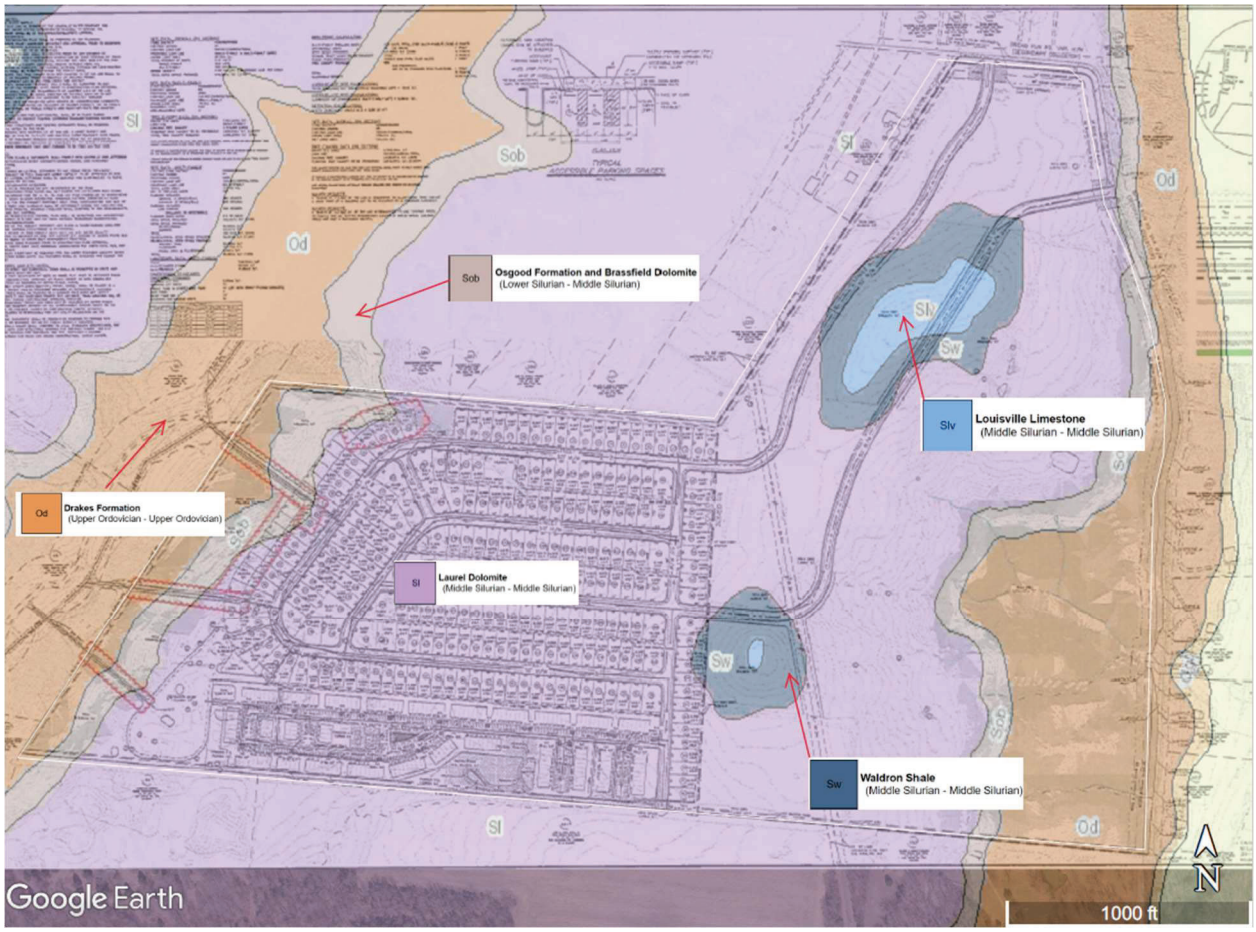

Figure 1: Reported Site Geology

Drakes Formation (Most Slope Areas)
Total Reported Thickness: ± 140 feet
Karst Potential: Low
Primary Lithology: Limestone, dolomite, and/or shale.
Members: Saluda Dolomite Member, Bardstown Member, and Rowland Member.

