Report of:

Geology and Field Reconnaissance
Portsmouth Bypass
Project SCI-823-10.13
Phase 2 – Stage I
Scioto County, Ohio

Prepared for:

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November 16, 2007

Prepared by:

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FOR

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1.0 INTRODUCTION

This report presents the findings of the field reconnaissance performed by DLZ Ohio, Inc. for the Phase 2 section of the Portsmouth Bypass in Scioto County, Ohio. The Phase 2 section of the project begins at Station 537+50 and ends at Station 904+79.54. The proposed Phase 2 alignment extends in a northwesterly direction for approximately 7 miles from the existing Lucasville-Minford Road (TR 28) to the existing US 23. The location of proposed Phase 2 alignment is illustrated on the location map in Appendix A.

This work was performed in conjunction with the subsurface investigation for the project performed by DLZ Ohio, Inc. The information contained in this report was compiled from conversations with property owners, field observations, GPS data collection, and an examination of available literature, aerial photos, and maps.

2.0 TOPOGRAPHY

The topography along the proposed SCI-823 alignment in Scioto County, Ohio is characterized by the steep dissected topography of the uplands and the low relief, relatively level areas in the lowlands. This erosional topography is located in the Shawnee-Mississippian Plateau of the unglaciated portion of the Appalachian Plateau.

The area along the proposed SCI-823 alignment is not highly developed and contains limited secondary roadways. The majority of roads are two-lane county roads and township roads. The county roads near or crossing the proposed alignment are Lucasville-Minford Road (CR 28) and Fairground Road (CR 55). The township roads near to or crossing the alignment are Blue Run Road, Flowers Ison Road, Morris Lane Road, and Flatwood Fallen Timbers Road. Several of the roads are located in cuts, or were constructed at grade along or within the stream valleys. There are also occasional roads running between ridgelines.

3.0 GEOLOGY

3.1 Regional Geology

The lithology of central Scioto County is primarily composed of Mississippian aged rocks including shale, siltstone, and sandstone. The middle to upper Devonian aged rocks of the Ohio Shale and Olentangy Shale are found within deeper portions of the Scioto River valley. The upper Devonian aged rocks are undivided from the lower Mississippian aged rocks in previous mapping efforts within the county. The undivided Devonian and Mississippian aged rocks are located within portions of the Ohio River valley, Scioto River valley, and some of the deeper tributary valleys of the major drainages. Overlying the Devonian aged rocks; the full Mississippian aged stratigraphic column is present throughout much of Scioto County. Some of the best exposures of the Mississippian aged Logan Formation are found in Scioto County. Along the higher ridgelines in the eastern and east central portions of Scioto County, Pennsylvanian aged rocks cap the higher hilltops with residual soils overlying the rock.

The geology is affected by both regional and local bedrock structural features. The controlling regional feature is the Cincinnati Arch, which is located to the west of the proposed SCI-823 alignment. Generally, the rock strata of the region vary in thickness towards the Arch and the beds appear at increasingly higher elevations. There are two local structural features evident that affect the bedrock seen near the proposed SCI-823 alignment; a low dome and a monoclinal arch. The low dome is located west of Sciotoville on the north bank of the Ohio River, resulting in a reversal of the local dip seen in the bedrock adjacent to the dome. The low monoclinal arch is located in the western portion of the county trending north-northeast and crossing Scioto Brush Creek near Otway. This structural feature may increase the dip of the bedrock in and adjacent to the northern portion of the proposed SCI-823 alignment. The regional dip of the bedding within Scioto County ranges between 13 and 43 feet per mile to the east-southeast (approximately E15°S to E20°S)[1].

3.2 Geology Along the Proposed SCI-823 Alignment

The following sections describe the general characteristics of the lithology found within the proposed limits of construction. The descriptions are organized by age of formation: Pennsylvanian, Upper Mississippian, Lower Mississippian, and Upper Devonian – Undivided.

Pennsylvanian Rocks

Pennsylvanian aged rocks from the Pottsville Group are found capping the higher ridgelines seen throughout the proposed SCI-823 alignment, except to the north in Valley Township. This unit is mapped as the Pennsylvanian Breathitt Formation on the open-file bedrock geology maps compiled by the Ohio Department of Natural Resources – Division of Geological Survey (ODNR – DGS). This name originated from mapping efforts of the Pennsylvanian Pottsville and Allegheny Groups in Kentucky.[2] The Pottsville Group members found within the proposed limits of construction will be referred to as the Breathitt Formation in this report to be consistent with bedrock geology maps prepared by ODNR – DGS.

The Breathitt Formation is found as thin bands generally following the topographic contours of the higher ridgelines. Due to the regional dip, the Pennsylvanian Breathitt Formation is generally absent or found above an elevation of 1000 feet within the

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[1] Hyde, J.E. (1953), *Mississippian Formation of Central and Southern Ohio*, Bulletin No. 51, Ohio Division of Natural Resources Division of Geologic Survey, Columbus, Ohio.

[2] Verbal communication with Ohio Department of Natural Resources Division of Geological Survey.

northern and northwestern portion of the proposed SCI-823 alignment, above an elevation of 850 feet in the central portion of the alignment, and above an elevation of 760 feet in the southern portion of the proposed SCI-823 alignment. The top of the underlying Mississippian aged Maxville Limestone is associated with an erosional unconformity and the contact is probably undulating and non-uniform. The Breathitt Formation consists of conglomerate, coal, shale, thin limestone, sandstone, and iron ores. Generally, shale and sandstone are the dominant lithologies with occasional thin, bony coal beds or blossoms.

The predominate marker beds found within the Breathitt Formation are the Harrison Ore, located immediately overlying the Mississippian aged Maxville Limestone, the Sciotoville Clay, the Sharon Ore, and the Anthony Coal. Of these members, the Harrison Ore is the only marker bed that is relatively continuous within proposed limits of construction. The Harrison Ore is described as being closely associated with the underlying Mississippian aged Maxville Limestone, sometimes described as being an alteration of the underlying limestone.[3] Even when the Maxville Limestone is absent, the Harrison Ore is generally found. The ore is often brecciated or conglomeratic and is described as being sedimentary in origin as opposed to an alteration product. Consequently, the material comprising the Harrison Ore varies greatly from place to place, but it is commonly interpreted as the basal unit of the Pennsylvanian rocks. The Sciotoville Clay is relatively continuous throughout the alignment, whereas the Sharon Ore and the Anthony Coal are reported within the proposed limits of construction, but neither are continuous or well developed.

Upper Mississippian Rocks

Upper Mississippian aged rocks from the Waverly Series, Cuyahoga, and Logan Formations comprise the majority of the rocks within the proposed limits of construction. These two formations are not divided on the bedrock geology maps compiled by ODNR – DGS. However, formal subdivisions do exist and are used in the following descriptions. These rocks represent the middle and upper portion of the Mississippian System within the region.

The Maxville Limestone, overlying the Logan Formation, marks the contact with the overlying Pennsylvanian aged Breathitt Formation. The Maxville Limestone consists of isolated, discontinuous pockets of limestone that can range from very pure to cherty and is discontinuous due to an erosional unconformity at its upper surface. Where the Maxville Limestone is absent, the Logan Formation marks the upper contact with the overlying Pennsylvanian aged Breathitt Formation.

The underlying Logan Formation varies in thickness in part due to the erosional unconformity at its upper boundary and consists primarily of gray to brown fine-grained sandstone, siltstone, and sandy shale, but is characterized by the dominance of sandstone. Three members of the Logan are identified within Scioto County. Working up the stratigraphic column, they are the Byer Sandstone, the Allensville Conglomerate, and the

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[3] Stout, W., (1916), *Geology of Southern Ohio*, Bulletin No. 20, Ohio Department of Natural Resources Division of Geologic Survey, Columbus, Ohio

Vinton Sandstone. Occasional iron ores are present within the Logan Formation, but are usually thin, isolated, and nodular. Generally, the Vinton member is a fine-grained sandstone which can be finely interbedded with sandy shale and often contains zones of fossils and ironstone concretions. The Allensville member is a fine-grained sandstone that can be finely interbedded with sandy shale with small pebble beds (1 to 2 inches) throughout. This member is not easily distinguishable from the Byer member and is often missing within the sequence. The Byer member is generally a fine-grained sandstone which can be finely interbedded sandstone and sandy shale or massive sandstone.

The Logan Formation is the dominant rock strata found within the proposed limits of construction. The hillsides in the southern and central portion of the proposed SCI-823 alignment are composed of sandstones of the Logan Formation with the exception of the Pennsylvanian Breathitt Formation capping the higher ridgelines as discussed in Section 2.2.1 of this report. Within the northern portion of the proposed SCI-823 alignment, the upper half to one third of the hillsides are composed of the Logan Formation. The Logan Formation gradually descends eastward until it passes under cover at the approximate eastern boundaries of Porter, Harrison, and Madison Townships to the east of the proposed SCI-823 alignment. Examples of the rock strata can be seen within several rock cuts throughout the area along the Ohio River and the lower Little Scioto River in which the cuts are composed entirely of the Logan Formation. Field observations of road cuts within the Logan Formation indicate that two regional joint set orientations are found within the proposed limits of construction. The main joint set is near vertical and trends east-west. A secondary joint set is near vertical and trends north-south.

The Cuyahoga Formation, underlying the Logan Formation, contains gray to brown shale interbedded with minor amounts of sandstone and siltstone with occasional massive sandstone beds. Two sandstone members of the Cuyahoga Formation are reported on the current stratigraphic column[4] as the Black Hand Sandstone and Buena Vista Sandstone. The Cuyahoga Formation, however, is characterized by the dominance of shale. Stout[3] reported three members within Scioto County. Working up the stratigraphic column, the members are the Henly siliceous shale, Buena Vista Sandstone member, and the Portsmouth Shale. The Buena Vista sandstone member dips below cover just east of the Scioto River and almost the entire visible portion of the Cuyahoga near the proposed SCI-823 alignment is composed of Portsmouth Shale. The Portsmouth Shale member of the Cuyahoga Formation is generally composed of blue to gray sandy shale with occasional thin sandstones or layers of concretionary ironstone, seldom over an inch or two in thickness. The shale readily weathers to buff colored flaky fragments and subsequently to clay. Areas within the northwestern portion of the proposed SCI-823 alignment underlain by the Portsmouth Shale of the Cuyahoga Formation exhibit undulating, hummocky terrain indicative of landslides and earth flow due to the high clay content of the weathered shale. The contact between the Logan and Cuyahoga Formations is generally transitional and may be up to 25 feet in thickness.[1] The Cuyahoga Formation gradually descends eastward from the Scioto River, and is

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[4] Hull, D., (1990), Larsen, G., (2000), Slucher, E., (2004). *Generalized Column of Bedrock Units in Ohio*, Ohio Department of Natural Resources Division of Geological Survey, Columbus, Ohio.

estimated to pass under cover approximately 1 mile west of Clarktown in the central part of the county and at Sciotoville in the south.

Lower Mississippian and Upper Devonian Rocks - Undivided

Along portions of the Ohio River and Scioto River valleys, the Lower Mississippian and Upper Devonian rocks have not been divided in previous mapping efforts. Previous mapping efforts combine the Mississippian aged Sunbury Shale, Berea Sandstone, and Bedford Shale with the upper Devonian aged rocks. However, formal subdivisions do exist and are used in the following descriptions. These rocks are poorly exposed at the ground surface due primarily to burial by glacial outwash, lacustrine soils, and alluvial deposits. The Sunbury Shale may be exposed in the lower slopes of the hills immediately east of the Scioto River, but is under cover throughout the rest of the alignment.

