GEOLOGIC HAZARDS ASSESSMENT

GENESEE PROPERTIES, INC.
SOCIETY TURN PARCEL
HIGHWAY 145
SAN MIGUEL COUNTY, COLORADO

June 15, 2020

Prepared for:

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1.0 EXECUTIVE SUMMARY

The Society Turn Parcel is a currently vacant parcel of land that Genesee Property proposes to develop into a Planned Unit Development/Subdivision (PUD) with mixed uses, including public, medical, commercial/retail, offices, lodging and employee housing. A new entrance road to State Highway #145 along with various infrastructure, parking areas and drives will be included as part of the PUD. As required during the review process at the County and State level, an analysis of relevant geologic hazards concerning the Society Turn Parcel was undertaken by DOWL over a multi-year period. The primary geologic hazards that were identified and mapped and affected certain limited portions of this Society Turn Parcel are flooding, wetlands, potentially unstable slopes and slopes >30%. Most of the Society Turn Parcel, including where most of the proposed development is concentrated, was identified as "stable slopes," indicating that these areas are considered stable, with minimal potential for the presence of geologic hazards. These are the areas consisting of gently-sloping terrain of the Remine Creek alluvial fan and river alluvium in the valley floor.

Although Remine Creek is subject to flooding, most of the debris appears to be captured by upstream basins, dense vegetation throughout the drainage, and the natural "detention basin" on the north side of Highway 145 created by the berm of the highway. DOWL's study of Remine Creek concluded mostly clearwater flooding, not debris flows, and that the Remine Creek culvert under Highway 145 is adequately sized to carry the 100-year event. Some wetland areas with potential for shallow groundwater were identified, but avoidance of low areas adjacent to the San Miguel River and Remine Creek are reduced by avoiding development in these areas and designating them as Open Space. The phased elimination of flood irrigation and other drainage improvements will also significantly reduce the potential for shallow groundwater.

Potentially unstable slope and slopes >30% generally lie on the steep slopes along the western and southern edges of the Society Turn Parcel associated with former or present channels of the San Miguel River and Remine Creek. Hazards relating to potential slope movement can be mitigated by avoiding these slopes, allowing for proper set-backs, and for providing site-specific shoring, where needed. Most of the Society Turn Parcel is mapped as "stable" with low risk of geologic hazards, while the small areas with moderate to high risk can be either completely avoided or can be reduced to low risk by implementing mitigation measures recommended herein during the PUD design process.

2.0 INTRODUCTION

DOWL investigated the geology and geologic hazards for the Genesee Properties, Inc. (aka "Genesee") Society Turn Parcel near Telluride, Colorado, in compliance with San Miguel County land use code requirements for a Planned Unit Development/Subdivision (PUD) and as required by the Colorado State House Bill 1041. This work was performed at the request of Genesee to be used as part of their submission package for development of the property. Our evaluation was based on resource review of available mapping and reports, our knowledge of the area, and field mapping of potential geologic hazard zones. No monitoring was performed on the property as part of this evaluation, nor, in our opinion, was any further monitoring required. DOWL performed a separate geotechnical evaluation on this Society Turn Parcel (dated 1/31/2020) that included drilling at various locations and laboratory testing to determine

subsurface conditions. We used the data we collected from the Society Turn Parcel geotechnical report to further evaluate geologic hazards and prepare this report.

According to the San Miguel County Land Use Code Section 5-404 and Colorado House Bill 1041, the following geologic hazards must be evaluated:

- avalanche
- landslide areas
- rockfall
- unstable and potentially unstable slopes
- slopes greater than 30%
- mudflow, debris and alluvial fans
- talus slopes
- Mancos Shale
- faults and seismicity
- ground subsidence
- radioactivity (radon gas)

We have also added discussions of:

- erosion
- expansive and compressible soil and rock
- flooding
- wetlands

We present the overall regional and geologic setting, followed by a separate evaluation of the geology, soils, and geologic hazards for the Society Turn Parcel. Because the County does not currently have much available data and specific geologic hazard mapping for this site, DOWL performed field evaluations for the Society Turn Parcel in preparation of this report. The purpose of this field work was to allow DOWL to identify the main hazards that could impact development of this Society Turn Parcel and to characterize those hazards by potential risk. Site visits occurred in the spring and summer 2009, 2011, June 2016, December 2018, and August 2019. Our afore-mentioned geotechnical exploration occurred on July 15-16, 2019. Our geohazard and risk assessment maps were used as part of the planning process to identify roads and building sites in a way that avoids high risk hazards and reduce the need for mitigation. Where mitigation was needed, DOWL assisted the owner and design team in developing acceptable mitigation alternatives, including avoidance. In this report DOWL addresses mitigation measures that are recommended for this Society Turn Parcel.

3.0 REGIONAL SETTING & SITE CONDITIONS

The Society Turn Parcel (19.9 acres) is in the San Miguel River valley, roughly 3 miles west of the Town of Telluride (see Vicinity Map, Map 1). It is southwest of the Society Turn intersection (round-about), with Highway 145 on the north and east sides, and Society Drive to the south. The Society Turn Parcel is the mostly gently-sloping terrain that sits on the north side of the San Miguel Valley at the base of a steep slope, which is the toe of Deep Creek Mesa.

The Conceptual Development Plan (Map 2) shows the Society Turn Parcel has a long and narrow shape that comes to a point on the west end and is approximately 2,390 feet long

(east-west) and 630 feet wide (north-south) at its' widest. The San Miguel River flows westerly through the southeast portion of the property and Remine Creek flows south through a narrow, steep gorge near the western tip of the property. As seen on a topographic map (Map 3), the Society Turn Parcel is located in the valley floor and most of it is gently sloping to the south to southeast, while the southern margin along the San Miguel River and western edge along Remine Creek are steeper. Additional maps of the property used for our study include the geology (Map 4), soil types (Map 5), slope classes (Map 6), and flood zones (Map 7). Our detailed geologic hazard mapping, based on aerial photography interpretation and multiple site visits, is shown on Map 8. The geologic hazard and risk assessments are on Maps 9-11.

Elevations range from 8,632 feet along the San Miguel River to 8,698 feet in the northeast corner of the Society Turn Parcel. The topographic map (Map 3) was generated by Foley Associates Inc. in conjunction with Olympus Aerial Surveys in 2008. Slopes range from 0-10% in upland areas in the majority of the Society Turn Parcel to over 30% along the present banks of the San Miguel River, in abandoned cut banks in the meander scars of the San Miguel River, along Remine Creek, and on a glacial moraine remnant in the northeast corner of the property (see Slope Classes, Map 6). There are five culverts that pass under Highway 145 and drain onto the property, shown on Map 2. In addition to the natural drainages of the San Miguel River and Remine Creek which cross portions of the Society Turn Parcel, there are three irrigation ditches in the western portion of the property that are seen on the aerial image of Photo 1 below.

Photo 1. Aerial image of western portion of Society Turn Parcel. Note the location of the San Miguel River along the southern margin, the Remine Creek channel along the western portion of the Society Turn Parcel, and the three irrigation ditches in the western portion of the open field (Google Earth image, 10/12/15).

Review of historic aerial photographs shows the eastern of the three field ditches formerly carried water from Remine Creek after it passed under Highway 145. Subsequent photos show an abandonment of this channel and redirection of runoff into a single Remine Creek channel. Currently, the western of the three ditches appears to carry most of the water and is discussed further in Section 5.0 below.

As seen in Photo 1 and Map 2, there are several roads and facilities on or near the Society Turn Parcel. Black Hills Energy has a small gas facility to the west of an access road on the Society Turn Parcel's west end. San Miguel Power Association (SMPA)/Tri-State Generation and Transmission have a substation, building, parking and storage accessed by the same dirt road along the southern edge of the Society Turn Parcel and the Town of Telluride's Waste Water Treatment Plant (WWTP) is along the south-central edge of the Society Turn Parcel in a "cut-out" area of the Society Turn Parcel that is accessed from the east from Highway 145.

Vegetation on the Society Turn Parcel consists mostly of native and seeded grasses in an open field, but there are also forbs and occasional low shrubs such as sagebrush, rabbitbrush, woods rose and other mountain shrubs. Along the San Miguel River, there are cottonwoods, spruce trees and willows, with some planted and native scattered trees on other areas of the Society Turn Parcel. The vegetative cover can be seen in Photo 1 above, Photo 2 below, and the cover photo (view to the east from the west end of the field).

Photo 2. Aerial image of eastern portion of Society Turn Parcel. Note the location of the San Miguel River, nearby facilities, Highway 145 on the north and east, and part of a recreational trail and bridge. (This Google Earth image is from 10/12/15).

A public, non-motorized recreation trail, called the Remine Creek Trail, crosses the Society Turn Parcel. The southeast portion of it is seen on the aerial image above (Photo 2). It connects to the Valley Floor Trails near the pedestrian/bike path underpass to the east. The trail crosses the San Miguel River on a pedestrian bridge on the Society Turn Parcel (seen in Photo 2) and continues north to northeast to cross the entrance road of the WWTP. The trail continues through a gate and traverses the north edge of the property to the west trailhead where there is another gate and the trail crosses Highway 145 to continue up the Remine Creek drainage (Photo 1).

4.0 PROPOSED DEVELOPMENT PLAN

As seen on Map 2 (Development Plan), the Society Turn Parcel is proposed to be developed with five (5) Planning Areas (PA); two (2) Open Space areas; a proposed WWTP expansion area on the west side of the existing WWTP; and two (2) access roads. The Planning Areas may be further divided or aggregated as part of the County review process. Road A will enter the Society Turn Parcel from Highway 145 to the north and Road C will enter the Society Turn Parcel from Highway 145 to the east. Other improvements (shown on Map 2) include an augmentation pond in western Open Space, an irrigation water tank (PA3), four underground drainage structures (two on PA1 and one on each Road C/D and PA4), one detention basin (PA5), and a pedestrian path with a bridge over Remine Creek. The boundaries of these planning areas were developed and refined based on input from our preliminary geologic hazard study from 2009 – 2011 and more recently from 2016 to present. The development plan was designed to avoid geologic hazard areas and to minimize the need for mitigation measures. For example, the two proposed Open Space areas (2.1 acres on the western end and 2.9 acres on the eastern end) were set aside for this purpose due to steep slopes and potential flooding from Remine Creek and the San Miguel River, respectively.

At this point in the planning development review process, the Society Turn Parcels have initially been separated out into five (5) Planning Areas that would accommodate the differing uses contemplated in the development plan. The Planning Areas are likely to be further divided into smaller development tracts as part of the development review process. Paved surface and underground parking areas are contemplated for the various buildings on the Society Turn Parcel (as will be determined with site-specific reviews of the proposed buildings and uses which would occur in the future). Along the northern edge of the Society Turn Parcel, berming or retaining walls are contemplated.

The Society Turn Parcel will be developed in multiple phases. We understand the first phase will provide for primary infrastructure improvements to serve the entire development, inclusive of the main highway intersection improvements onto Highway #145 to serve the project along with Road A and the main utility lines. The initial phase would also consider development of Planning Area 1 (which is currently anticipated to accommodate the new regional medical center). The surface irrigation currently serving livestock grazing activities will be relocated to other locations in the project, while allowing for irrigation to continue, until full buildout of the project, at which time the irrigation ditches will be removed through regrading and the surface water will be diverted back into Remine Creek on the north side of Highway 145.

5.0 GEOLOGY

5.1 Regional Geology

The San Juan Mountains of southwestern Colorado are a region of uplifted Paleozoic and Mesozoic sedimentary formations intruded by Tertiary volcanics. In the Telluride region, uplifting that accompanied the volcanic eruptions caused warping and alteration of older sedimentary bedrock. As magma rose towards the ground surface, some was injected into fractures in the sedimentary strata forming a network of dikes and sills. The magma was rich in mineralized fluids, forming the gold and silver veins that made the area a rich mining district. In the millions of years since the intrusives were formed and the region was uplifted, much of the overlying sedimentary rock has been weathered and stripped away by erosion, landslides, and glaciation to create the current dramatic landscape.

Telluride lies within a deep valley near the headwaters of the San Miguel River. The valley has cut through the surrounding volcanic and sedimentary formations by glacial and fluvial scouring and deposition. Since the end of the last glacial period, the scoured valley floor was filled to a depth of over 200 feet with alluvial and fluvial materials deposited by the San Miguel River and its' tributaries like Cornet Creek, Bear Creek, and Remine Creek, as well as with glacial moraine deposits and colluvium from the steep valley walls. Underlying this valley fill near the Town of Telluride is the Permian Cutler Formation (*Geologic Map of the Telluride Quadrangle*, Burbank and Luedke, 1966). The Cutler Formation consists of well-cemented, fluvial, reddish-brown sandstone with some layers of conglomerate, siltstone and micaceous shale. In the vicinity of the Society Turn Parcel, the bedrock in the canyon walls is Jurassic Morrison and Cretaceous Dakota Sandstone (*Preliminary Geologic Map of the Gray Head Quadrangle San Miguel County, Colorado*, Bush et at 1961). The Morrison Formation consists of variegated mudstone with some interbedded sandstone in the upper member and gray to yellow lenticular sandstone beds with some interbedded mudstone and limestone beds in the lower member. The Dakota Sandstone is a gray to yellow quartzitic sandstone and conglomeratic sandstone with gray to black carbonaceous shale and some thin coal seams. The distinctive dipping sandstone cliff above Airport Road to the north of Society Turn is the Dakota Sandstone. We did not observe bedrock outcrops on or adjacent to the Society Turn Parcel, and expect bedrock is quite deep under the site due to glacial scouring of the San Miguel River canyon during the Pleistocene and significant valley in-filling over that past roughly 10,000 years.