Saluda Dolomite Member: Primarily dolomite, dolomitic mudstone, with minor shale and limestone. Dolomite is greenish gray to olive gray, weathers same to yellowish gray and dark yellowish orange. Shale, light gray to olive black, locally carbonaceous; as persistent parting 0.1 to about 1 foot thick in lower part of laminated dolomite, generally 12 to 16 feet above base of unit. Limestone is bluish gray, weathers olive gray to brownish gray; dense, micritic; conchoidal fracture; commonly as a single bed immediately below or above shale marker bed and as one or two thin beds in lower part of unit.

Bardstown Member: Primarily limestone and shaly mudstone. Limestone, medium to olive gray, is of two main types: shaly limestone and coquinoidal limestone. Shaly limestone is fine to very fine grained, contains sparse to abundant coarse grains and fossil fragments, grades locally to calcareous shale. Coquinoidal limestone is characterized by fossils fragments in a sparry to muddy matrix; bluish cast common where fresh, weathers yellowish gray, dark yellowish orange, and light olive gray. Shaly mudstone, thin bedded, mainly calcareous, olive gray to greenish gray; locally dark brownish gray to olive black where carbonaceous.

Rowland Member: Primarily limestone and shale. Dominant limestone is medium and greenish gray to medium bluish gray calcisiltite; weathers pale olive to yellowish gray; dolomitic and argillaceous; streaked with irregular burrows filled with dusky yellowish-green glauconitic material which weathers out readily to form holes and pitted bed surfaces; thin to thick bedded in continuous but poorly defined planar beds. Dominant shale is olive gray, light olive gray, greenish gray, and dark greenish gray; weathers yellowish gray to light gray; calcareous; in beds as much as 3 feet thick near upper and basal contacts. Small ponds for livestock and recreation are common in areas underlain by the Waldron Shale and by shale of the Osgood Formation and the Bardstown and Rowland Members of the Drakes Formation.

Osgood and Brassfield Formations (Upper Slope Areas)
Total Reported Thickness: 15-25 feet
Karst Potential: Nonkarst
Primary Lithology: Shale and minor dolomite
Members: Osgood Formation and Brassfield Formation

Osgood Formation: Shale and dolomite: Shale is greenish gray, silty, poorly fissile, dolomitic; weathers to gray flakes or to yellowish gray or grayish yellow clay. Dolomite is yellowish gray with reddish or orange mottling (probably a weathered color), fine grained; occurs at base of unit; resembles lowest dolomite bed of the Laurel Dolomite.

Brassfield Formation: Limestone of three types, each generally two feet or less thick, any of which may be missing at a given locality. At top is an orange yellow, medium grained, fossil fragmental limestone; in middle is a medium to dark gray, fine grained, unfossiliferous limestone; at base is a light olive gray, coarse grained, highly fossiliferous limestone.

Laurel Dolomite (Reportedly Underlying Most of the Subdivision)
Total Reported Thickness: 44-52 feet
Karst Potential: Medium
Primary Lithology: Dolomite and shale

Dolomite and minor shale in three distinct parts: Uppermost part is dolomite, light olive gray to olive gray with dark gray mottling, weathers yellowish gray to grayish orange; finely crystalline to medium crystalline (0.02 to 0.25 mm); distinguished by even "quarry stone" bedding ranging in thickness from 0.2 to 2.8 feet; locally contains interbedded and intermixed oolitic dolomite in upper 1.5 feet; Middle part is moderate brown and medium gray to medium light gray dolomite that weathers yellowish gray to pale yellowish orange; mottled, vuggy, without distinct partings; calcitic; Basal part, in descending order, is shale, dolomite, and shaly dolomite. Shale is dark greenish gray, weathers grayish yellow; dolomitic, calcareous; in a single bed 1.5 to 2.5 feet thick; equivalent to upper shale of Osgood Formation as mapped by Butts (1915). Dolomite and shaly dolomite are greenish gray to light olive gray, weather same to grayish orange; finely crystalline to medium crystalline (0.02 to 0.25 mm); beds 0.3 to 2.0 feet thick. Basal contact gradational through as much as 3 feet with dolomitic shale and shaly dolomite of underlying formation; contact commonly coincides with break in slope. Springs at base contribute to slumping of lower dolomite down shaly slopes of underlying formation.