Generally, outcrops of these rocks are not seen within the limits of construction and are primarily found beneath the overburden of the larger stream channels. The Mississippian aged Sunbury Shale is located at the contact with the overlying Mississippian Cuyahoga Formation. Generally, the Sunbury is a brown to black carbonaceous shale that is thin, fissile, and planar, often containing small pyritic concretions. The Sunbury ranges in thickness from 10 to 50 feet. Underlying the Sunbury Shale, the Mississippian Berea Sandstone consists of gray sandstone and minor shale and ranges in thickness from 10 to 50 feet with thin to thick bedding. The bottom of the group is composed of the Mississippian and Devonian aged Bedford Shale. The Bedford contains gray to brown shale with interbedded sandstone beds up to two to three feet in thickness. The sandstone beds consist of thin platy sandstones seldom over a fraction of an inch thick and separated by thinner shale partings. The Bedford shale overlies the Devonian aged Ohio Shale.

Quaternary Geology

Soils found within the limits of construction can be divided into three groups. First, residual and colluvial soils derived from weathering of underlying rock and downslope transport; second, there are lacustrine and outwash deposits of glacial origin; and finally, soils consisting of recent alluvial deposits. The residual and colluvial soils are found along the ridge tops and hillsides, glacial soils are typically found within the major stream valley and their tributaries, and recent alluvial deposits are found along and within stream channels and valleys.

Residual and Colluvial Soil

Residual and colluvial soils are found on the ridge tops and the hillsides within the proposed limits of construction. Along the proposed SCI-823 alignment, residual and colluvial soils are generally thin to moderately deep, covering moderate to very steep slopes. Residual and colluvial soils on the hillsides are prone to landslides. Landslide susceptibility within the proposed limits of construction for the proposed Phase 2 section of the project is addressed in Section 7.0 of this report.

Four soil complexes are reported along the hillsides consisting of: Shelocta-Brownsville, Shelocta-Wharton-Latham, Latham-Wharton-Shelocta, and Shelocta-Steinburg-Latham.

These complexes combined make up approximately 80 percent of the soils found within the county having slopes ranging from 8 to 70 percent and are composed of residuum and colluvium derived from shale, siltstone, and sandstone.

Lacustrine Soils and Glacial Outwash

The two types of glacial soils encountered within the proposed limits of construction are lacustrine deposits and glacial outwash deposits.

The lacustrine soils are commonly known as the 'Minford Silts' or the Minford Complex. The soils within this group will be referred to as the Minford Complex in this report. These deposits are primarily found within the Little Scioto River Valley and its tributaries in the central and southern portions of the proposed SCI-823 alignment. The Minford Complex soils are generally found between elevations of 650 to 780 feet. These deposits were formed during the early to middle Pleistocene Age when the northward flowing Teays River system was blocked by the southward advance of the Kansan aged ice sheets. As the glaciers advanced, the course of the Teays River was blocked south of Chillicothe and a large lake was formed from the impoundment of the waterways. As a result of the impoundment, vast quantities of sediments were deposited ranging from 10 to 80 feet in thickness, thinning towards the margins.

The deposits range from a basal lag deposit, consisting of sands with pebbles and cobbles, to very plastic clays that usually have a high water content. The Minford Complex soils vary considerably throughout the area of the proposed SCI-823 alignment, partially due to original deposition and change since the time of formation. When present, these materials lie on or near bedrock. The Minford Complex soils have no regular succession, but typically sands and sandy silts are found near the bedrock and fine laminated silts and clays are found at the higher levels of the sequence. Occasionally, the Minford Complex contains sandstone cobbles and boulders and quartz pebbles in the lower parts of the sequence. These cobbles, boulders, and pebbles within the sequence are believed to be of local origin. However, the silt and clay deposits are peculiar for Ohio in that they typically contain up to 50 percent sericitic mica, indicating that they are probably derived from a metamorphic schist terrain such as the Piedmont province within the Appalachian Mountains[5]. Most lacustrine deposits within Ohio are glacial, consisting of "rock flour" derived from the movement of glaciers or are composed of materials derived from weathered sandstones, shales, and calcareous rocks which dominate the lithology of the rocks within Ohio. Thin alluvial and/or glacial outwash deposits are frequently found overlying the Minford Complex soils. The typical section for the Minford Complex soils is located in a rail cut on the outskirts of the Village of Minford, Ohio.

Glacial outwash deposits are found along the Scioto River valley occupying the valley of the preglacial Teays-aged Portsmouth River and within the Ohio River valley. The glacial deposits are late Wisconsinan in age and consist of sand and gravel deposits with

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[5] Stout, W. and Schaaf D., (1931), *Minford Silts of Southern Ohio*, Bulletin of the Geological Society of America, Vol. 42, pp. 663-672.

small isolated peat deposits. Generally, these deposits are saturated at shallow depths with high recharge rates. Several sand and gravel pits can be seen along existing US 23, where these sand and gravel deposits have been or are currently being extracted.

Four soil complexes are reported along the preglacial valleys and on flood plains, terraces, and fans consisting of Omulga-Monongahela-Haymond, Weinbach-Wheeling-Elkinsville, Nolin-Shelocta-Omulga, and Tioga-Sardinia-Fitchville. These complexes combine to make up approximately 15 percent of the soils found within the county having slopes ranging from 0 to 40 percent (majority are between 0 and 15 percent) and are formed in colluvium, lacustrine sediments, flood plains, fans, and in preglacial valleys.

Alluvial Soils

Generally, the largest deposits of alluvial soils are found along the Little Scioto River and the Ohio River. These deposits are usually granular with high fines (clay and silt) content. Alluvial soils, to some extent, are found along all of the creeks and rivers within the proposed limits of construction. Generally, alluvial deposits range from silty clay to coarse sand. Where bedrock is shallow, alluvial deposits may contain coarse sand, gravel, and cobbles.

Two soil complexes are reported along the flood plains consisting of Nolin-Genessee and Stendal-Cuba-Tioga. These complexes combine to make up approximately 5 percent of the soils found within the county having slopes ranging from 0 to 3 percent and are formed in alluvium within the flood plains.

4.0 LAND USE

Land use along the project varies from managed forests and wooded areas, to agricultural and residential usage. Generally, road access and topography determine the use, with the steeper, more remote terrain forested or used as pasture. Along the roads, the valley and low relief lowlands are maintained as residential areas or utilized as cultivated fields. The area within the proposed Phase 2 limits of construction is generally remote, steep, and wooded. The following is a detailed discussion of the land use along the proposed Phase 2 alignment of the project.

Station 537+50 to Station 542+50

This area consists of the right-of-way for Lucasville-Minford Road (County Road 28) and a mowed field. A residential structure and outbuilding can be found approximately 350 feet to the left of the alignment at station 541+50.

Station 542+50 to Station 571+00

The proposed Phase 2 alignment traverses a nearly 2H:1V slope before following a ridge to station 550+00. The slope is covered in dense brush and small evergreen trees. Along the ridge, the area is wooded with numerous access trails crossing the proposed Phase 2 alignment. Flower-Ison Road roughly parallels the alignment to the left, and several residential structures are located near the township road.

Station 571+00 to Station 579+20

Just right of the alignment at station 571+75 is a residential structure and two small outbuildings. A cultivated hay field crosses the alignment from station 572+00 to station 576+00. A large embankment pond exists approximately 200 feet to the right of station 573+00. From station 575+00 to station 570+20, there are several residential structures just to the right of the proposed limits of construction.

Station 579+20 to Station 593+50

The proposed Phase 2 alignment crosses Blue Run Road at station 579+25. The alignment traverses a 3H:1V slope to a ridge at station 593+50. This area is wooded, but has been timbered in the past. Most of the logging roads are used as ATV trails. At station 592+41, a 34Kv electrical transmission line crossed the proposed Phase 2 alignment.

Station 593+50 to Station 606+50

The proposed Phase 2 alignment crosses a hollow with slopes steeper than 3H:1V. The slopes of the hollows are wooded, and the bottom of the hollow is an open field. A shallow well can be found 68 feet to the right of station 599+58. A small embankment pond is located 370 feet right of station 602+50.

Station 606+50 to Station 630+00

This area has been frequently timbered in the last 10 years. As a result, there are many logging roads, dense brush, and immature trees. There is considerable erosion and slope instability that could be attribute to the logging activities. The proposed Phase 2 alignment crosses three hollows with slopes of 3H:1V or steeper, and the vertical relief ranges of 50 to 120 feet.

Station 630+00 to Station 717+00

This section of the proposed Phase 2 alignment is remote and wooded. The proposed Phase 2 alignment crosses 6 hollows in this area. There are several older logging roads within the proposed limits of construction and crossing the proposed Phase 2 alignment. The logging roads are generally used as ATV trails. There are several areas of erosion and instability as a result of logging activities. As the alignment continues towards the northwest, the hollows and valleys become steeper and the vertical relief increases. From station 695+50 to station 610+00, there are slopes approaching 1H:1V and the vertical relief is approximately 270 feet.

Station 717+00 to Station 719+20

This is a low relief area that contains the right-of-way for Morris Lane – Blue Run Road (TR 54). There are piles of debris and random fill to the left of station 718+90, along Morris Lane Blue Run Road. There is also a perennial stream that crosses the proposed Phase 2 alignment at station 717+00. The vegetation in this area consists of dense brush and immature trees.

Station 719+20 to Station 756+00

This section of the proposed Phase 2 alignment is wooded with areas of dense brush. The slopes in this section are 3H:1V or steeper with vertical relief of up to 200 feet. Several logging roads exist within the proposed limits of construction and crossing the proposed Phase 2 alignment.

Station 756+00 to Station 776+00
Flatwood Fallen Timber road crosses the proposed Phase 2 alignment from Station 756+00 to station 756+20. The area from station 756+20 to 776+00 of the proposed Phase 2 alignment is a managed forest. The slopes in this section are 3H:1V or steeper with vertical relief of up to 230 feet. Several logging roads can be found within the proposed limits of construction.

Station 776+00 to Station 851+00
This section of the proposed Phase 2 alignment is remote and densely wooded. The proposed Phase 2 alignment crosses six hollows in this area. There are several areas of erosion and instability as a result of logging activities. The slopes in this section are 3H:1V or steeper with vertical relief of up to 270 feet. Several logging roads can be found within the proposed limits of construction.

Station 851+00 to Station 860+45
This is an area of dense brush and immature trees. There is a 138Kv transmission line that crosses the proposed Phase 2 alignment at station 858+00.

Station 860+45 to Station 867+00
This low relief area with gentle slopes is utilized as a pasture.

Station 867+00 to Station 890+00
This area of the proposed Phase 2 alignment is wooded. Within the limits of construction, a cultivated field is located to the right of this section.

Station 890+00 to Station 904+79.54
This area includes the right-of-way for Fairground Road, a CSX railroad line, and US 23. The area from station 892+50 to station 895+00 is utilized as a parking lot. From the western edge of US 23 to the end of the project, the land is utilized as a cultivated field.

5.0 BEDROCK EXPOSURES

Two natural bedrock exposures and one rock cut were identified along the alignment. Bedrock exposures within 500 feet of the centerline of the proposed Phase 2 alignment were considered for this section. Representative photos and logs of the bedrock exposures can be found in Appendix C. Bedrock exposure locations are illustrated on the land use and reconnaissance notes in Appendix A.

Station 573+20
Approximately 420 feet right of the proposed Phase 2 alignment, a 10 to 15-foot resistant bed of sandstone is exposed mid slope. The sandstone is medium hard to hard, brown, thin to massively bedded, and very fine-grained. There are several areas of quartzite conglomerate in the exposed sandstone.

Station 716+95
Just to the right of the proposed Phase 2 alignment, a perennial stream has eroded the overburden to reveal a 1.5-foot bedrock exposure. Soft, thin bedded, moderately weathered gray shale was observed in and along the northern side of the streambed.

Station 798+50
To the right of the proposed Phase 2 alignment, an 8-foot rock exposure was created during the construction of a logging road. The rock consists of weathered, massively bedded very hard, fine-grained sandstone. The cut is nearly vertical and is failing.

6.0 DRAINAGE AND WATER CROSSINGS

6.1 Ponds

There are five man-made ponds that are within or near the limits of construction. All of the ponds are excavated embankment ponds built across a valley or on the side of a hill to contain water from an existing stream or surface runoff. Two of the ponds were built by developing existing springs as the primary sources of water. The pond sources, depths, types of construction, and other details were determined from landowner conversations and field observations. Photos of several of the representative ponds are shown in Appendix B.

