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+ Airstrip O City Unpave road Hydrography

CARTOGRAPHIC — — — International boundary

Indigenous Prot

Ecological Area

National Park

0 12,5 25



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- Mineral Resources (Evidence) Gemstone (Diamond)
 - - Dyke interpreted

CONVENTIONS

- Ferrous metals (Fe) Non-ferrous and semi-metallic metals (Sn)
- Source: DDMC Geological Survey of Suriname
- Different geologic structure (fault/indiscriminated fracture, fault/shear zone, milonitic zone)

Geologic

100

- GEODIVERSITY MAP OF THE BRAZIL-SURINAME BORDER
 - SCALE 1:500.000 50 UNIVERSAL TRANSVERSE MERCATOR PROJECTION ZONE 21N - DATUM: SIRGAS2000 **2017**
 - Sector Formation ABC

- DC CENOZOIC UNCONSOLIDATED TO PO CONSOLIDATED SEDIMENTS, OF AQUEC DEPOSITIONAL SYSTEMS DCDL – LATERITIC FORMATIONS DOMA (PALEOPROTEROZOIC TO CENOZOIC DCA – DIFFERENTIATED INTRUSIVE AND EX ALKALINE COMPLEXES DOMAIN, TERTI MESOZOIC AND PROTEROZOIC
- DSVP1 VOLCANIC AND VOLCANOCLAS SEQUENCES DOMAIN, PROTEROZOIC, NO SLIGHTLY FOLDED AND METAMORPHIZ
- DGB GREENSTONE TYPE VOLCANO-SEDIN SEQUENCES, ARCHEAN TO MESOPROTER
- DCMU MAFIC-ULTRAMAFIC BODIES DO (KOMATIITE SUITES, TOLEITIC SUITES, BA COMPLEXES)
- DCGR1 UNDEFORMED GRANITOID COMF DOMAIN
- DCGR3 INTENSELY DEFORMED GRANI COMPLEXES DOMAIN: ORTHO GNEISS T DCGMGL – GRANULITES AND MIGMATITIC COMPLEXES

INFLUENCE OF GEOLOGICAL-ENVIRONMENTAL UNITS AND RELIEF PATTERN OF RELEVANCE IN THE ADEQUACIES / POTENTIAL AND LIMITATIONS OF LAND USE AND OCCUPATION (ENGINEERING, AGRICULTURE, WATER RESOURCES, POLLUTANTS) AND IN THE POTENTIAL MINERAL AND GEOTOURISM