Karst Potential

The majority of the site is reportedly underlain by the "Laurel Dolomite" formation which is designated as having a "Medium" karst potential. The karst potential is based on the tendency for the site to develop or have karst features as shown on the KGS Geologic Map Information Service. Karst potential designation is not definitively indicative of the actual presence or absence of karst activity at the site. According to the KGS Potential Classification definitions, the development of karst features is variable and dependent on site-specific conditions in formations designated as a "medium" karst potential.

Several karst features were reported within the site boundaries and most appears to be located in the southwest and northeast portions of the site. These reported areas were visually evaluated and reported as part of the one-hundred and seven (107) possible karst-related features that were identified onsite in the previous Karst Survey (Broad Run Road – Karst Survey, ECS Project No. 61-2612, dated December 14, 2021). Refer to the previous Karst Survey Letter for the approximate locations of said features.

Soil Conservation Service Soil Survey

The USDA Natural Resources Conservation Service "Web Soil Survey" website indicated 11 general soil types at the site as shown in **Figure 2**. Descriptions of these soil types are summarized below.

NRCS CUSTOM SOIL RESOURCE REPORT				
Map Unit Symbol	**Map Unit Name**	**Parent Material**	**Acres in AOI (Approximate)**	**Percent of AOI (Approximate)**
BeB	Beasley silt loam, 2 to 6 percent slopes.	Clayey residuum weathered from calcareous shale.	4.5	2.3%
BeC	Beasley silt loam, 6 to 12 percent slopes.	Clayey residuum weathered from calcareous shale and/or calcareous siltstone.	9.7	4.8%
CaC2	Caneyville silt loam, 6 to 12 percent slopes, eroded, very rocky	Clayey residuum weathered from limestone.	9.6	4.8%
CrB	Crider silt loam, 2 to 6 percent slopes	Fine-silty noncalcareous loess over clayey residuum weathered from limestone.	114.0	56.7%
CrC	Crider silt loam, 6 to 12 percent slopes	Fine-silty noncalcareous loess over clayey residuum weathered from limestone.	4.6	2.3%
FaD	Faywood silt loam, 12 to 25 percent slopes.	Clayey residuum weathered from limestone and shale.	0.2	0.1%

FsF	Faywood-Shrouts-Beasley complex, 25 to 50 percent slopes.	Clayey residuum weathered from limestone and shale.	52.5	26.1%
ShD3	Shrouts silt loam, 12 to 25 percent slopes, severely eroded, very rocky	Clayey residuum weathered from calcareous shale and/or siltstone.	4.9	2.4%
uBwfA	Boonewood silt loam, 0 to 4 percent slopes, frequently flooded	Fine-silty alluvium derived from limestone.	0.2	0.1%
UmC	Urban land-Alfic Udarents-Crider complex, 0 to 12 percent slopes	Thin fine-silty loess over clayey residuum weathered from limestone and dolomite.	0.0	0.0%
WoC	Wooper silt loam, 6 to 12 percent slopes, rarely flooded	Clayey colluvium derived from limestone.	0.6	0.3%

Figure 2: Reported Soil Data

Site Reconnaissance

Based on our review of the provided drawing, the areas of interest (western slopes) included either 20-30% slopes or >30% slopes that may be disturbed during development. A site reconnaissance was conducted on June 10, 2022, by Ben Emery, E.I.T. of ECS. Steep slopes with various indications of minor slope instability were observed along the areas of interest and typically became more prevalent approaching the existing drainage swales. A relatively flat area (AOI-03) was observed to contain a ridgeline outcropping, with no other visible signs of instability. Refer to the attached **Site Reconnaissance Plan** for the approximate locations of areas of interest (AOI-01 to AOI-05) and observed features.