Station 544+00
Approximately 400 feet left of the proposed Phase 2 alignment is a 0.2-acre excavated embankment pond. Both surface runoff and a spring feed the pond. There is approximately 1.5 feet of fine sediment in the bottom of the pond, which is approximately 6 feet deep.

Station 548+00
Approximately 630 feet left of the proposed Phase 2 alignment is a 0.09-acre excavated embankment pond. Both surface runoff and a spring feed the pond. There is approximately 1.5 feet of fine sediment in the bottom of the pond, which is approximately 5 feet deep.

Station 573+00
Approximately 200 feet right of the proposed Phase 2 alignment is a 0.8-acre excavated embankment pond. The pond is fed by surface runoff. There is approximately 2 feet of fine sediment in the bottom of the pond, which is approximately 10 feet deep.

Station 602+60
Approximately 367 feet right of the proposed Phase 2 alignment is a 0.01-acre excavated embankment pond. The pond is fed by surface runoff. There is approximately 1.5 feet of fine sediment in the bottom of the pond, which is approximately 3 feet deep.

Station 841+50
Approximately 290 feet right of the proposed Phase 2 alignment is a 0.1-acre excavated embankment pond. The pond is fed by surface runoff. There is approximately 1.5 feet of fine sediment in the bottom of the pond, which is approximately 2 feet deep. This pond also contains an abundance of organic material.

6.2 Wetlands

According to the national wetlands inventory, other than ponds, there are no areas that meet the definition of a true wetland. There is one area that is very soft and wet during the winter months approximately 180 feet to the left of station 578+00. This area is indicated on the land use and reconnaissance notes in Appendix A.

6.3 Streams

There are a large number of streams near or within the limits of construction at various locations. Three of the streams are perennial, normally flowing throughout the year. A number of streams are intermittent, flowing only during the wet season. All other streams are ephemeral, without a clearly defined channel and flowing only during heavy rainfall events. The streams are labeled as perennial, intermittent, or ephemeral on the land use and reconnaissance notes in Appendix A.

6.4 Springs and Seepage

There are three known springs within 500 feet of the proposed Phase 2 alignment. Two springs were developed as sources of water for ponds. Seepage was noted during the winter to the left of the proposed Phase 2 alignment from station 867+00 to station 870+00. Seepage and spring locations are noted on the land use and reconnaissance notes in Appendix A.

7.0 LANDSLIDES

The hillsides and natural slopes along the Phase 2 alignment range from very steep with thin soil cover and colluvium to hummocky, undulating hills with varying depths of overburden. Generally, the dominant rock type along the proposed Phase 2 alignment is sandstone of the Mississippian aged Logan Formation. However, in several locations siltstone and shale are commonly found interbedded with the sandstone. These siltstones and shales generally weather to clays with low shear strengths. The low shear strengths of the residual and colluvial soils combined with the steep topography makes some of the hillsides within the proposed limits of construction prone to landslides.

Thirteen inactive landslides were observed along the proposed Phase 2 alignment. Inclinometers were installed in four locations and monitored throughout the duration of the investigation. None of the inclinometers showed movement throughout the duration of the two-year investigation. The locations of the inclinometers can be found on the land use and reconnaissance notes plans in Appendix A.

Field indicators of instability included displaced or misshapen trees, debris piles on lower portions of the slope, and visible scarps. Most slope instability appeared to be relatively shallow soil creep contained within the overburden, in most cases less than 10 feet of colluvial soil. However, drilling in several of these landslides indicated significantly more overburden.

In the steep terrain of Scioto County, soil creep is common and is often exacerbated by construction of side hill logging roads and the erosion associated with logging activities. Also, in many of the hollows and valleys that the alignment crosses, small streams gradually undercutting the toe of the steep slopes further destabilize the soil. In the areas where slope instability was observed, the unstable mass will be stabilized by special benching during embankment construction or removed during excavation for cut slopes.

Areas of slope instability were first identified using survey grade contour mapping and aerial photography. Areas of slope instability were then verified during the fieldwork by identification of surface features. All areas of slope instability are shown on the land use and reconnaissance notes in Appendix A. The following paragraphs discuss each area of slope instability in greater detail.

Station 616+80 to 618+00
This area is steep and hummocky, and is likely a shallow landslide. An intermittent stream has undercut the toe of the slope. There is considerable erosion from past logging operations.

Station 623+50
This area has slopes of 2H:1V or steeper and is likely a shallow landslide. Two intermittent streams have eroded the slope. There is also erosion from past logging operations.

Station 646+75 to Station 650+00
This area is likely a shallow landslide. A small intermittent stream has eroded the slope. Logging operations have contributed to the slope movement in this area.

Station 656+00 to Station 664+00
This is a large area of instability, encompassing most of a steep valley. The valley has slopes of 2H:1V or steeper. A perennial stream drains the valley and has undercut the slopes on both sides in several places. Several intermittent streams and logging activities have also eroded the slopes on both sides of the valley. Two inclinometers were installed in this valley when drilling showed the overburden to be up to 30 feet at mid slope locations. Monitoring of the inclinometers during the investigation showed no measurable movement at these locations.

Station 670+50 to Station 673+50
This area is steep and hummocky. The area of instability encompasses most of a small drainage basin. An intermittent stream has eroded the toe of the slopes in this area. An inclinometer was installed at station 673+36.1, 44.1 feet left of the proposed centerline, but showed no movement during monitoring.

Station 680+00 to Station 682+00
This area has slopes steeper than 2H:1V. Two small intermittent streams have eroded the slope. There is also erosion from past logging operations. An inclinometer was installed at station 680+71.2, 152.5 feet left of the proposed centerline, but showed no movement during monitoring.

Station 689+00 to Station 695+00
This area is also steep and hummocky. The area of instability encompasses most of a small drainage basin. An intermittent stream has eroded the toe of the slopes in this area. There is also erosion from past logging operations.

Station 696+50 to Station 702+75
This area has slopes of steeper than 2H:1V and includes a relatively large drainage basin. A perennial stream has eroded the toe of the slopes in the area. There is also extensive erosion from past logging operations. Inclinometers were installed at station 698+30, 214 feet left of the proposed centerline and at station 700+67.2, 80.3 feet left of the proposed centerline. No movement was detected during monitoring of the inclinometers.

Station 760+50 to Station 766+10 and Station 760+50 to Station 766+10
This is a large area of instability that was possibly caused by construction of extensive logging roads and the resulting erosion. The areas of instability are likely shallow and contained in the relatively thin overburden in the area.

Station 779+00 to Station 786+50
This area of instability may have also been caused by construction of extensive logging roads and the resulting erosion. The areas of instability are probably shallow and contained in the relatively thin overburden in the area.

Station 790+75 to Station 796+75
This steep area of instability was likely caused by construction of extensive logging roads, clear cutting, and the resulting erosion. The areas of instability are also probably shallow and contained in the relatively thin overburden in the area.

Station 808+75 to Station 828+25
This large area of instability has slopes of 3H:1V or steeper and is likely a shallow landslide. Construction of extensive logging roads and the resulting erosion were likely contributing factors to the instability in this area. There is also a perennial stream that has undercut the toe of the slopes in the area.

Station 834+50 to Station 848+75
This large area of instability has slopes of 2H:1V or steeper and is likely a shallow landslide. Several small intermittent streams have eroded the slope. In addition, erosion from past logging operations was also probably a contributing factor to the instability in this area.

8.0 MINING AND PREVIOUSLY UNKNOWN WELLS

An examination of the Ohio Department of Natural Resources' Abandoned Underground Mine Database showed no known abandoned underground mines within 1000 feet of the proposed Phase 2 alignment. Conversations with property owners confirmed this. There was, however, possible surface and small "pit" mining of clay 700 feet right of Station 742+00, outside of the proposed limits of construction. The disturbed area was small and the resulting mining pits were shallow. The locations of the surface pit mines are shown on the land use and reconnaissance notes in Appendix A. In addition to the limited surface mining, two previously unknown gas wells were discovered at approximately 760 feet left of station 659+00 and 175 feet to the left of station 636+00. The gas well locations are shown on the land use and reconnaissance notes in Appendix A.

9.0 DUMPS AND DEBRIS

Many small dumps, miscellaneous junk, and other debris can be found along the alignment within the limits of construction. The dumps are generally small and are indicated on the land use and reconnaissance notes in Appendix A.

10.0 EXISTING ACCESS ROADS AND TRAILS

There are a large number of access roads created by private property owners along the alignment. These roads could prove useful during construction. The access roads are labeled on the land use and reconnaissance notes in Appendix A.

11.0 EXISTING EMBANKMENTS.

The only existing embankment is a ten-foot embankment constructed for County Road 28 (Lucasville-Minford Road) near the intersection with Flowers-Ison Road. This embankment was constructed with slopes of 2H:1V to 1H:1V. The embankment slopes appeared stable.

12.0 EXISTING PAVEMENTS

The existing pavement for Lucasville-Minford Road (CR 28), Blue Run Road, Flowers Ison Road, Morris Lane Road, Flatwood Fallen Timbers Road, and Fairground Road (CR 55) were evaluated as part of the field reconnaissance. Photos illustrating the pavement conditions of these roads are in Appendix B. All existing pavements appeared to be performing adequately, with no serious signs of deterioration or rutting. However, Blue Run Road, Flowers Ison Road, Morris Lane Road, and Flatwood Fallen Timbers Road showed minor signs of transverse cracking and raveling.

13.0 GEOTECHNICAL DESIGN CHECKLIST

The geotechnical design checklist applicable to this report is included in Appendix C.

14.0 CLOSING REMARKS

We appreciate the opportunity to be of service to you on this project. Please do not hesitate to contact us with any questions or concerns regarding this report.

Sincerely,

DLZ OHIO, INC.

Andrew M. Jalbrzikowski
Engineering Geologist

Pete Nix, P.E.
Geotechnical Division Manager

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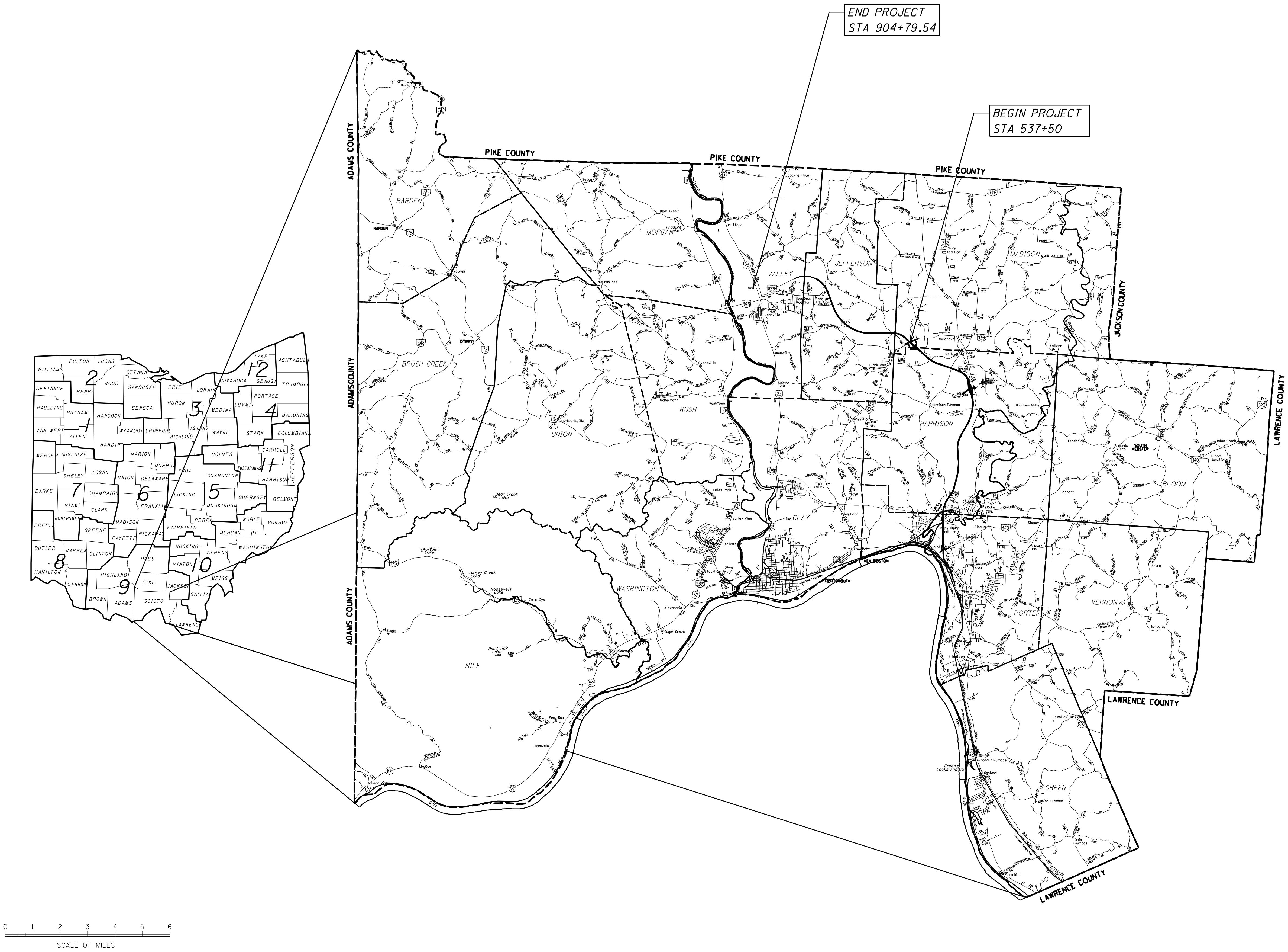
APPENDIX A

