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31 JULY 2025

ENGAGED BY:

Agency for Cultural Resource Management (ACRM)

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PALAEONTOLOGICAL IMPACT STATEMENT

UPGRADE OF SEWERAGE LINE FROM GREENHAVEN TO CRICKET FIELD PUMPSTATION

Mossel Bay Municipality, Mossel Bay Magisterial District, Western Cape

BACKGROUND

Mossel Bay Municipality proposes to upgrade the bulk sewerage line from Amy Searle Street, Greenhaven, to the Cricket Field Sewerage Pumpstation (Figure 1).

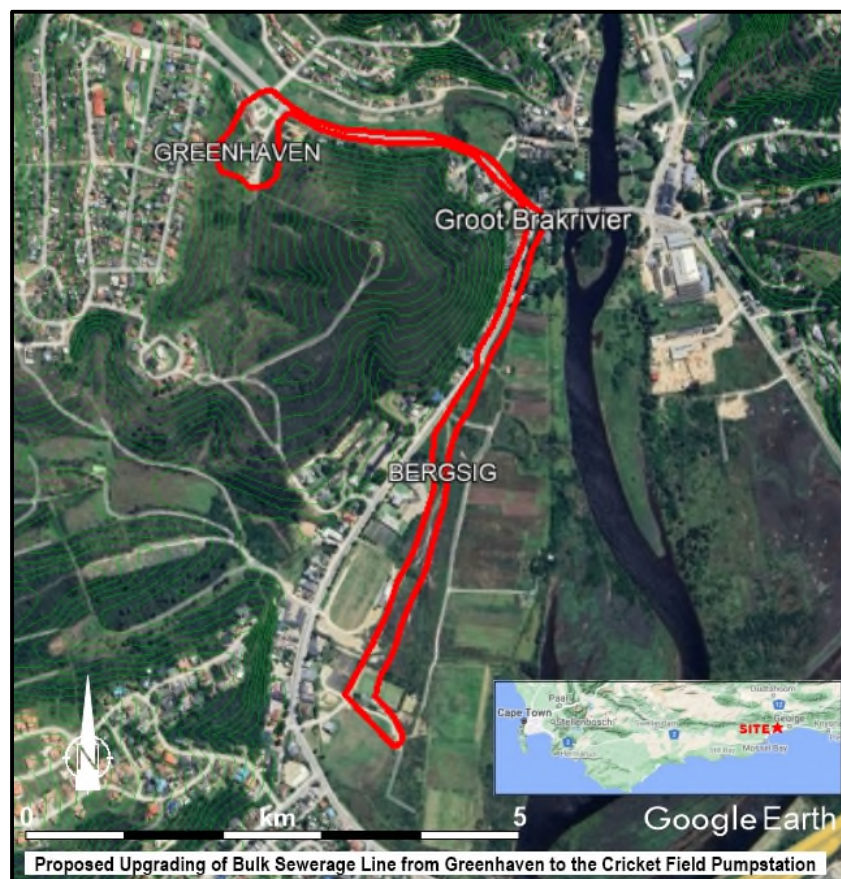


Figure 1. Location of the bulk sewer upgrade route.

This brief Palaeontological Assessment is to inform about the palaeontological sensitivities of the sewer route and the probability of fossils being uncovered in the subsurface and being lost or destroyed during the installation of the upgrade. For Methodology see Appendices 1 and 2.