Surface drainage generally was directed to the north and west across the site by the existing surface topography and drainage swales. Several drainage swales were observed intersecting the areas of interest. Indications of erosion were observed primarily along the swales including occasional patches of bare soil, exposed bedrock along the bottom of swales, and gullies. Particularly steep slopes, as well as several localized, minor slope failures were observed along the existing swales.

Some visual indications of minor slope instability were observed throughout the areas of interest including: slight displaced rock fragments (gravel and cobbles); unusual tilting and bowed trees; and minor eroded soil. No indications of large, wide-scale or deep seated slope movements were noted. However, slight slope movements (wedge or bowl-shaped failures) were observed in isolated areas (typically at slope areas > 20% within 20 feet of the banks of drainage swales). For the remainder of the site, the slopes appeared to be stable (excluding drainage swale banks). In general, signs of slope failure were rare or absent outside of the observed drainage swales. See below for photos at each area observed as shown on the attached **Site Reconnaissance Plan.**

Photo 1: View of tilted trees (AOI-1).

Photo 2: View of drainage swale (AOI-1)

Photo 3: Evidence of minor dumping (AOI-1).

Photo 4: Evidence of streambank erosion at drainage swale (AOI-1).

Photo 5: View of slope and outcropping (AOI-1).

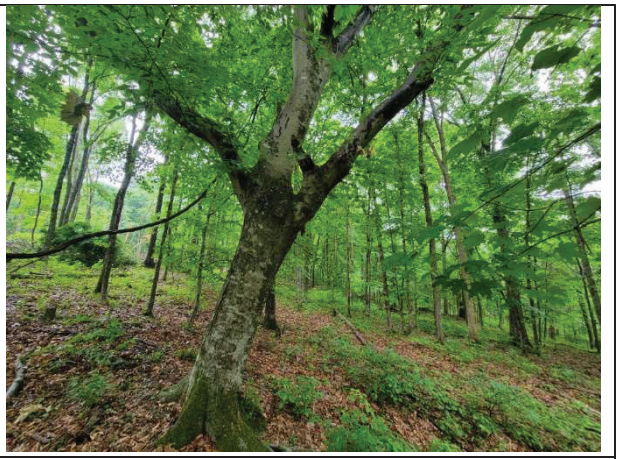

Photo 6: View of bent tree – upslope portion (AOI-2).

Photo 7: Outcropping along drainage swale (AOI-2).

Photo 8: Slight surficial erosion near the crest of the slope (AOI-2).

Photo 9: Eroded slopes along drainage swale (AOI-2).

Photo 10: Large outcropping – eastern portion of AOI-2.

Photo 11: Slope profile (AOI-2).

Photo 12: Standing water observed in drainage swale – downslope portion of (AOI-2).

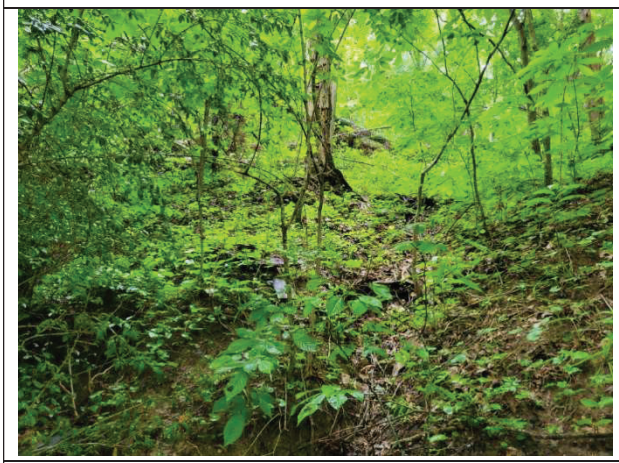

Photo 13: Steep gulley and minor bowl-shaped failure along drainage swale (AOI-2).