General Location Map
Land Use and Reconnaissance Notes



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LOCATION MAP

PORTSMOUTH BYPASS PHASE 2

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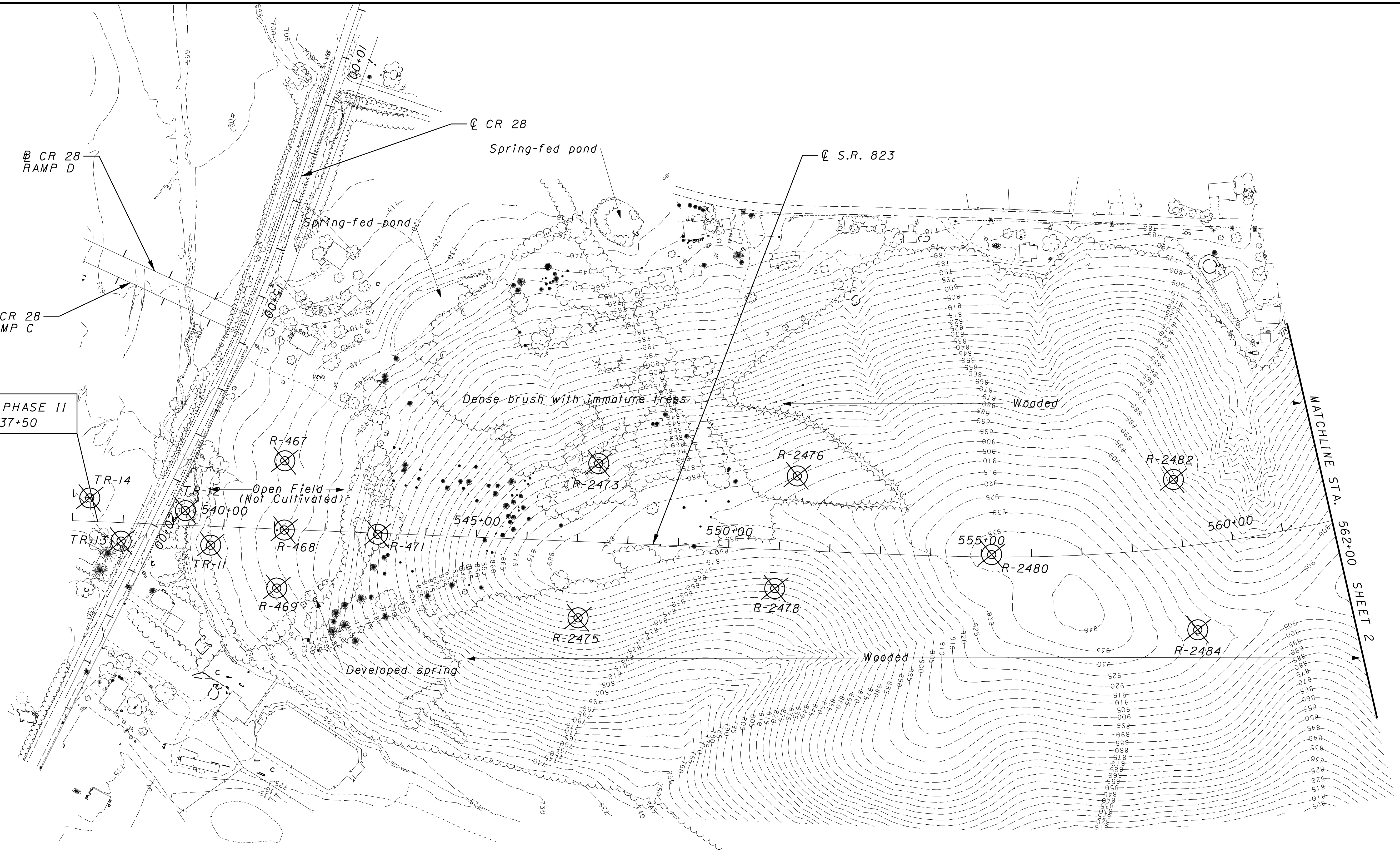

LAND USE AND RECONNAISSANCE NOTES
S.R. 823 STA. 537+50 TO STA. 562+00

0 50 100 200
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SCALE IN FEET

CALCULATED DRAWN AMJ

CHECKED AEN

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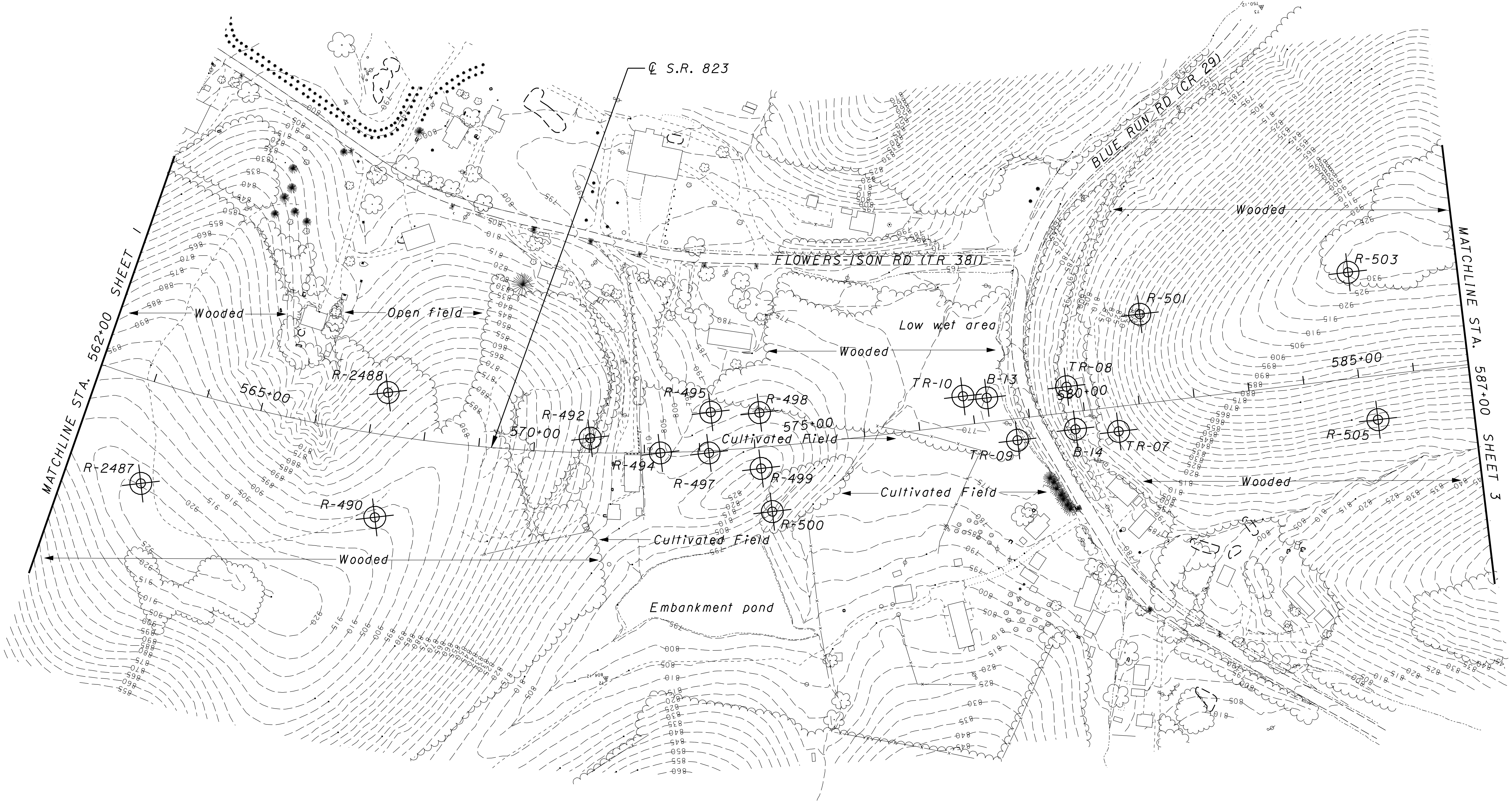

LAND USE AND RECONNAISSANCE NOTES
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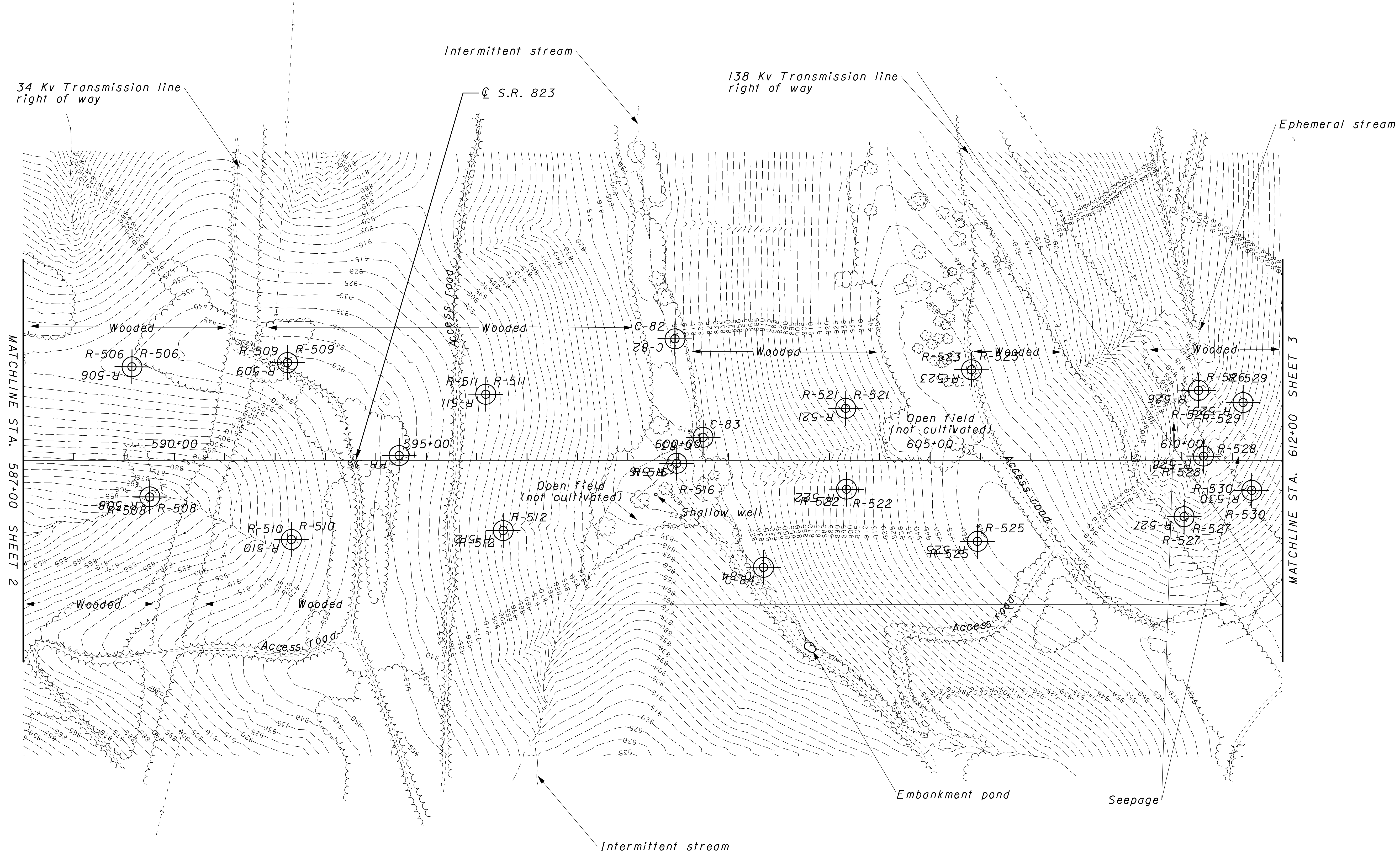