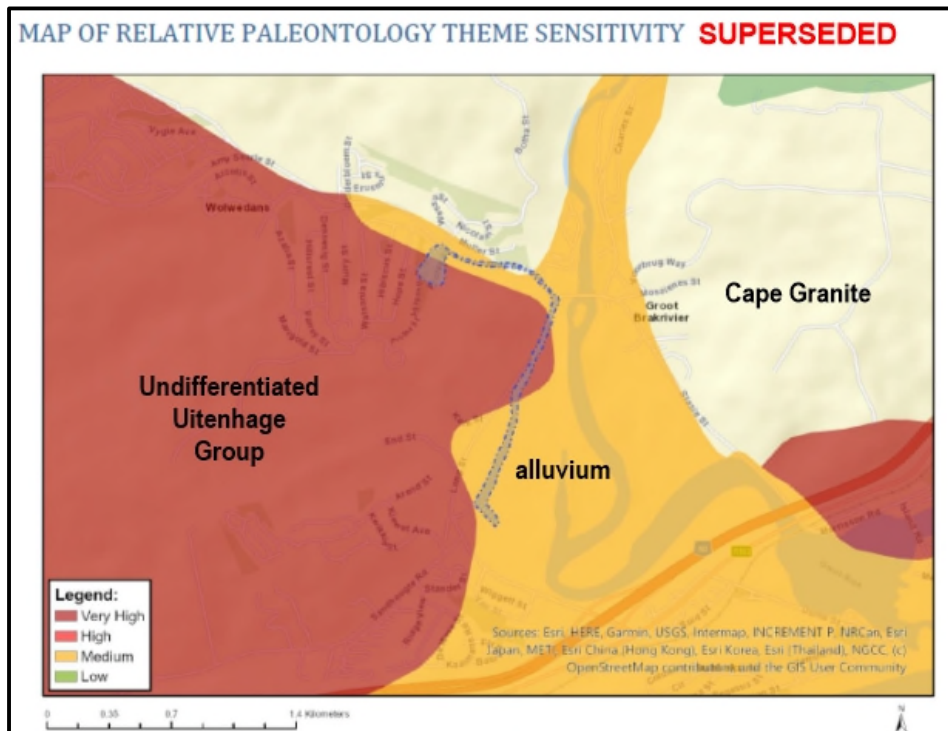


Figure 2. Geological context of the sewer upgrade route.

GEOLOGICAL CONTEXT OF THE SEWER UPGRADE ROUTE

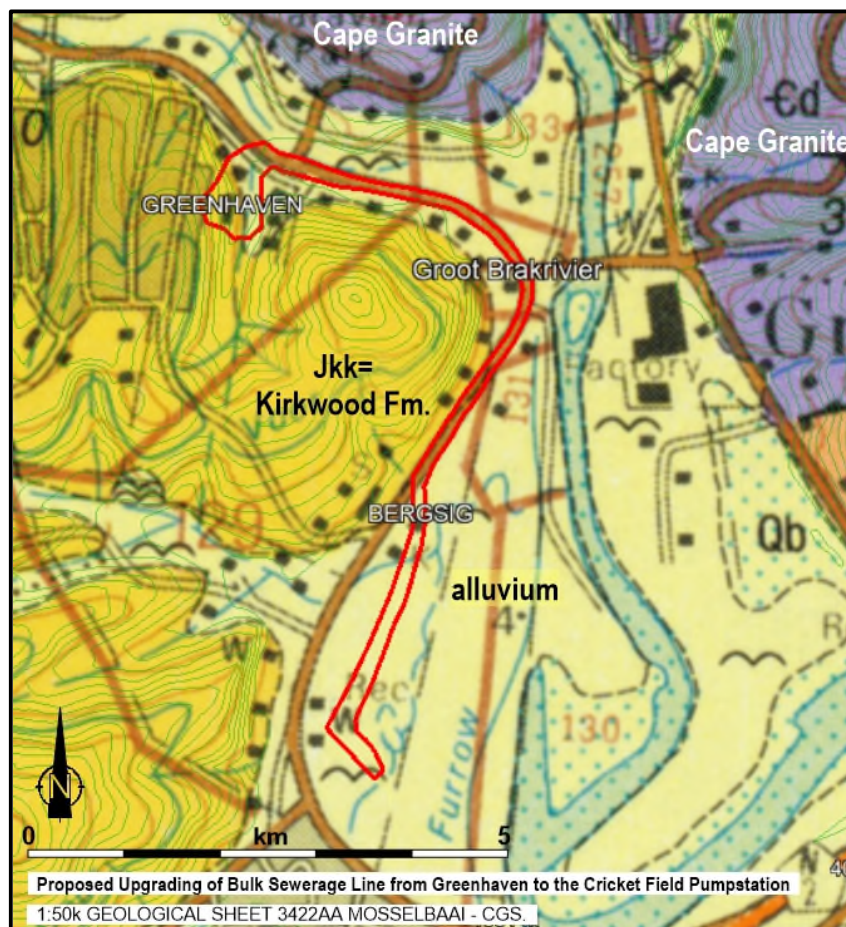


Figure 3. Geological context of the sewer upgrade route.

According to the SAHRIS Palaeontological Sensitivity Map presented in the Screening Report the sewer line route traverses a formation of VERY HIGH palaeontological sensitivity (Figure 2). However, the SAHRIS Palaeo-Map is based on the out-of-date 1979 1:250 000 3322 OUDTSHOORN geological map. On this old map the Very High sensitivity polygon represents the Uitenhage Group, which at the time of map compilation was not differentiated into its constituent formations. The formations comprising the Uitenhage Group have differing sensitivities and fossil contents, including Very High and Low, but the Very High grading was applied as a precaution applicable to the Uitenhage Group as a whole on the outdated OUDTSHOORN geological map.

The outdated OUDTSHOORN geological map is superseded in part by the 1993 1:50 000 3422AA MOSSELBAAL geological map. This later map has revised the geology and the applicable formation of the **Uitenhage Group** is now recognized as the **Kirkwood Formation** (Figure 3).

The Uitenhage Group of formations, named from this area where they are well exposed, originate from the separation of Africa from South America. Southern Africa was once embedded in the Gondwana supercontinent. Inexorable tectonic crustal forces led to the breakup of Gondwana from about 180-170 Ma (Ma = million years ago). Along the South Coast the pattern of crustal stretching and faulting was complex and several local fault-bounded basins were formed, e.g. the Mossel Bay Basin. A “fresh” suite of sediments, eroded from the mountainous hinterland, filled the new coastal basins so created during the Jurassic and early Cretaceous, deposited between about 170 Ma and 130 Ma.

The Kirkwood Fm. is mainly comprised of multicoloured green, grey and pink mudstones with variously pale brown sandstone interbeds and minor, thin conglomerates. The formation is considered to have been deposited by meandering rivers debouching downstream into lake environments in the fault-bounded valleys (Muir *et al*, 2017).

The sewer upgrade route substantially traverses the edge of the alluvial plain of the lower Groot Brakrivier, labelled alluvium (Figure 3). However, this is an over-simplification, being the estuary of a major river. In addition to river-delivered alluvium, **estuarine deposits** and the **marine deposits of previous high sea-level periods** are expected to occur.

PALAEONTOLOGY

THE KIRKWOOD FORMATION

The Kirkwood Fm. includes important floras of petrified wood (the “Wood Beds”), impressions of leaves (ferns, cycads, conifers), freshwater invertebrates (bivalves, crustaceans) and the mainly fragmentary remains of a limited range of small to large dinosaurs, other reptiles, and Mesozoic mammals (Almond *et al*, 2009.). The most noticeable fossil material are logs of petrified (silicified) wood which occur mainly in conglomeratic beds.

The Kirkwood Formation is considered to be of VERY HIGH palaeontological sensitivity by the SAHRIS Palaeontological Sensitivity Map classification, due mainly to the occurrence of the fossil reptiles. Most of the fossil reptile dinosaur finds have come from the northern part of the Algoa Basin (Port Elizabeth/Gqeberha area), from exposures on eroding valley flanks.

Finds of fossil bones are evidently not recorded from the Mossel Bay Basin Kirkwood Fm. In addition to petrified wood, fossil plant impressions are recorded at some localities in the Herbertsdale-Mossel Bay area. The preservation of fossils depends on processes involved in transforming unconsolidated sediments into rock and subsequent weathering when later exposed at the surface. Much of the Kirkwood Fm. in the Mossel Bay Basin is comprised of soft, easily-weathered muds (Figure 4) in which plant impressions on hard mudstone “tiles” do not occur, although charcoal and crumbly coalified plant material may be present. Petrified wood associated with the terrain of the Kirkwood

Fm. is quite common in the Mossel Bay region. **The palaeontological sensitivity of the Kirkwood Fm. in this area may consequently be revised to LOW, as also noted by Almond (2010).**



Figure 4. Exposure of the Kirkwood Fm. in the Groot Brak area showing the grey surficial coversands and the underlying lateritic soil profile developed in grey muds of the Kirkwood Fm.

THE GROOT BRAK ESTUARY

The Groot Brakrivier estuary has the same geological history as that of the Klein Brakrivier just to the west, which is the type area of the mid- and late Quaternary Klein Brak Formation deposits (Malan, 1991). Open-coast “raised beach” sequences occur in the vicinity of the estuary mouths and have been described and dated (Carr *et al.*, 2010; Roberts *et al.*, 2012) and related to a high sea level of about 13 m asl. around 400 ka (ka=thousand years ago) and to the about 6 m asl. sea-level highstand of the Last Interglacial around 125 ka. The estuaries around the coast were considerably expanded during these sea-level highstands and became embayments and large lagoons. These sheltered environments were colonized by several warm-water mollusc species beyond their normal habitat limits/ranges (extra-limitals), of Indo-Pacific and, very curiously, also of West African subtropical origin (Angolan), as well as a few species which are now extinct. Known as the **Swartkops Fauna**, from the exposures there, Davies (1972) provided the species lists from various sites and Kilburn & Tankard (1975) described the extralimital and extinct species. Typically the shelly beds bearing the Swartkops fauna are preserved around the margins of the estuary a few metres above the river level.

Estuarine and alluvial deposits within estuaries are very favourable locations for the deposition of animal carcasses, both of animals introduced from upriver such as during floods and marine mammals which have entered the estuary. In addition, there are remains from the rich estuarine fauna and its surrounds – hippo, otters, pigs, seabirds and various fish. An example of a fossil fauna from an estuarine setting is the world-famous Langebaanweg early Pliocene Varswater Fm. site celebrated at the West Coast Fossil Park.

ANTICIPATED IMPACTS

On the basis of the sewer route polygon provided it is assumed that the new pipeline proceeds alongside the existing line. Although re-excavating the pipeline trench involves disturbed ground, it may also involve excavation of undisturbed ground and fossils may occur in both. According to the

geological map the route skirts the Kirkwood Fm. (Figure 3), but geological boundaries are not necessarily exact and the Kirkwood strata extend beneath the sedimentary cover along the slope break at the foot of the hill. However, as indicated above, on existing observations the Kirkwood Fm. in the Mossel Bay Basin has low fossil potential (Figure 5).

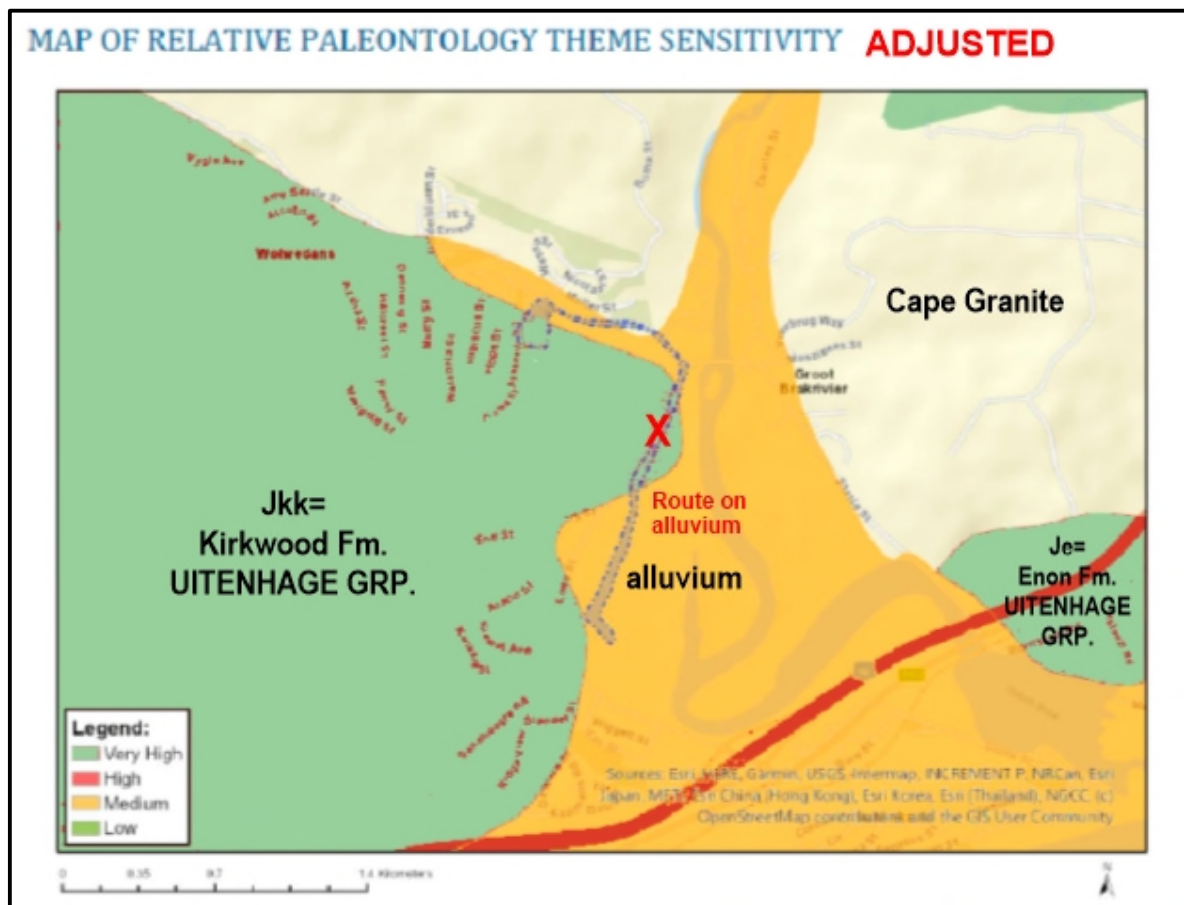


Figure 5. Revised Palaeontological Sensitivity.

In addition, note that the georeferencing of the map in the Screening Report is inaccurate and the VERY HIGH impact grading of that part of the sewer upgrade route does not apply.

Where the sewer route traverses the alluvium it is possible that shelly beds of the Klein Brak Fm. could be intersected and fossil bones could occur. As the Swartkops Shell Fauna is well described and existing sites occur in the region for further sampling the shell material is ascribed a LOW sensitivity.

The fossil bones that may occur, are expected to be of late Quaternary age and therefore mainly comprised of representatives of the extant (living) fauna, but unexpected species may occur, as a result of phases of different ecological and palaeoclimatic conditions in the past, as well as the bones of some species which became extinct in the geologically-recent past. The late Quaternary fauna is fairly well known from archaeological sites and hyaena bone accumulations. The sewer route traversing "alluvium" is confirmed as MODERATE sensitivity (Figure 5). However, in view that most of the earthworks entail re-excavation of services, the probability of fossil bone finds is likely to have been reduced and a LOW sensitivity is feasible.

In summary, the installation of the new sewer pipeline is not anticipated to significantly impact palaeontological heritage, due mainly to re-excavation of disturbed ground.

RECOMMENDATIONS

Nevertheless, an occurrence of fossil bones cannot be entirely dismissed. It is advisable that a protocol for finds of bones, the **Fossil Finds Procedure (FFP)**, is included in the Environmental Management Plan (EMP) for the project.

The Project Manager, foremen and workers involved in earthmoving must be informed of the need to watch for fossil bones. Workers seeing potential objects are to cease work at that spot and report to the Project Manager and/or the Environmental Control Officer (ECO) who must report the find to Heritage Western Cape (HWC), following the FFP.

Links to the HWC FFP are below:

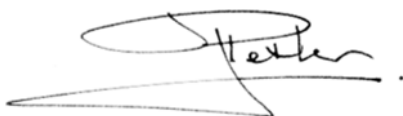
https://www.hwc.org.za/sites/default/files/3_11%20Protocol%20Fossil%20Finds%20Final%20June%202016.pdf

Heritage Western Cape will assess the information and liaise with an archaeological or palaeontological specialist, as appropriate.

The intersection of a shelly bed must also be reported to HWC as per the FFP. The Mossel Bay Museum should be informed.

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John Pether

DECLARATION OF INDEPENDENCE

PALAEONTOLOGICAL IMPACT STATEMENT

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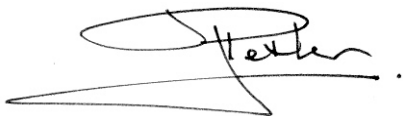
Terms of Reference

This assessment forms part of the Heritage Impact Assessment and it assesses the overall palaeontological (fossil) sensitivities of formations underlying the Project Area.