Photo 14: Steep slopes along drainage swale (AOI-2).

Photo 15: Slope profile (AOI-3).

Photo 16: Small isolated rock outcropping (AOI-3).

Photo 17: Bent tree – downslope portion of AOI-4.

Photo 18: Drainage swale with slope profile (AOI-4).

Photo 19: Slope profile (AOI-4).

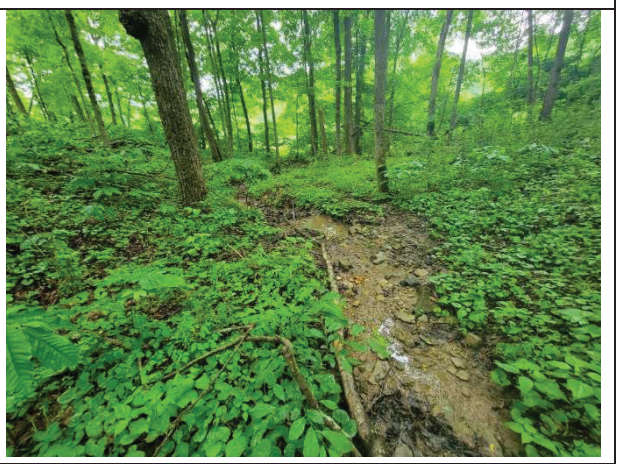

Photo 20: Additional drainage swale with displaced cobbles and slope profile (AOI-4).

Photo 21: Shear rock face (approximately 15 to 20 feet tall) within drainage swale (AOI-5).

Photo 22: Large outcropping – upslope portion of AOI-5.

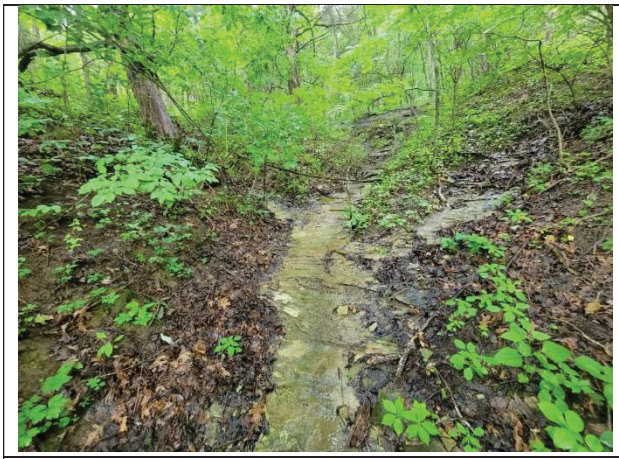

Photo 23: Outcropping along drainage swale (AOI-5).

Photo 24: Slight surficial erosion (AOI-5).

Photo 25: Slope profile (AOI-5).

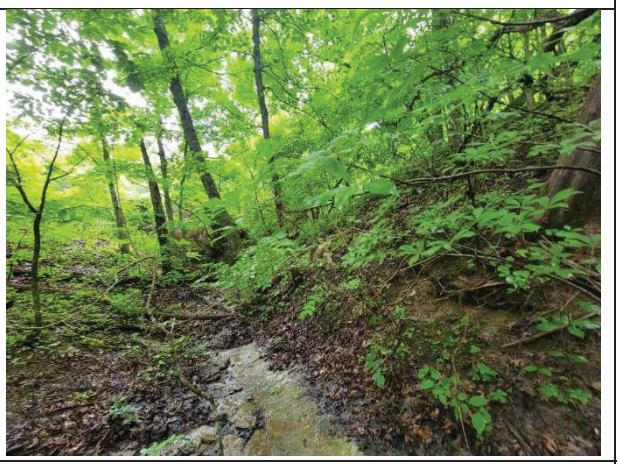

Photo 26: Steep, eroded banks along drainage swale (AOI-5).