HORIZONTAL SCALE IN FEET

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CADD/DRAWN AMJ

CHECKED AEN

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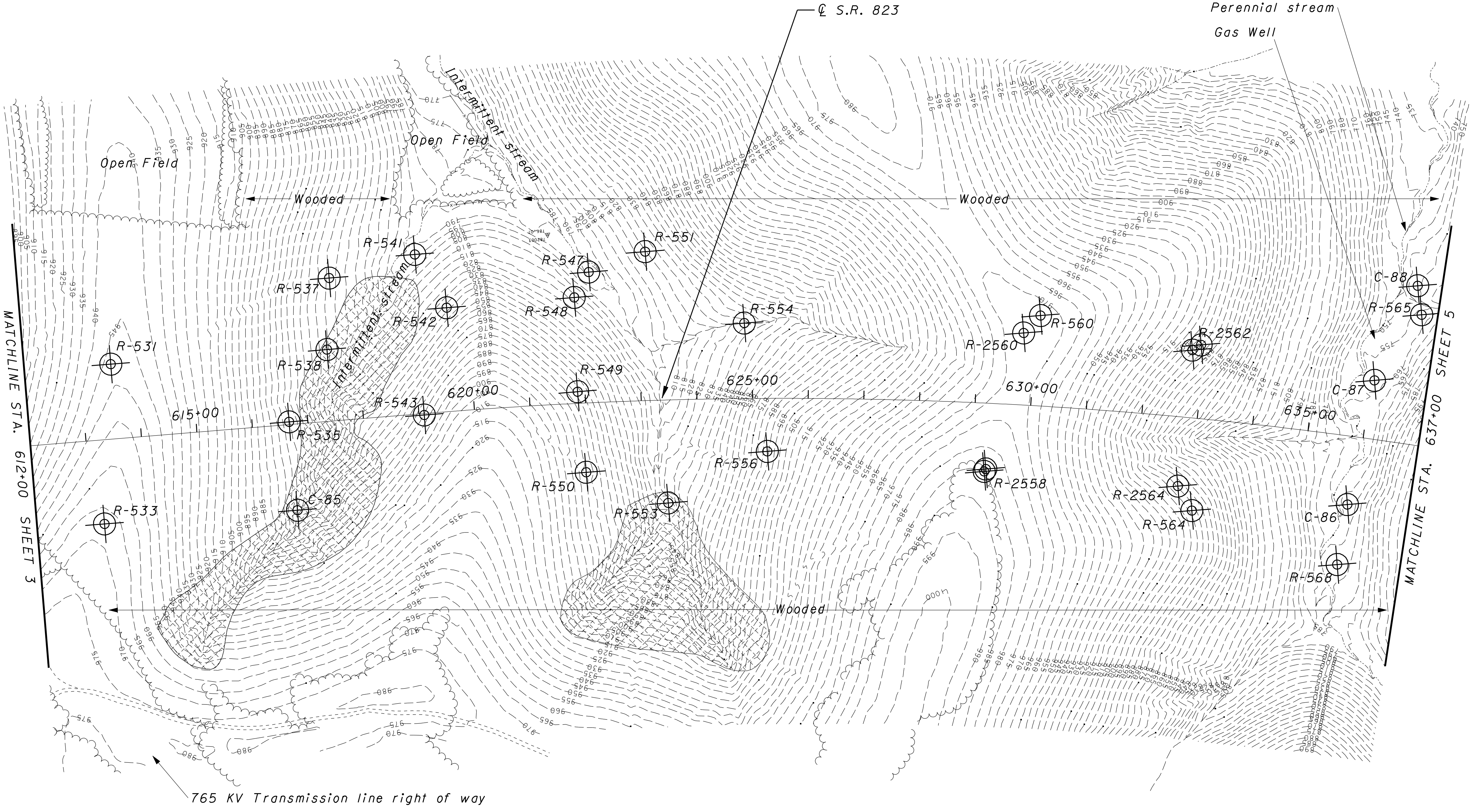

▨ Slope Instability

LAND USE AND RECONNAISSANCE NOTES
S.R. 823 STA. 612+00 TO STA. 637+00

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HORIZONTAL SCALE IN FEET

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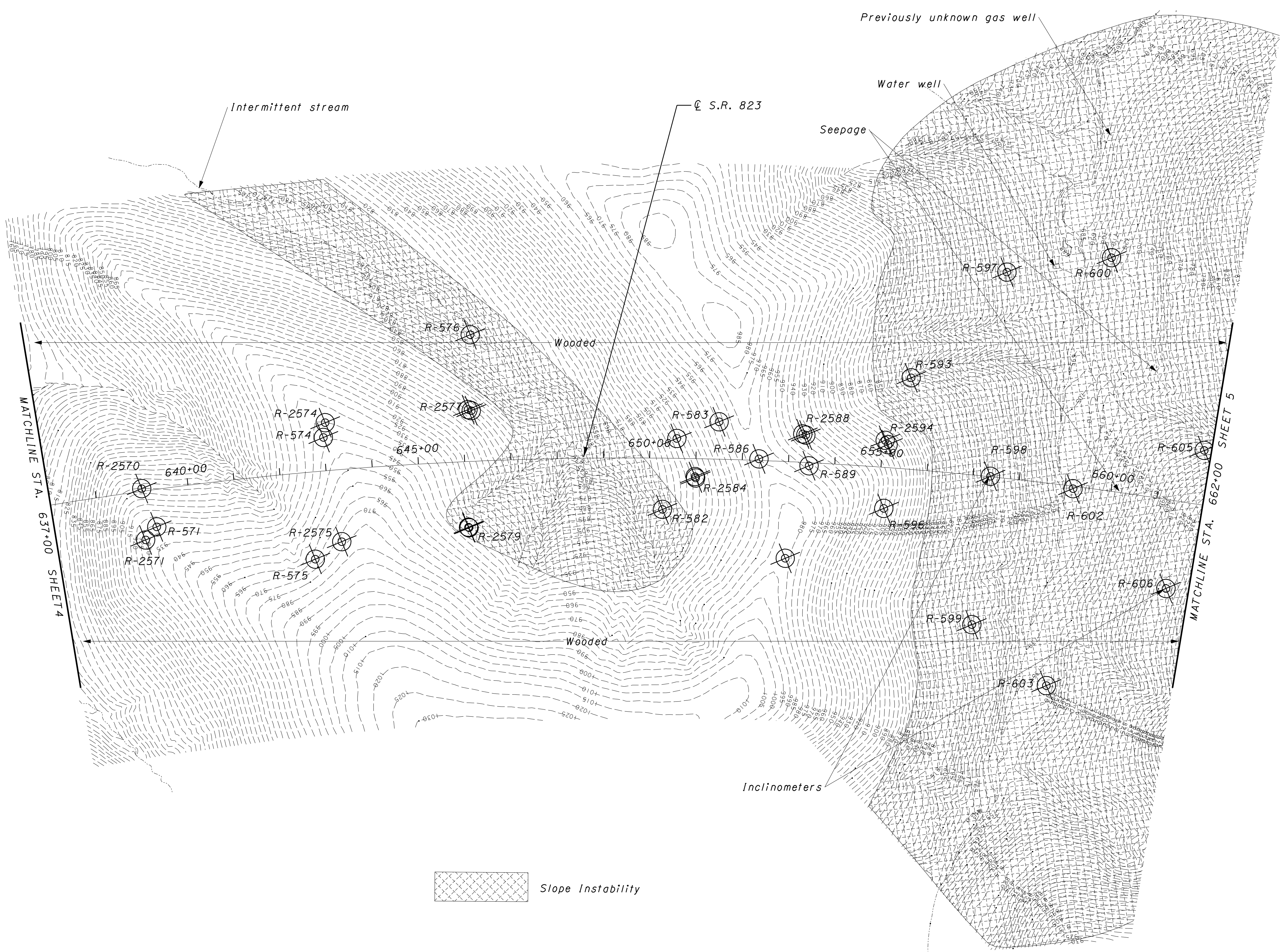

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HORIZONTAL
SCALE IN FEET

CADRAWED AMJ
CHECKED AEN

LAND USE AND RECONNAISSANCE NOTES
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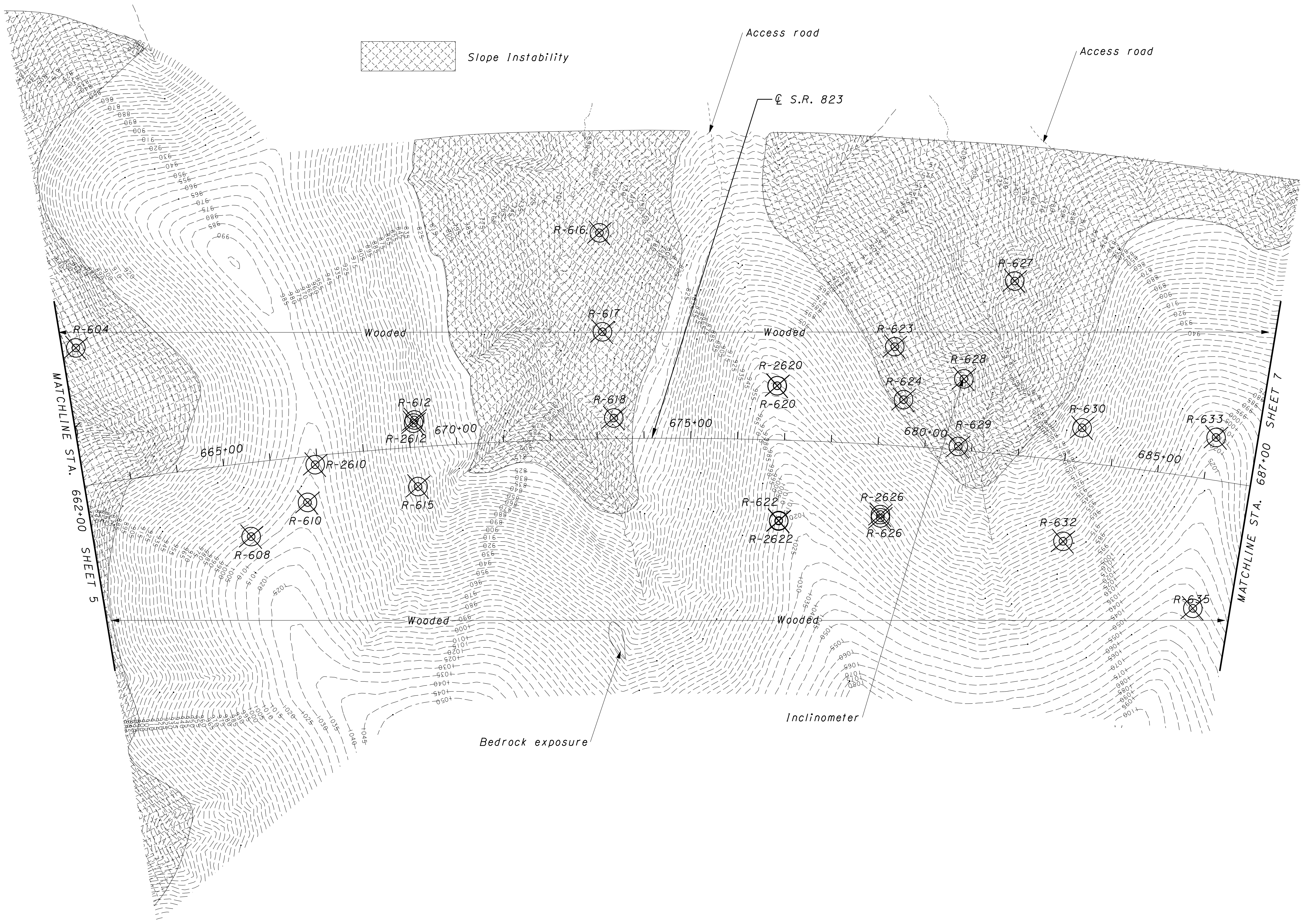