Declaration

I ...**John Pether**....., as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in the compilation of the above report;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed to the EAP any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management act;
- have provided the EAP with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.



Signature of the specialist

Date: 31 July 2025

APP. 1 - METHODOLOGY

Deposits or formations are rated in terms of their potential to include fossils of scientific importance, viz. their palaeontological sensitivity. Palaeontological sensitivity refers to the likelihood of finding significant fossils within a geological unit. The rating criteria are included in App. 2.

Note that different types of fossils occur in a single formation which differ in their scientific/palaeontological importance. The fossil bones and teeth of vertebrate animals are always of high palaeontological sensitivity and scientific importance and generally occur quite sparsely in deposits. For example, in aeolian formations the scarce fossil bones are rated HIGH, while fossil shells of land snails and the trace fossils made by termite burrowing are commonly present and are of LOW palaeontological sensitivity. Similarly, in shallow marine deposits fossil seashells are usually common, but the important fossil bones of marine mammals and seabirds are scarce.

Assumptions

The study is based on a number of assumptions and is subject to certain limitations, which should be borne in mind when considering information presented in this report. The validity of the findings of the study is not expected to be affected by these assumptions and limitations:

The main assumption is that the fossil potential of a formation in the study area will be typical of that found in the region and more specifically, similar to that already observed in the study area. A limitation on predictive capacity exists in that it is not possible to predict the buried fossil content of an area or formation other than in such general terms. The important fossil bone material is generally sparsely scattered in most deposits.

For successful palaeontological mitigation much depends on spotting the sparse fossil bone material as it is uncovered during digging, *i.e.* by monitoring excavations, but success is limited by the difficulty of seeing the bone fragments in freshly-excavated faces and spoil. They become more evident on weathering and wind-etching of the excavation faces and the deflation of spoil heaps.

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APP. 2 - PALAEOONTOLOGICAL SENSITIVITY RATING

Palaeontological Sensitivity refers to the likelihood of finding significant fossils within a geologic unit.

VERY HIGH: Formations/sites known or likely to include vertebrate fossils pertinent to human ancestry and palaeoenvironments and which are of international significance.

HIGH: Assigned to geological formations known to contain palaeontological resources that include rare, well-preserved fossil materials important to on-going palaeoclimatic, palaeobiological and/or evolutionary studies. Fossils of land-dwelling vertebrates are typically considered significant. Such formations have the potential to produce, or have produced, vertebrate remains that are the particular research focus of palaeontologists and can represent important educational resources as well.

MODERATE/MEDIUM: Formations known to contain palaeontological localities and that have yielded fossils that are common elsewhere, and/or that are stratigraphically long-ranging, would be assigned a moderate rating. This evaluation can also be applied to strata that have an unproven, but strong potential to yield fossil remains based on its stratigraphy and/or geomorphologic setting.

LOW: Formations that are relatively recent or that represent a high-energy subaerial depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains. A low abundance of invertebrate fossil remains can occur, but the palaeontological sensitivity would remain low due to their being relatively common and their lack of potential to serve as significant scientific resources. However, when fossils are found in these formations, they are often very significant additions to our geologic understanding of the area. Other examples include decalcified marine deposits that preserve casts of shells and marine trace fossils, and fossil soils with terrestrial trace fossils and plant remains (burrows and root fossils)

MARGINAL: Formations that are composed either of volcanoclastic or metasedimentary rocks, but that nevertheless have a limited probability for producing fossils from certain contexts at localized outcrops. Volcanoclastic rock can contain organisms that were fossilized by being covered by ash, dust, mud, or other debris from volcanoes. Sedimentary rocks that have been metamorphosed by the heat and pressure of deep burial are called metasedimentary. If the meta sedimentary rocks had fossils within them, they may have survived the metamorphism and still be identifiable. However, since the probability of this occurring is limited, these formations are considered marginally sensitive.

NO POTENTIAL: Assigned to geologic formations that are composed entirely of volcanic or plutonic igneous rock, such as basalt or granite, and therefore do not have any potential for producing fossil remains. These formations have no palaeontological resource potential.

Adapted from Society of Vertebrate Paleontology. 1995. Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources - Standard Guidelines. News Bulletin, Vol. 163, p. 22-27.

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