Findings

Based on our review of the above reference observations and information, and on our past experience with site development for similar conditions in Jefferson County, it is our opinion that most of the on-site slopes (excluding small, localized erosion features along swales) in the observed areas were generally stable at the time of our reconnaissance. Evidence of minor instability was observed in isolated areas along or near the observed drainage swales. Refer to attached **Site Reconnaissance Plan** for the approximate locations of observed minor instability, identified in yellow ("Observed Minor Failure Areas").

The current, on-site localized slope instability observed likely is related to the following factors:

- Relatively thin depths of soil in slope areas
- Cohesive (clayey) soil matrix
- Rocky soil texture
- Limestone, dolomite, and or shale bedrock
- Numerous trees and other vegetation

Based on the conditions observed, additional geotechnical exploration/analyses including soil/rock test borings/coring, shear strength tests of soils, etc. are not required for most of the evaluated on-site slopes, provided that the planned subdivision is designed and constructed utilizing the guidelines included in this report.

Per the **Site Reconnaissance Plan,** the isolated swale areas shown in yellow ("Observed Minor Failure Areas") where minor instability was observed should be further investigated during the construction phase of the project, once the location and planned elevation of the proposed structures and related improvements are known.

The following guidelines should be used to help maintain the stability of the existing and planned slopes during the design and construction of the new subdivision, and over the life of the new homes. These guidelines include:

- Plan grading to minimize changes to existing topography along slopes.
- Minimize disturbance to slopes and vegetation outside new construction areas.
- Avoid significant transverse cuts along face or at the toe of existing slopes.
- Avoid significant embankments on the face, or along or at the crest of existing slopes.
- Avoid placing new construction at or within 10 feet of the crest of existing slopes.
- Maintain the following limits for new embankments without additional geotechnical exploration and analysis:
  - 3:1 (horizontal: vertical) or flatter slopes.
  - Properly strip all vegetation, topsoil, etc. where fill will be placed.
  - Construct embankments with controlled fill compacted to at least 98 percent of the Standard Proctor maximum dry density and within 2 percent of the optimum moisture content.
  - Maximum fill embankment height – 5 feet.
  - Horizontally bench new fill into existing slopes in maximum one-foot vertical steps.
- Maintain the following limits for new cuts in soil without additional geotechnical exploration and analysis:
  - 3:1 (horizontal: vertical) or flatter slopes.
  - Maximum cut height – 5 feet.
- Provide adequate erosion and surface water drainage control during construction and over the life of the subdivision.
- Establish permanent vegetative cover as soon as practical.

Closing

We appreciate the opportunity to serve as your geotechnical consultants for this project. We look forward to future association with you on this and other projects.