LAND USE AND RECONNAISSANCE NOTES
S.R. 823 STA. 662+00 TO STA. 687+00

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CADD/DRAWN AMJ
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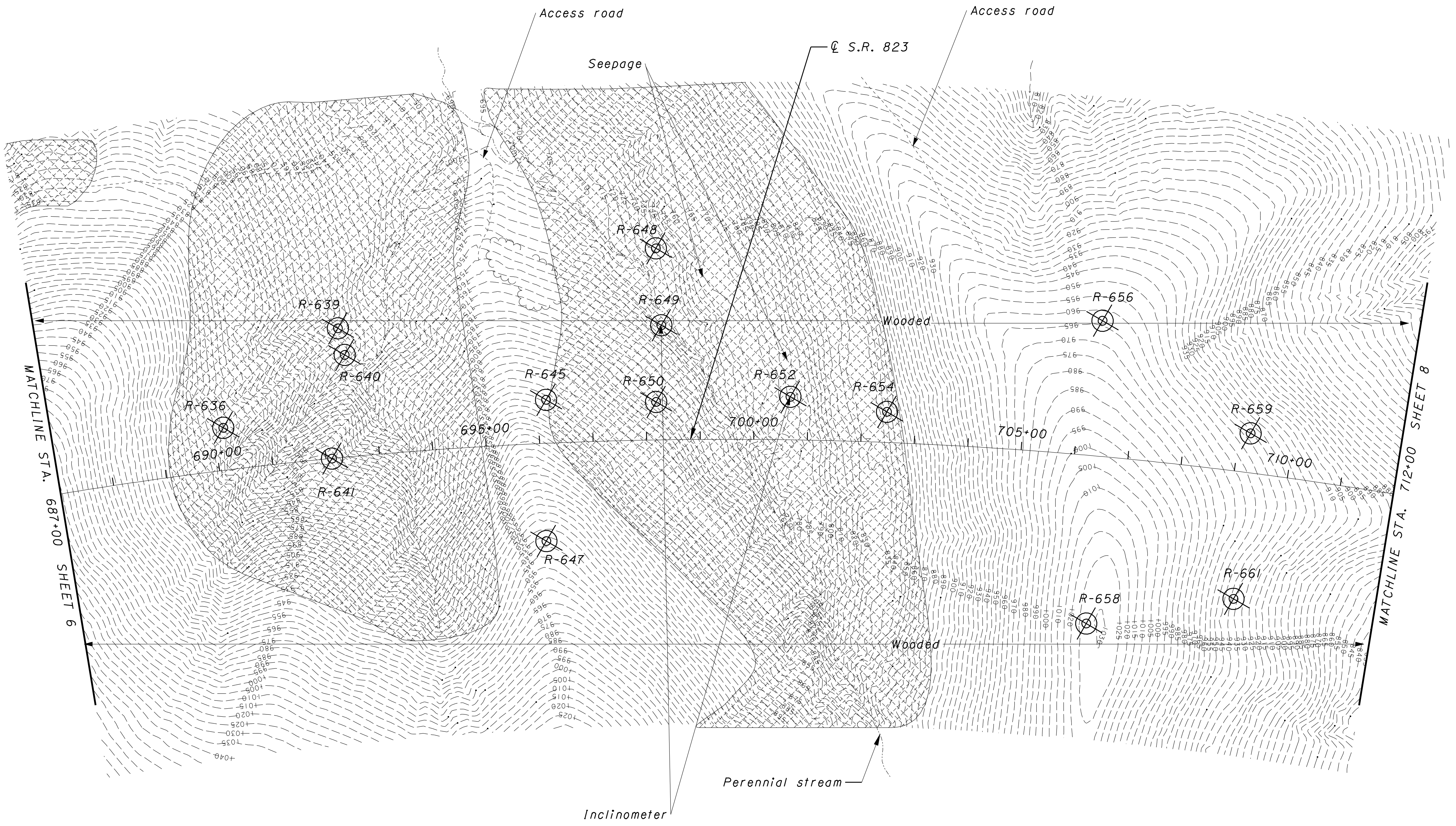

▨ Slope Instability

LAND USE AND RECONNAISSANCE NOTES
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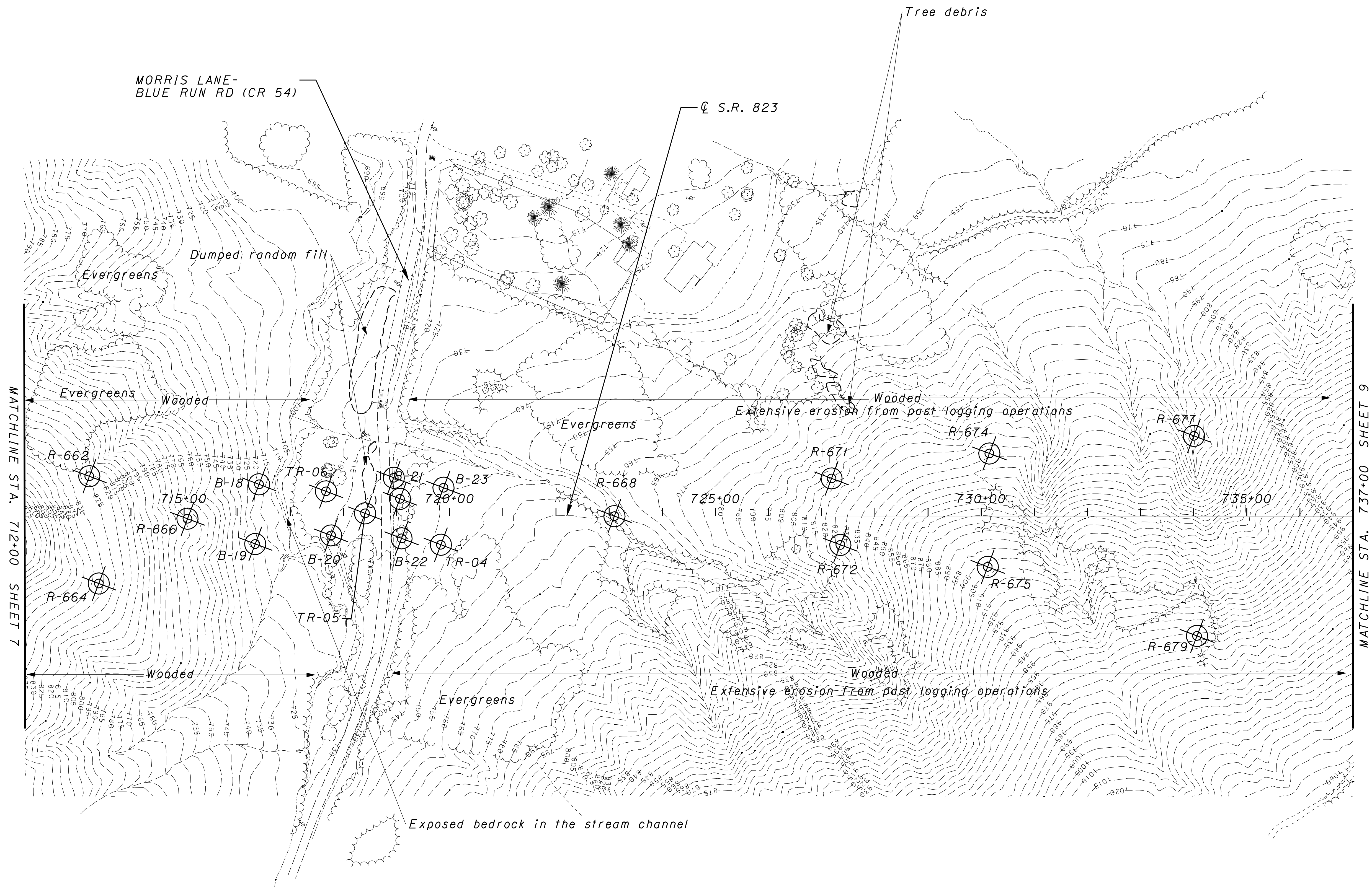

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LAND USE AND RECONNAISSANCE NOTES
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LAND USE AND RECONNAISSANCE NOTES
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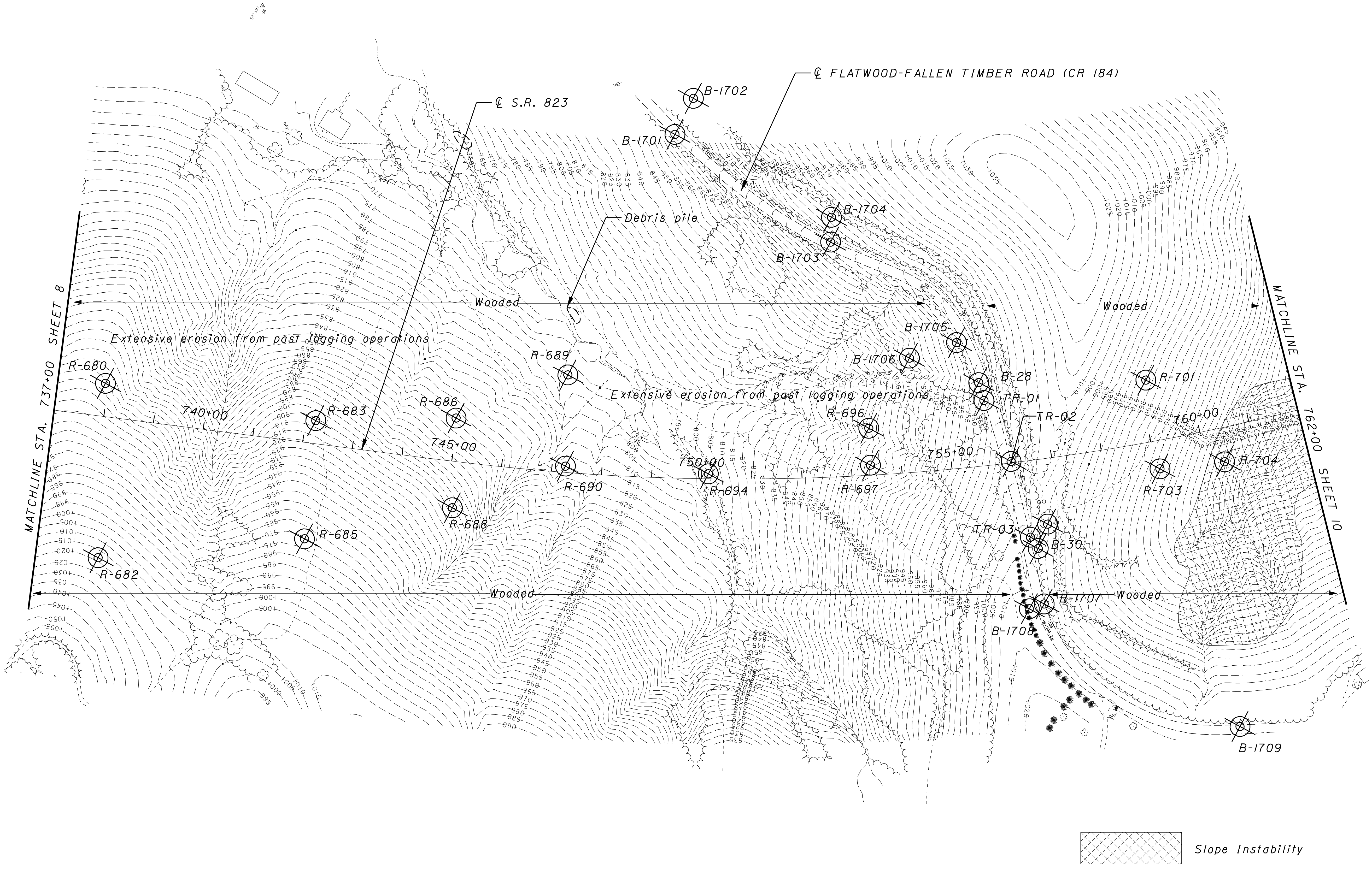