The consistency of the valley fill depends on the energy environment under which it was deposited. The upper alluvial fan of regional tributary streams like Cornet, Bear, Mill, Butcher and Remine Creeks contain coarse-grained sand and gravel along with cobbles to large boulders. This heavy material was deposited where the velocity and volume of flow was high, at the mouth of each canyon. The lighter clay, silt, sand and small gravel was carried further down the alluvial fan into the valley floor where the velocity decreased and was deposited. The valley floor also contains coarse alluvium from the San Miguel River as well as muds from overbank flows during flood stage and in low gradient wetland areas. Remnants of a terminal moraine are found in the Society Turn area and down valley to the top of Keystone Hill, west of the Society Turn Parcel. Glacial debris in the valley caused temporary damming of the San Miguel River resulting in subsequent deposition of silt and clay, so the valley fill contains sequences of finer-grained materials within beds of coarser alluvium, colluvium and glacial deposits.

5.2 Site Geology

As seen on the geologic map (Map 4), the Society Turn Parcel contains Quaternary river alluvium (*Qal*), Quaternary alluvial cone or fan (*Qac*) deposits, and Quaternary young glacial drift or moraine (*Qd*) deposits. The entire Society Turn Parcel contains geologically recent, Quaternary (less than 1.8 million-year-old), unconsolidated deposits. The deposit that dominates the western half of the Society Turn Parcel is the Remine Creek alluvial fan (cone) deposits (*Qac*) where it enters the valley floor, while the eastern half is primarily river alluvium (*Qal*) associated with fluvial deposits of the San Miguel River. There are also two remnant glacial drift/moraine (*Qd*) deposits at the northeast and southeast corners of the Society Turn Parcel, and one small area on the western tip of the Society Turn Parcel (see Map 4).

There is no bedrock mapped on this Society Turn Parcel, as it covered by thick sequences of geologically recent glacial, colluvial, and alluvial deposits. Due to deep glacial scouring and later infilling, bedrock is anticipated to be deep below the Society Turn Parcel. A review of water wells constructed on the property, available on the Colorado Division of Water Resources (CDWR) website on 2/6/19, revealed that no bedrock was found in any of the three wells to depths of 70, 130 and 177 feet (*www.water.state.co.us/groundwater/wellpermit*). According to the well logs, the valley fill consists of glaciofluvial silt, sand, gravel, cobbles and boulders. Our July 2019 geotechnical drilling also found no bedrock, although the depths of exploration in that study were much shallower than the drilling performed for the construction of wells.

The shape of the Remine Creek fan (Qac) on the western half of the Society Turn Parcel can be seen in the contour lines of Map 4. Near the western corner of the Society Turn Parcel, Remine Creek incises into this fan as it drops steeply to its' confluence with the San Miguel River within a narrow gorge. The following photograph (Photo 3) shows the low gradient of the Remine Creek fan from a view to the east.

Photo 3. Looking east across the Remine Creek fan towards Telluride from near the northwest corner of the Society Turn Parcel shows the vegetative cover and the gentle slope of the alluvial fan. Highway 145 is to the left of the image.

Alluvial deposits (Qal) typically consist of sand and gravel with cobbles and some boulders, but some areas of silt and clay can accumulate during flood events in areas of overbank flow. These unconsolidated deposits were spread throughout the valley floor by the migrating river channel. Alluvial fan deposits are similar in composition to river alluvium, but the landform is more conical in shape, with the apex of the fan at the mouth of the canyon where the slopes dramatically become less steep and material is deposited as the stream loses energy. Coarser material (boulders and cobbles) are typically found near the mouth of the canyon, while finer material (silt, sand, and gravel) are carried to the mid- and distal fan areas. In the central portion of the Society Turn Parcel, the Remine Creek fan deposits have pushed the San Miguel River to the south.

Glacial moraine (Qd) deposits at this site were pushed by glacial ice moving down valley from the head of the valley in the box canyon east of Telluride. The San Miguel River canyon served as a trunk glacier fed by smaller glaciers in tributary basins. A terminal moraine was located on the Society Turn Parcel, but subsequent erosion has left only remnant fragments of these deposits at the east and west margins of the property. The moraine in the northeast corner (Photo 4) and one in the southeast corner were originally connected and were later breached by the San Miguel River. This glacial material typically consists of a jumble of cobbles and boulders in a sand and gravel matrix with variable amounts of fines (see Photo 5). The following is a view of the glacial moraine at the northeast corner of the Society Turn Parcel and a close-up of the morainal material.

Photo 4 (left) is a view east towards the glacial moraine in the northeast corner of the Society Turn Parcel. Note the large boulders at the base, which were likely reworked to this area by man, are also likely remnants of the moraine located on this Society Turn Parcel. **Photo 5 (right)** is a close-up of the sandy gravel and cobbles composing the moraine. This glacio-fluvial deposit contains river alluvium that was incorporated into the moraine as the glacial scoured the river channel.

5.3 Soils

According to the Web Soil Survey 2.1 (*www.websoilsurvey.com*, NRCS 2019), there are two major soil types on the Society Turn Parcel, as shown on Map 5 (Soil Types). They are:

(1.) Cryoborolls-Cryaquolls association (0-15% slopes) – soils which consist of alluvial or glacial moraine (till or drift) soils located between the river floodplain and the base of the steep canyon walls; and

(2.) Cryaquolls-Borohemists complex (0 to 5% slopes) – alluvial soils which are developed on stream terraces, valley floors, and drainageways.

These soils have similar textures and composition but are on different landforms and/or slopes. Most of the Society Turn Parcel is located on Cryaquolls-Borohemists complex with gentle slopes. Most of the steeper slopes of the Cryoborolls-Cryaquolls complex are found along the steep banks of the San Miguel River and on glacial moraine deposits. These areas were avoided for development and most are planned for open space use. A portion of Planning Area 5 and Planning Area 6 also contain the Cryoborolls-Cryaquolls soils, as they form on stream terraces.

According to the Web Soil Survey (WSS), shrink-swell potential is low, soil materials are predominately granular, and these soils are somewhat erodible due to low cohesion. According to the engineering properties tables offered in the WWS, both these soils classify as sandy to clayey gravels, gravelly sandy clay loams, silt loams, and sandy clay (Unified Soil Classification: GC-GM-GW-GP, ML, and SC). Limitations to roads, shallow excavations, and dwellings are primarily flooding and depth to saturated zone, and secondarily, potential for frost action and cutbank caving.

6.0 GEOLOGIC HAZARDS EVALUATION

We reviewed existing geologic hazard mapping that includes some or all the Society Turn Parcel that includes:

(1.) *Map Showing Potential Geologic Hazards in the Telluride Quadrangle* (Luedke and Burbank 1977);
(2.) *San Miguel County Geologic Hazards Map* (formerly available on San Miguel County GIS website 2009);
(3.) *Natural Hazards of San Miguel County, Colorado* (Bovis 1976);
(4.) *Rockfall Hazard and Risk Study for Town of Telluride and Highway 145 Spurs* (Mears 2009);
(5.) *Geologic Hazard Mapping for the Grand Mesa Uncompahgre and Gunnison National Forests* (Fehlmann 1991); and
(6.) *Map of Snow Avalanche Areas and Known Accident Sites in the Telluride Region, San Miguel County, Colorado* (Armstrong and Carrara 1981).

The available geologic hazard mapping was found to be inadequate for the purposes of this study because of the general nature of the hazards, inaccuracies, and lack of quantification of the intensity of the hazards or their associated risks. Many of these studies are primarily based on aerial photograph interpretations with little, if any, ground verification. The level of detail was deemed inadequate for use in subdivision design-level evaluations of the geologic hazards. As is required in a Geologic Hazard Evaluation according to San Miguel County and Colorado House Bill 1041, all possible geologic hazards are to be evaluated for a site (listed on page 2). A discussion of each of these hazards are provided below with a focus on those that are relevant.

Most of the Society Turn Parcel was identified as "stable slopes," indicating that these areas have gentle terrain that are considered stable, with minimal potential for the presence of geologic hazards. These relevant hazard categories are presented on Maps 8 and 9 for the Society Turn Parcel. The following is a discussion of all geologic hazards required to be evaluated on the Society Turn Parcel.

6.1 Avalanche

According to the regional avalanche maps (Armstrong and Carrara, 1981 and INSTAAR, 1976), "minimal" avalanche hazard is assigned to the valley floor on the Society Turn Parcel. These "Minimal Avalanche Hazard" areas include regions where avalanches are unlikely or where the hazard is too small to identify at the mapped scale. The steep hillside north of Highway 145 (north of the Society Turn Parcel) is mapped as "moderate" avalanche hazard, shown on Maps 8 and 9. These include areas of open, south-facing slopes below timberline that may be susceptible to avalanche activity during extend periods of snowfall and relatively small slab avalanches could result. However, the hillside is generally well vegetated, there is a deep ditch on the north side of Highway 145, the road acts as a deceleration bench (runout zone), and slab avalanches have not been observed in the recent past in this type of setting at this elevation. Based on our site reconnaissance and decades of experience in the region, we conclude that there is little to no risk of avalanche on the Society Turn Parcel and, therefore, no mitigation for avalanche hazard is recommended.

6.2 Landslides

According to the geologic hazard mapping of the *Telluride Quadrangle* by the USGS (Luedke and Burbank: 1977), there are not landslides mapped on the eastern portion (limit of mapping) of the Society Turn Parcel. There is no hazard mapping completed for the adjacent USGS Gray Head Quadrangle. We did not observe evidence of active or recent landslides on the Society Turn Parcel during our field mapping. In our opinion, landslide mitigation is not necessary for the proposed development at the Society Turn Parcel.

6.3 Potentially Unstable Slopes

There are no potential unstable slopes (PUS) mapped by Luedke and Burbank (1977) in the eastern half of the Society Turn Parcel. Generally, PUS slopes are those that do not exhibit landslide topography or other indicators of slope instability, but which exceed their angle of repose or are composed of material that can be readily destabilized with the addition of water or further over-steepening. Our field mapping identified PUS slopes on the steep banks immediately adjacent to the San Miguel River and Remine Creek (Map 8). We also identified the steep slope along the south-central edge of the Society Turn Parcel where there is a curved slope (relic cut bank of the San Miguel River) with a wetlands area at the toe of the slope. These slopes are composed of fluvial and alluvial fan deposits with low cohesion and they are susceptible to erosion and slope failure if over-steepened. Additionally, there is a small, remnant glacial moraine deposit in the northeast corner of the Society Turn Parcel that we mapped as PUS due to its low cohesion and steep side slopes.

The primary mitigation of PUS slopes is avoidance. However, development is possible on and near PUS slopes if careful analysis is performed to design structures and drainage that do not create instability. For example, development at the top of a PUS should be set back sufficiently to not add weight to the slope or concentrate runoff which could initiate slope movement. A slope stability analysis should be performed to determine the depth of embedment of footings and setbacks from the edge of slope for buildings at the top of PUS areas, such as for PA2 and PA5. Development at the toe of PUS's should also not cut into the toe of the slope without adequate shoring and/or setbacks. Developing on a PUS or at the crest or toe of a PUS is possible; however, slope stability analyses must be performed to evaluate slope stability and provide stabilization recommendations (if necessary).

6.4 Slopes Greater than 30 Percent

The Slope Classes Map (Map 6, based on aerial topographic survey) was generated for the Society Turn Parcel and the slopes over 30% clearly show up on this map as darker browns. The steep areas are associated with the San Miguel River, Remine Creek, and the morainal hill in the northeast corner. Additionally, a 30% slope boundary is shown as a jagged blue line on our geologic hazard maps (Maps 8 and 9). As seen on Map 6, the majority of the Society Turn Parcel contains slopes of less than 10%. Generally, the areas with slopes over 30% were mapped as PUS slopes (previously discussed) due to the unconsolidated nature of the alluvial

and glacial deposits and steep to very steep slopes. Some areas with slopes over 30% are included in the general areas to be developed (see Map 9). We recommend slope stability analysis be conducted on the slopes that will be developed. Results of these analyses can identify the need for and provide alternative mitigation measures necessary for stabilizing the slopes. The following photographs (Photos 6 and 7) show an area with slopes >30% and which were also mapped as PUS slopes. This site is the abandoned cutbank of the San Miguel River north of the SMPA facility.