GEOLOGICAL-ENVIRONMENTAL DOMAIN	GEOLOGICAL-ENVIRONMENTAL UNIT	RELIEF PATTERN	LIMITATIONS	ADEQUACIES
CENOZOIC UNCONSOLIDATED TO POORLY NSOLIDATED SEDIMENTS, OF AQUEOUS DEPOSITIONAL SYSTEMS	1 - Recent alluvial plains environment (DCa).	a - Retouched or Degraded Planation Surfaces.	Collapsible soils with low bearing capacity, show compaction and deformation when submitted to heavy loads. The sediments have contrasting mineralogical, granulometric, and hydraulic characteristics, which cause geomechanical discontinuities and stimulate erosion and destabilization of cutting slopes, susceptible to slump and cracks. The water table is close to the surface, which limits the execution of engineering projects. Possible existence of organic matter may contribute to formation of corrosive acids. Poorly drained areas, both superficially and sub-superficially, subjected to formation of large water puddles and long lasting flood events, which hinders the development of deeply rooted crops. The aquifers have low thickness and large textural variability, and are only capable of supplying small water demands. Sandy portions have high permeability, which results in high vulnerability to microbiological contamination of superficial hydric resources and to groundwater pollution. Clay portions are excellent barriers to contaminants propagation.	Unconsolidated sediments by the river margins or along the channels periodically flooded. The sediments are composed of gravel, sand, silt and clay in fluvial plains. The regions along the alluvium plains have low construction costs. Flat terrains that have low resistance to cutting and penetration with flat areas that favour mechanized agriculture and irrigation, soils have moderate to high soil fertility, good potential to short cycle crops. The unit has good hydrodynamic properties and lateral homogeneity; it forms porous, shallow and vast aquifers; which however have a low to moderate hydrogeological potential. The environment is favourable to accumulation of pebbles, sand and clay.
CDL – LATERITIC FORMATIONS DOMAIN (PALEOPROTEROZOIC TO CENOZOIC)	2 - Undivided - Products of laterization processes in varied composition rocks (DCDLin).	d - Dissected Hills and Low Hills Domain.	Terrain formed by planation surfaces to wavy slightly waved surfaces, layers have varied thickness and horizontal continuity, and are moderately lithified. Terrain shows irregular boulder and block exposures, which hinder excavations and drilling. Soils may show high cohesion and compaction, which results in high resistance to cutting and penetration. Materials are intensely leached and have high Al and/or Fe content. Usually soils that have very low soil fertility, acidic and difficult to correct, with imperfect drainage. The unconfined superficial aquifers have low hydrogeological potential. Underwater with usually high Fe an Al content, which alters the flavour and represents risk to human health. Aquifers with punctual and irregularly spaced exploration potential, that depends on the climate conditions and relief pattern. Those are very shallow aquifers; the water table touches the surface or gets close to it.	Ferruginous rock deposits with variable thickness and hardness, horizontally and vertically. Unit has low natural erodibility, and good stability in cutting slopes, suitable for road projects. In flat to slightly wavy areas the use of soil correctives favours the agricultural capability. Important areas regarding aquifers recharge. Ferruginous concretions can be used as borrow pits or as gravel for concrete, for road pavements. The mottled clayey soils of these petroplinthite averagely 200cm thick may be used for production of bricks and daub. The laterization processes may favour the residual concentration of Fe and Mn.
	3 - Saturated alkaline and sub saturated alkaline series (DCAalc).	c - Broad Gentle Hills Domain. e - Hills and Low Sierras Domain. f - Mountainous Domain.	In the steep slopes there are is a great amount of rock blocks and boulders with high potential for mass movements, which hinders excavations and drilling. Rock block and boulders may roll down the hills with high destruction capacity. The unit has deep, highly developed soils that may contain rock fragments or blocks, destabilizing buildings pillars and foundation. The slopes are steep and susceptible to geotechnical problems; they require stabilization procedures in slope cutting. Weathering in these alkaline rocks results in clayey soils; and advanced soil development releases high amounts of Al ion, resulting in acidic soils and low agricultural production. Continuous use of heavy machinery in agriculture results in soil compacting and impermeable soils layers, causing high susceptibility to laminar erosion. Changes in soil compaction and impervious layers will imply in increased drainage flow speed, reducing infiltration rates. Irregularly spaced, open, large fractures are locally displaced pollutants infiltration spots that contaminate the underground aquifers. The fractured rock basement with shallow or inexistent weathered soil cape is highly vulnerable to aquifers pollutant contamination.	The crystalline rocks on this domain form small residual hills, they have homogeneous mineralogic, structural and textural characteristics and they are isotropic and massive. Rocks have high cohesion, bearing capacity and compression resistance values, very homogeneous in the geomechanical and hydraulic response, both vertically and horizontally. Weathering produces clayey soils, plastic and highly silky; permeability varies from low in not very developed soils. up to high in more developed soils. Weathering in these rocks results in clayey soils and releases plant nutrients such as Na and K; in smaller proportion also Fe and AI. The irregularly spaced, open fractures, when interconnected form fissure aquifers, with potential for stocking and circulating underground water, the rocks however have low primary porosity; therefore the discharge capacity of these aquifers is highly variable. The geological ambience of the silica saturated and unsaturated alkaline series is favourable for the occurrence of P, Nb, U and rare earth elements ores. It is important to mention the laterites of high Nb and Sn content of the Muri Alkaline Suit.
VP1 – VOLCANIC AND VOLCANOCLASTIC UENCES DOMAIN, PROTEROZOIC, NOT OR JIGHTLY FOLDED AND METAMORPHIZED	4 - Mainly acid to intermediary volcanism (DSVP1va).	 a - Retouched or Degraded Planation Surfaces. b - Hills and Low Height Sierras Domain. c - Broad Gentle Hills Domain. d - Dissected Hills and Low Hills Domain. e - Hills and Low Sierras Domain. f - Mountainous Domain. 	The rocks in this domain, when not weathered, have high resistance to cutting and penetration which may make it necessary to use explosives for clearing. In gentle smooth hills areas there are deep soils, where may occur irregularly distributed buried rock blocks and boulders, that hinder excavations and drilling. The steep slopes or high declivity areas have a high potential for mass movements, such as boulder rolls and rock falling and toppling; therefore it is not recommended to occupy those terrains, due to the high cost of the interventions that would be necessary to stabilize the cutting slopes. Terrains have low natural soil fertility, steep relief in slope areas. In sandy areas, soils have low capacity to retain humidity and nutrients. Soils are more susceptible to erosive processes due to the elevated textural gradient, especially in the slopes (acrisol). In low height hills and sierras areas there are mostly shallow soils, not very advanced soil development; soils commonly have high stoniness and cragginess. The rocks in this domain have almost null porosity and permeability. In the low height hills and sierras areas, the underground water fracture recharge potential is low. The frequent presence of faults and fractures, especially in the edges of the rock bodies, facilitate the infiltration of contaminants to the underground water.	Rocks in this domain, due to their volcanic nature, exhibit high values for hardness, compression resistance and bearing capacity. Soils present good textural characteristics. The fissure aquifers have very irregular exploration potential and variable hydrogeological favourability. Interconnected faults and fractures lead to expressive and significant high secondary porosity in these aquifers.
GREENSTONE TYPE VOLCANO-SEDIMENTARY	5 - Mainly volcano- sedimentary sequences (DGBss).	a - Retouched or Degraded Planation Surfaces. b - Buttes. d - Dissected Hills and Low Hills Domain. e - Hills and Low Sierras Domain.	In this domain the rock basement is composed of different lithotypes with distinct geotechnical and hydraulic characteristics, responsible for important discontinuities. This anisotropy facilitates the erosive processes, cause destabilizations and favour water springs in cutting slopes. The layers dip varies, interfering in the execution excavations, where unfavourable dips may cause cutting slopes destabilization. Quartzose rocks terrains, when not weathered, offer high resistance to excavations and rotary drilling, due to high hardness and abrasiveness of the quartz mineral. In the sediments of iron formations it is likely that the weathering cape is acidic and corrosive. When present, the fractured quartzite layers are susceptible to mass movements, especially where hill ridges show steep slopes. The meta-basic and meta-ultrabasic rocks show differentiated textures, presenting distinct geotechnical characteristics; they may generate buried rock blocks and boulders that can move if exposed in cutting slopes. Rocks are favourable to existence of hydrogeological traps and barriers, related to the structural discontinuities, which associated to the lithological diversity present different hydrodynamic characteristics.	Rocks in this domain have high compression resistance and bearing capacity and compacting capability. In flat terrains, the clayey, highly developed soils have low natural erodibility. The rock exposures occur in strongly wavy topography, with various chemical weathering resistance levels, resulting in a moderately thick weathering cape. Weathering in different lithologies produces different types of soil, sand, clay and silty-clay, thus resulting in varied fertility in agricultural areas from region to region, alternating very good and very bad spots. In a general manner, there are flat and/or sub-horizontal areas that are suitable for agricultural mechanization, with high amounts of clayey sandy soil. In the rocks of this domain there are lithologic, morphologic and structural characteristic that favour the occurrence of hydrogeological traps and barriers; those are related to faults, fractures, folds and schistosity associated to the variable lithology, which present different hydrodynamic characteristics When the soils are thick, the risk of overlapping aquifer contamination will be low. Geologic ambience favours the occurrence metallic deposits.
U - MAFIC-ULTRAMAFIC BODIES DOMAIN IATIITE SUITES, TOLEITIC SUITES, BANDED COMPLEXES)	6 - Mafic – ultramafic series (DCMUmu).	a - Retouched or Degraded Planation Surfaces. b - Buttes. c - Broad Gentle Hills Domain. e - Hills and Low Sierras Domain.	These ultramafic rocks show texturally and compositionally variable layers, vertically and horizontally; resulting in heterogeneous geotechnical properties. Proximal portions show magmatic cooling and decompressing fractures systems, creating percolation surfaces and forming rock blocks and boulders susceptible to rolling in cutting slopes. When not altered, these rocks have high resistance to cutting and drilling, it may make it necessary to use explosives for clearing. These are rocks low to moderately resistant to physical and chemical weathering, and are likely to be shaped by spheroidal weathering; preserved rock blocks and boulders may fall or roll in cutting slopes, or even destabilize building foundations. Usually the well- developed soils have high fertility due to availability of Mg Ca and K. Continuous use of heavy machinery in agriculture may result in soil compacting and impermeable soils layers, causing high susceptibility to laminar erosion. There are occurrences of high stoniness and cragginess in shallow soil areas. Fissure aquifers have very irregularly spaced potential: a specific well may show excellent flow rate while another one close to it may be completely dry. Rocks covered by faults, open fractures, joints and deep structural discontinuities that when interconnected may conduce contaminants to aquifers.	The soils have moderate to high bearing capacity, low to moderate resistance to cutting and penetration and are stable in cutting slopes. Residual, well developed soils formed by weathering of these rocks have low erodibility, high compacting capability and usually stable in cutting slopes, can be used as borrow pits. The rocks in this domain due to the basic and ultrabasic composition and the rich ferromagnesian minerals have low resistance to weathering; which forms clayey soils and releases nutrients such as Mg, Ca and K. Usually the residual soils are clayey, have low erodibility, and are deep and very developed. These terrains may have spots of Terra Rossa soil, which is very suitable for agriculture. The geological ambience favours the occurrence of Ni, Cr, Co, platinoids, and Au deposits. Suitable to use as crushed rock in construction. It is possible to find occurrences of asbestos and chrysoprase in serpentine veins.
AT - UNDEFORMED GRANITOID COMPLEXES DOMAIN	7 - Alkaline granitic series (DCGR1alc).	 a - Retouched or Degraded Planation Surfaces. b - Buttes. c - Broad Gentle Hills Domain. d - Dissected Hills and Low Hills Domain. e - Hills and Low Sierras Domain. f - Mountainous Domain. a - Retouched or Degraded Planation Surfaces. b - Buttes. 	Strongly cohesive rocks covered by lateritic soils with variated thickness, outcrops occur as slabs, boulders fields or steep rock walls. These steeper terrains with high gradient slopes are more susceptible to formation of gullies, grooves and ravines. Rocks have high resistance to cutting and penetration, which require explosives for clearing. These granites have a higher fracture density in apical and marginal zones, those fractures represent geomechanic and hydraulic discontinuities that facilitate fluid percolation, in cutting slopes those fractures may break and create rock blocks and boulders that may fall or roll. The weathering in these rocks is heterogeneous and may preserve rock blocks and boulders buried in the soil; which hinders excavations and drilling, and which, if exposed by steep natural slopes or cutting slopes, may fall or roll. In steep relief areas there are natural terrain instabilities, causing landmass movements, rock fall and roll. Steep relief areas are favourable to a faster natural drainage, which may cause flash floods. The rocks in this domain, when weathered, form soils composed of clayey silty sands with minerals that release few nutrients and a significant amount of Al in the soil, increasing acidity of the soil and toxicity towards plants. Continuous use of heavy machinery in agriculture may result in soil compacting and impermeable soils layers, causing high susceptibility to laminar erosion. In the degraded planation surfaces the soils have low to very low soil fertility usually rocky and sandy. The mountainous regions are not favourable to de development of pedogenetic processes and have shallow soils and high stoniness.	This unit have a predominance of rocks with isotropic properties. The rocks have a low fracturing level and homogenous geomechanical response. The unit is adequate for large buildings foundations. When unweathered rocks have a high resistance to cutting and penetration and may require explosives for clearing. In flat terrains the soils usually are thicker, well developed and mainly clayey. The soils have low erodibility and good compacting capability. There is a predominance alkaline soil, rich in Na, K and Ca, which are essential nutrients for plant growth. Soils have a good capacity to retain and fixate nutrients and respond well to fertilizers; the soils store water and protect overlapping aquifers from contaminants. Regarding mineral potential it is worth to mention the Sn evidences in the Sipaliwini Leucogranite.
	8 - Sub-alkaline granitic series: Calc-alkaline (low, moderate and high K) and toleitic (DCGR1salc).	c - Broad Gentle Hills Domain. d - Dissected Hills and Low Hills Domain. e - Hills and Low Sierras Domain.		
GR3 - INTENSELY DEFORMED GRANITOID OMPLEXES DOMAIN: ORTHO GNEISSES	9 - Sub-alkaline granitic series: calc-alkaline (low, moderate and high K) and toleitic (DCGR3salc).	 a - Retouched or Degraded Planation Surfaces. b - Buttes. c - Broad Gentle Hills Domain. d - Dissected Hills and Low Hills Domain. e - Hills and Low Sierras Domain. f - Mountainous Domain. 	The unit is composed of intensely deformed granitic rocks with very well marked structural anisotropies, including geomechanical and hydraulic discontinuities; related mostly to micaceous layers. There are block fields with cohesive, anisotropic, intensely fractured rocks, highly resistant to cutting and penetration may require explosives for clearing. Steep areas are susceptible to erosion. The fissure aquifers are discontinuous and have irregular hydrogeological potential. The existence of underground water is conditioned to the existence of crevices, fractures and other structural discontinuities. Planar discontinuities favour the fluid percolation and water table contamination, especially where the basins are shallow or where the soil layers are thin.	The unit have high bearing capacity and low to moderate to high resistance to cutting and penetration, usually have thick weathering capes. The flat and slightly wavy terrains are suitable for agriculture mechanization. Unit is suitable for agriculture under the condition of soil correctives and fertilizers application. The developed soils show good compaction capability and capacity to retain and fixate nutrients. Usually the soils are porous with capacity to retain water for extended periods of time during droughts. Geological environment favours the existence of hydrologic trap related to faults, fractures and other discontinuities. It is possible to find fissure water reservoirs, with variable hydrogeological potential.
GL - GRANULITES AND MIGMATITIC GNEISS COMPLEXES	10 - Undifferentiated gneiss (DCGMGLgni).	 a - Retouched or Degraded Planation Surfaces. c - Broad Gentle Hills Domain. d - Dissected Hills and Low Hills Domain. e - Hills and Low Sierras Domain. 	Complex association of polydeformed rocks in a moderate to high grade metamorphic grade; highly variable textural and mineral characteristics, intensely and complexly folded and tectonized. Variable migmatization and milonitization degree. Mainly composed of rocks with anisotropic geomechanical and hydraulic properties. The rock foliation associated to the intense fracturing cause geomechanical and hydraulic discontinuities. In situ rock blocks and boulders cause problems to agricultural mechanization and hinder excavations and drilling. Additional precautions must be taken on the placement of building foundations, it is recommended to make individual geotechnical investigations before building tunnels or underground facilities. Soils are mostly residual and have contrasting geomechanical and hydraulic properties. The rocks are intensely tectonized (faults, folds, open fractures and other planar structures), which favour pollutants percolation to the underground water. The residual soils are clayey and have low to moderate permeability, which is unfavourable to aquifer recharge. Fissure aquifer with moderate hydrogeological potential, the water storage is conditioned to the existence of open and interconnected fractures. Water must be desalinated to be suitable for human consumption.	In this domain the rocks have high hardness and coherence degrees, low primary porosity and moderate to high weathering resistance. The soils are well developed, have moderate plasticity, low erodibility, good compaction capability, and high bearing capacity and are usually stable in cutting slopes. In flat or slightly wavy areas the landmass movement potential is reduced, the weathering cape is thicker and easily excavated. Usually weathering in these migmatites rocks forms silty sandy clay soils, which have low to moderate permeability and erodibility. The soils are very porous with good capacity to retain and fixate nutrients, assimilate organic matter, respond well to fertilizers, and have a good capacity to store water, which maintain water available for plants during dry seasons. The rocks usually have ferromagnesian minerals (biotite and amphibole) in its natural composition and/or meta-basic rock enclaves, which when weathered release high amounts of Ca, Na and Mg into the soil, increasing natural fertility. The rocks are intensely tectonized, the brittle deformation occurs as faults, fractures and other structural discontinuities. These anisotropic deformations created a geological ambience that favours the existence of hydrogeological traps and discontinuous fissure aquifers, which have variable water exploration potential. In the weathering capes, the risk of contamination of overlapping aquifers is low.

(Julho - 2017)