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▨ Slope Instability

LAND USE AND RECONNAISSANCE NOTES
S.R. 823 STA. 762+00 TO STA. 787+00

HORIZONTAL SCALE IN FEET
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CADD/DRAWN AMJ
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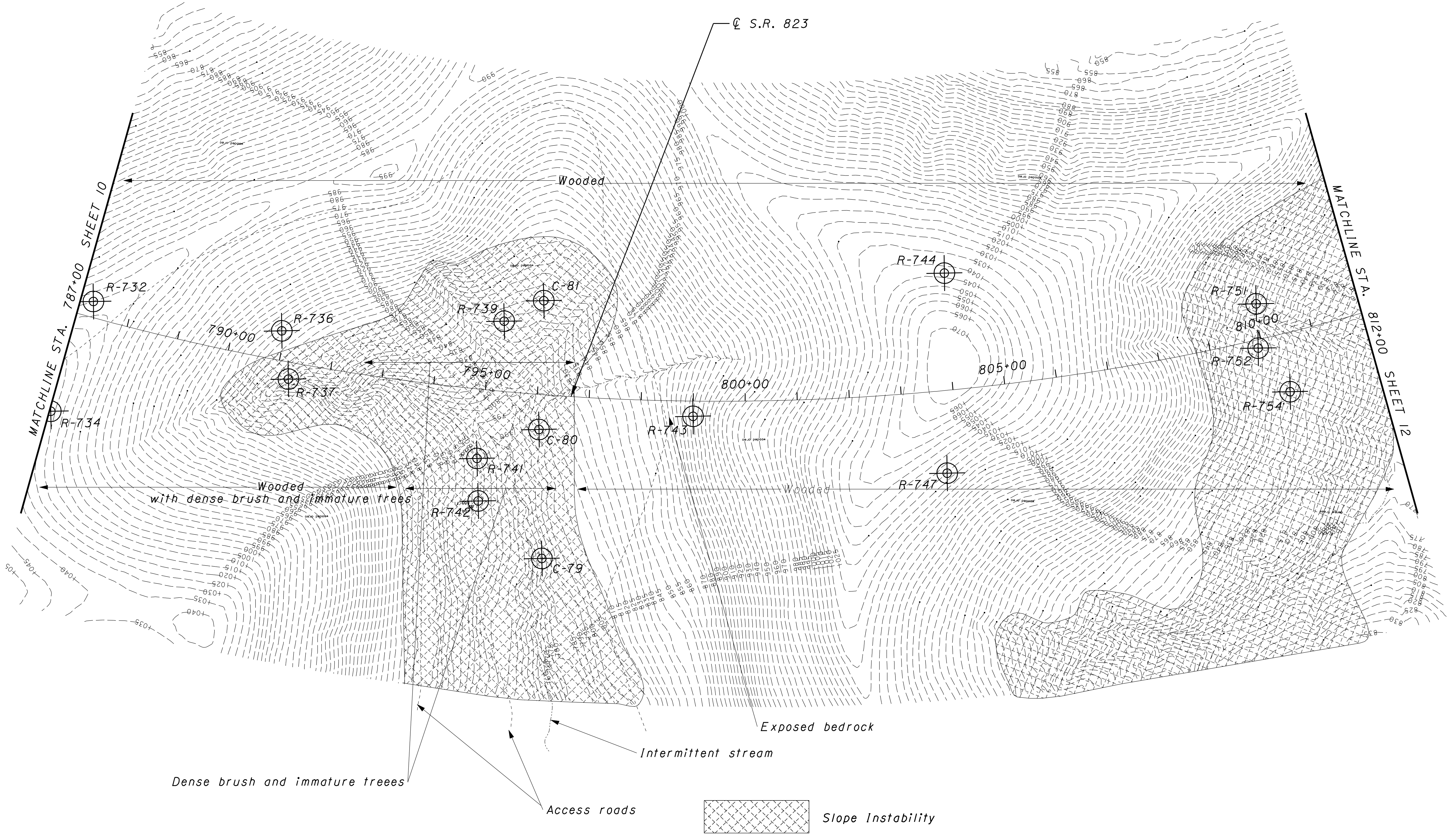

LAND USE AND RECONNAISSANCE NOTES
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HORIZONTAL SCALE IN FEET

LAND USE AND RECONNAISSANCE NOTES
S.R. 823 STA. 812+00 TO STA. 837+00

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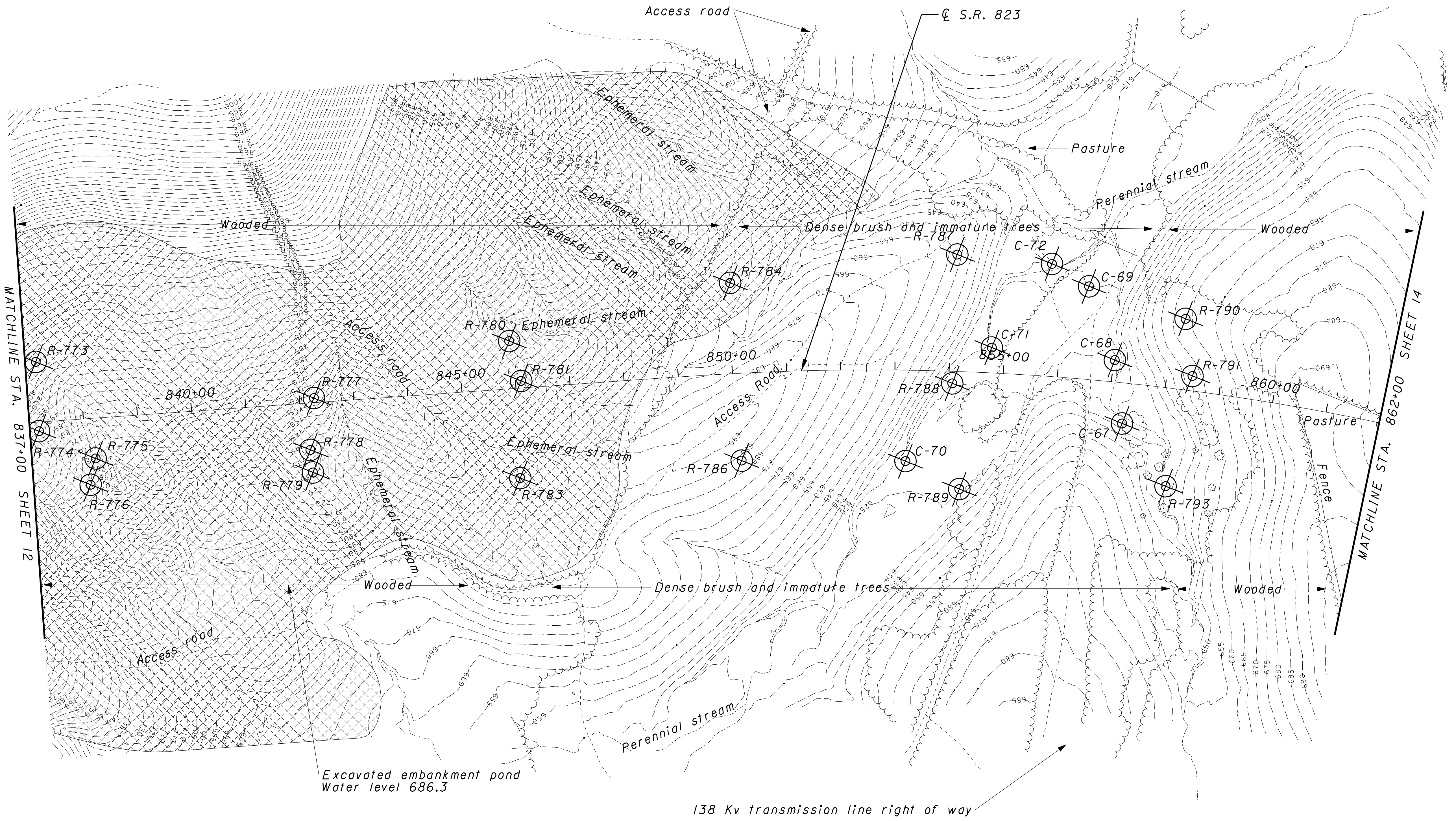

▨ Slope Instability

LAND USE AND RECONNAISSANCE NOTES
S.R. 823 STA. 837+00 TO STA. 862+00

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SCALE IN FEET

CAD/DRAWN AMJ
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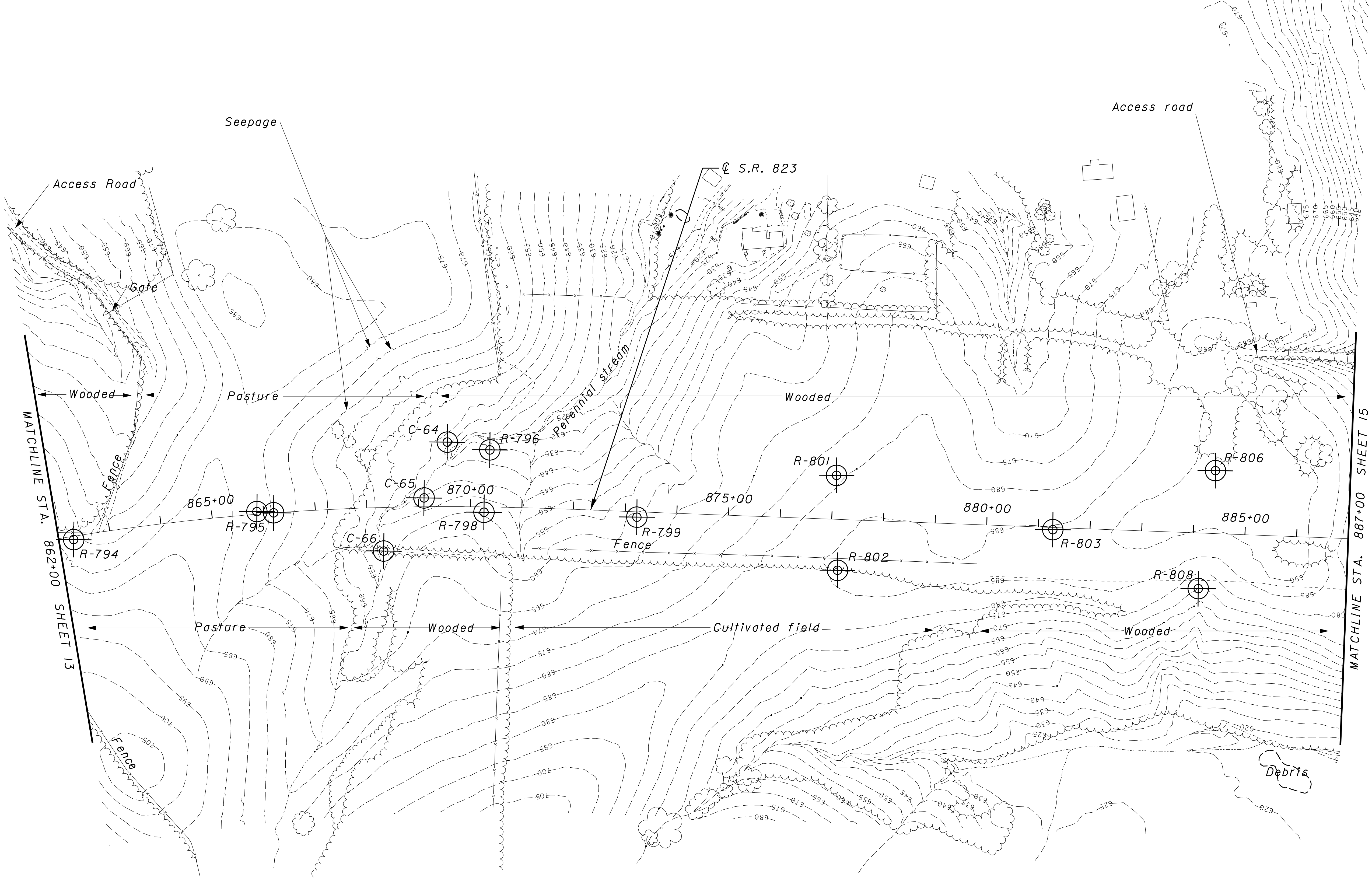