Photo 6 (left) is a view east at the steeper slopes within the WWTP Expansion area and the southern edge of Planning Area 2. This curved area is a former cutbank of the San Miguel River when the river was at a higher elevation. **Photo 7 (right)** is a close-up of the soil materials in this relic cutbank. Note the many rounded to subrounded cobbles and boulders in this sandy gravel deposit with low cohesion.

6.5 Rockfall

There are no rockfall source areas on the Society Turn Parcel. Although there is rockfall hazard to the north of the Society Turn Parcel and Highway 145 due to outcrops and subrounded morainal cobbles and boulders that weather or erode out of the hillside, we did not observe evidence that rockfall that has made it to the Society Turn Parcel east of Remine Creek. We observed some rockfall on the western side of Remine Creek, but this area is designated as open space on the development plan (Map 2). It is likely that both Airport Road (directly below outcrops of Dakota Sandstone) and Highway 145 (located at the toe of the steep slope), serve as benches to attenuate rockfall originating from the hillside. In addition, some small rockfall was observed in the deep bar ditch on the north side of Highway 145. No evidence of rockfall was found on the portions of the Society Turn Parcel proposed for development. We conclude that there is little risk of rockfall on the Society Turn Parcel and, therefore, mitigation of rockfall hazard is not necessary.

6.6 Talus Slopes

No areas of talus slopes were identified on or adjacent to the Society Turn Parcel on available geologic and geologic hazard maps. We also did not observe talus slopes during our field geologic hazard mapping. Mitigation for hazards resulting from talus slopes is not necessary for the proposed development at the Society Turn Parcel.

6.7 Erosion

Surface runoff from rainfall and snowmelt drains as sheetflow to the south and southeast across much of the Society Turn Parcel where it is then concentrated in drainage channels, Remine Creek and the San Miguel River. The soils at the site are generally granular with low cohesion, so are susceptible to erosion on steep slopes and where runoff is concentrated. Preliminary site grading and drainage plans have been prepared by DOWL for the Society Turn Parcel to reduce potential erosion impacts.

6.8 Alluvial Fans/Debris Flows/Mudflows/Sheetflow

The Remine Creek alluvial cone fans out onto valley floor across the western half of the Society Turn Parcel (*Qac* on Map 4). The fan shape of the deposit is clearly seen in the contours of the topographic map (Map 3) and the slope classes map (Map 6). The hazard from an alluvial or debris fan is the potential for flooding and, when the mouth of the main channel is choked with large debris, the floodwaters are forced out of the channel onto other parts of the fan. Large debris, including boulders and trees, can be caught up in the flood event and cause significant damage if a structure or road is in the new stream's path. However, since Highway 145 and a large culvert that carries Remine Creek under the highway were constructed, the alluvial fan on the Society Turn Parcel is now an isolated landform that is no longer active. In other words, the fan feature on the Society Turn Parcel is a remnant landform that rarely receives flood flows and debris from Remine Creek due to improvements to Highway 145.

The Remine Creek alluvial fan likely developed after the retreat of the most recent glacier when sediment was washed down and there was very little vegetation to capture the material. Since then, the creek has eroded a relatively deep channel with basins and mature vegetation that contain the small amounts of debris that would wash down during modern runoff events.

Examination of the Remine Creek drainage from Highway 145 up to Airport Road reveals very little rocky debris built up on the upslope sides of trees or in levees or other piles more typical of a stream subject to debris flows. The upper portion of the basin is above timberline, steep, and contains loose talus and glacial materials, but the middle and lower portions of the Remine Creek basin are heavily wooded and contain steps in the slope, such as by Airport Road, where debris is captured. Additionally, this area is not highly mineralized nor does it contain interbedded weak and strong sedimentary layers that are susceptible to debris flows as found both up and down valley from Remine Creek.

The 4-foot diameter culverts that carry Remine Creek under Highway 145 and Airport Road both have high water marks roughly half-way up the culverts, which indicates they are sized appropriately for most flood events. Most of the debris appears to be smaller in size and is carried in the stream channel to the San Miguel River. Although some boulders were observed in the Remine Creek fan north of the highway, they were mostly lichen-covered and embedded in soil, indicating they are not recent deposits on the fan. Also, due to recent man-made improvements along the highway, debris is anticipated to be captured on the north side of the highway. Our July 2019 geotechnical investigation confirmed that there are few larger rocks in

the Remine Creek fan on the property. Based on our analysis, the fan appears to be a remnant landform that is cut off from its' source and even extreme runoff events in Remine Creek and on the slope north of Highway 145 can be contained by the basin and bar ditch north of Highway 145 and the culvert under Highway 145. Based on our assessment there is low potential for mudflows and debris flows on the Society Turn Parcel and no specific mitigation is recommended.

6.9 Flooding

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map number 08113C0286C Panel 286 (Flood Zones map, Map 7), the majority of the Society Turn Parcel is located outside of any flood areas. The San Miguel River channel, its' 100-year floodplain (Zone A), and Zone X (areas of 500-year flood or areas of 100-year flood with average depths of less than 1 foot) are flanked by Open Space, not any proposed parcels for development. The channel and streambanks immediately adjacent to the San Miguel River are mapped as Zone A (where no base flood elevations have been determined) or Zone AE (base flood elevations have been determined for the 100-year flood). At the eastern end of the Society Turn Parcel, the 100-year flood elevation has been given as 8,640 feet immediately downstream of the Highway 145 bridge and as 8,637 feet roughly 250 feet downstream of the bridge. These flood elevations are still confined within the floodway and floodplain of the San Miguel River. These areas of potential flooding are designated as open space in the development plan, so no development is planned in these areas.

No flood elevations have been determined by FEMA for Remine Creek. Since the area where the creek crosses the Society Turn Parcel will be reserved for open space, no development would be impacted by flooding that occurs within the channel. Both StreamStats© and USDA TR-55 models were run for Remine Creek as part of our geologic hazard assessment. Based on these models, flows of 263 and 316 cfs were determined for 50 and 100-year events. Based on calculations of the two 48-inch corrugated metal pipe (CMP) culverts that cross Airport Road and Remine Creek using Manning's equation, both culverts pass the estimated 100-year event flow of 316 cfs without overtopping. It is our understanding that the Colorado Department of Transportation (CDOT) will review the Remine Creek culvert capacity in their 2020 regional drainage audit and confirm its ability to pass the 100-year flow.

There are five culverts under Highway 145 that carry water onto the Society Turn Parcel (Map 2). The western-most culvert is the largest and carries Remine Creek. The next culvert east carries water from Remine Creek to the property for irrigation purposes. The remaining three culverts drain runoff from the slope to the north of Highway 145. These are in various stage of disrepair or are clogged with sediment, so they do not appear to carry much water to the site. However, there is some potential for localized flooding at the mouth of the culverts during large runoff events. Deep ditches on the north side of the highway capture sheetflow from the hillside, so sheetflow flooding is not probable. Various phases of site development will block or disable all culverts (except for Remine Creek) and grading and drainage plans will divert water to the east and west, not under the highway.

6.10 Wetlands

There are three wetland areas on the Society Turn Parcel delineated by SGM (map dated 1/14/2020 job #115.06.07) and shown on Maps 2 and 8. One wetland area is along Remine Creek in the western Open Space area, a second wetland area is along the banks of the San Miguel River in the eastern Open Space area (see Photo 8 below), and a third wetland area is on the south side of the San Miguel River and near the southeast corner of the Parcel, located in the eastern Open Space.(see Photo 9 below).

Photo 8 (left) is a view of the San Miguel River and associated wetlands looking east towards the pedestrian bridge and Highway 145. **Photo 9 (right)** is looking north at the wetlands near the southeast corner of the Society Turn Parcel.

All delineated wetland areas (along Remine Creek and the San Miguel River) are designated as Open Space in the development plan. The eastern delineated wetland area (seen in Photo 9) is in a topographically low area that receives runoff from a culvert draining Highway 145 and possibly from other sources from the south. This area has been identified as Open Space in the development plan..

As seen in Photo 1 and on Map 2, there are some ditches that currently provide irrigation water from Remine Creek to the pastureland on PA1, PA2 and PA3. Photo 10 below shows the ditch that carries water seasonally onto PA1, which is then distributed throughout the pasture area for livestock grazing. There are no delineated wetlands associated with these water sources. These irrigation ditches will be relocated to easterly areas of the Society Turn Parcel, contemplated for future development phases, and ultimately eliminated as full development buildout occurs. By removing the irrigation ditches as part of the initial development of PA1, potential for water to enter the subsurface from this source will be eliminated. No shallow groundwater was encountered during our July geotechnical drilling investigation to depths of up to 26.5 feet on the property. The granular nature of the soils allows for good drainage of these soils except in topographically low areas adjacent to the San Miguel River and Remine Creek.

Photo 10. This is a view to the south at the irrigation ditch shown on Map 2 that enters PA1. The source of this water is from Remine Creek that is conveyed through a culvert under Highway 145, which is behind the photographer. There are no wetlands associated with this man-made irrigation ditch.

Groundwater can be problematic as it weakens foundation soils, creates hydraulic pressure, and can seep into the interior of structures if foundation components are not properly waterproofed and drained. At the toe of the slopes, saturated soil conditions also can contribute to unstable slope conditions. Consequently, management of surface and subsurface water is very important for long-term performance of foundation components and the preservation of slope stability. Although not observed during the Feasibility Geotechnical Investigation performed by DOWL in July 2019, site-specific geotechnical investigations should be conducted to determine if groundwater is present at a building site prior to development. Potential groundwater hazard can be mitigated by careful site grading and drainage plans that control surface and groundwater drainage, avoidance through reasonable setbacks, and the design of elements that are waterproofed and capable of resisting hydraulic forces, if necessary.

6.11 Mancos Shale

Mancos Shale is not mapped within the Society Turn Parcel on the geologic quadrangles (Map 4). Mancos Shale is found on the mesas above the Society Turn Parcel to the north and south but has been stripped from the valley floor by glacial scouring and river erosion. Therefore, mitigation for hazard from Mancos Shale is not necessary for the proposed development at the Society Turn Parcel.

6.12 Expansive & Compressible Soil and Rock

In the Telluride area, expansive (high plasticity) clays are derived from fine grained parent material such as those contained in the Mancos Shale, Dakota Sandstone, Morrison Formation, and volcanic material. However, the alluvial, alluvial fan, and glacial moraine deposits that comprise virtually all of the Society Turn Parcel (Map 4) are sands, gravels, cobbles, boulders, and low plasticity clay and silt which have low to very low expansive potential. Some pockets or lenses of clay can exist in these deposits, but they are not usually extensive laterally or vertically.

According to the International Building Code (IBC) soil should be considered expansive if it meets all of the following criteria:

1. Plasticity Index ≥ 15
2. ≥ 10% passing #200 sieve
3. ≥ 10% smaller than 5 µm (hydrometer)
4. Expansion index ≥ 20

Based on the laboratory test results from the geotechnical evaluation, soil tested has a plasticity index less than 7. Based on our laboratory tests, the site soil does not classify as expansive. Due to the nature of the landforms on the Society Turn Parcel and their typical granular soil types, the potential for expansive soils is considered to be low.

Compressible soils are generally soils that have been laid down rapidly, have a weak matrix containing voids, and/or are not naturally in a dense or compacted state. Compressible soils typically have a large proportion of fine-grained materials, especially silt, but they can also contain a mixture of material if deposited in a chaotic manner. For example, alluvial fan deposits are often laid down rapidly and are composed of materials that are not sorted or reworked, leaving behind voids and a loose matrix of rocks, soil, and possibly organic debris. Clayey soils can also be compressible if they are saturated when loads are applied. Based on the explorations that were part of our geotechnical investigation, subsurface soil is generally granular and is generally medium dense to dense. Based on our exploration, the potential for compressible native soil is low.

Man-placed fill can also be compressible. An area of known fill material, located on the southern edge of Planning Area 2, was evaluated in our July 2019 geotechnical investigation. The depth of fill was relatively shallow and the fill had a similar composition to native soils, so the potential for excessive consolidation in this area is considered low.

Due to the nature of the landforms on the Society Turn Parcel and their typical granular soil types, the potential for expansive soils is considered to be low and the potential for compressible soils generally low to moderately low. However, we recommend site-specific geotechnical testing to evaluate the nature of the soils and potential for compressible conditions below the proposed building(s) in that planning area, consistent with the standard of care for geotechnical engineering.

6.13 Faults/Seismicity

According to the two available USGS geologic quadrangles (*Site Geology* section 4.2), there are no faults that cross the Society Turn Parcel. The closet fault is the Vanadium Fault, located roughly ½-mile to the southwest. This northwest trending fault, which extends from the intersection of the Skunk Creek drainage and Highway 145 (western edge of the Telluride Mountain Village) to the south side of Gray Head Mountain, is inferred for much of its length and is not considered active. It is not identified in either of the Colorado Geological Survey (CGS) reports identifying geologically recent (Quaternary-aged) and potentially active faults (Kirkham and Rogers 1981 and Widmann et al 1998). The closest mapped potentially active

faults to the subject property are the San Miguel Canyon Faults (located roughly 14 miles west of Telluride). These faults, interpreted as active during the Quaternary, are thought to be related to salt tectonism (movement of deep-seated salt deposits). A maximum credible earthquake for this fault zone is a magnitude M5.0 event. The next closest potentially active faults are the Ridgway, Busted Boiler, and Log Hill Mesa Graben Faults north of Ridgway (roughly 16 miles north of Telluride). These faults are located at the southern end of the Uncompahgre Plateau and are also interpreted to be Quaternary-aged. The maximum credible earthquake inferred for these faults is M6.0 to M6.75.

Not all earthquakes are expressed on the surface as faults and many faults are inactive, representing former stresses in the crust that may not be active today. Consequently, an evaluation of seismic risk should include an analysis of the historic record of earthquake events. The Telluride area is located in the Western Mountain Seismotectonic Province in Colorado, where maximum credible earthquakes are estimated to be on the order of magnitude 6 to 6.5, equivalent to Modified Mercalli (MM) VI to VIII (Kirkham and Rogers 1981). According to Kirkham and Rogers (2000) and the CGS website database of earthquake events (*http://geosurvey.state. co.us*), the largest recorded earthquake in the region was the 1994 M4.4 (MM VI) Norwood event. There were several other similar magnitude earthquakes in the Telluride region: Telluride in 1894 (MM IV), Ridgway in 1897 (MM V), Lake City in 1913 (MM VI) and 1955 (MM VI), and Cimarron Ridge/Montrose in 1960 (MM VI) and 1962 (MM V). Many other earthquake events less than MM V have been identified for the region.

Site-specific seismic design criteria should be determined in accordance with the applicable building codes accepted by the San Miguel County Building Department at the time of development. Applying these criteria in the design of structures built within the Society Turn Parcel will appropriately mitigate this risk.

6.14 Ground Subsidence

Regarding the natural potential for ground subsidence, there are no known solution cavities in limestone or other forms of naturally occurring underground caverns beneath the San Miguel River valley floor. Regarding man-made potential, the only evidence of mining activity observed on the Society Turn Parcel during our field mapping was a wooden loadout structure on the north bank of the San Miguel River near the east end of the Society Turn Parcel. This is a surface structure historically used to load locally mined gravel or ore into trucks or wagons that drove on the bench below the structure. No mine features, adits, or other symbols are indicated on the topographic or geologic maps of the area and no evidence of mining was found on the surface during our field investigations. A search of mining claim records on the GeoCommunicator website (*www.geocommunicator.gov*) indicated only placer (stream bed) mining claims on the Society Turn Parcel. These claims are designated as closed. Since no adits or underground mining would be associated with this type of mining, mine-related ground subsidence is not anticipated at this Society Turn Parcel. Therefore, mitigation for subsidence hazards is not necessary for the proposed development at the Society Turn Parcel.

6.15 Radon Gas

Radon gas is produced by decay of radioactive minerals contained in subsurface rock and soil. The U.S. Environmental Protection Agency (EPA) has determined that radon is the second leading cause of lung cancer and that radon can accumulate in buildings and homes if the gas is not properly ventilated. The EPA map of Radon Zones indicates that virtually all western Colorado, including San Miguel County, is in Zone 1 (*www.epa.gov/radon/zonemap.html*). Although there is no known safe level of radon, Zone 1 is the zone of highest risk for exposure to radon gas [i.e., greater than 4 picoCuries per Liter (pCi/L)].

The EPA does not specifically address testing and management of radon in commercial structures. However, owners should be aware of the potential health implications of constructing upon radon emitting soils, assess risks, and take appropriate action. The Colorado Geological Survey suggests that new residential construction in Zone 1 areas should be should assume radon to be present and the structures should be designed with a passive radon mitigation system. Once the building is constructed, radon tests should be performed, and if the radon levels exceed 4 pCi/L, then the system should be converted to an active system, such as with exhaust fans. Additional information about radon gas can be found at the websites *www.epa.gov/radon/* or *www.cdphe.state.co.us/hm/rad/radon*.

7.0 SUMMARY OF GEOLOGIC HAZARD ASSESSMENT

Most of the property is mapped as "Stable Slopes" (Maps 8 and 9) and the four primary hazards identified on the Society Turn Parcel are flooding (Map 7), wetlands (Map 8), potentially unstable slopes (PUS) and slopes >30% (Map 6). It is important to note that the presence of these hazards is for existing conditions, not permanent developed conditions. It is the intent of the development plan to address each of these hazards and reduce or eliminate them through avoidance, geotechnical methods, or site modifications and improvements.

Development Area	Acres	Flooding	PUS	Slopes >30%	Wetlands
Open Space (west)	2.1	X	X	X	X
Open Space (east)	3.8	X	X	X	X
Roads A & B	1.98		X	X	
Roads C & D	0.5		X	X	
WWTP Expansion	1.5		X	X	
Planning Area 1	2.6		X	X	
Planning Area 2	1.2		*	*	
Planning Area 3	2.8				
Planning Area 4	2.6		*	*	
Planning Area 5	0.8		*	*	

*Adjacent to PUS or Slopes >30% (special mitigation applies)

Table 1. Summary of Geologic Hazards on the Society Turn Parcel

8.0 GEOLOGIC HAZARD RISK ASSESSMENT

In addition to presenting the geologic hazards within the various landforms on the Society Turn Parcel this report provides a map showing the levels of risk associated with the existing hazards (Map 10). There are three levels of risk: low, moderate and high, as defined below. The higher the level of risk, the greater the need for mitigation. It is worth mentioning that through the use of standard mitigation measures such as rockfall fences, mechanically stabilized slopes, improved drainage, berms, engineered cuts and fills, etc. the risk in an area can often be reduced to a lower level. This analysis is meant as a general planning tool and was used by the design team to assist in refining the development plan. Once mitigation methods have been designed to reduce the risk and are shown on plans, this report can be revised to indicate revised levels of geologic hazards to reflect specific mitigation or improved drainage. The following are definitions of the three risk categories:

8.1 Low Risk

These areas of low risk (shown in yellow on Map 10), are generally the most suitable for development because there is low risk from geologic hazards that could limit building site or roadway construction. However, site-specific geotechnical testing would be necessary to determine soil, bedrock or groundwater conditions that may impact foundation design. The majority of the Society Turn Parcel has low risk relating to sheetflow flooding over the lower reach of the Remine Creek alluvial fan (shown in yellow on Map 10). An analysis of Remine Creek flood potential determined that flood events are accommodated by the culvert under Highway 145 and within the natural "detention basin" created by the road embankment. Sheetflow flooding of water and mud can be accommodated by elevating the ground floor elevations of all structures on the north side of the river. Site-specific geotechnical investigations should be performed for all proposed development to determine if any areas of shallow groundwater exist and mitigation methods and design recommendations can be made at that time specific to the intended construction.

8.2 Moderate Risk

Moderate risk areas (shown in orange on Map 10) have one or more geologic hazards, but with the use of common mitigation measures the risk generally can be reduced to "low" and are suitable for development. Careful building and roadway placement and site-specific evaluations to determine the potential hazard impacts and mitigation options will be necessary. There are small areas with moderate risk, which are associated with Remine Creek and the San Miguel River (flooding and shallow groundwater) and PUS slopes. These areas will need further evaluation and/or mitigation appropriate for the level of site disturbance and proposed uses. The primary concerns are preservation of slope stability, dewatering or waterproofing, and designing to accommodate hydraulic pressures.

8.3 High Risk

High risk areas (shown in red on Map 10), have one or more geologic hazards that severely limits development. Generally, an area designated with "high" risk should be avoided. However, with appropriate mitigation measures and careful placement of building sites and roadways,

some areas with "high" risk are buildable. These areas may require extensive and expensive mitigation measures to reduce the risk condition. Clustering buildings to share mitigation devices would be a design option to consider.

Areas of high risk due to flooding along the San Miguel River have been avoided in the development plan. However, there is some high risk due to PUS slopes associated with the steep banks of unconsolidated alluvial material along the San Miguel River, Remine Creek, and the relic cut bank scarp on the south side of PA2. These areas will need slope stability analyses tailored to intended uses and degree of site disturbance. Mitigation, if necessary, may include one or more of the following: shoring methods (reinforced slopes, soil nails, retaining walls, etc.), deep foundation systems, setbacks to avoid disturbing the edge of slope, and drainage improvements. Controlling drainage in areas of high risk also is important for maintaining slope stability on these steep slopes.

9.0 GEOLOGIC HAZARD MITIGATION

As summarized above, risk from geologic hazards ranges from low to high. Mitigation measures, typical of those found elsewhere in the Telluride area, can be employed on the Society Turn Parcel to lower hazard and risk levels. The relative risks of hazards after recommended or planned mitigation efforts have occurred are presented on Map 11 (attached) to compare to the pre-mitigated risks on Map 10. Recommendations for mitigation of slope instability, flooding, sheetflow flooding, shallow groundwater, expansive soil, seismic effects, and rockfall/avalanche hazards are outlined below. The measures apply in general to each hazard as identified in the Society Turn Parcel. However, in all cases, site-specific investigations and analyses should dictate appropriate mitigation measures for each building site.

Table 2 below is a summary of the existing geologic hazard risks as depicted on Maps 8 and 9 and the resulting reduction of risk based on specific mitigation measures recommended in this report and implemented in the development plan. DOWL is working closely with the design team to ensure that mitigation measures are incorporated into the plan. For example, areas of high risk along Remine Creek and the San Miguel River due to steep slopes, flooding and shallow groundwater were designated as Open Space and, therefore, avoided for future commercial development. Also, lot lines were drawn with steep slopes in mind. Mitigation measures are offered following Table 2 for each of the specific hazards identified. Please note that alternative risk measures may be developed as part of site-specific evaluations are conducted for each site. Map 10 includes the current risks and Map 11 shows the resulting risks with mitigation measures applied by the PUD developer.

Society Turn Parcel Geologic Hazard Assessment

Planning Area (PA) or Feature	Flooding**		Wetlands		Potentially Unstable Slopes (PUS) and slopes >30%		Comments
	Current Hazard Risk	Hazard Risk After Mitigation	Current Hazard Risk	Hazard Risk After Mitigation	Current Hazard Risk	Hazard Risk After Mitigation	
PA1	L*	L	L	L	H	L	The irrigation ditch through PA1 will be redirected offsite at the end of all phases of site development to eliminate irrigation and drainage from Remine Creek. Retaining wall to be constructed along south property line to mitigate slope hazards.
PA2	L	L	L	L	H***	L	Steep slope downhill of PA2 requires slope stability analysis to determine adeqate shoring and/or setbacks to maintain stable slopes. Retaining walls to be constructed along south property line to mitigate slope hazards.
PA3	L	L	L	L	L	L	No mitigation of these hazards is warranted unless determined by site-specific geotechnical study.
PA4	L	L	L	L	M***	L	Steep slope uphill of PA4 requires slope stability analysis to determine adeqate shoring, slope layback, and/or setbacks to maintain stable slopes. The glacial moraine will be removed during site development.
PA5	L	L	L	L	M***	L	Steep slope downhill of PA5 requires slope stability analysis to determine adeqate shoring and/or setbacks to maintain stable slopes.
Open Space West	L-H	L-H	L-H	L-H	L-H	L-H	Hazards on open space will generally not be mitigated except for recreational improvements such as trails and bridges which would require site-specific analysis of hazards.
Open Space East	L-H	L-H	L-M	L-M	L-M	L-M	Hazards on open space will generally not be mitigated except for recreational improvements such as trails and bridges which would require site-specific analysis of hazards.
WWTP Expansion	L	L	L	L	H	L	Mitigation to be performed by others. This lot is not part of the development plan, as it will be conveyed to the Town of Telluride. A slope stability analysis will be needed to determine adequate shoring and/or setbacks to maintain stable slopes. Standard methods of slope retention and drainage are anticipated to reduce all hazards to low level.
Road A	L	L	L	L	L	L	No mitigation of these hazards warranted unless determined by site-specific geotechnical study.
Road B	L	L	L	L	M	L	Engineered fill on east end of Road B will mitigate the PUS slope area.
Augmenta-tion Pond	L	L	L	L	L-H	L-H	A site-specific geotechnical evaluation and slope stability analysis are required for determining mitigation at this site once the size and location of the pond are known. Slope retention and pond lining may be necessary.
Surface Detention Basins	L	L	L	L	L-M	L-M	Surface detention basins on PA5 will require slope stability analyses to determine cut and fill requirements to maintain stable slopes.
Under-ground Drainage Structures	L	L	L	L	L-H	L	Underground drainage structures on PA1 and Road C/D will require slope stability analyses to determine cut and fill requirements to maintain stable slopes. Other geotechnical considerations may be needed as determined by a site-specific geotechnical evaluation of each site.
Trails	L	L	L	L	L-H	L-M	The location and width of the trail (and Remine Cr bridge) will determine needed mitigation. Where slope modification will be needed (cuts, fills, retaining walls), site specific geotechnical analysis and slope stability assessments will be needed.

*L = Low Risk, M = Moderate Risk, H = High Risk **Clearwater flooding (Remine Creek, San Miguel River) ***adjacent to PUS or slopes >30%

Table 2. Summary of Current Hazard Risks vs. Risk After Mitigation

9.1 Slope Instability

- Site-specific geotechnical investigations should be performed at each building site within or adjacent to PUS zones. This includes all buildings and parking structures, bridges, trails, water tank, detention basins, augmentation pond, and underground drainage structures. The soil strength parameters and groundwater conditions identified by the investigations together with the proposed geometry and loading should then be used to develop a slope stability analysis. This analysis must show that the proposed foundation system, stabilization measures, and site grading design for all improvements provide a suitable factor of safety (typically 1.5) against potential slope failure. The effects of soil creep and soil erosion must be included in the slope stability analysis.

- A similar slope stability analysis should be performed to assess impacts of deep construction excavations such as basements, underground parking structures, and underground drainage structures. Temporary retaining structures and/or special precautions may be necessary to preserve slope stability and comply with OSHA standards. Safety factors of at least 1.3 should be used for temporary support systems, pending concurrence and approval of the project design engineer.
- We recommend following the setbacks shown in Chapter 18 of the 2018 International building code unless slope stability analysis show that the slope can be stable with another setback distance.
- Permanent cut and fill slopes should be limited to no steeper than 2:1 (horizontal to vertical) unless site specific testing and analysis show that a steeper slope is stable. All 2H:1V cut slopes greater than 4 feet in height will be restrained by a retaining wall system designed by a Professional Engineer using the lateral earth pressures and soil strength parameters determined through site-specific soil testing.
- It is our understanding that landscaping will be limited to the use of native vegetation, especially trees and shrubs that have deep root systems to assist in knitting together the soil. Landscape irrigation should be eliminated or severely restricted within and adjacent to PUS zones.
- Avoiding construction on and providing protection at the base of PUS slopes will reduce the risk of runaway rocks that can roll downslope when dislodged and potentially impact downslope properties. Rocks within moraines and alluvial deposits are rounded to subrounded in shape, which have the tendency to roll downslope if dislodged by construction, vibrations, wildlife, and hikers.

9.2 Flooding/Sheetflow Flooding

- No development should be located the channels and/or floodplains of the San Miguel River or Remine Creek. These areas have been appropriately designated for Open Space use in the PUD plan, which should mitigate the risk of flooding from the river on developed portions of the Society Turn Parcel.
- An assessment should be conducted of the natural "detention basin" of Remine Creek to verify that flood flows will be appropriately channeled on the north side of the highway to be properly directed under the highway. DOWL has completed a drainage study of Remine Creek and calculated there is sufficient capacity of the basin and culvert to detain and convey the 100-year event provided the culvert is maintained. DOWL has communicated with CDOT staff to ensure compliance with existing roadway design and maintenance.
- It is important that the Remine Creek channel and drainage ditch on the north side of Highway 145, from Remine Creek to the Society Turn roundabout, is regularly maintained so that it is free of debris and overgrown vegetation to limit potential hazards from flooding. These areas should be inspected annually at a minimum and cleared of debris and vegetation. The preliminary site grading and drainage plan, prepared by DOWL, includes excavation and grading details to ensure that the drainage ditch on the north side of Highway 145 is deep enough and properly graded to carry water to the east and west, as intended to capture and drain runoff.
- A separate overall site drainage plan, in tandem with the landscape and grading plans, has been prepared by DOWL to ensure that the proposed construction does not impede natural drainage patterns. Surface water is intended to be removed and not allowed to accumulate or stand anywhere near building foundations either

during or after completion of construction. This includes water from landscaped areas, driveways, flatwork, and roofs. This runoff will be dispersed (not concentrated) in a manner consistent with the natural, pre-construction drainage pattern. A preliminary Society Turn Parcel-wide grading and drainage plan has been prepared by DOWL to accomplish this stated goal/objective for all roads, infrastructure and other PUD improvements. Site-specific grading and drainage plans will be finalized for each Planning Area during its development approval process when final building siting, parking and similar site improvements are finalized.
- No water should be allowed to accumulate or stand behind retaining walls or adjacent to foundation walls. Final design of retaining walls and building foundations will include drainage systems to prevent water accumulation to mitigate this hazard.

9.3 Wetlands/Shallow Groundwater

- Site-specific geotechnical investigations should be conducted on each lot prior to the final design of buildings to be constructed to determine possible groundwater conditions. The results of such investigations will provide design parameters and guidelines for appropriate hazard mitigation.

9.4 Compressible Soil and Rock

- Site-specific geotechnical investigations should be conducted on each lot prior to the final design of buildings to be constructed to determine soil composition and properties. The results of such investigations will provide design parameters and guidelines for appropriate foundation design and soil preparation.
- If thick lenses or layers of clay or silt are encountered during excavation, they should be removed to firm native sands and gravels to provide a uniformly dense bearing surface.
- Foundations and floors must be designed to reduce the potentially damaging effects of compressible soil.
- Although groundwater is not anticipated, if it is found during site-specific geotechnical investigations, basements should not be used where there are shallow groundwater conditions unless they are completely waterproofed and designed to resist buoyancy forces.

9.5 Seismic Effects

- Site-specific seismic design criteria should be determined in accordance with the most current building code adhered to by the San Miguel County building department.
- These criteria should be applied in the design of structures built within the Society Turn Parcel to appropriately mitigate seismic risk.
- The appropriate Site Class (soil type) would need to be determined during a geotechnical evaluation of each building site.

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11.0 CLOSING CONSIDERATIONS

The Society Turn Parcel exhibits geologic conditions typical of the Telluride region. Due to its mountain setting, the Society Turn Parcel comes with some risk due to the geologically young landforms, steep terrain, high snowfall, and physical properties of the slope materials. This report identifies the hazards, qualitatively rates the levels of risk, and offers suggestions for mitigation. In summary, the geologic hazards present on the Society Turn Parcel are less hazardous than is typical in the region due to the position of the site in the valley floor and gentle slopes for the majority of the property. Provided the recommendations discussed in this report are incorporated into design and construction of the proposed phases of site development, it is our opinion that all hazards are or can be avoided or reduced to low hazard risk where development would occur, thus not limiting the proposed development of the Society Turn Parcel.

DOWL is a full-service engineering firm providing geotechnical engineering, geohazard mitigation design, foundation, on-site wastewater system, site drainage, structural, road and retaining structure design services, as well as watershed and floodplain studies, surveying, construction materials testing, and inspections. For a full description of our services, please visit our website: ***www.DOWL.com.*** Thank you for the opportunity to perform this geologic hazard analysis for you. If you require any of these services or have any questions regarding this report, please contact us.

Respectfully Submitted,
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6-4-20
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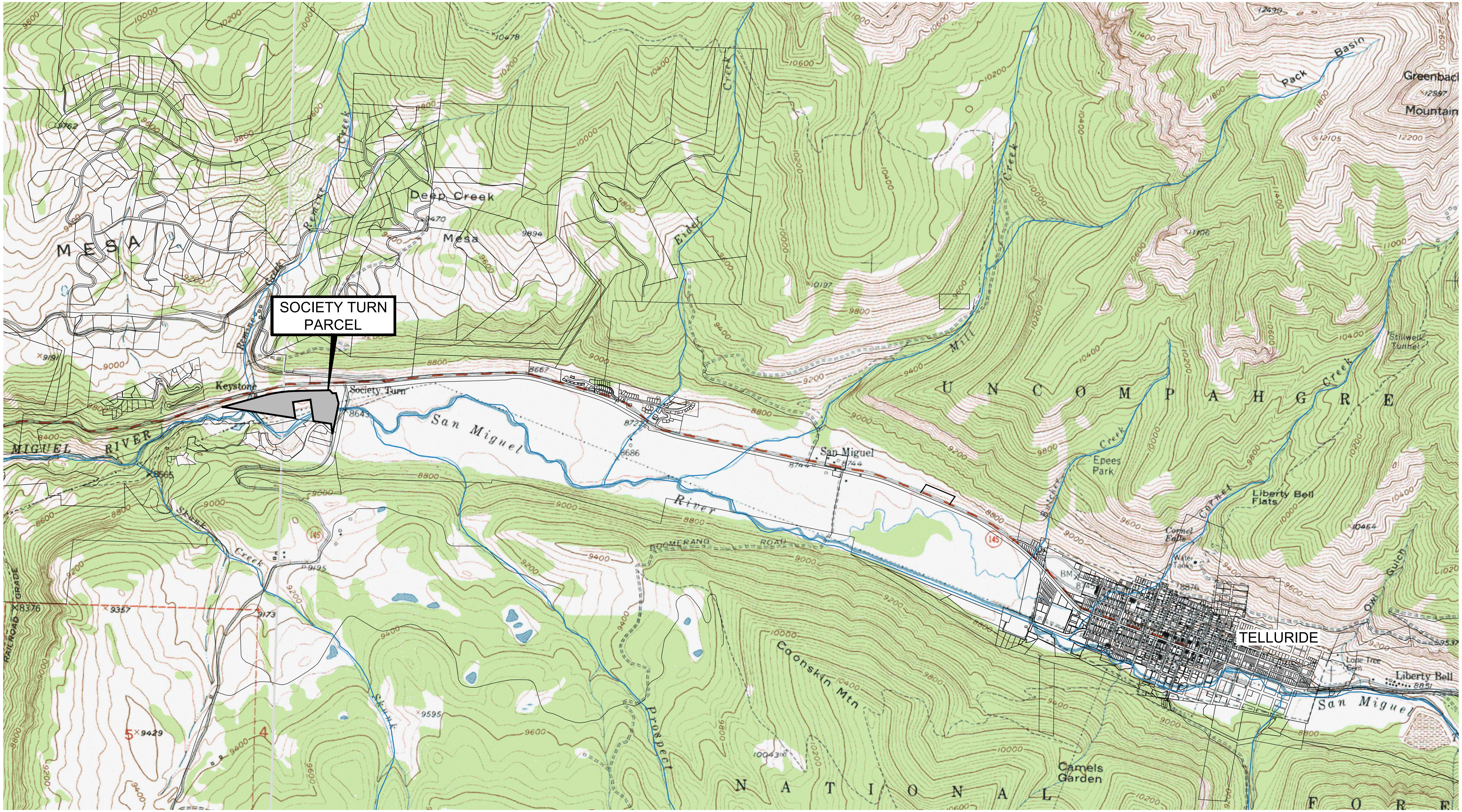
Senior Geotechnical Engineer



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SCALE IN FEET

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Source: Gray Head Topographic Quadrangle (USGS: 1953) and Telluride Topographic Quadrangle (USGS: 1955) https://ngmdb.usgs.gov/topoview/viewer/#14/37.9438/-107.8579

O:\22\74614-01\45Geohazard Evaluation\Geo CAD\Society Turn GEO-Vicinity_Map1.dwg PLOT DATE 2020-6-24 11:49 SAVED DATE 2020-02-03 15:25 USER: dcastillo

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SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
VICINITY MAP

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 1

REMINE CREEK
NEW HIKING TRAIL
NEW PEDESTRIAN PATH
COLORADO STATE HIGHWAY 145
PROPOSED TRAIL BRIDGE
NIMBUS DR.
PROPOSED AUGMENTATION POND
AUG. POND
Open Space 2.1 acres
PROPOSED UNDERGROUND IRRIGATION SYSTEM TANK
Planning Area 3 3.2 acres
ROAD A
ROAD B
Utility Easement / R.O.W. 1.66 acres
DETENTION BASIN 1
Planning Area 4 2.7 acres
Planning Area 5 0.5 acre
EXIST. PEDESTRIAN PATH
Road C & D Parcel 0.7 ac.
Planning Area 1 2.6 acres
Planning Area 2 1.2 acres
Existing Wastewater Treatment Plant
UNDERGROUND DRAINAGE STRUCTURE 3
Open Space 3.8 acres
UNDERGROUND DRAINAGE STRUCTURE 4
Proposed WWTP 1.5 acres
EXIST. BRIDGE
UNDERGROUND DRAINAGE STRUCTURES 1 & 2
SAN MIGUEL RIVER
San Miguel Power Association
EXIST. BRIDGE
EXIST. PEDESTRIAN PATH
SAN MIGUEL RIVER
SOCIETY DRIVE
COLORADO STATE HIGHWAY 145

LEGEND

- NEW PEDESTRIAN BRIDGE
- NEW PEDESTRIAN PATH
- NEW HIKING TRAIL
- EXISTING PEDESTRIAN PATH
- 8640 MAJOR CONTOUR
- MINOR CONTOUR
- PROPERTY LINE AND PLANNING AREA LINES
- CREEK CHANNEL
- EXISTING CULVERTS
- ARMY CORP OF ENGINEERS AND SAN MIGUEL COUNTY WETLANDS, BY SGM
- SAN MIGUEL COUNTY POTENTIAL WETLANDS, BY SGM

Property lines shown hereon, produced by Foley Associates Inc. in conjunction with Olympus Aerial Surveys, June & July 2008

N

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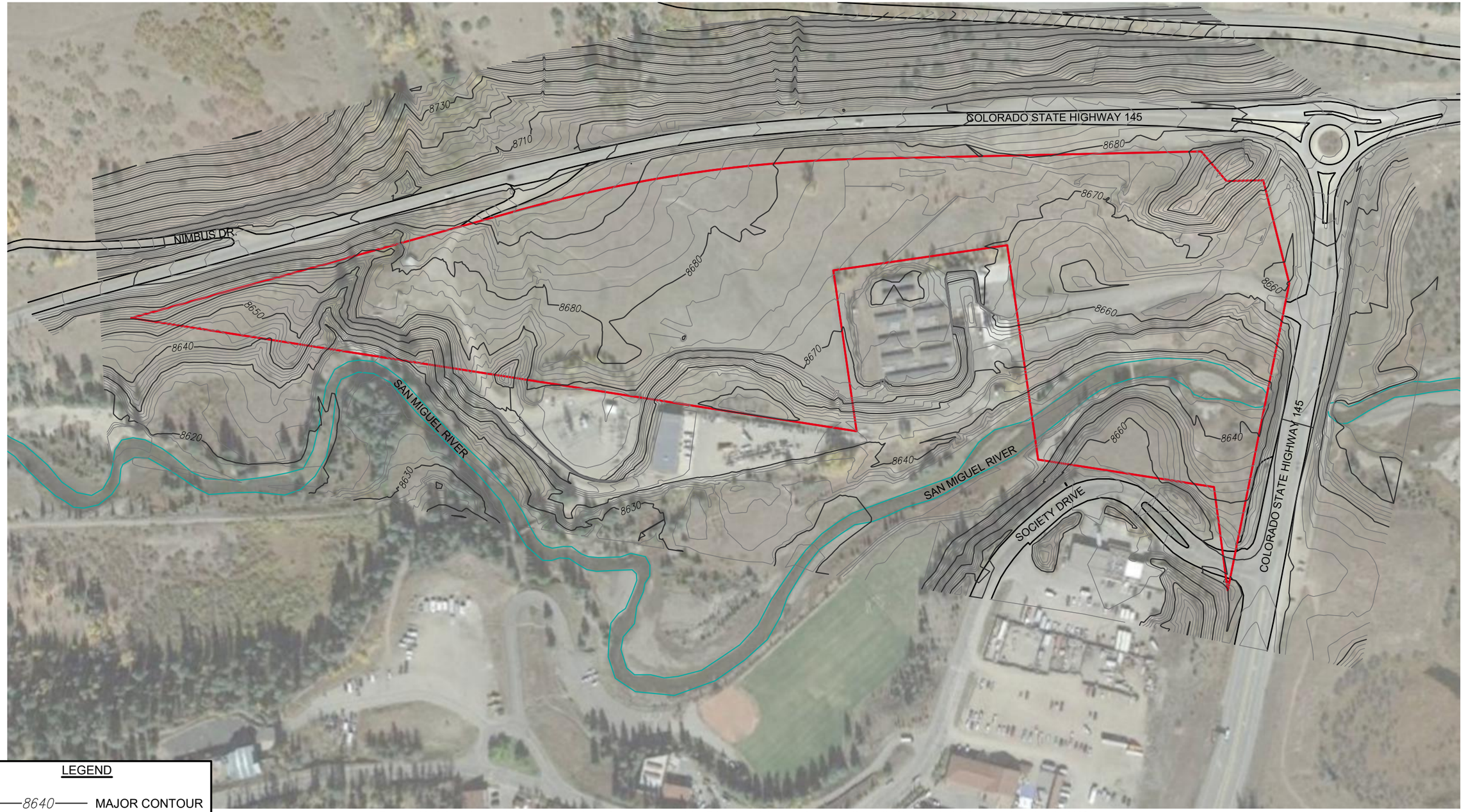
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
CONCEPTUAL DEVELOPMENT PLAN

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 2



LEGEND

8640 MAJOR CONTOUR

MINOR CONTOUR

PROPERTY LINE

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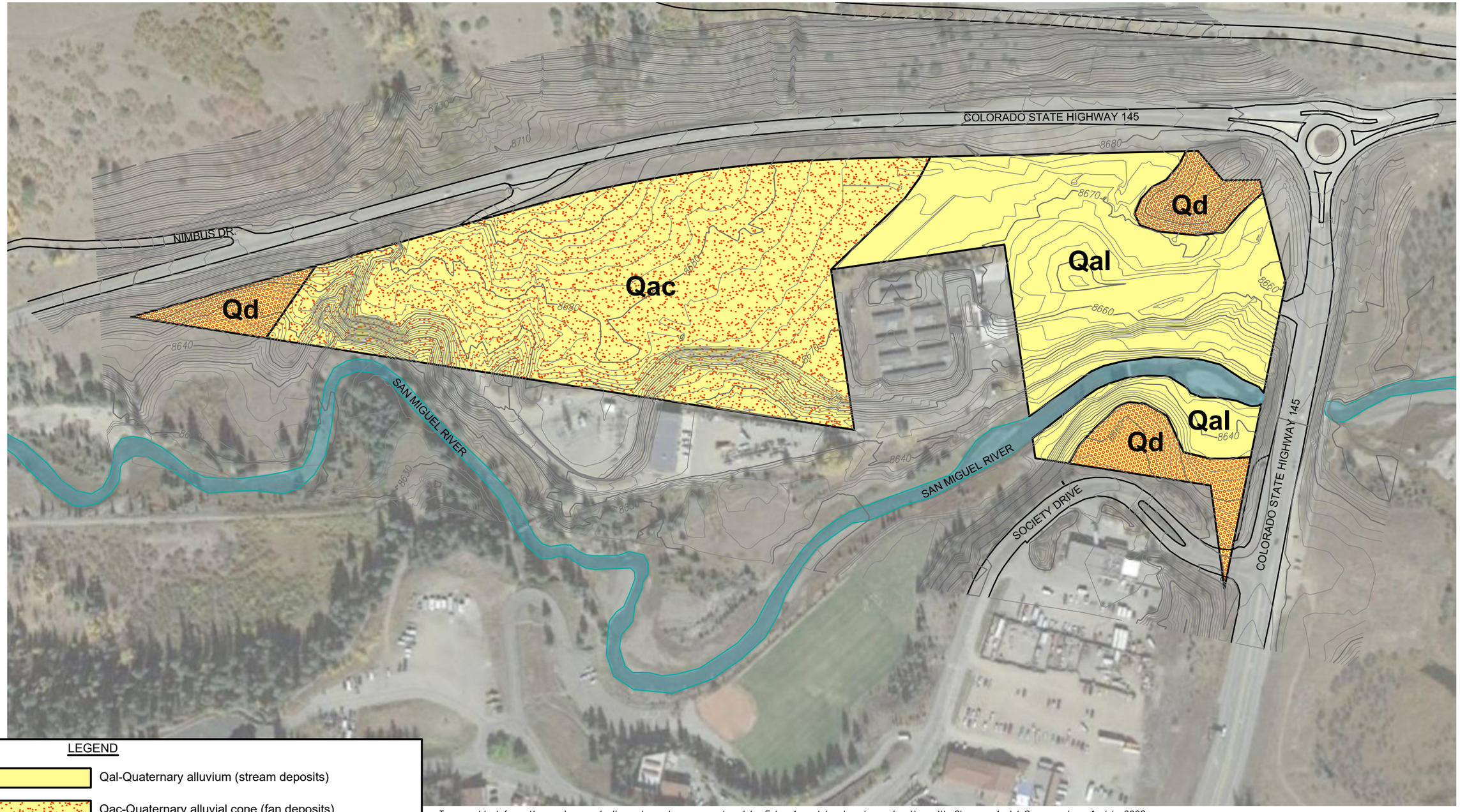
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
TOPOGRAPHY

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 3



LEGEND

- Qal-Quaternary alluvium (stream deposits)
- Qac-Quaternary alluvial cone (fan deposits)
- Qd-Quaternary young glacial drift (moraine deposits)

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SCALE IN FEET

Source: Geologic Map of the Telluride Quad, USGS Map GQ-504 by Burbank & Luedke 1966 and Preliminary Geologic Map of Gray Head Quad, USGS Map MF-176 by Bush et al: 1961

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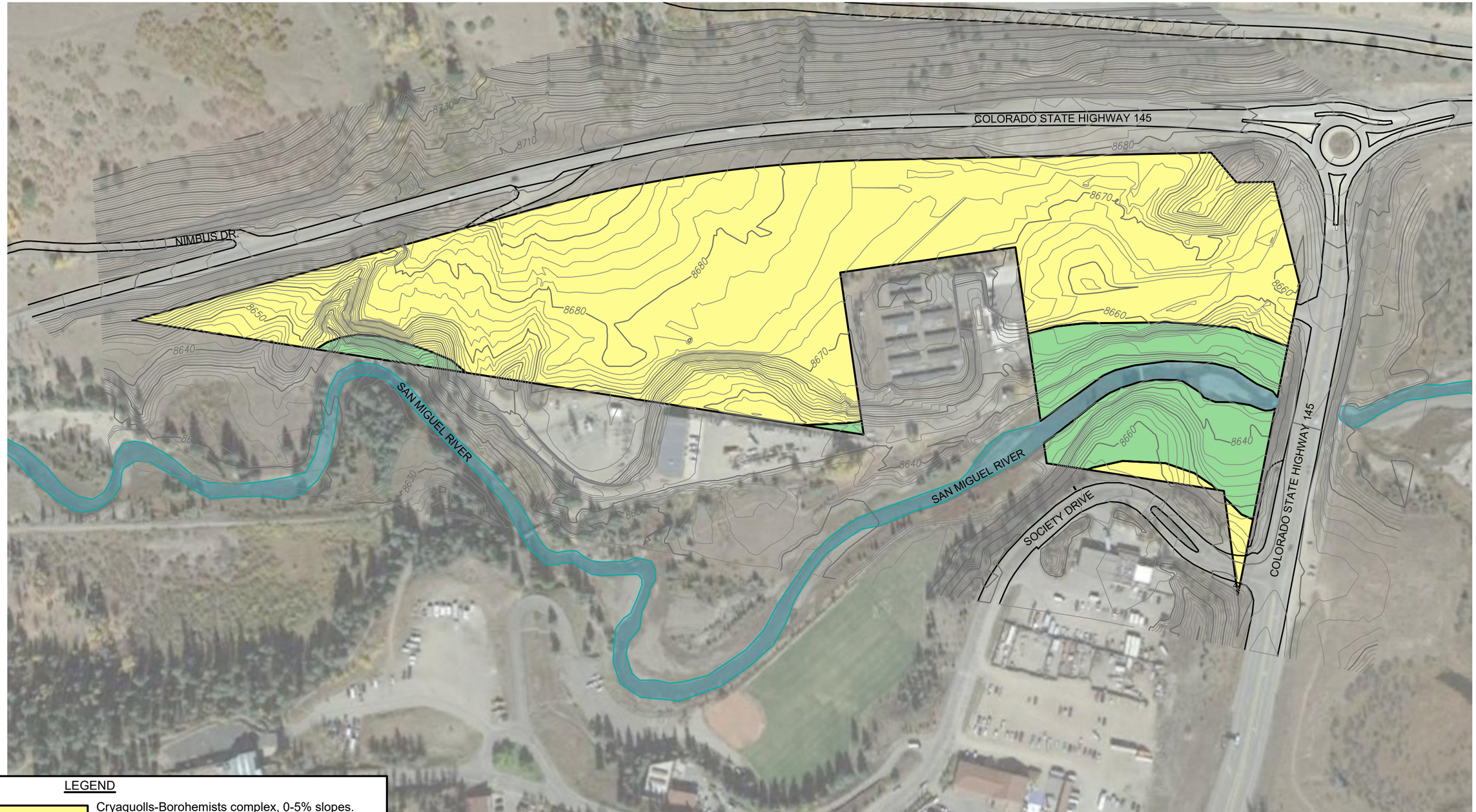
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
GEOLOGY

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 4



LEGEND

- Cryaquolls-Borohemists complex, 0-5% slopes. Not Highly Erodible Land
- Cryoborolls-Cryaquolls association, 0-15% slopes. Not Highly Erodible Land

Source: San Miguel County GIS (from Natural Resources Conservation Service database)