Respectfully submitted,

ECS Southeast, LLP

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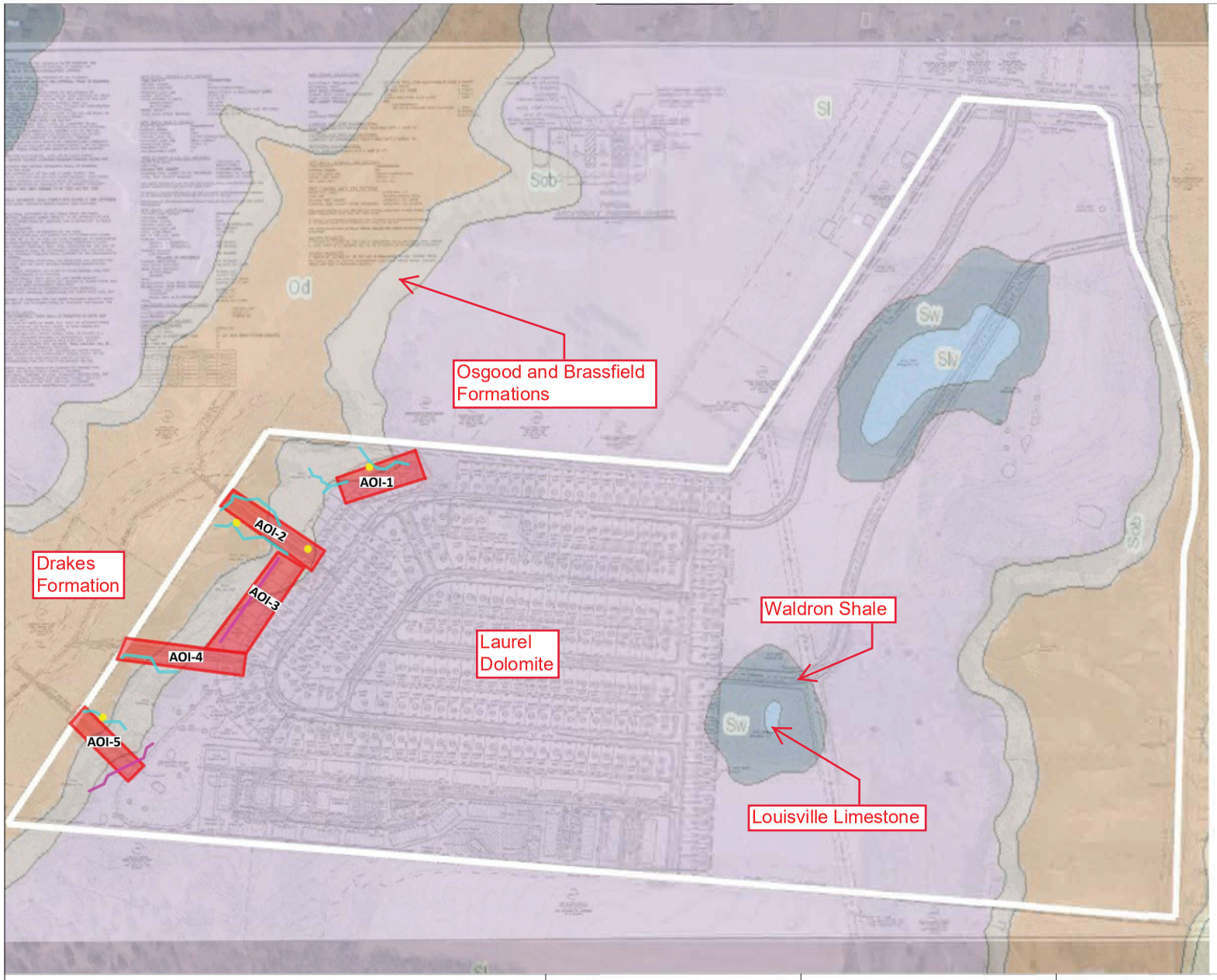
Attachments: Site Vicinity Diagram
Site Reconnaissance Plan
"Preliminary Plan – 8000 Broad Run Road Subdivision" provided by Mindel Scott & Associates

SITE LOCATION DIAGRAM
BROAD RUN ROAD - PRELIMINARY SLOPE EVALUATION

8000 BROAD RUN ROAD - LOUISVILLE, KENTUCKY 40291

HIGHGATES DEVELOPMENT COMPANY

ENGINEER	FEN
SCALE	AS NOTED
PROJECT NO.	61:2612-A
FIGURE	1 OF 1
DATE	6/14/2022



Site Reconnaissance Plan
8000 Broad Run Road - Slope Evaluation
8000 Broad Run Road
Louisville, Jefferson County, Kentucky 40291

Project No.: 61:2612-A	Drawn By: BCE
Drawing No.: SRP	Checked By: FEN
Date: 06/16/2022	Scale: As Shown

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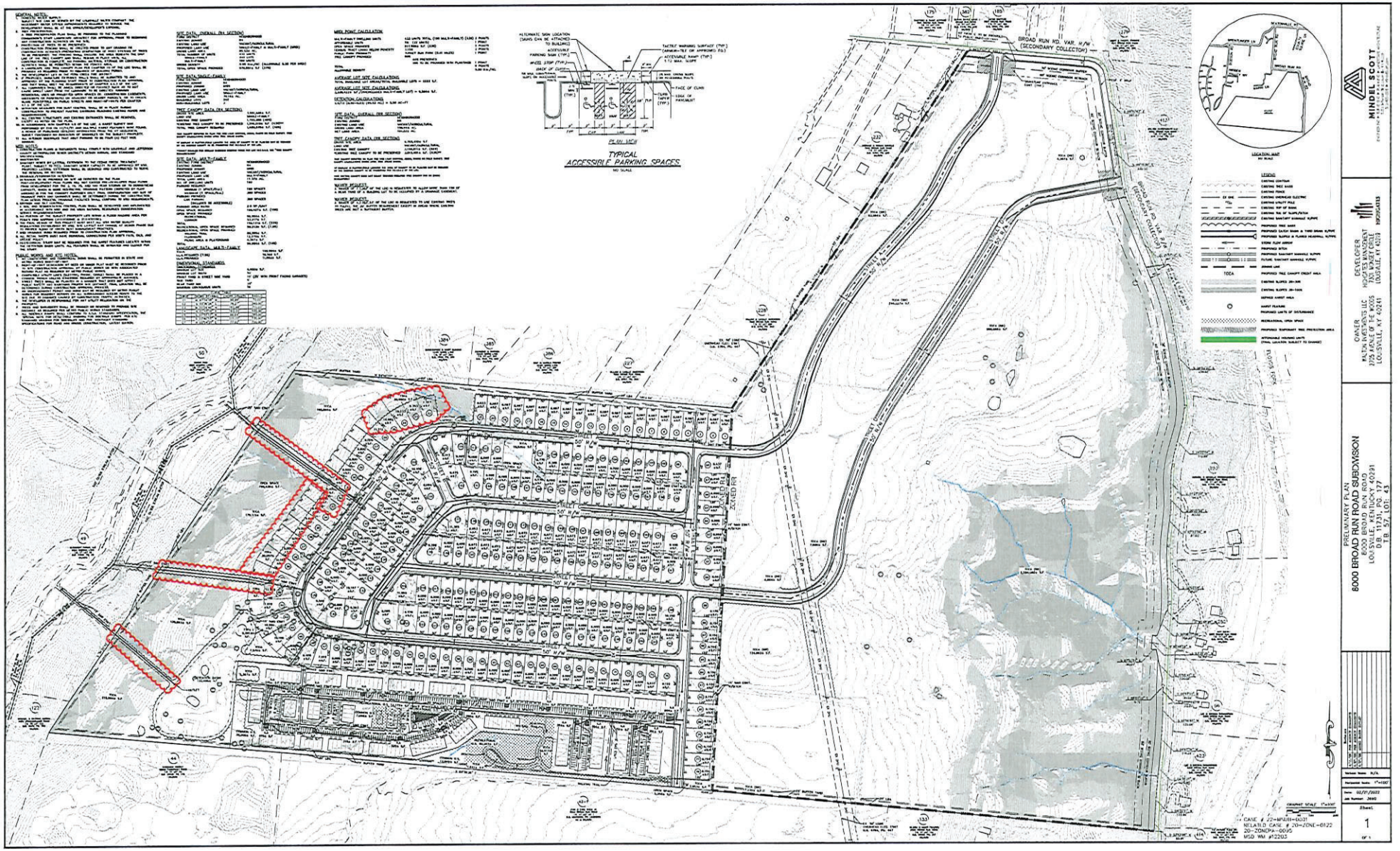

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