Section 4 Geology, Landform and Soils

4.1 Regional Conditions

4.1.1 Geology

Regional geology

The Maud Creek Gold Project Area is situated on the extreme southern end of the Pine Creek Geosyncline, which is an early Proterozoic intracratonic sedimentary basin forming part of the North Australian Orogenic Province (Ahmad et al. 1993). The Maud Creek Gold Project Area is within the Katherine-El Sherana sequence located on the south eastern zone of the Pine Creek Geosyncline. The Pine Creek Geosyncline covers around 66,000 km^2 south and east of Darwin.

The geosyncline is overlain by Middle Proterozoic sediments in the east, Palaeozoic sediments in the south and Mesozoic sediments in the north. The Katherine-El Sherana area contains rocks comprising two main groups. The lower group is Early Proterozoic metasediments and volcanics known as the El Sherana Group. The upper group are Early to Middle Proterozoic metasediments and volcanics of the Edith River Group.

The Katherine River group overlies the Edith River Group and is represented in the El Sherana area by the Kombolgie Formation and the Antrim Plateau Volcanics. This formation is composed of medium to coarse grained sandstone that is intruded by dolerite dykes. The overlying Antrim Plateau Volcanics were deposited during the Cambrian and are composed of amygdaloidal basalts, sandstones and basic volcanics.

Local geology

The major rock units represented near the mine site are the Tollis Formation, Maud Dolerite, Antrim Plateau Volcanics and Kombolgie Formation. The Tollis Formation consists of interbedded greywacke, siltstone, phyllite and tuff and is the uppermost unit of the El Sherana Group. The Maud Dolerite intrudes the Tollis Formation and outcrops as irregular bodies.

The Kombolgie Formation is composed of arenite and conglomerate and overlies the Tollis Formation and the Maud Dolerite. Antrim Plateau Volcanics, consisting of amygdaloidal basalt and basic volcanics, overlie all other geological units.

The orebody is associated with sulphide mineralisation although carbonates (principally calcite) provide buffering capacity in the waste rock (Appendix L).

4.1.2 Landforms

The Maud Creek Gold Project Area is approximately 20 km east north east of Katherine. The terrain in the surrounding area ranges from undulating rises to rugged hills. The southern and south western parts of Maud Creek Station are undulating mildly dissected lands with rounded crests. Slopes are generally within a range of 1 to 3%. In the project area the landscape is gently sloping to flat (approximately 1% slope).

To the north and east of the Maud Creek station, the landscape changes to low rounded hills with slopes from 5% to 15%. Some hills are significantly steeper with slopes up to 40% or more. Beyond Maud Creek Station to the north east, the landscape becomes steep and rugged with high hills and scarps of the Kombolgie Formation sandstones (Arnhem Plateau).

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The local geomorphology is described by a series of land units which were initially mapped by Speck et al. (1961) and later incorporated into a report on the Lands of the Katherine-Douglas Area NT (Aldrick and Robinson, 1972). Each land unit represents a unique combination of parent material (bedrock or sediments), landform, surface drainage, vegetation and soil type. The land units were mapped at a scale of 1:100,000 and are listed in Table 4-1.

Table 4-1. Land units of the mine area (Aldrick and Robinson, 1972)

Land unit	Description
2B	Rugged terrain with slopes 15-40% with shallow or skeletal soils
2C	Hilly terrain with slopes 5-15%, rocky and boulder strewn with shallow or skeletal soils
2E	Gently undulating crests and upper slopes to 5% with shallow rocky soils
6A	Undulating terrain with slopes 5-10% with grey and brown clays
7E	Major creeks and severely gullied tributaries

The properties associated with soil units in the project area are identified in Table 4-2. The soils are varied and range in depth from shallow and rocky in sloping terrain to deep in level to gently sloping terrain over rock. Soil types vary with parent material. The metamorphic and sedimentary geologies produce loams and sands, sometimes sodic at depth (Kandosols, Sodosols). Carbonate parent materials produce calcareous soils (Calcarosols). The volcanic geology produces cracking clays (Vertosols).

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Table 4-2 Description and coverage of geology, geomorphology, and soils.

Soil Unit	Area	Geology	Geomorphology	Soils	Australian Soil Classification
1	16%	Tollis Formation in the north and Edith River volcanics in the east	Proterozoic Tollis Formation in the northern sector of the site. This soil also occurs on sedimentary sequences on Edith River Volcanics.	Gravelly soils. Sandy, loamy or clayey gravels. Skeletal soils	Rudosols (Skeletal soils)
2	1%	Antrim Plateau Volcanics west		Sands, earthy sands – siliceous sands	Dermosol (Earthy sands)
3	3%	Maud Dolerite in the east	Shallow to medium deep uniform gravelly red loams-lithosols develop on the Maud Dolerite formation in the central east of the site. Landscape consists of low hills.	Loams, gravely loams, uniform or gradational profiles	Rudosols (Shallow gravely red loams)
4	19%	Antrim Plateau Volcanics in the north, Edith River Volcanics in the north and east, Antrim Plateau Volcanics in the south		Red clay soils with a uniform or gradational profile	Kandosols (Red earths)
5	10%	Antrim Plateau Volcanics in the south and west.		Red clay soils with a uniform profile	Kandosols (Red earths)
6	15%	Cainozoic Residual soil/slope wash in the north and the east		Medium deep uniform or thin loamy surface duplex soils with dark brown or yellow brown clay subsoils underlain by calcrete or calcareous clays	Calcarosols
7	6%	Quaternary Alluvium in the north and east		Deep loamy surface duplex soils with alkaline mottled clay subsoils	Sodosols
8	25%	Antrim Plateau Volcanics in the southwest		Shallow to medium deep grey, brown or dark coloured cracking clay soils over basalt	Vertosols
9	5%	Quaternary Alluvium in the north and south		Deep dark coloured grey or brown cracking clay soils. Alluvial soils	Vertosols

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4.2 Issues and Impacts

The potential issues and impacts relating to the re-commencement and expansion of mining processes on Maud Creek Station include sediment and erosion control, weed control, feral animal control, and impacts from mine dewatering on groundwater dependent ecosystems in the immediate area.

Cattle, buffaloes, horses, donkeys, pigs, weeds and inadequately managed fire significantly impact on current land and watercourse conditions on Maud Creek Station, a pastoral property. Riparian areas are degraded by trampling and compaction from livestock that use Gold Creek and Maud Creek for watering and wallowing. Mine management would aim to remove or significantly reduce these existing environmental impacts within the mining area.

Soil types classified as Sodosols occurring in the mine area are not water stable and tend to erode readily when disturbed and subjected to concentrated overland flow. The erosion and sedimentation risk may be ameliorated by applying gypsum in the rehabilitated areas of these soils.

4.3 Mitigation of Impacts

The core strategy for minimising impacts from the mine development on the local environment involves minimising the disturbed area. Guidelines for sediments and erosion control on construction sites will be followed (Witheridge and walker 1996).

At the completion of mining, the landscape will be rehabilitated to a condition consistent with the land use at the site prior to the commencement of mining, namely pastoral land. The pre-existing waste rock stockpile will remain. Any additional waste rock produced form the underground will be placed in the existing pit.

4.4 Commitments

- *Terra Gold commits to undertake effective sediment and erosion control.*