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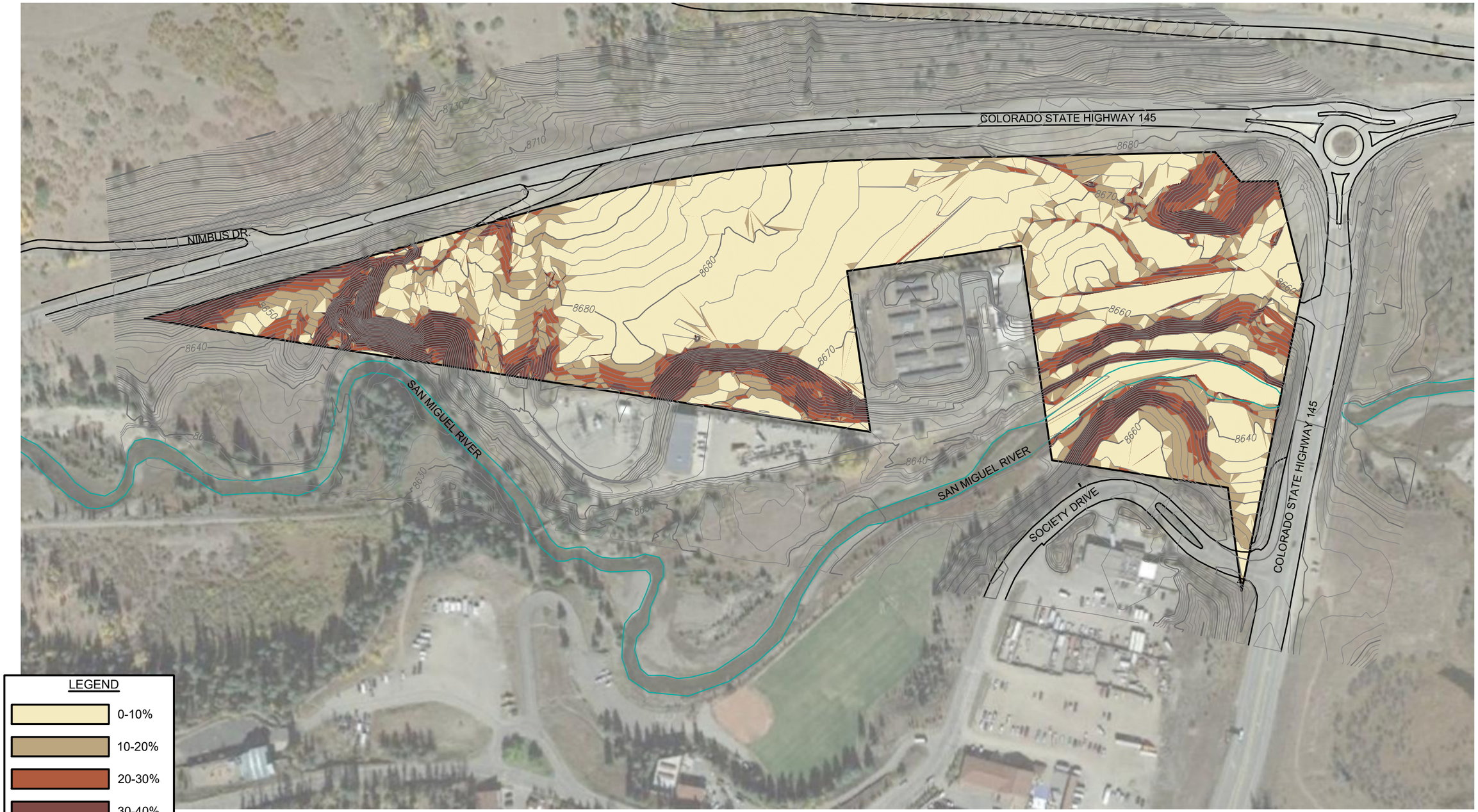
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
SOIL TYPES

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 5



Source: Civil 3D Computer Terrain Mapping

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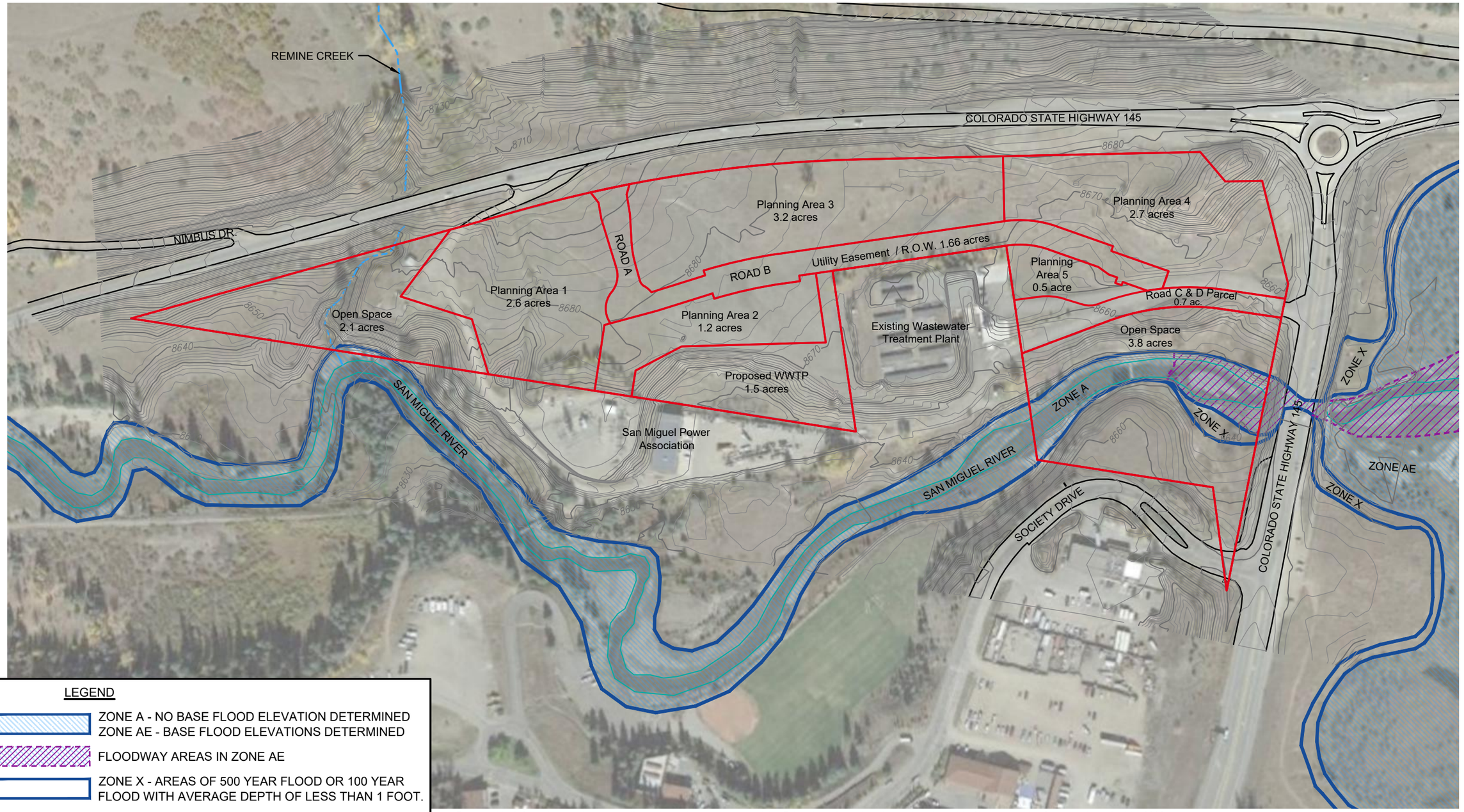
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
SLOPE CLASSES

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 6



LEGEND

- ZONE A - NO BASE FLOOD ELEVATION DETERMINED
  ZONE AE - BASE FLOOD ELEVATIONS DETERMINED
- FLOODWAY AREAS IN ZONE AE
- ZONE X - AREAS OF 500 YEAR FLOOD OR 100 YEAR FLOOD WITH AVERAGE DEPTH OF LESS THAN 1 FOOT.
- STREAM
- PROPERTY LINE AND PLANNING AREA LINES

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SCALE IN FEET

Source: FEMA, FIRM map number 08113c0286 C

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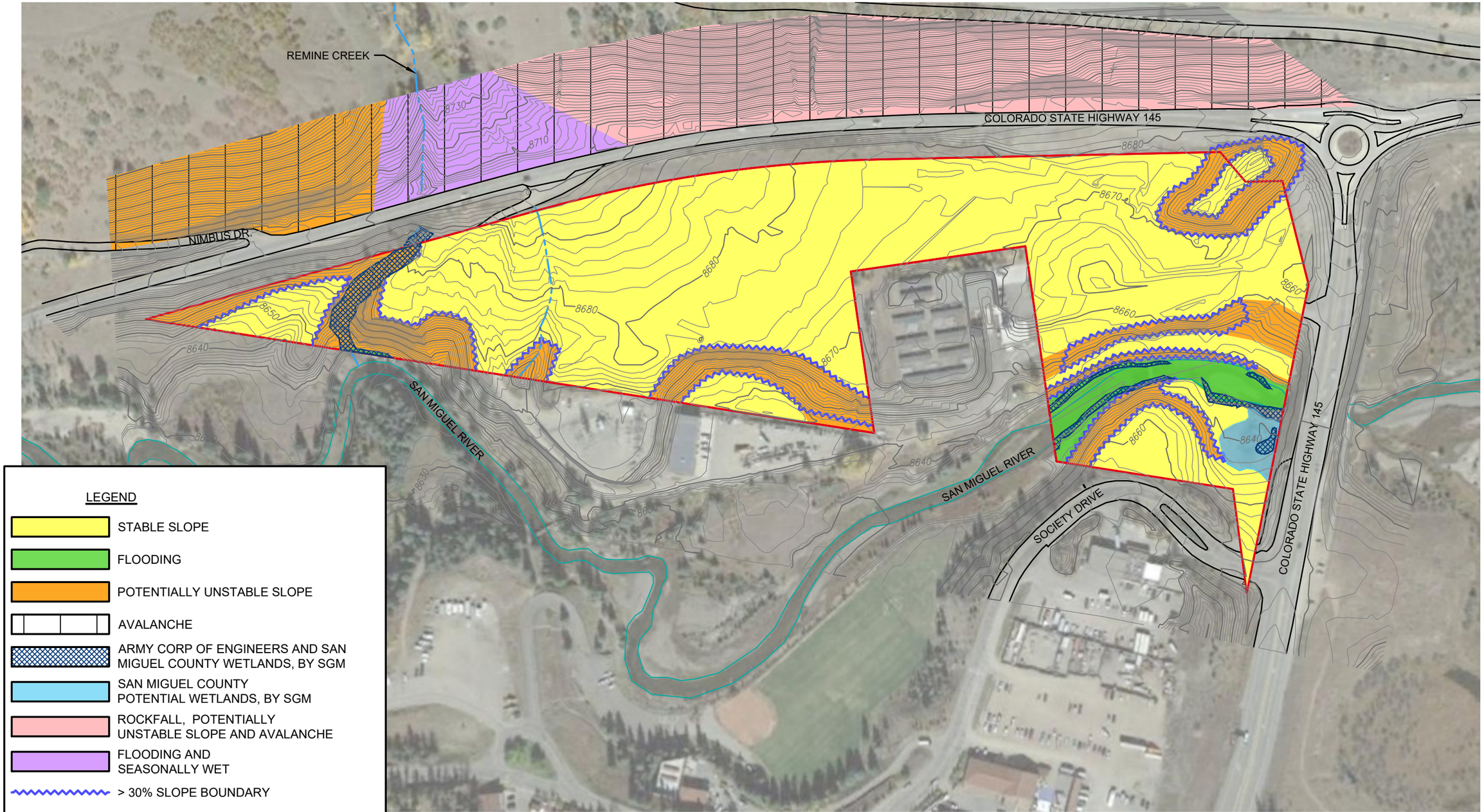
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
FLOOD ZONES

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 7



LEGEND

- STABLE SLOPE
- FLOODING
- POTENTIALLY UNSTABLE SLOPE
- AVALANCHE
- ARMY CORP OF ENGINEERS AND SAN MIGUEL COUNTY WETLANDS, BY SGM
- SAN MIGUEL COUNTY POTENTIAL WETLANDS, BY SGM
- ROCKFALL, POTENTIALLY UNSTABLE SLOPE AND AVALANCHE
- FLOODING AND SEASONALLY WET
- > 30% SLOPE BOUNDARY
- STREAM
- PROPERTY LINE

Sources: Geologic hazard analysis performed by DOWL. Wetland delineation by SGM.

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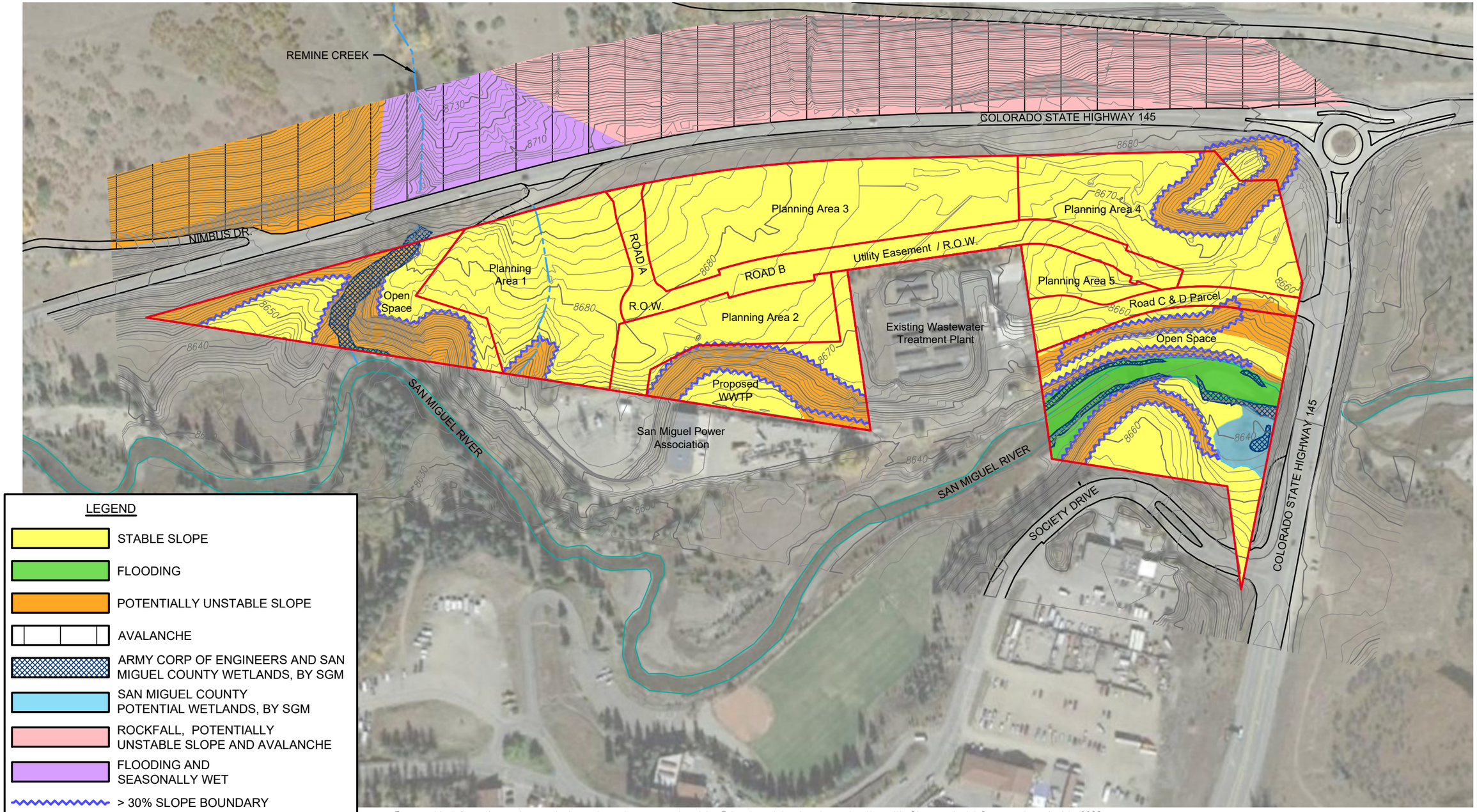
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
GEOLOGIC HAZARDS

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 8



LEGEND

- STABLE SLOPE
- FLOODING
- POTENTIALLY UNSTABLE SLOPE
- AVALANCHE
- ARMY CORP OF ENGINEERS AND SAN MIGUEL COUNTY WETLANDS, BY SGM
- SAN MIGUEL COUNTY POTENTIAL WETLANDS, BY SGM
- ROCKFALL, POTENTIALLY UNSTABLE SLOPE AND AVALANCHE
- FLOODING AND SEASONALLY WET
- > 30% SLOPE BOUNDARY
- STREAM
- PROPERTY LINE

Sources: Geologic hazard analysis performed by DOWL. Wetlands by SGM.

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SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
GEOLOGIC HAZARDS WITH PLANNING AREAS

PROJECT	7122.74614.01
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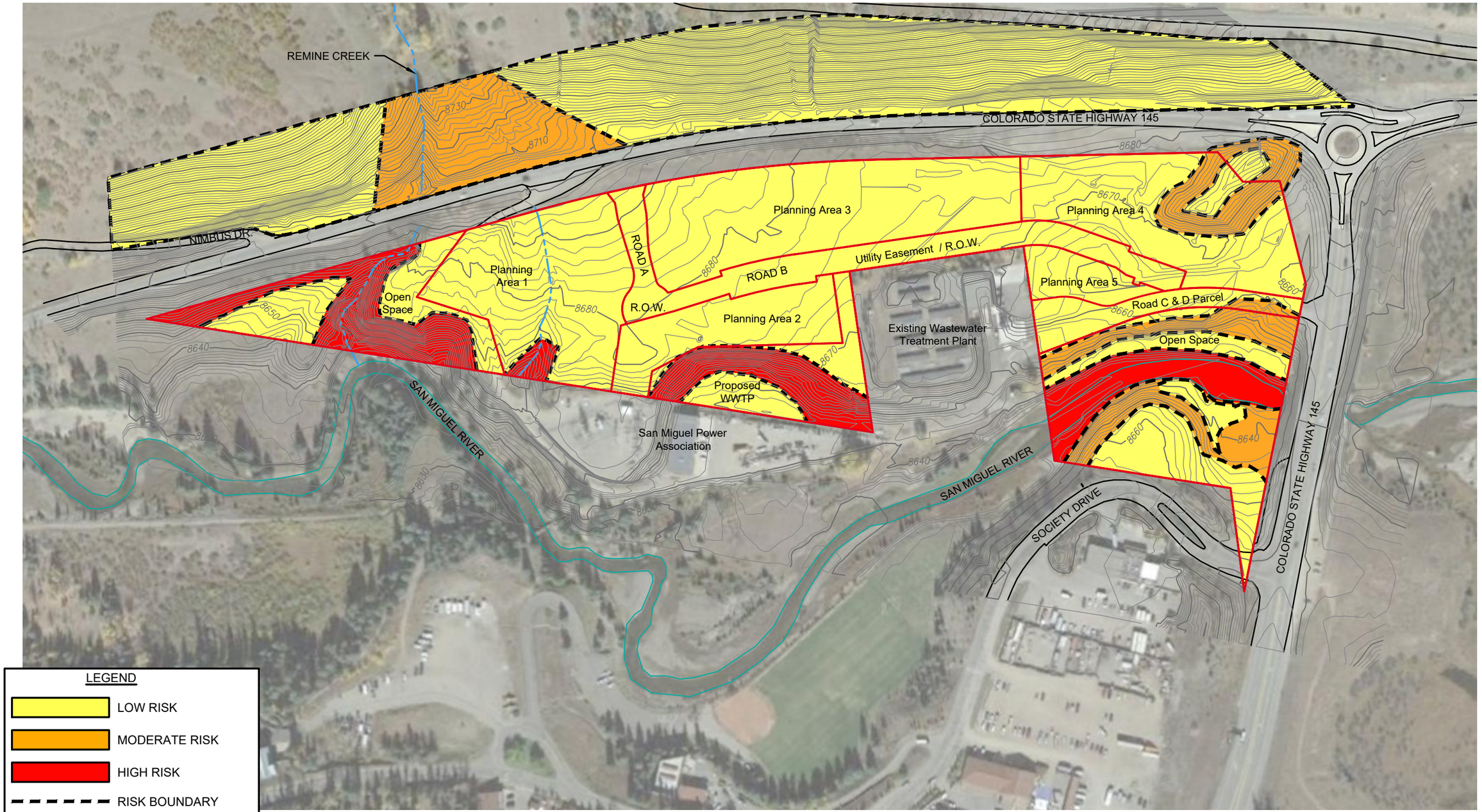
MAP 9



LEGEND

- LOW RISK
- MODERATE RISK
- HIGH RISK
- RISK BOUNDARY
- STREAM
- PROPERTY LINE AND PLANNING AREA LINES

Source: Geologic hazard analysis performed by DOWL.

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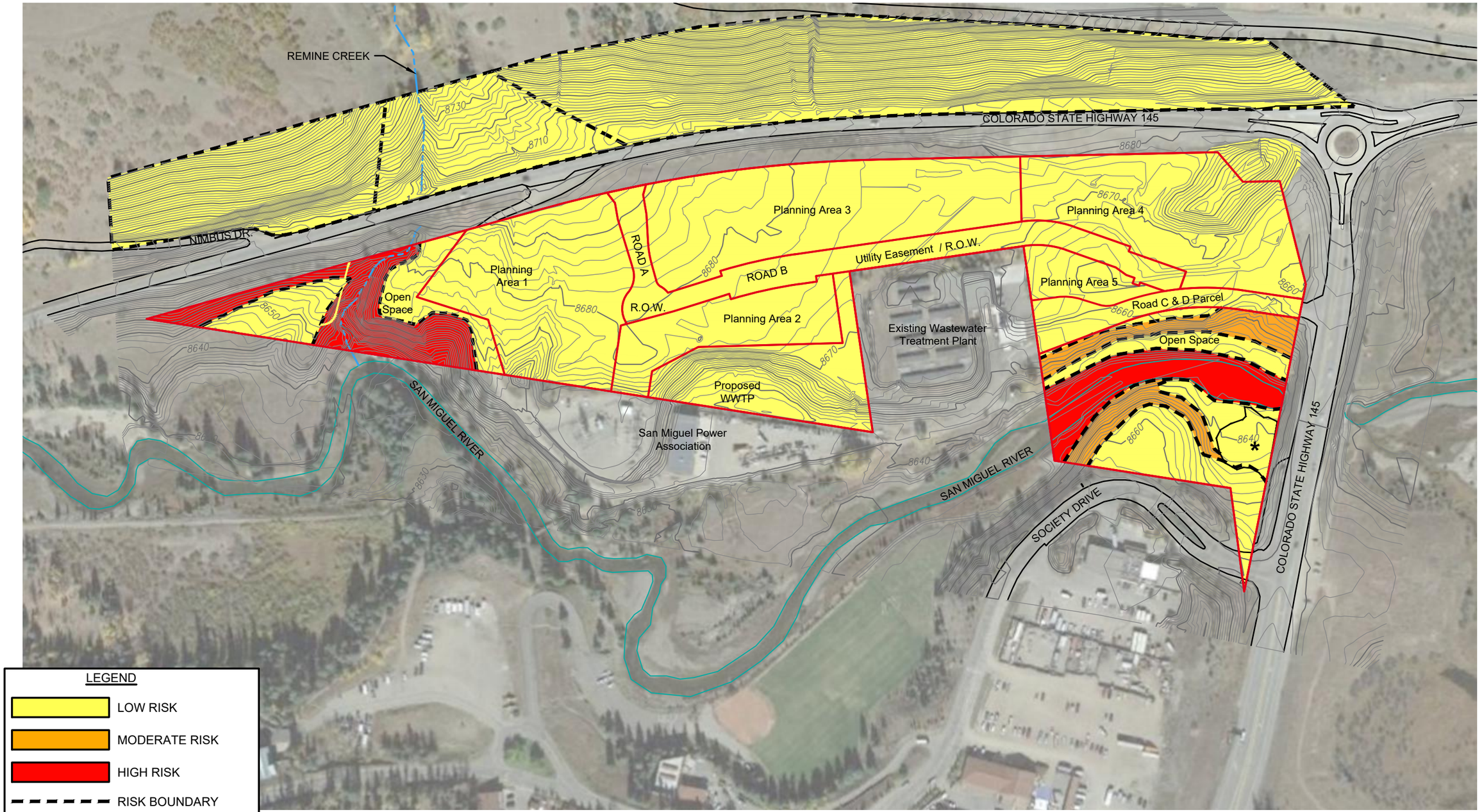
SOCIETY TURN PARCEL
SAN MIGUEL COUNTY, COLORADO
GEOLOGIC HAZARD RISK (NO MITIGATION)

PROJECT	7122.74614.01
DATE	06/24/2020

MAP 10



LEGEND

- LOW RISK
- MODERATE RISK
- HIGH RISK
- RISK BOUNDARY
- STREAM
- PROPERTY LINE AND PLANNING AREA LINES

Source: Geologic hazard analysis performed by DOWL.

Topographic information and property lines shown hereon, produced by Foley Associates Inc. in conjunction with Olympus Aerial Surveys, June & July 2008

* Further study of the surface and subsurface hydraulics of this area would be necessary to determine drainage options which could reduce groundwater hazard in this area to low risk.

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SOCIETY TURN PARCEL
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GEOLOGIC HAZARDS RISK (AFTER MITIGATION)

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MAP 11