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CADD/DRAWN AMJ
CHECKED AEN

LAND USE AND RECONNAISSANCE NOTES
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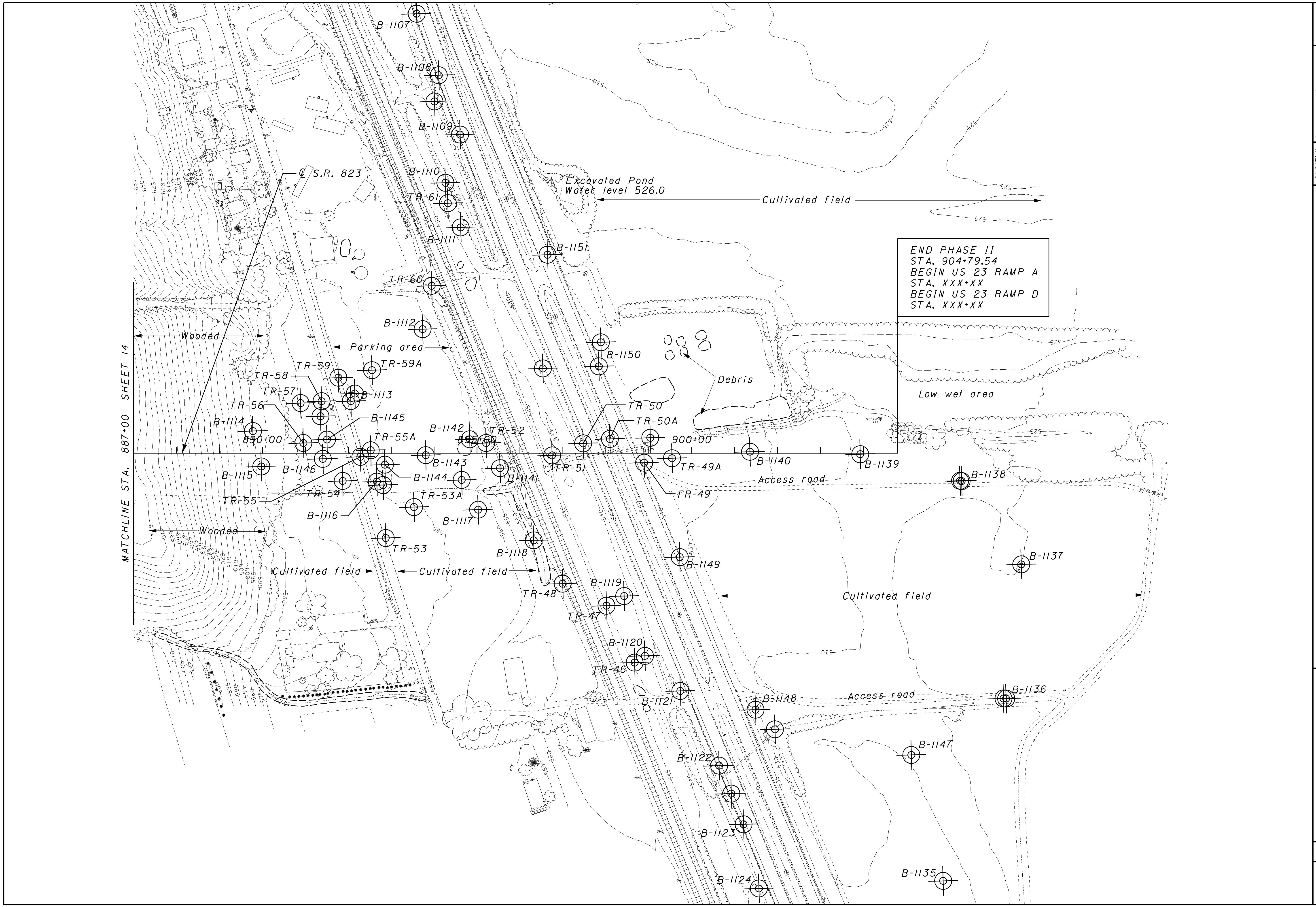

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STA. 904+79.54
BEGIN US 23 RAMP A
STA. XXX+XX
BEGIN US 23 RAMP D
STA. XXX+XX

N

0 50 100 200
HORIZONTAL
SCALE IN FEET

CADDRAWER AMJ
CHECKED AEN

LAND USE AND RECONNAISSANCE NOTES
S.R. 823 STA. 887+00 TO STA. 904+79.54

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APPENDIX B

Spring and Well Photos
Bedrock Exposure Photos
Photo of Slope Instability Indicators
Pond Photos
Pavement Photos

Photo 1. Developed spring.

Photo 2. Shallow water well.

Photo 3. Previously unknown gas well 760 feet left of station 659+00.

Photo 4. Bedrock exposure at Station 573+20, 420 feet right.

Photo 5. Bedrock Exposure at Station 716+95, 165 feet right.

Photo 6. Bedrock exposure at station 798+50.

Photo 7. Indicators of slope instability, right of station 673+50.

Photo 8. Shallow excavated embankment pond, 367 feet right of station 602+60.

Photo 9. Excavated embankment pond, 200 feet right of station 573+00.

Photo 10. Lucasville-Minford Road.

Photo 11. Morris Lane – Blue Run Road.

Photo 12. Flatwoods-Fallen Timbers Road

Photo 13. Fairground Road

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring RE-8
Location: STA 573+20 420' R
Date Drilled: 4-2-2007

WATER OBSERVATIONS:
Water seepage at:
Water level at completion:

Depth (ft)	*Elev. (ft)*	*Blows per 6"*	*Recovery (in)*	*Sample No.* *Drive*	*Sample No.* *Press / Core*	*Hand Penetro-meter (tsf) / * Point-Load Strength (psi)*	*DESCRIPTION*	*% Aggregate*	*% C. Sand*	*% M. Sand*	*% F. Sand*	*% Silt*	*% Clay*
0	945.0						Medium hard brown SANDSTONE interbedded with SILTSTONE; fine to medium grained, moderately to highly weathered, thinly bedded to medium bedded, moderately fractured, contains occasional seams of quartzite congolomerate..						
14.0	931.0						Bottom of Boring - 14.0'						

Depth scale (ft): 0, 20, 40, 60, 80, 100, 120

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢—⊣ *LL*
Blows per foot - ○
10 20 30 40

FILE: 0121-3070-03 [11/13/2007 1:54 PM]

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring RE-9
Location: STA 716+98
Date Drilled: 4-2-2007

WATER OBSERVATIONS:
Water seepage at:
Water level at completion:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
0	707.0													
1.5	705.5						Soft to medium hard gray SHALE; moderately to highly weathered, arenaceous, thinly laminated to laminated, slightly to moderately fractured.							
							Bottom of Boring - 1.5'							
20														
40														
60														
80														
100														
120														

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring RE-10
Location: STA 798+50 10' Right
Date Drilled: 4-2-2007

WATER OBSERVATIONS:
Water seepage at:
Water level at completion:

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf) / * Point-Load Strength (psi)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	880.0						Medium hard to hard brown SANDSTONE; fine to medium grained, slightly to moderately weathered, thinly bedded to medium bedded, moderately fractured.						
8.0	872.0						Bottom of Boring - 8.0'						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○
10 20 30 40

Depth scale: 0, 20, 40, 60, 80, 100, 120

FILE: 0121-3070-03 [11/13/2007 1:54 PM]

APPENDIX C

Reconnaissance and Planning Checklist

II. Reconnaissance and Planning Checklist

C-R-S:SCI-823-0.00	PID:79977	Reviewer:AMJ	Date:11-16-2007

All projects must establish the geologic setting and identify possible geologic hazards that may exist in the project area prior to preliminary design. This Reconnaissance and Planning Checklist should be followed as a guide to establishing the above conditions.

[✓ Y] N 1 Has the "Planning and Reconnaissance" section of the ODOT Specifications for Subsurface Investigations been followed?

2 Have the following ODOT sources of geotechnical information been reviewed:

[✓ Y] N X a past construction plans, including soil profile sheets from District

Y N [✓ X] b past project construction diaries

[✓ Y] N X c interviews with people knowledgeable of the project site

[✓ Y] N X d archived boring logs on file with the OGE

[✓ Y] N X e past District and County Garage maintenance records

[✓ Y] N 3 Has ODNR geotechnical information been reviewed?

Indicate which references were reviewed:

9 "Bedrock Geologic Map(s)"

9 "Bedrock Topography Map(s)"

9 "Known and Probable Karst in Ohio"

9 "Soil Survey(s)"

9 Ohio Wetland Inventory Map

9 "Landslides and Related Features"

9 aerial photographs

9 boring logs

9 water well logs

9 Other

9 "Bedrock Structure Map(s)"

9 "Geologic Map of Ohio"

9 "Quaternary Geology of Ohio"

9 National Wetland Inventory Map

9 Report of Investigations

9 measured geologic section(s)

9 Bulletins

9 Information Circulars

List Other items:

[✓ Y] N 4 Has information regarding the possible existence of geologic hazards in, or adjacent to, the project area been requested and obtained from individuals in the project area?

Indicate which individuals were consulted:

9 ODOT construction and maintenance employees

9 ODOT employees (active or retired) who were involved with the original construction?

9 current, former, adjacent landowner(s)

9 County Engineer / County employees

9 Township Trustees and employees

II. Reconnaissance and Planning Checklist

9 local planning and zoning officials

9 City or Village officials

9 Other List Other items:

[✓ Y] N X 5 Has information pertaining to the existence of underground mines within, or adjacent to, the project area (requested from the District AUMIRA Coordinator, DMRM, and DGS) been reviewed?

[✓ Y] N X 6 Has the information from DMRM and DGS been reviewed regarding the existence of active, reclaimed, or abandoned surface mines within, or adjacent to, the project areas?

Y [✓ N] X 7 Has any of the geotechnical information gathered in Question 3, indicated the potential presence of lake bed sediments, organic soil, or peat deposits?

8 Identify the geologic features that may influence the design on this project:

[✓ 9 Landslide]	9 Wetland or Peat	9 Fractures / Faults in exposed rock faces	9 Other
[✓ 9 Rockfall]	9 Karst	9 Underground Mine	9 Surface Mine

Notes

Stage 1: