Reconnaissance Energy Namibia (REN) (Pty) Ltd

Final Environmental Management Plan (EMP) for Drilling of the Proposed Multiple Exploration and Appraisal Wells with Supporting Infrastructures such as Borrow Pits, Access Roads, and related Services in the Areas of Interest (AOI), Kavango Sedimentary Basin (KSB), Petroleum Exploration License (PEL) No. 73,
Kavango East and West Regions, Northern Namibia

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March 2023

OPERATOR
Reconnaissance Energy Namibia (REN) (Pty) Ltd Subsidiary of
Reconnaissance Energy Africa Ltd (ReconAfrica)

NEW ECC APP REFERENCE No.
APP- 00459

LICENSE PEL 73
Covering Parts of the Degree Square Blocks Nos. 1819, 1820, 1821, 1719, 1720, and 1721

WORKING INTERESTS
Reconnaissance Energy Namibia owns 90%
National Petroleum Corporation of Namibia (Namcor)
(A State-Owned Company) 10% with costs carried to the development stage

TYPE OF PETROLEUM EXPLORATION ACTIVITIES
Drilling of Multiple Exploration and Appraisal Wells in the Area of Interest (AOI)
with Supporting Infrastructures such as Borrow Pits, Access Roads
and related services, Kavango Sedimentary Basin (KSB),
Petroleum Exploration License (PEL) No. 73,
Kavango West and East Regions, Northern Namibia

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CONSULTING TEAM LEADERS AND CONTRIBUTORS

Name of Key Specialist/ Team Leaders Excluding Sub Teams	Project Role / Position / Specialisation	Affiliation / Company
1. Dr Sindila Mwiya	Project Environmental Assessment Practitioner (**EAP**) Team Leader, Engineering Geology / Geotechnical / Geoenvironmental / Environmental Engineering, Artificial Intelligence and Knowledge-Based Systems with special focus on EIAs, EMPs, EMSs, SEAs and SEMPs with respect to subsurface resources (minerals, petroleum, water) and energy in Arid and Semiarid Environments (**Engineering and Environmental Geologist**).	Risk-Based Solutions (RBS) CC
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20. Mr Ashley Julius	Water, Geology, Hydrology, Groundwater and Water Supply Project Specialist Consultant for Pioneer Minerals and Mining Consulting Team	Pioneer Minerals and Mining Consulting

DR SINDILA MWIYA, TEAM LEADER / ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP) DECLARATION

I, Dr Sindila Mwiya, the Team Leader / EAP for this Environmental Management Plan (EMP) study report for the proposed multiple exploration and appraisal wells with supporting infrastructures such as borrow pits, access roads, and related services in the Areas of Interest (AOI), Kavango Sedimentary Basin (KSB), Petroleum Exploration License (PEL) No. 73, Kavango West and East Regions, Northern Namibia, for Reconnaissance Energy Namibia (REN) (Pty) Ltd (the Proponent), hereby declares that:

1. This Environmental Management Plan (EMP) Report has been prepared in accordance with the provisions of the Environmental Protection Clause 11 of the Model Petroleum Agreement, Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991), Petroleum Laws Amendment Act, 1998, (Act 24 of 1998), the Environmental Management Act, 2007, (Act No. 7 of 2007), all other applicable national laws, and Regulations.

2. As a Team Leader and EAP for this project, I am highly qualified and experienced in onshore oil and gas exploration and production operations and hold a PhD with research interests, academic training, and technical knowledge in Engineering Geology, Geotechnical, Geoenvironmental and Environmental Engineering, Artificial Intelligence and Knowledge-Based Systems with special focus on EIAs, EMPs, EMSs, SEAs, SEMPs and ESG with respect to subsurface resources (minerals, petroleum, water) and energy in arid and semiarid environments.

3. I am an **Engineering and Environmental Geologist** with extensive technical knowledge and experience in conducting environmental assessments, management, and monitoring for subsurface resources (petroleum, solid state minerals, water, geothermal), and have undertaken more than 200 projects since 2004, including more than sixty (60) oil and gas exploration and production related environmental assessments, management, and monitoring projects in different parts of the World.

4. I have performed the work relating to this project in an objective manner, even if the outcomes will result in views or Records of Decision that may not be favourable to the Stakeholders or the Proponent, and.

5. I am an independent consultant not related to the Proponent, I co-own and operate an independent company (Risk-Based Solutions CC) which is not related to the Proponent. Except for the fees payable for professional consulting services rendered to the Proponent, I have no shares, interests, or involvement in the license, financial or other affairs or business or operational decisions of either the Proponent or the decision-making structures of Government.

Risk-Based Solutions CC
03 MAR 2023

…………………………………………
Dr Sindila MWIYA
Environmental Assessment Practitioners (EAPs) Team Leader
RISK-BASED SOLUTIONS (RBS) CC

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NON-TECHNICAL SUMMARY

Reconnaissance Energy Namibia (REN) (Pty) Ltd, (the "**Proponent"**), is a subsidiary of Reconnaissance Energy Africa Ltd (ReconAfrica), a Canadian publicly listed company. The Proponent holds petroleum exploration rights under the Petroleum Exploration License (PEL) No. 73 covering parts of the Degree Square Blocks 1719, 1720, 1721, 1819, 1820 and 1821 over the newly discovered Kavango Sedimentary Basin in Kavango West and East Regions in northern Namibia. The Proponent is proposing to drill several seismically defined prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6 falling in the KSB, PEL No. 73, Kavango East and West Regions. The proposed exploration and appraisal drilling operations are inclusive of the supporting infrastructures such as borrow pits and access roads. The objectives of the proposed exploration and appraisal wells drilling programme is to continue with the search for oil and gas in the KSB and the associated subbasins and to identify potentially commercial petroleum systems.

REN is the Operator of PEL 73 holding 90% of the license interests and the remaining 10% is held by the National Petroleum Corporation of Namibia (Namcor) with its costs carried to the development stage. As part of the provisions of the Petroleum Agreement signed between ReconAfrica and the Government of the Republic of Namibia represented by the Ministry of Mines and Energy (MME), the Proponent has committed to undertaking petroleum exploration activities in PEL 73. The Petroleum Agreement provides for the initial exploration period (4 years), first and second two (2) years renewal exploration periods subject to possible one-year extension. In an event of a discovery of economic oil and gas reserves, the Proponent may apply for a 25-year production license, which should be granted within six (6) months of the date of application.

The proposed drilling of the prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6, forms part of the ongoing petroleum exploration work programme for PEL No. 73 as agreed in the Petroleum Agreement signed between the Ministry of Mines and Energy (MME) and REN. The results of the 6-1 Mbambi, and 6-2 Kawe, 8-2 Makandina stratigraphic test wells drilled by REN in 2021 and 2022 respectively, and the subsequent 2D seismic survey data acquired in the Kavango Sedimentary Basin (KSB), have established a significant rift basin similar to other major petroleum provinces / rift basins in other parts of World. Thus far, the integrated interpretation has established the following three (3) groups of hydrocarbon opportunities ("Plays"), Primary: Karoo Rift Fill (Light Oil), Secondary: Intra-Rift Fault Blocks (Light Oil), and Secondary: Damara Fold Belt (New Play, Gas/Gas Condensate). A new petroleum system ("Play") for KSB, the Damara Fold Belt, has been established based on the interpretation of the seismic data acquired since 2021. The Damara Fold Belt was not anticipated in the original studies of the KSB.

The drilled stratigraphic wells have been designed to confirm and map the KSB, associated subbasins and petroleum systems with well targets, prospects and leads as part of a de-risking process based on regional data sets including airborne geophysics, initial 2D seismic and regional geological mapping results. As this de-risking progresses, the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 are designed to confirm the existence of economic oil and / or gas resources with the delineated targets / prospects and leads process based on additional 2D seismic survey data acquisition and interpretation, airborne geophysical surveys and the stratigraphic well data sets.

The proposed exploration and appraisal wells drilling activities cannot be undertaken without an Environmental Clearance Certificate (ECC) as required by the Environmental Management Act, 2007, (Act No. 7 of 2007) and the Environmental Impact Assessment (EIA) Regulations 30 of 2012. In fulfilment of the environmental requirements, the Proponent has appointed Risk-Based Solutions (RBS) CC as the environmental / permitting de-risking Consultant, led by Dr Sindila Mwiya and supported by Ms Emerita Ashipala and Mr Samison Mulonga as the Environmental Assessment Practitioners (EAPs) to prepare EIA and Environmental Management Plan (EMP) Reports to support the application for ECC.

The drilling of the proposed exploration and appraisal wells will be undertaken using the Crown 750 truck mounted drill rig used by REN to drill the stratigraphic wells and will apply the same drilling technology with the addition of well testing in an event of a commercial discovery. Each of the proposed well sites to be drilled will be conventional and will affect a maximum surface area measuring less than 3Ha. It is important to note that, not all the proposed twelve (12) prioritised exploration and appraisal wells sites will be drilled. Based on the current priority list, it is highly likely that only six (6) wells may be drilled and subject to the positive outcomes of the initial drilling to be undertaken. Even if all the twelve (12) wells were to be drilled, the total ground footprint of the operations will be around 36 Ha of the 2534133 Ha size of the Kavango Sedimentary Basin.

Each well site to be drilled will hold the drilling rig and additional equipment along with the administrative containerised area and material storage and handling areas. To prepare for the drilling operations, access roads to each site will be created and vegetation around the proposed well sites will be selectively cleared and ground levelled. A grader, and bulldozer combined with labour-based workforce where it exists will be required to grade, level, and resurface the access tracks and drill sites to accommodate for the transportation of the heavy truck-mounted drill rig as well as other supply trucks that will be used to service each of the operational sites. The likely key sources of negative environmental (physical, biological, and socioeconomic/cultural/ archaeological) impacts that may be associated with onshore oil and gas exploration drilling operations can be divided into two (2) main categories and these are:

(1) Routine and physical presence operational activities:

(i) Pre-construction and onsite assessment of the drilling requirements.

(ii) Site construction and preparation including clearing, ground levelling and compactions.

(iii) Mobilisation, equipment installation and testing.

(iv) Spudding and conductor casing.

(v) Drilling surface / intermediate and setting casing and cementing process through up 900 m or top section of the well as per the well design.

(vi) Drilling and continuous coring from 900 meters (2953’) to 1900 meters (6234’) or as per the specific well design.

(vii) Drilling below 1900 meters to total depth, estimated at 2500 meters (+/-8202’) or as per the specific well design.

(viii) Well testing / appraisal and equip the well for possible production support in an event of a commercial discovery.

(ix) Plug and abandon hole if dry.

(x) Rehabilitate all surface disturbances and clear the site of any debris, and.

(xi) Camp removal, site closure / abandonment.

(xii) Site restoration into a local community site equipped with water supply and associated supporting infrastructure as may be applicable.

(2) Unplanned accidental events:

(i) Major land accidental incidence such as diesel / oil spill / fire / explosion.

The drilling fluid system to be used for the proposed drilling operations comprises the following three (3) main components, namely: The drilling fluid system, the circulating/cleaning system, and the reserve pits. REN will be using a water-based Partially-hydrolyzed polyacrylamide (PHPA) mud system which uses freshwater as the base fluid. PHPA is a functional additive that will control wellbore shales and extends bentonite clay in low-solids mud. As a shale-control mud, PHPA is believed to seal microfractures and coat shale surfaces with a film that retards dispersion and disintegration. The plant-based products added to the base fluid are created through organic processes and are biodegradable. The reserve pit to be situated adjacent to the drilling rig and, along with storage tanks, is where the excess fluids and cuttings will be managed. The reserve pit will be sealed using an organic gel/clay barrier that will be sprayed at the bottom and side walls to prevent seepage of the reserve pit water into groundwater and surrounding soils. This approach is better than polyurethane pit linings, which are easy to install but challenging to remove during reclamation, which can lead to shredding and leakages.

During the drilling process various tests and activities may be undertaken subject to the outcomes of the drilling process. Test that may be undertaken are inclusive of the following: Drill Stem Testing (DST) in open hole during drilling phase, DST in cased hole after well is drilled, cased and cemented and other general tests that may be considered or routinely undertaken such as sample collection / sampling at appropriate depths, logging operations, Modular Formation Dynamics (MDT), wireline formation testing and formation fluid sampling, formation evaluation test that may allow fluids in the formation being evaluated to flow into the drill stem and to the surface and pressure-recording devices tool measure and record pressure in the well while it is both flowing and not flowing (shut in), as well as any additional tests as may be applicable and agreed with / requested by the Partners and / or MME.

Once exploration drilling activities are completed, and the well is dry, with no requirements for possible re-entry, the affected 3Ha drilling site and all the associated supporting infrastructures areas such as borrow pits, access roads and related services will be rehabilitated to minimise surface disturbances. The rehabilitation of each of the proposed drilling locations shall be focused on establishing common local community sites with supporting facilities as may be applicable or requested by the local communities or land owner/s. As part of the rehabilitation and restoration process, each of the drilling sites will already have supporting infrastructure such as the road access and fully fitted water boreholes. The following is the summary of the local community site usages that shall be considered, evaluated and implemented in consultation with the various local communities, Village Development Committees (VDCs), Community Headperson (Foreman/Forewoman), Traditional Authority and Local Councillor representing the Regional Council: Common local community meeting centre with shade, handling pen / facilities for cattle and small stock, community garden and nursery centre and other additional supporting site infrastructures that could support common community facilities.

The proposed exploration and appraisal wells locations Nos. D1-D6 and G1-G6 fall in the Ncamangoro, and Ncuncuni Constituencies of Kavango West Region and Mashare Constituency of the Kavango East Region and within the boundaries of the Mbunza and Sambyu Traditional Authorities. The local land uses and livelihood in the general area are depended on communal / subsistence farming comprising cattle, donkeys, seasonal crop farming, grass, and wood / timber harvesting, conservancies and forestry conservation and natural resources harvesting, and very limited to no local tourism products within the area of interest. The well locations Nos. D1-D6 and G1-G6, and, supporting infrastructures such as the new access roads to each of the proposed wells sites, borrow pits owned by the traditional authority where construction materials will be purchased from and other associated services, and the AOI do not fall within an active catchment area of the Okavango River Basin linked to the Okavango Delta in Botswana. The fossilised channel of the Omatako–Omuramba Ephemeral River and its ephemeral tributaries cut across the Kavango Sedimentary Basin.

Important larger tree/shrub species occurring on the proposed well locations Nos. D1-D6 and G1-G6, and supporting infrastructure areas area: Baikiaea plurijuga (Protected; LR-nt; Near Threatened [IUCN 2021]), Burkea africana (Protected), Guibourtia coleosperma (Protected), Dialium engleranum (Protected), Philenoptera violacea (Protected), Pterocarpus angolensis (Protected; LR-nt), Schinziophyton rautanenii (Protected), Sclerocarya birrea (Protected) and Strychnos species (Protected). All the key trees have been mapped and marked on each of the proposed well sites and supporting infrastructure areas such as the new access roads and borrow pits areas. A harvesting permit will be required before any marked tree is removed.

The most important habitats in the general wider area around D1-D6 and G1-G6 well locations but not necessary on actual proposed well sites are: Perennial Okavango River located more than 50 km away from the any of the proposed well locations, fossilised Ephemeral Omuramba Omatako, Ephemeral Pans, Khaudum National Park, Mangetti National Park, Undisturbed areas, Kapinga Kamwalye Conservancy, Community Forests. Due to the high density of protected tree species in the general area and to minimise the overall impact of the habitat destruction associated with the proposed wells drill sites developments, larger (parent trees) protected tree species have been marked to be protected during the process of developing each of the proposed well sites and supporting infrastructure areas. Overall, the general area has been heavily impacted in places, especially along the Fossilised Omuramba Omatako Ephemeral River Channel and areas close to towns and settlements due to subsistence farming and logging activities. The actual proposed development areas such as the D4 near communities are not pristine as there are extensive slash-and-burn agriculture activities, fire damage to large trees and trees felled for honey. The protected trees species occur widespread throughout the general area and not exclusively associated with the proposed D1-D6 and G1-G6 well locations.

It is estimated that at least 67 species of reptile, 32 amphibian, 116 mammal and 210 bird species (breeding residents) are known to or expected to occur in the general Kavango East and West Regions of the proposed project area. It is estimated that at least 107 species of larger trees and shrubs (>1m in height) and up to 111 species of grasses are known to or expected to occur in the general project area inclusive of the proposed drilling sites and the areas surrounding the well locations Nos. D1-D6 and G1-G6, and supporting infrastructure areas.

The proposed exploration and appraisal wells drilling sites fall within the greater Kalahari Sedimentary Basin which was formed because of uplift of the Great Escarpment of Namibia and deposition of Kalahari Group Sediments in grabens which formed during various tectonic events that shaped the current landscapes of Southern Africa. The Kalahari Sedimentary Basin is a vast inland basin stretching over Angola, Namibia, Zambia, Botswana, and South Africa. Within the proposed drilling site areas, basement rocks below the top Kalahari Group of the Kavango Sedimentary Basin are expected to be of the Damara and Pre-Damara age.

The source of water supply in the area is primary from the aquifers of the Kalahari Group sediments. The Kalahari sediments have variable yields and water qualities with groundwater potential of moderate to low. Aquifers present along the Ephemeral rivers including along the fossilised channel of the Omatako–Omuramba Ephemeral River are saline artesian aquifers overlain by alluvium aquifers of paleo-channels of the Okavango River. Hand dug wells and boreholes are the main sources of groundwater supply especially for the rural communities. Groundwater is located deeper in the western compared to the eastern parts of Kavango Sedimentary Basin. Groundwater flow in the area is controlled by regional and local faulting, with a low-gentle gradient. Borehole yields in the AOI on average, can supply approximately between 8-10 m3/h or 192-240 m3/day. The results of the ongoing groundwater analysis have determined that the average borehole yield in the AOI satisfies the required water demand per community water point. The required water demand for the proposed drilling of an oil and gas well has been given as approximately 7m3/h, which is close to the average borehole yield for the region. Normal operational or safe yield is normally taken as 70-80% of sustainable yield. This indicates that a borehole must yield at least 9m3/h to fulfil the water requirements of the drilling of the exploration and /or appraisal well. A detailed groundwater study has been implemented to provide more detailed site-specific data on water resources use, management and protection for the proposed exploration and appraisal drilling operations.

All human induced activities, including the proposed petroleum exploration activities have potential negative environmental consequences, but identifying the most important fauna and flora species including high risk habitats beforehand, coupled with environmentally acceptable recommendations (mitigating factors), lessens the overall impact of such activities. This EMP Report provides detailed mitigation measures for the proposed drilling of the prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6, inclusive of the supporting infrastructures such as the new access roads, the use of existing borrow pits and other associated services. This EMP Report incorporates all the REN corporate best practices that have been developed since the implementation of the drilling operations in January 2021. The Environmental Assessment process for proposed drilling of the prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6, inclusive of the process of preparing this EMP report based on the findings of the EIA Report, has taken into considerations all the applicable national regulations, the corporate requirements of the Proponent, international best practices, public, stakeholders and local community inputs and sensitivity of the receiving environment (physical, biological, socioeconomic and ecosystem services and functions).

The Proponent shall incorporate the provisions of this EMP in the Environmental Management System (EMS) in line with the Environmental Policy of the company. The Proponent must implement precautionary measures / approach and the developed best practices to environmental management.
Mitigation measures have been recommended and are contained in this EMP Report. Direct supervision, involvement, and continuous monitoring of the process of clearing of all the drilling sites,

access tracks, and borrow pit areas, and actual drilling operations shall always be implemented. All the responsibilities to ensure that the recommendations are executed accordingly, rest with the Proponent. REN as the Proponent and operator shall provide all appropriate human and financial resources necessary for the effective implementation and monitoring of this EMP. It is the responsibility of the Proponent to make sure that all members of the workforce including contractors and subcontractors are aware of the provisions of this EMP and its overall objectives. The following is the summary of the key additional recommendations that may form part of the Record of the Decisions:

1) All the applicable permits, authorisation, and consents shall be obtained before the start of preconstruction, construction and drilling operations.

2) The Proponent shall adhere to the provisions of all the national legislation, regulations, policies, procedures, and all the required permits / authorisation / consents must be obtained before the start of the operations for each of the proposed well sites and supporting infrastructure areas.

3) Mitigation measures detailed in this EMP Report are based on the findings of the EIA Report, and have been modelled around two main concepts namely: Best industry practices which are based on the Best Practicable Environmental Option (BPEO) and local Namibian requirements unique to the area of exploration.

4) All the provisions of the EMP and mitigation measures shall be implemented, adhered to and monitored and sites inspections by the external project specialist consultants and EMP monitoring teams shall be undertaken before, during and after the start of construction, operational and closure, rehabilitation and restoration activities for each of the proposed well sites and supporting infrastructure areas.

5) Before the implementation of the individual well drilling operations, the Proponent shall consult with the land owners / land rightsholder / local community / owners of the communal fields and villages that may be affected or likely to be disturbed by the proposed project activities including access to the well locations and sources of construction materials covering the existing borrow pits areas. All the consultations and engagements shall be undertaken through the existing regional and local structures covering the Office of the Governors for Kavango West and West Regions, Councillors, Traditional Authorities, Farmers Associations, Village Headpersons, and Village Development Committees (VDCs) and local community levels.

6) Before any form of field-based activities are started in a local area, written consent shall always be obtained from the land owners / local community through the village headperson, traditional authorities, and regional council as may be applicable to avoid misunderstanding and unnecessary surface user rights conflicts.

7) All borrow pits belong to the traditional authorities and construction materials must be purchased from the relevant traditional authority having jurisdiction over a given borrow pit area and a purchase agreement must be signed before construction materials can be obtained from any given borrow pit in Kavango East and West Regions.

8) Appropriate setback distances (exclusion zones) around sensitive structures such protected areas and human settlements shall always be observed. Such exclusion zone shall be for example be in the ranges of between 400m-500m from an exploration well site to a nearest settlement\ village, and.

9) Precautionary principles / approaches shall always be exercised especially in situations where specific mitigations, regulatory guidelines, standards, or appropriate setback distances (exclusion zones) around sensitive local cultural resources such as traditional houses, burial or cultural sites have not been provided. Local communities shall always be consulted on matters related to sensitive local cultural resources not provided for in the international guidelines / standards.

1. BACKGROUND TO THE PROJECT

1.1 Introduction

Reconnaissance Energy Namibia (Pty) Ltd, the Proponent, and herein referred to as "**REN**" holds petroleum exploration rights under the PEL No. 73 covering parts of the Degree Square Blocks Nos. 1819, 1820, 1821, 1719, 1720, and 1721 in the Kavango Sedimentary Basin, Kavango West and East Regions, northern Namibia (Figs. 1.1 and 1.2). PEL 73 was granted under Section 29-38 of the Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991) administered by the Ministry of Mines and Energy (MME) as the Competent Authority. REN is a subsidiary of Reconnaissance Energy Africa Ltd (ReconAfrica), a Canadian public listed company. REN is the Operator of PEL 73 holding 90% of the license interests. The National Petroleum Corporation of Namibia (Namcor), a Namibian State-owned company (Parastatal) holds the remaining 10% interest in the Licence, with its costs carried to the development stage. The license was granted in January 2015 and exploration period continues to January 2024 with the rights to extend to January 2026 (Figs. 1.1 and 1.2). Following declaration of a commercial discovery, the Petroleum Agreement entitles REN to apply for a production licence having a 25-year term. The fiscal terms of the Petroleum Agreement call for a corporate income tax of 35%, royalty of 5%, and an additional profits tax that applies late in the life of a producing field.

1.2 Proposed Exploration and Appraisal Wells Drilling Programme

1.2.1 Types of Oil and Gas Wells

The Proponent is proposing to drill the exploration and appraisal wells Nos. D1-D6 and G1-G6 as part of the ongoing oil and gas exploration programme for the period 2023-2024 inclusive of the supporting infrastructures such as the new access roads to each of the proposed new wells sites, the use of existing borrow pits and other associated services. Oil and gas well drilling process involve creation of an engineered hole (well) in the ground for a given objective. The following is the summary of different type of wells that are drilled for different objectives:

(i) Stratigraphic well drilled to study the geology or confirm the presence of a petroleum system (Sedimentary Basin) such as the drilled 6-2 Kawe, 6-1 Mbambi, and 8-2 Makandina.

(ii) Exploration and Appraisal Wells. Exploration well such as the proposed D1-D6 and G1-G6 wells are drilled in new areas to confirm the presence of an oil or gas reservoir that may contain economic oil or gas based on the results of the seismic survey, airborne gravity, and stratigraphic well drilling data sets. Exploration wells (or wildcat wells) are drilled for exploration purposes in new areas. Appraisal wells such as the proposed D1-D6 and G1-G6 wells drilled within the same area where exploration wells were drilled and found oil or gas or both. Appraisal drilling operations are undertaken to determine the size and characteristics of a petroleum discovery made during the exploration drilling process. The appraisal drilling characteristics to be determined include the quantity of oil and/or gas present, the location of fluid contacts, the presence and distribution of baffles and barriers to fluid flow, and the quality of the reservoir, and.

(iii) Production wells are drilled for the extraction oil or gas from the subsurface reservoir.

The proposed drilling of the prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6, forms part of the ongoing petroleum exploration work programme for PEL No. 73 as agreed in the Petroleum Agreement signed between the Ministry of Mines and Energy (MME) and REN. The results of the 6-1 Mbambi, and 6-2 Kawe, 8-2 Makandina stratigraphic test wells drilled by REN in 2021 and 2022 respectively, and the subsequent 2D seismic survey data acquired in the Kavango Sedimentary Basin (KSB), have established a significant rift basin similar to other major petroleum provinces / rift basins in other parts of World. Thus far, the integrated interpretation has established the Karoo Rift Fill (Light Oil), Secondary: Intra-Rift Fault Blocks (Light Oil), and Secondary: Damara Fold Belt (New Play, Gas/Gas Condensate) with the Damara Fold Belt being the current key exploration priority area (Figs. 1.3-1.5).

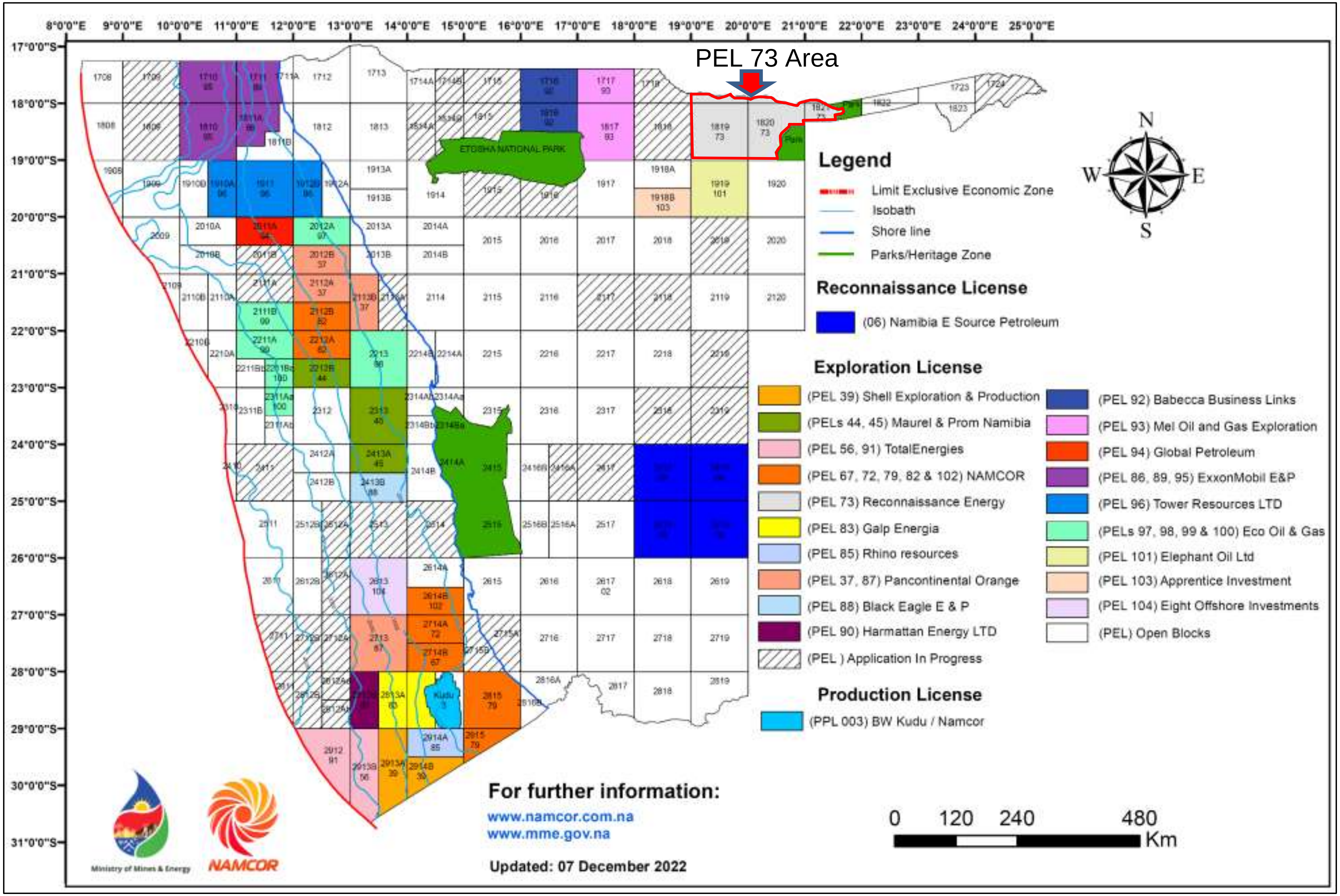


Figure 1.1: Hydrocarbon Map of Namibia showing Petroleum Exploration License (PEL) No. 73 covering parts of the Degree (Latitude and Longitude) Square Blocks Nos. 1719, 1720, 1721, 1819, 1820 and 1821 in the Kavango Sedimentary Basin, Kavango West and East Regions, northern Namibia (Source: www.namcor.com).

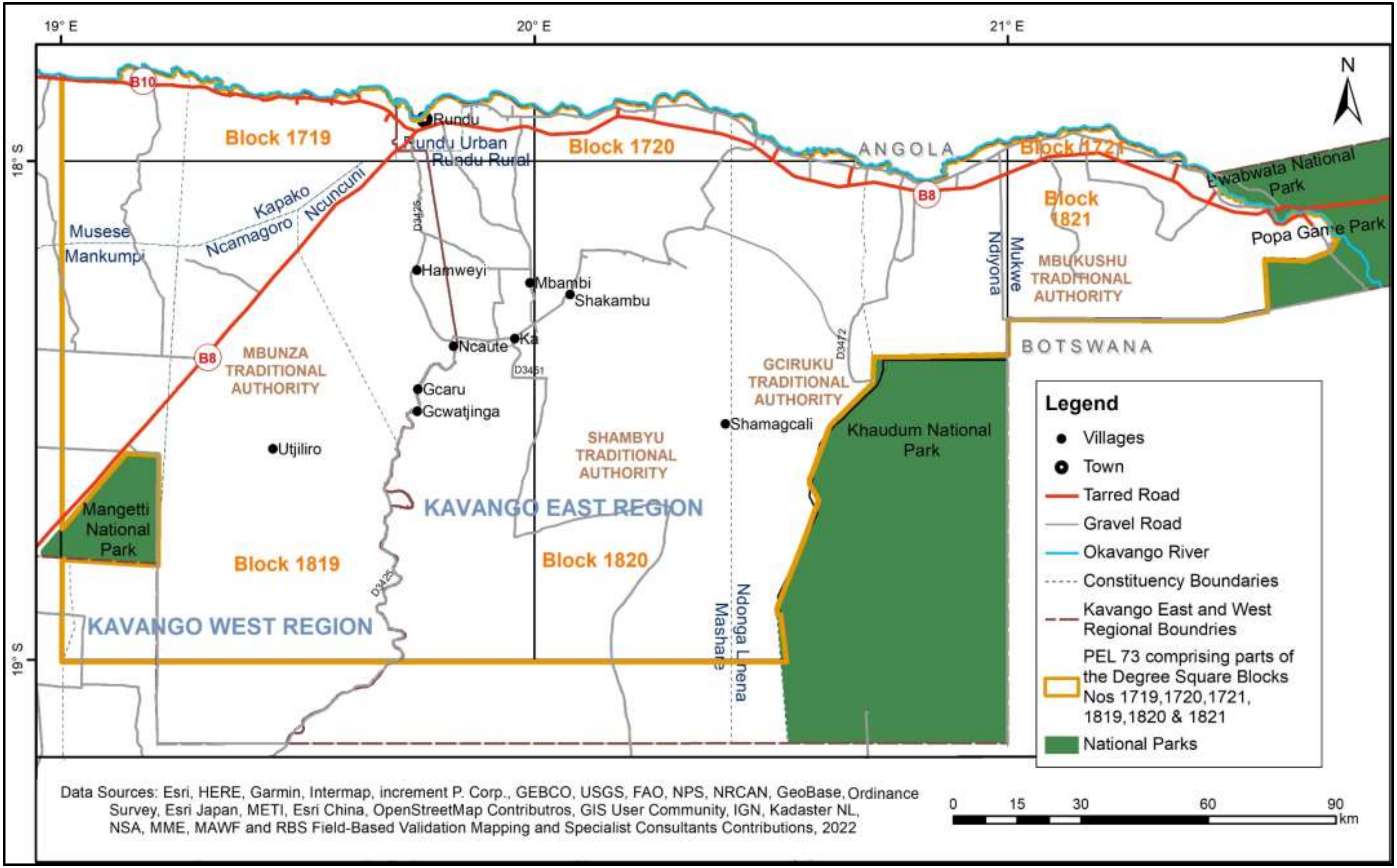


Figure 1.2: Regional location of PEL No. 73 covering parts of the Degree Square Blocks Nos. 1819, 1820, 1821, 1719, 1720, and 1721 falling within the KSB covering multiple traditional authorities in Kavango East and West Regions.

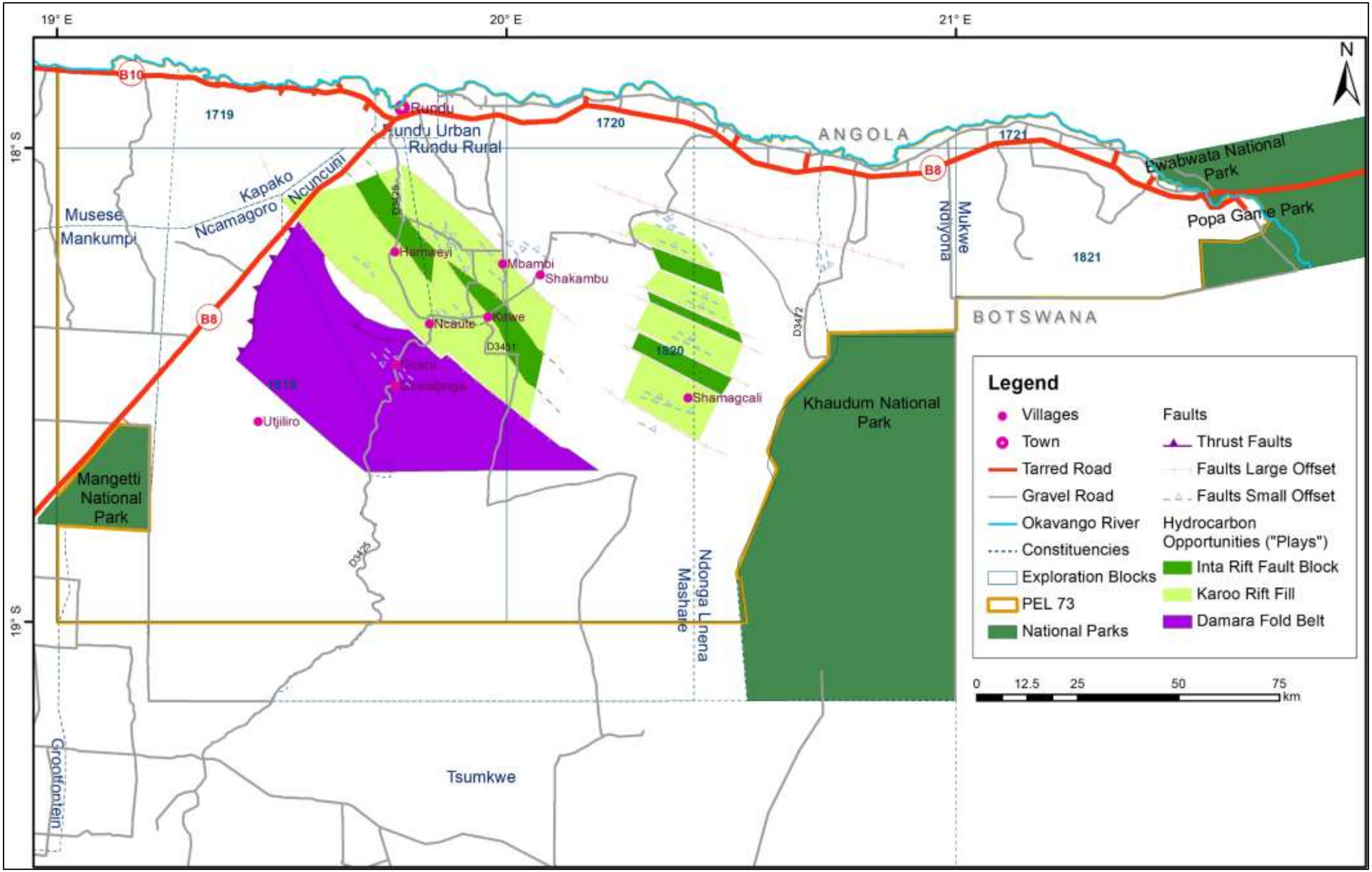


Figure 1.3: REN established hydrocarbon Plays of the Kavango Sedimentary Basin showing the Primary: Karoo Rift Fill (Light Oil), Secondary: Intra-Rift Fault Blocks (Light Oil), and Secondary: Damara Fold Belt (New Play, Gas/Gas Condensate), (Data Source: REN, 2022).

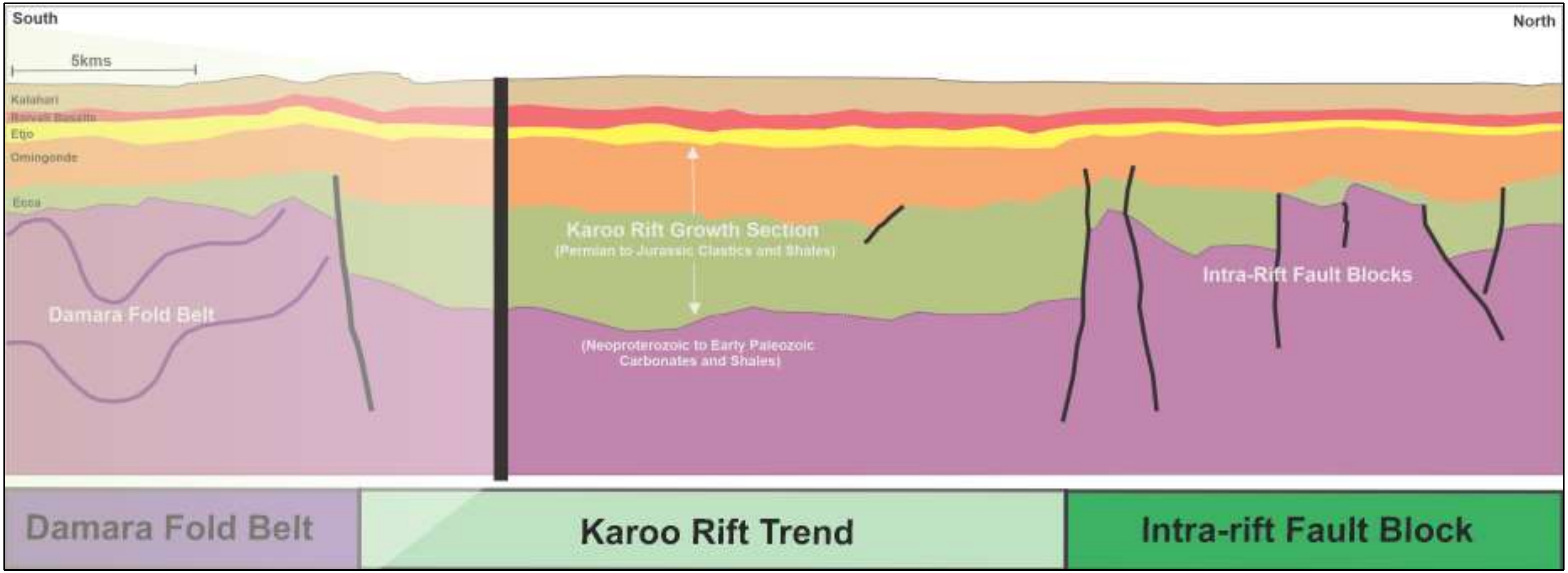


Figure 1.4 REN delineated Kavango Sedimentary Basin (KSB) hydrocarbon plays showing the Primary Karoo Rift Fill (light oil), Secondary Intra-Rift Fault Blocks (light oil), and Secondary Damara Fold Belt (new play, gas/gas condensate). Karoo Rift Basin showing the main and perched grabens (rift valleys); note the series of normal faults controlling the rift basin architecture and depositional stratigraphy (Source: REN, 2022).

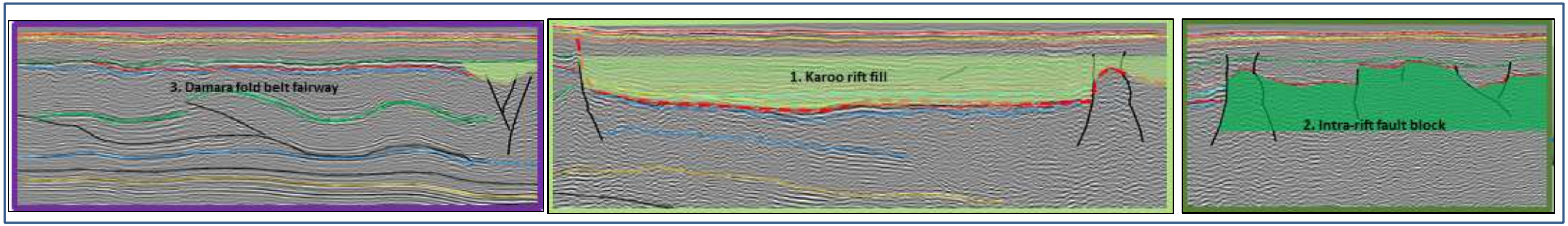


Figure 1.5: REN preliminary seismic interpretation sections showing the Damara Fold Belt, current priority exploration focal area and note the train of anticlinal folds developed above the basal thrust detachment (Black horizontal line) and intersected by reverse faults, Karoo Rift Fill and Intra-Rift Fault Blocks hydrocarbon plays (Source: REN, 2022).

1.2.2 Proposed Exploration and Appraisal wells Nos. D1-D6 and G1-G6

As part of the progressive processes of de-risking the KSB, REN is proposing to drill the prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6 designed to confirm the existence of economic oil and / or gas resources with the delineated targets / prospects and leads process based on additional 2D seismic survey data acquisition and interpretation, airborne geophysical surveys and the stratigraphic well data sets (Table 1.1).

The drilling of the proposed exploration and appraisal wells will be undertaken using the Crown 750 truck mounted drill rig currently being used by REN to drill the stratigraphic wells and will apply the same drilling technology with the addition of well testing in an event of a discovery.

REN will continue with the drilling of the stratigraphic wells programme for 2022-2023 as shown in Table 1.1, based on the current granted permits until all the required permits, consents and authorisations to drill the proposed prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6 have been granted by the Government.

1.2.3 Objectives of the Proposed Exploration and Appraisal Wells

The following is the summary of the overall well/ operational objectives of drilling the proposed D1-D6 and G1-G6 exploration and appraisal wells:

- ❖ To evaluate the hydrocarbon potential safely and efficiently of the Kavango Sedimentary Basin.
- ❖ Geologically date the sediments and stratigraphy via post-well palynology and stratigraphic analysis of cuttings and sidewall cores.
- ❖ Obtain relevant and accurate petrophysical data via sample analysis, whole core, and wireline logging, and.
- ❖ Evaluate the economic / commercial opportunities of producing oil and gas within the Kavango Sedimentary Basin.

1.3 Location of the Proposed Exploration and Appraisal Wells

1.3.1 Overview of the Proposed Exploration and Appraisal Wells

The proposed exploration and appraisal wells locations are based on the interpretation of the processed 2D seismic survey and drilled stratigraphic wells data sets (Table 1.1 and Figs. 1.6-1.10). According to REN, 2022, the acquired 2D seismic survey data show that the Karoo Rift Basin is composed of several sub-basins that should open new plays within the context of the original exploration concepts (Fig. 1.8).

In addition, the 2D seismic survey and drilled stratigraphic wells data sets also identified targets in the "Damara Fold Belt", an extensive area of folded and faulted anticlines to the southwest of the Karoo Rift Basin, potentially serving as excellent structural and stratigraphic traps in the Pre-Karoo stratigraphy (Fig. 1.9).

Table 1.1 and Figs. 1.6-1.10 shows the locations of the proposed prioritised new exploration and appraisal wells to be drilled in 2023-2024.

Based on the stratigraphic wells data and interpretation of the 2D seismic surveys conducted to date, the proposed and prioritised twelve (12) exploration and appraisal wells programme has been grouped into Damara Fold Belt Leads ("D" numbered Wells) and Graben ("G" numbered Wells) covering the primary Karoo Rift Fill and secondary Intra-Rift Fault Blocks Leads (Table 1.1 and Fig. 1.8).

Table 1.1: List of the stratigraphic and exploration and appraisal wells status for PEL 73.

<table>
<tr><th>No.</th><th>Type of Well</th><th>Well Reference No.</th><th>Latitude</th><th>Longitude</th><th>Description</th><th>Status and Priority Rating</th></tr>
<tr><td>1.</td><td rowspan="12">STRATIGRAPHIC WELLS:

Designed to confirm and map the KSB, associated subbasins and petroleum systems with well targets, prospects and leads as part of a de-risking process based on regional data sets including airborne geophysics, initial 2D seismic and regional geological mapping results.</td><td>Prospect (P) 23</td><td>18°14'29.2256"S</td><td>19°41'33.1983"E</td><td>Hamweyi Village Well Site Not Drilled</td><td rowspan="2">Not a Priority at Present</td></tr>
<tr><td>2.</td><td>Prospect (P) 32</td><td>18°21'15.9030"S</td><td>19°51'40.3686"E</td><td>Cumezao Village Well Site, Not Drilled</td></tr>
<tr><td>3.</td><td>8-2 Makandina (Prospect (P) 33)</td><td>18°21'18.9137"S</td><td>19°55'01.9628"E</td><td>Makandina Village Stratigraphic Well drilled in 2022</td><td>Completed and Site to be Rehabilitated</td></tr>
<tr><td>4.</td><td>Wisdom 5-1 Well (Prospect (P) P2-7)</td><td>18°24'42.6361"S</td><td>20°02'18.2718"E</td><td>Farm Wisdom Stratigraphic Well</td><td>To be Drilled Starting December 2022</td></tr>
<tr><td>5.</td><td>6-2</td><td>18°20'25.7"S</td><td>19°58'29.0"E</td><td>Kawe Village Well Drilled in 2021</td><td>Proposed for Sidetracked in 2022-2023 Work Programme</td></tr>
<tr><td>6.</td><td>6-1</td><td>18°13'18.0"S</td><td>19°59'37.5"E</td><td>Mbambi Village Stratigraphic Well Drilled in 2021</td><td>Completed and Site to be Rehabilitated</td></tr>
<tr><td>7.</td><td>2-7</td><td>18°26'11.23"S</td><td>20° 1'37.47"E</td><td rowspan="6">Initial identified wells aimed at confirming the existence of a Sedimentary Basin not drilled and not priority</td><td rowspan="6">Not a Priority at Present</td></tr>
<tr><td>8.</td><td>4-3</td><td>18°31'41.76"S</td><td>20° 2'26.86"E</td></tr>
<tr><td>9.</td><td>5-2</td><td>18°27'7.60"S</td><td>19°36'6.70"E</td></tr>
<tr><td>10.</td><td>5-4</td><td>18°24'50.12"S</td><td>19°34'27.76"E</td></tr>
<tr><td>11.</td><td>5-6</td><td>18°34'10.34"S</td><td>19°34'21.34"E</td></tr>
<tr><td>12.</td><td>5-7</td><td>18°38'19.61"S</td><td>19°33'20.95"E</td></tr>
<tr><td>13.</td><td rowspan="13">Exploration and Appraisal Wells:

Designed to Confirm the Existence of Economic Oil and / or Gas Resources with the Delineated Targets / Leads De-Risking Approach Based on 2D Seismic Survey, Airborne Surveys and Stratigraphic Wells Data Sets</td><td>D1</td><td>18°16'44.8394"S</td><td>19°31'53.6353"E</td><td>Ncamagoro Community Forest</td><td rowspan="2">Proposed Well Priority No. 3</td></tr>
<tr><td>14.</td><td>D2</td><td>18°19'36.1605"S</td><td>19°33'25.2871"E</td><td>Mbeyo Community Forest</td></tr>
<tr><td>15.</td><td>D3</td><td>18°26'12.2958"S</td><td>19°41'37.2901"E</td><td>Gcaru Village Well Site</td><td>Proposed Well Priority No. 2</td></tr>
<tr><td rowspan="2">16.</td><td>D4 Original</td><td>18°33'19.6969"S</td><td>19°42'43.7835"E</td><td rowspan="2">Naingopo Village Well Site</td><td rowspan="2">Proposed Well Priority No. 3 Alternative to D5 (Priority No. 1)</td></tr>
<tr><td>D4-1 Alternative</td><td>18°33'20.2392"S</td><td>19°42'39.5532"E</td></tr>
<tr><td>17.</td><td>D5</td><td>18°35'54.6514"S</td><td>19°44'37.8243"E</td><td>Gcwatjinga Community Forest</td><td rowspan="2">Proposed Well Priority No. 1</td></tr>
<tr><td>18.</td><td>D6</td><td>18°35'32.4710"S</td><td>19°54'10.1501"E</td><td>Farm 1529</td></tr>
<tr><td>19.</td><td>G1</td><td>18°14'37.5326"S</td><td>19°44'30.2843"E</td><td>Hamweyi Village Well Site</td><td rowspan="2">Proposed Well Priority No. 3</td></tr>
<tr><td>20.</td><td>G2</td><td>18°27'14.7688"S</td><td>19°57'25.2756"E</td><td>Farm 1562</td></tr>
<tr><td>21.</td><td>G3</td><td>18°24'18.2999"S</td><td>20°0'39.7775"E</td><td>Farm 1564</td><td>Proposed Well Priority No. 2</td></tr>
<tr><td>22.</td><td>G4</td><td>18°26'37.2785"S</td><td>20°4'52.2771"E</td><td>Farm 1565</td><td>Proposed Well Priority No. 3</td></tr>
<tr><td>23.</td><td>G5</td><td>18°26'35.5441"S</td><td>20°10'27.7691"E</td><td>Farm 1567</td><td rowspan="2">Proposed Well Priority No. 1</td></tr>
<tr><td>24.</td><td>G6</td><td>18°26'24.1417"S</td><td>20°18'33.8072"E</td><td>Farm 1572</td></tr>
</table>

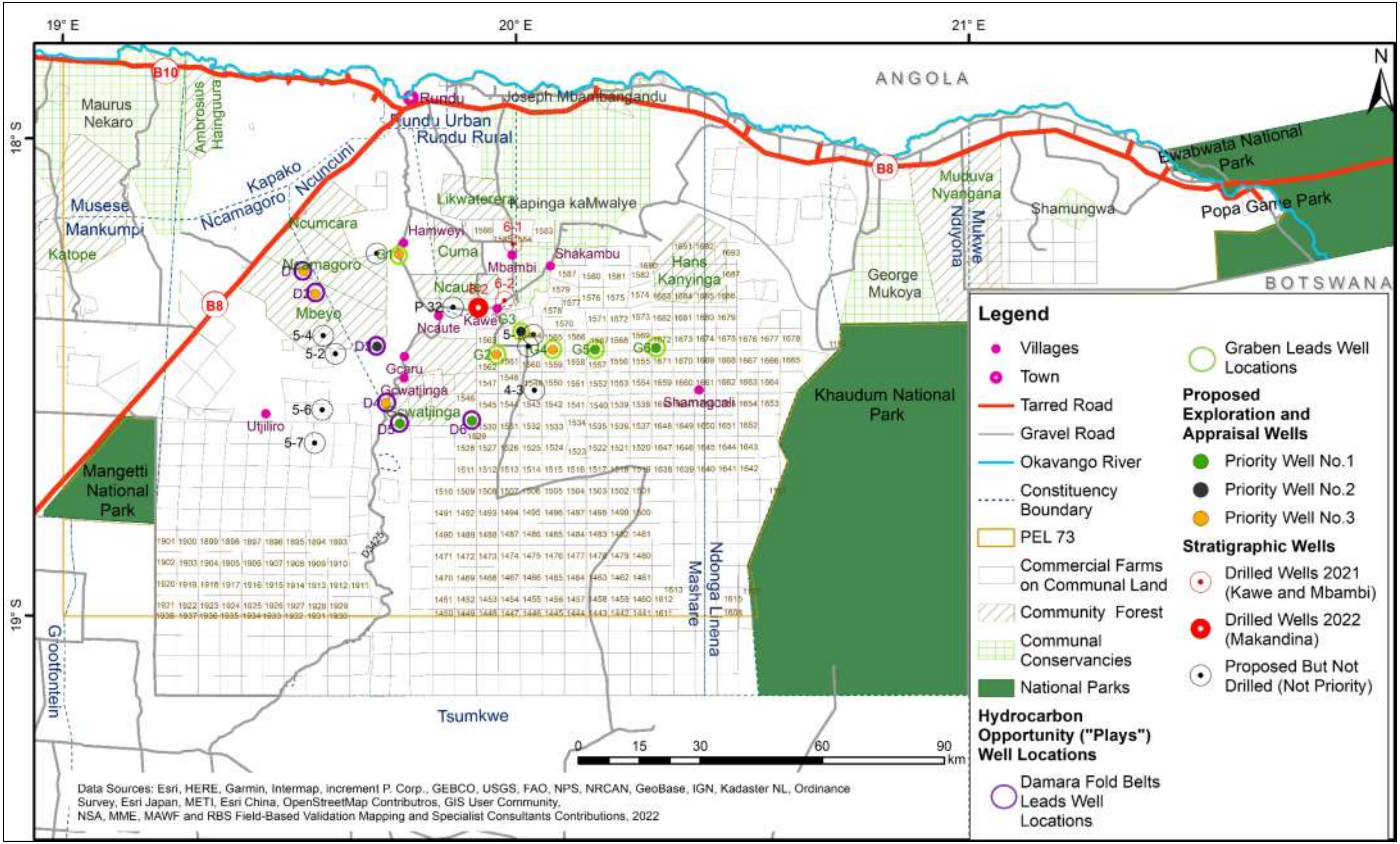


Figure 1.6: PEL No. 73 regional map showing the stratigraphic well locations with respect to the proposed exploration and appraisal wells locations, and other land uses such as commercial farms on communal land, community forest, community conservancies and national parks.

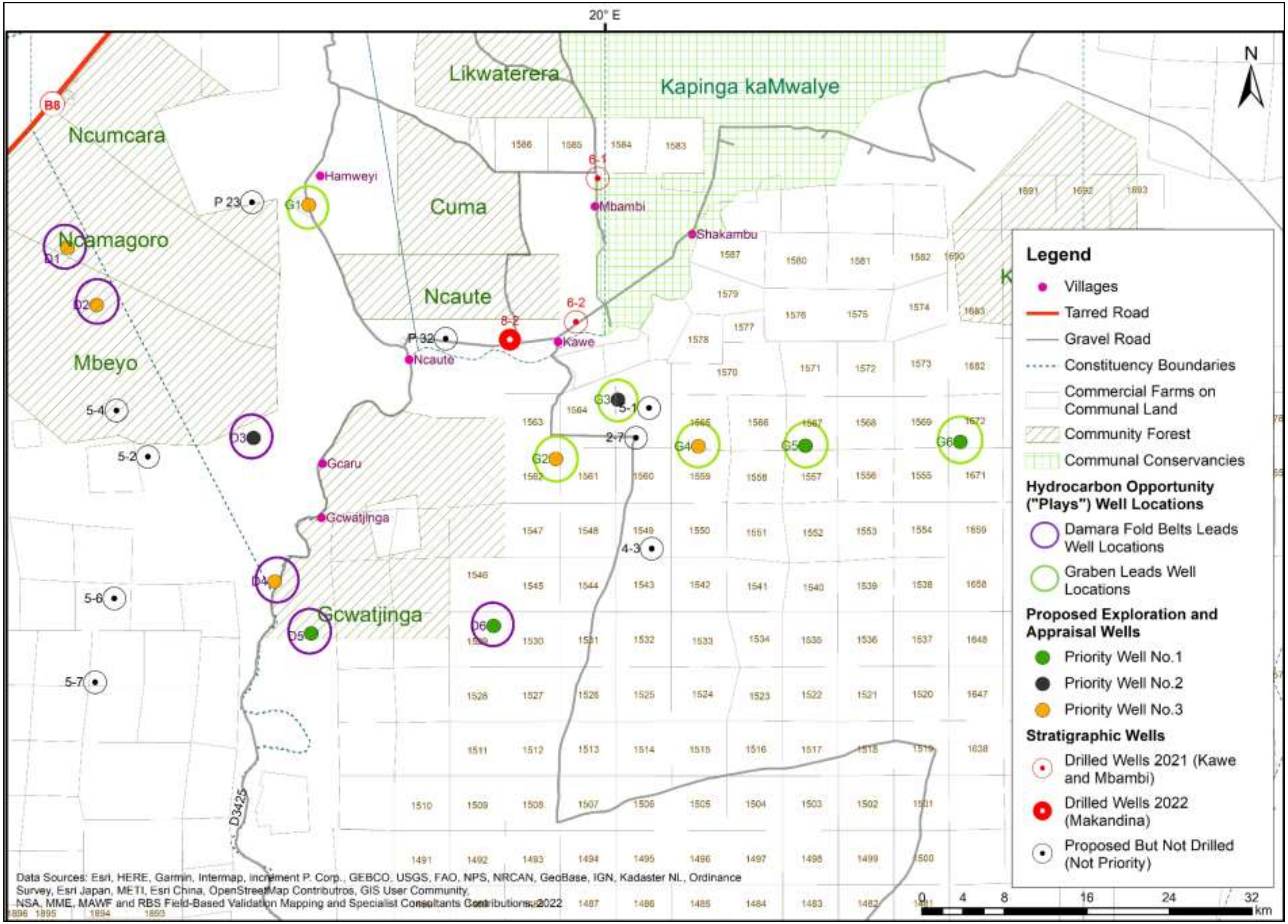


Figure 1.7: Local AOI map showing all the stratigraphic well locations with respect to the new proposed exploration and appraisal wells locations, and other land uses such as commercial farms on communal land, community forest and community conservancies.

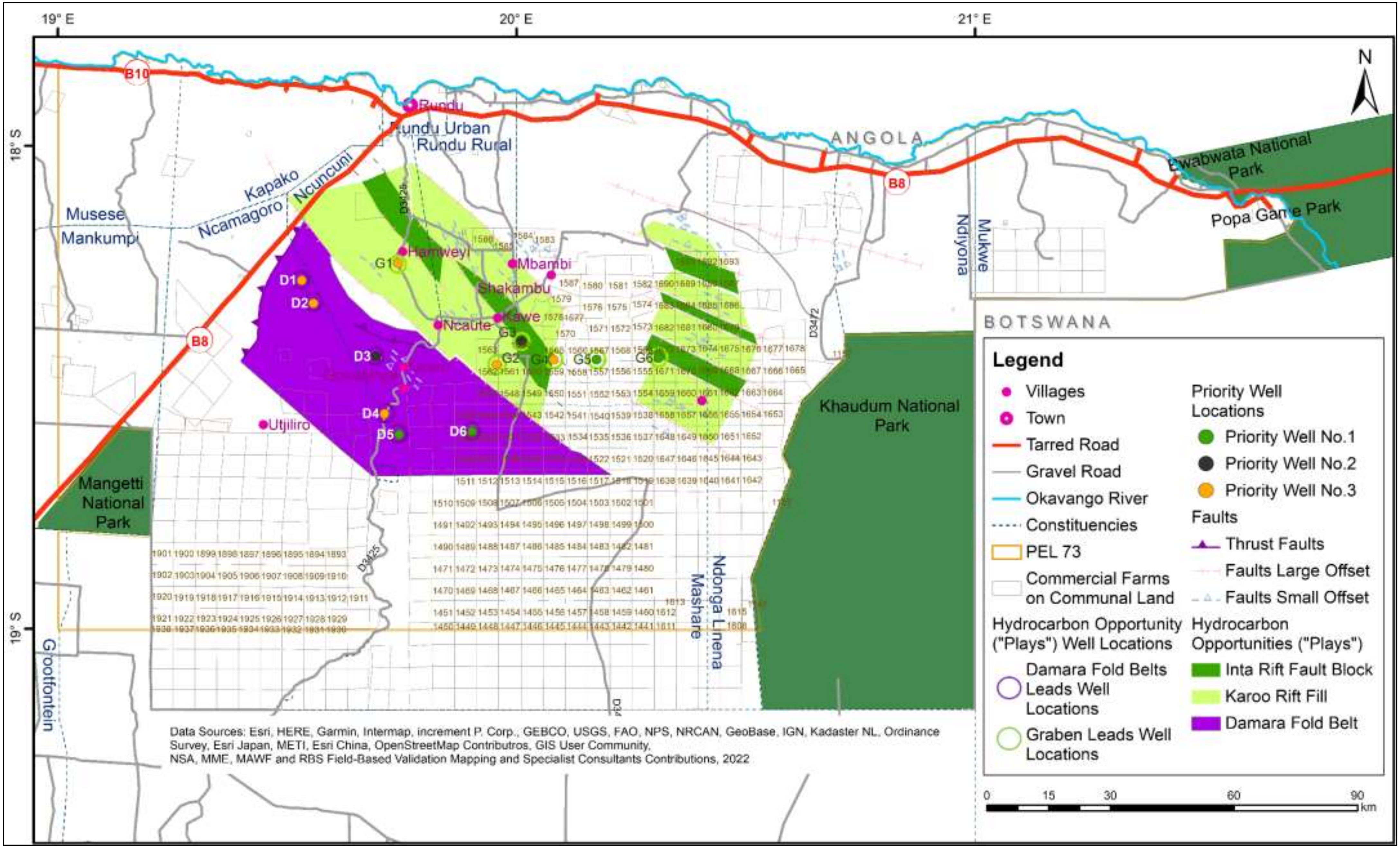
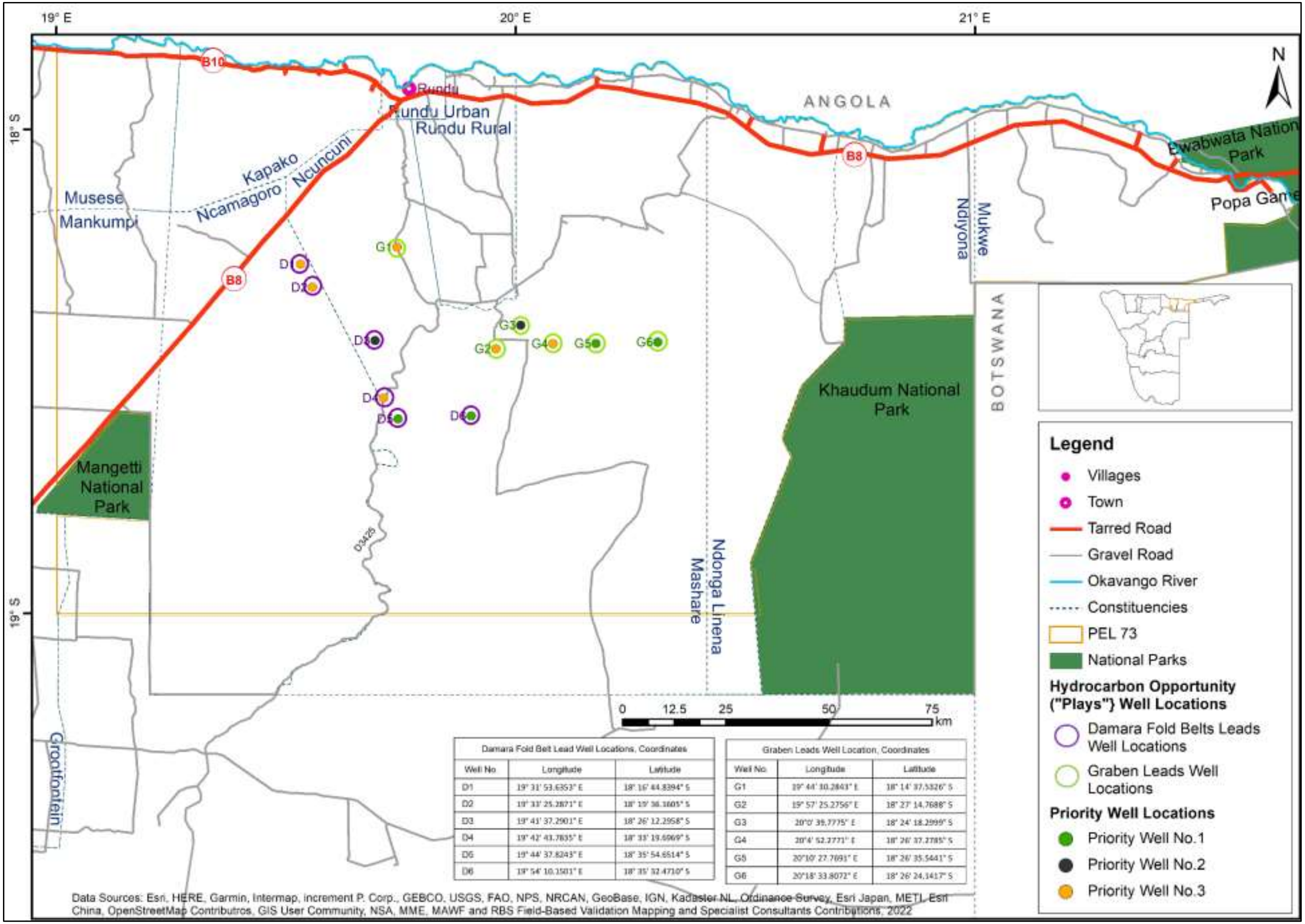


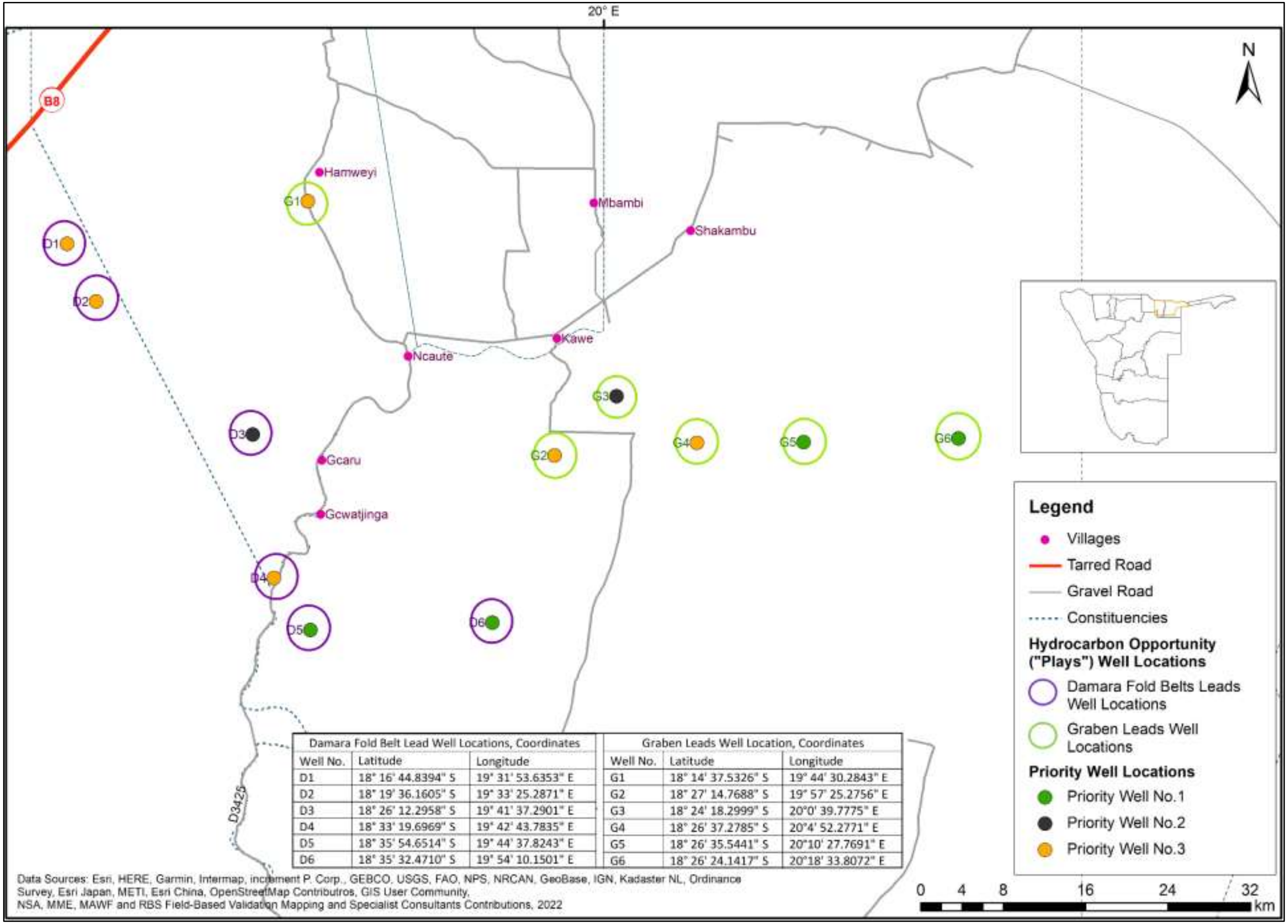
Figure 1.8: PEL No. 73, Kavango Sedimentary Basin regional hydrocarbon subsurface opportunities ("Plays") map based on 2D seismic survey interpretation and showing the locations of the proposed new exploration and appraisal wells locations aimed at validating the commerciality of the established hydrocarbon plays (Data Source: REN, 2022).



Damara Fold Belt Lead Well Locations, Coordinates		
Well No	Longitude	Latitude
D1	19° 31' 53.6353" E	18° 16' 44.8394" S
D2	19° 33' 25.2871" E	18° 19' 36.1605" S
D3	19° 41' 37.2901" E	18° 26' 12.2958" S
D4	19° 42' 43.7835" E	18° 33' 19.6969" S
D5	19° 44' 37.8243" E	18° 35' 54.6514" S
D6	19° 54' 10.1501" E	18° 35' 32.4710" S

Graben Leads Well Location, Coordinates		
Well No	Longitude	Latitude
G1	19° 44' 30.2843" E	18° 14' 37.5326" S
G2	19° 57' 25.2756" E	18° 27' 14.7688" S
G3	20°0' 39.7775" E	18° 24' 18.2999" S
G4	20°4' 52.2771" E	18° 26' 37.2785" S
G5	20°10' 27.7691" E	18° 26' 35.5441" S
G6	20°18' 33.8072" E	18° 26' 24.1417" S

Figure 1.9: PEL No. 73 regional map showing the new proposed exploration and appraisal wells locations coordinates.



Damara Fold Belt Lead Well Locations, Coordinates		
Well No.	Latitude	Longitude
D1	18° 16' 44.8394" S	19° 31' 53.6353" E
D2	18° 19' 36.1605" S	19° 33' 25.2871" E
D3	18° 26' 12.2958" S	19° 41' 37.2901" E
D4	18° 33' 19.6969" S	19° 42' 43.7835" E
D5	18° 35' 54.6514" S	19° 44' 37.8243" E
D6	18° 35' 32.4710" S	19° 54' 10.1501" E

Graben Leads Well Location, Coordinates		
Well No.	Latitude	Longitude
G1	18° 14' 37.5326" S	19° 44' 30.2843" E
G2	18° 27' 14.7688" S	19° 57' 25.2756" E
G3	18° 24' 18.2999" S	20°0' 39.7775" E
G4	18° 26' 37.2785" S	20°4' 52.2771" E
G5	18° 26' 35.5441" S	20°10' 27.7691" E
G6	18° 26' 24.1417" S	20°18' 33.8072" E

Figure 1.10: Detailed Area of Interest (AOI) map showing the new proposed exploration and appraisal wells locations coordinates.

1.3.2 Detailed Locations of the Damara Fold Belt Leads Wells Sites

The following is the summary of the prioritised Damara Fold Belt Leads ("D" numbered Wells) exploration and appraisal wells locations (Table 1.1 and Figs. 1.7-1.23 and Plates 1.1 -1.6):

(i) The Damara Fold Belt Leads priority group No. 1 covers the D5 (Figs. 1.12 and 1.13 and Plate 1.1) and D6 (Figs. 1.14 and 1.15 and Plate 1.2), with D4 (original Well site) and D4_1 (Alternative site moved away from the communal farmland) (Figs. 1.16 and 1.17 and Plate 1.3) being an alternative to the D5. The D5 well location falls inside the southern margin / boundary of the Gcwatjinga Community Forest, accessible along the D3425 Road. The well site is about 100 km from Rundu, 45 km from Ncaute and 5km off the D3425, along the existing community fire cut line. A new 70m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access will need to be created. If the need to drill this well location arises, the current well location may be moved outside the Community Forestry boundary, if applicable. The D6 well location is situated on a commercial Farm 1529 on Communal land accessible along the D3425 Road. It is located about 17 km to the east of D5 and accessible along an existing fire cut line which turns into local farm boundary access. A new 175 m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access will need to be created to access this site. The D4 well location is situated at Naingopo Village which is about 32 km and 92 km from Ncaute and Rundu, respectively, and accessible along the D3425 gravel road. This well location (D4) has been shifted to D_4 away from the local settlement and subsistence farmlands. A new 490m long, 10 m wide with a curve radius of less than 22m access road from the D3425 will need to be created.

(ii) Priority group No. 2 covers the D3 well site situated about 7km to the west of the village of Gcaru and accessible along an existing track linked to the D3425 road through Ncaute to Rundu (Figs. 1.18 and 1.19 and Plate 1.4). The proposed well site is about 22 km from Ncaute and 82 km from Rundu. A new 260m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access from Gcaru will need to be created linking to the D3425 Road at Gcaru, and.

(iii) Priority group No. 3 cover the D1 (Figs. 1.20 and 1.21 and Plate 1.5) and the D2 (Figs. 1.22 and 1.23 and Plate 1.6) well locations fall within the Ncamagoro and Mbeyo Community Forests, respectively. Both wells are accessible along the B8 (11 km from Rundu) east turnoff into an existing fire cut line through the Community Forest. The D1 and D2 well sites are about 11 km and 20 km respectively from the B8 turnoff. D1 well location will require a new 360m long access road from the existing upgraded access to be created linking to the B8 Road. The D2 well location will require a new 20m long access road from the existing upgraded access to be created linking to the B8 Road.

1.3.3 Detailed Locations of the Graben Leads Wells Sites

The following is the summary of the prioritised leads of the Graben Play ("G" numbered Wells) covering the Karoo Rift Fill and Intra-Rift Fault Blocks exploration and appraisal wells locations (Table 1.1 and Figs. 1.7, 1.24-1.35 and Plates 1.7-1.12):

(i) The Graben (G) priority group No. 1 covers the G5 (Figs. 1.24 and 1.25 and Plate 1.7) and G6 (Figs. 1.26 and 1.27 and Plate 1.8) well locations are located on commercial farms on communal land, Farms Nos. 1567 and 1672, respectively. The well sites are located to the south southeast of Mutweghombahe and Kawe settlements. From Mutweghombahe the proposed well sites G5 and G6 are situated about 30 km and 45km, respectively, along the large-scale agricultural commercial farming units on communal land existing access road network (Plate 1.1). The G5 and G6 well locations will require new 130m and 430m long access roads respectively, from the existing upgraded accesses to be created. The new access roads to be upgraded and created will need to be 10m wide with a curve radius of less than 22m.

(ii) Graben (G) priority group No. 2 covers: The proposed G3 well site is situated to the south of Mutweghombahe and south southeast of Kawe settlements. The location of the G3 well site falls on privately owned large-scale agricultural commercial farming units on communal land (Figs.

1.28 and 1.29 and Plate 1.9). Specifically, G3 falls on Farm No. 1564 named Wisdom owned by Mr. Hannes Balzar. From Mutweghombahe the proposed well site G3 is situated about 13km along the large-scale agricultural commercial farming units on communal land existing access road network. A new 420m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access will need be created, and.

(iii) Graben (G) priority group No. 3 cover the G1 (Figs. 1.30 and 1.31 and Plate 1.10), G2 (Figs. 1.32 and 1.33 and Plate 1.11), and G4 (Figs. 1.34 and 1.35 and Plate 1.12) well locations. G1 well site is located at Hamweyi Village along the eastern side of the D3425 road linking Rundu to Ncaute (Fig. 1.21). The G1 well site is about 43km from Rundu and 18km from Ncaute and will require a new 810m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access to be created. The G2 and G4 well locations both falls on privately owned large-scale agricultural commercial farming units on communal land Farm Nos. 1562 and 1565, respectively. The well sites are located south southeast of Mutweghombahe and Kawe settlements. From Mutweghombahe the proposed well sites G2 and G4 are situated about 22 km and 20km, respectively, along the large-scale agricultural commercial farming units on communal land existing access road network. The G2 and G4 well locations will require new 250m and 810m long access roads respectively, from the existing upgraded accesses to be created. The new access roads to be upgraded and created will need to be 10m wide with a curve radius of less than 22m.

1.3.4 Access to Surface Land Rights Only with Consent

Although the ownership of communal land is vested in the State with the traditional authorities in Namibia having custodianship, access to surface land rights by REN to exercise its subsurface petroleum exploration rights may require one of the following temporary consents or long-term leaseholders as may be applicable or required:

(i) Obtain consent from a leaseholder/s for temporary use for the duration of the drilling period only with no need for long-term usage.

(ii) In the absence of leaseholder, REN shall obtain consent by approaching a local village headman / headwoman, with surface land rights ownership confirmed by the traditional authority before approaching the Communal Land Board either Kavango West or East Regional Council for endorsement of the temporary consent as may be required, and.

(iii) To obtain a leaseholder for a longer period to support the drilling operations locally or elsewhere within the PEL 73, REN shall approach the leaseholder or a local village headman / headwoman, with surface land rights ownership confirmed by the traditional authority before approaching the Communal Land Board in the relevant Regional Council for a leasehold.

At the end of the drilling operations, the portion of the land offered for the drilling activities shall be rehabilitated and given back to the owner. Note that each of the wellheads that will remain on each of the drilling sites are a property of the State and shall be secured and not to be tampered by the land owner or local community.

1.3.5 Local Communities Not Going to be Relocated / Lose Land / Displaced

During any oil and gas exploration programme (seismic survey or drilling of stratigraphic or exploration / appraisal wells), no community relocation whatsoever takes place and no one will be relocated, lose their land, or displaced during the proposed exploration and appraisal wells drilling operations. No community relocations are undertaken during oil and gas exploration operations and rarely undertaken even during the oil or gas field development stages following a commercial discovery. Instances of community relocations may only affect a community settlement that may be located too close to a critical oil and gas supporting infrastructure that cannot be situated anywhere within the discovered oil or gas field. Such infrastructure may include a production well/s, pipeline, power station, refinery or any other supporting infrastructure to the oil or gas field development and operational safety requirements. Such issues will indeed be addressed in a separate environmental assessment that may be implemented for the production phase of any commercially discovered oil or gas resources within PEL 73.

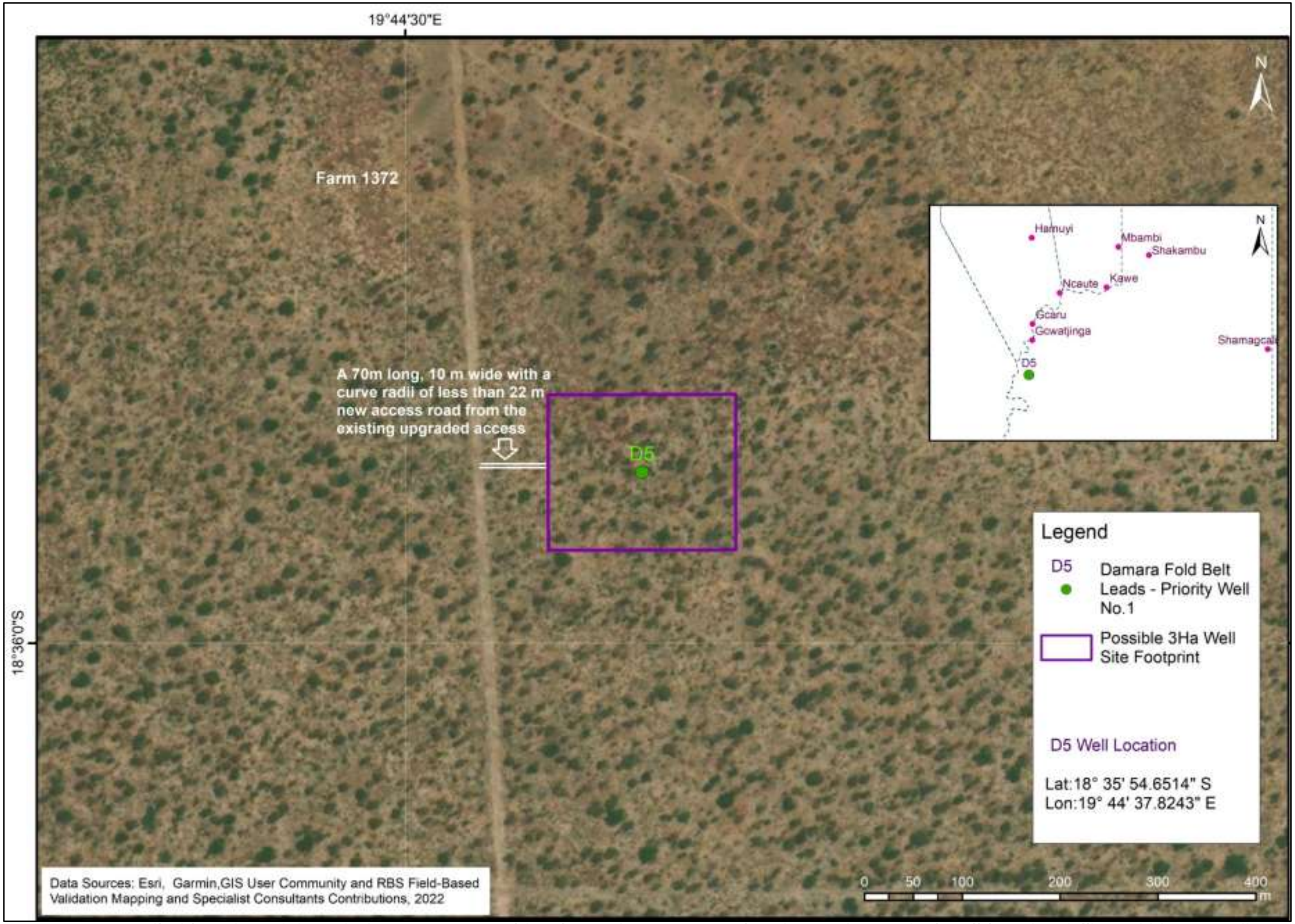


Figure 1.11: Detailed location of the priority 1 Damara Fold Belt Leads No. D5 exploration and appraisal well location falling within Gcwatjinga Community Forest boundary. The D4 well location is an alternative site to the D5 well location. A new 70m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

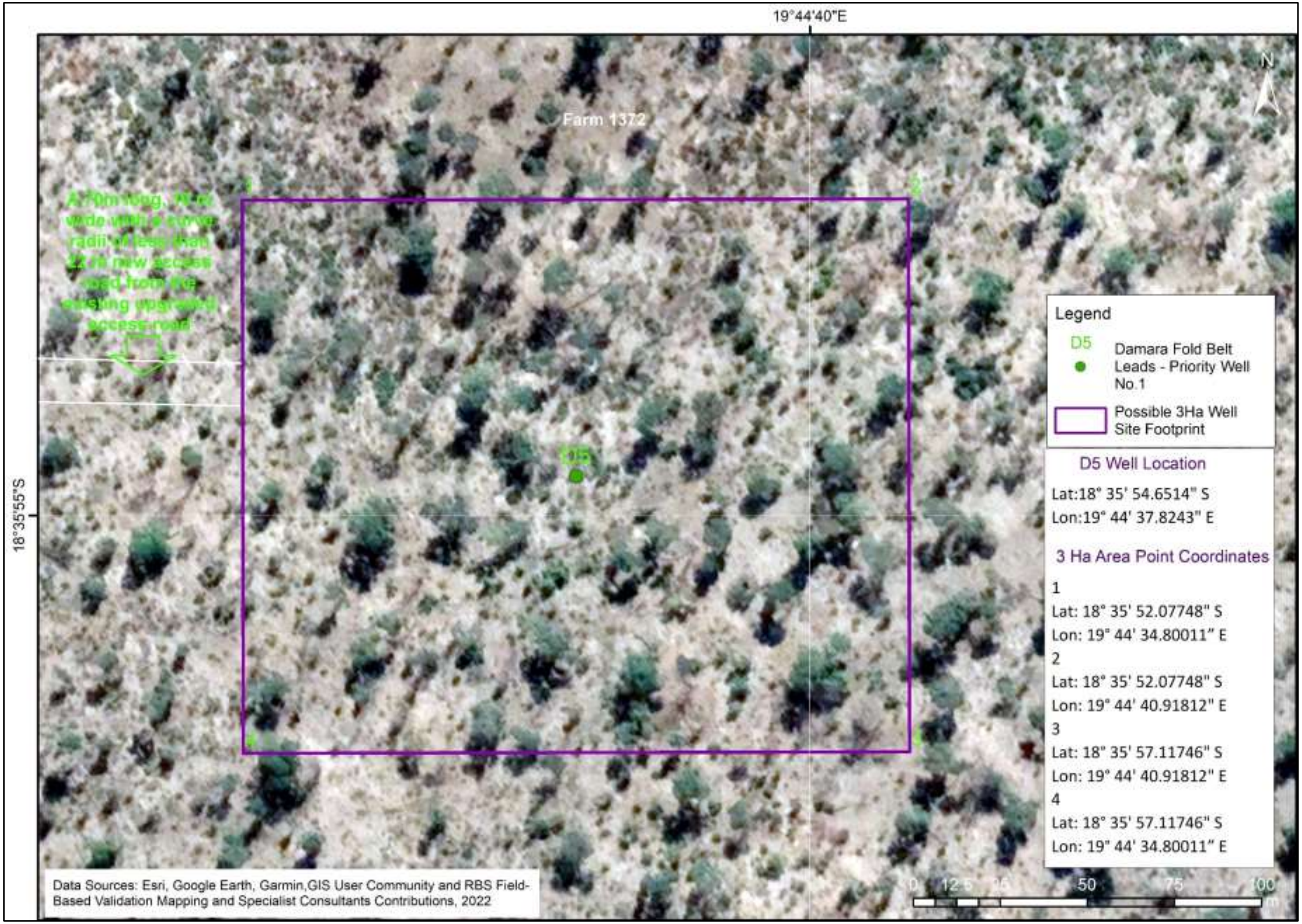


Figure 1.12: Detailed outline of the 3Ha area of the priority 1 Damara Fold Belt Leads No. D5 exploration and appraisal well location falling within Gcwatjinga Community Forest boundary. The D4 well location is an alternative site to the D5 well location. A new 70m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Plate 1.1: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. D5.

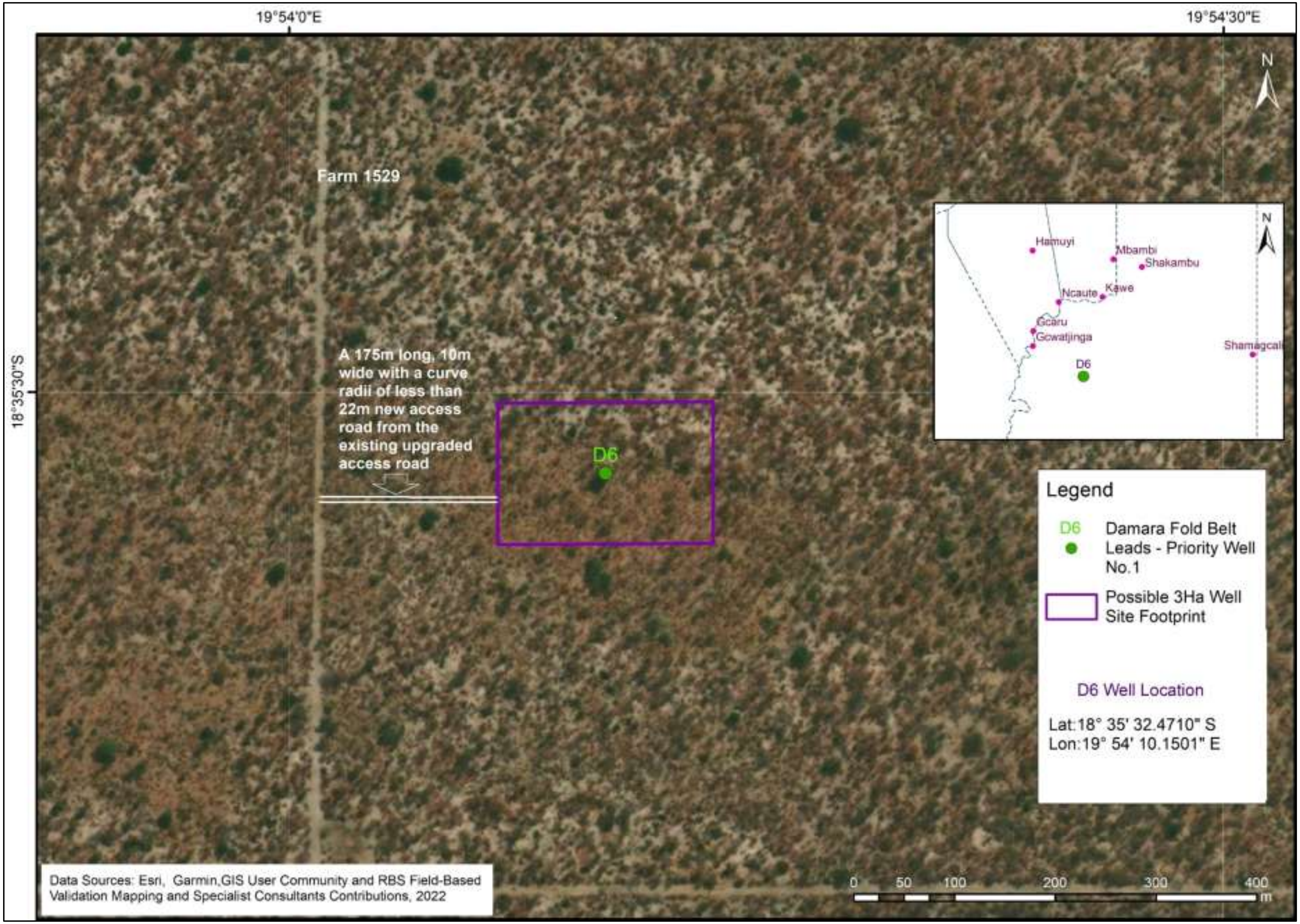


Figure 1.13: Detailed location of the priority 1 Damara Fold Belt Leads No. D6 exploration and appraisal well location falling on a commercial farm on communal land, Farm No. 1529. A new 175m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

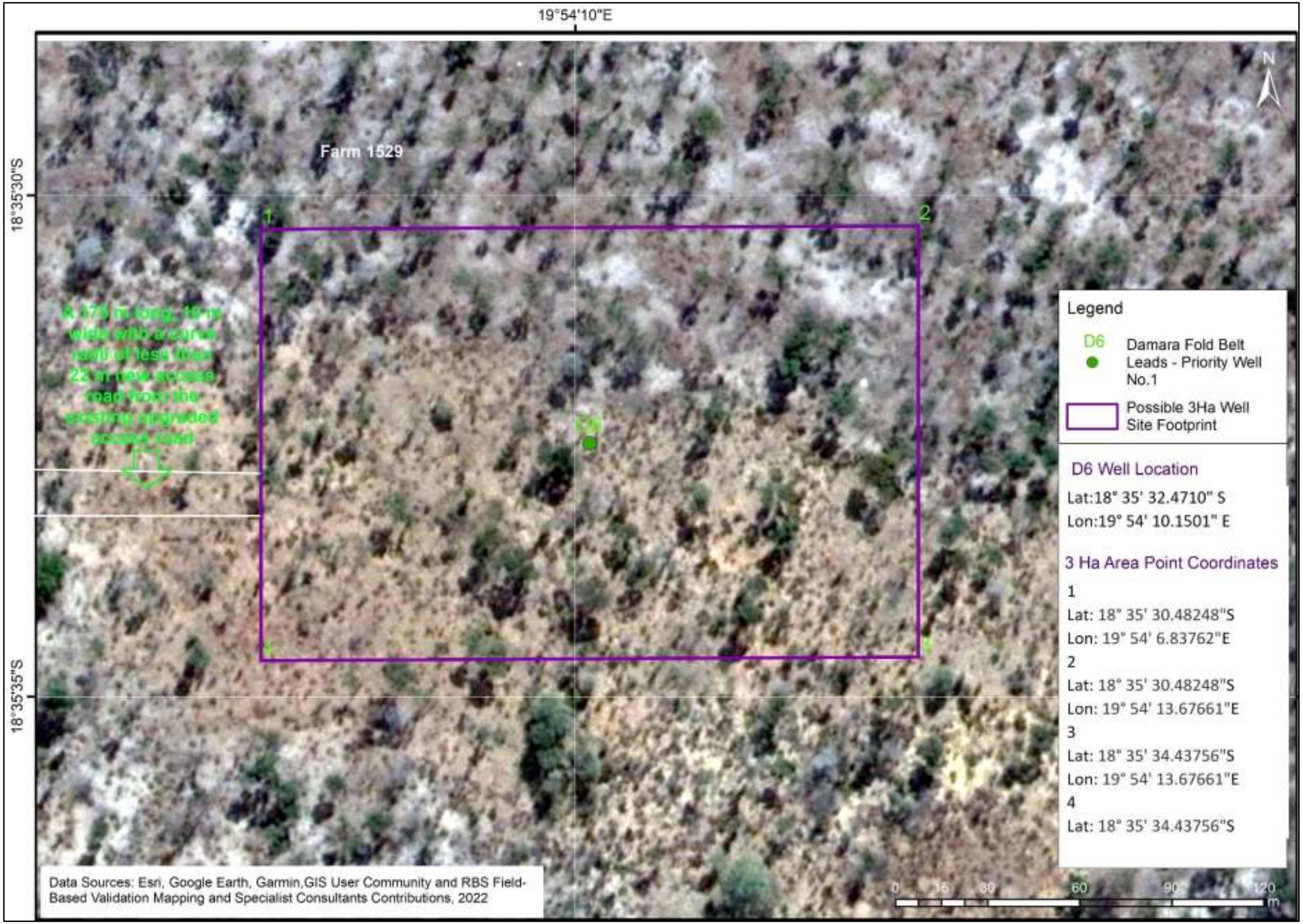


Figure 1.14: Detailed outline of the 3Ha area of the priority 1 Damara Fold Belt Leads No. D6 exploration and appraisal well location falling on a commercial farm on communal land, Farm No. 1529. A new 175m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Plate 1.2: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. D6.

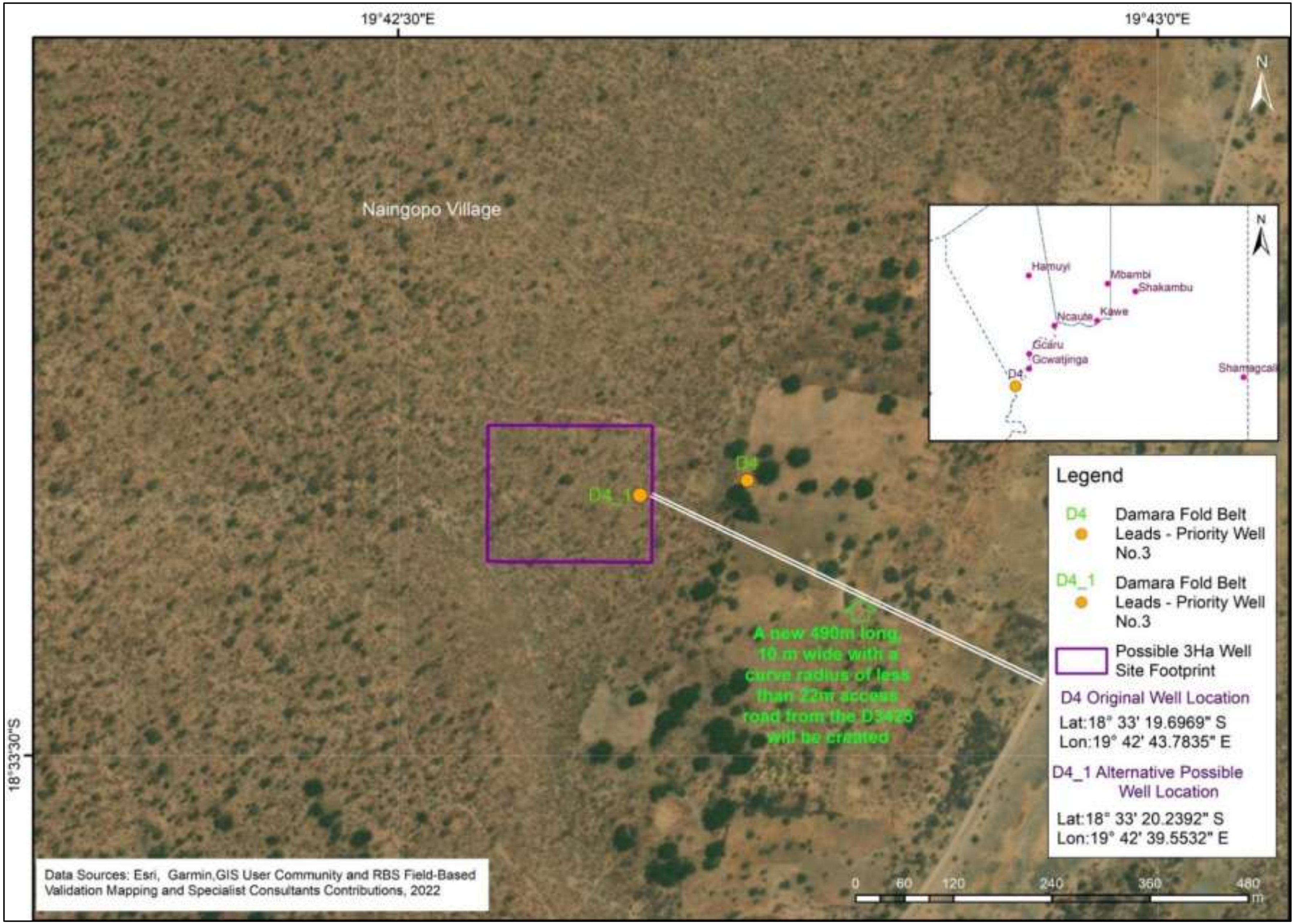


Figure 1.15: Detailed location of the priority 1 Damara Fold Belt Leads proposed exploration and appraisal well location No. D4 at Naingopo Village with the original location D4 moved west to D4_1 out of the communal fields. This well location is an alternative to the D5 well site, has been shifted away from the local settlement and subsistence farmlands. A new 490m long, 10 m wide with a curve radius of less than 22m access road from the D3425 will be created.

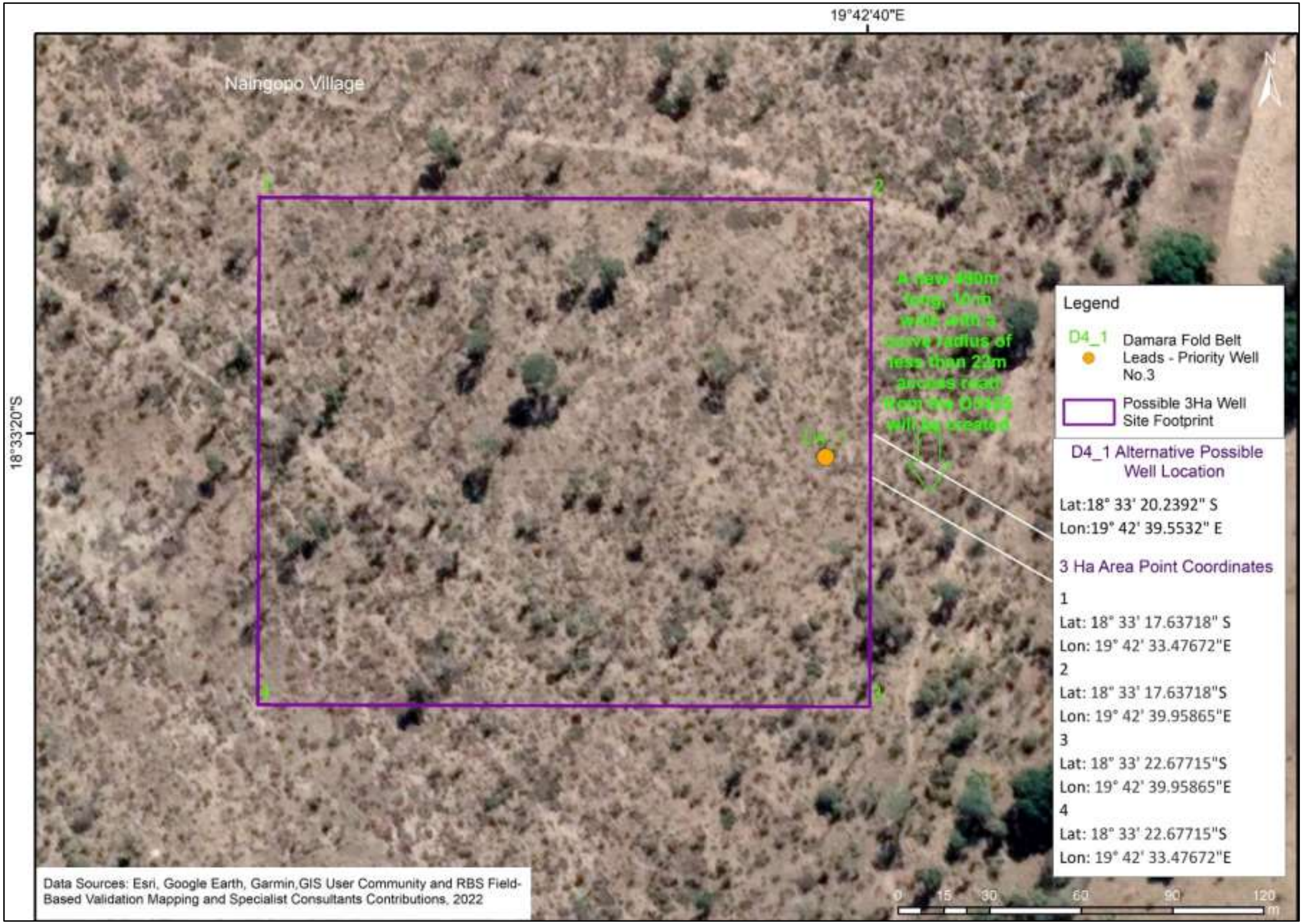


Figure 1.16: Detailed outline of the 3Ha area of the priority 1 Damara Fold Belt Leads proposed exploration and appraisal well location No. D4 at Naingopo Village with the original locationD4 moved west to D4_1 out of the communal fields. This priority 1 alternative well location to the D5 well site, has been shifted away from the local settlement and subsistence farmlands. A new 490m long, 10 m wide with a curve radius of less than 22m access road from the D3425 will be created.

Plate 1.3: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. D4_1 at Naingopo Village with the original location D4 moved west to D4_1 out of the communal fields.

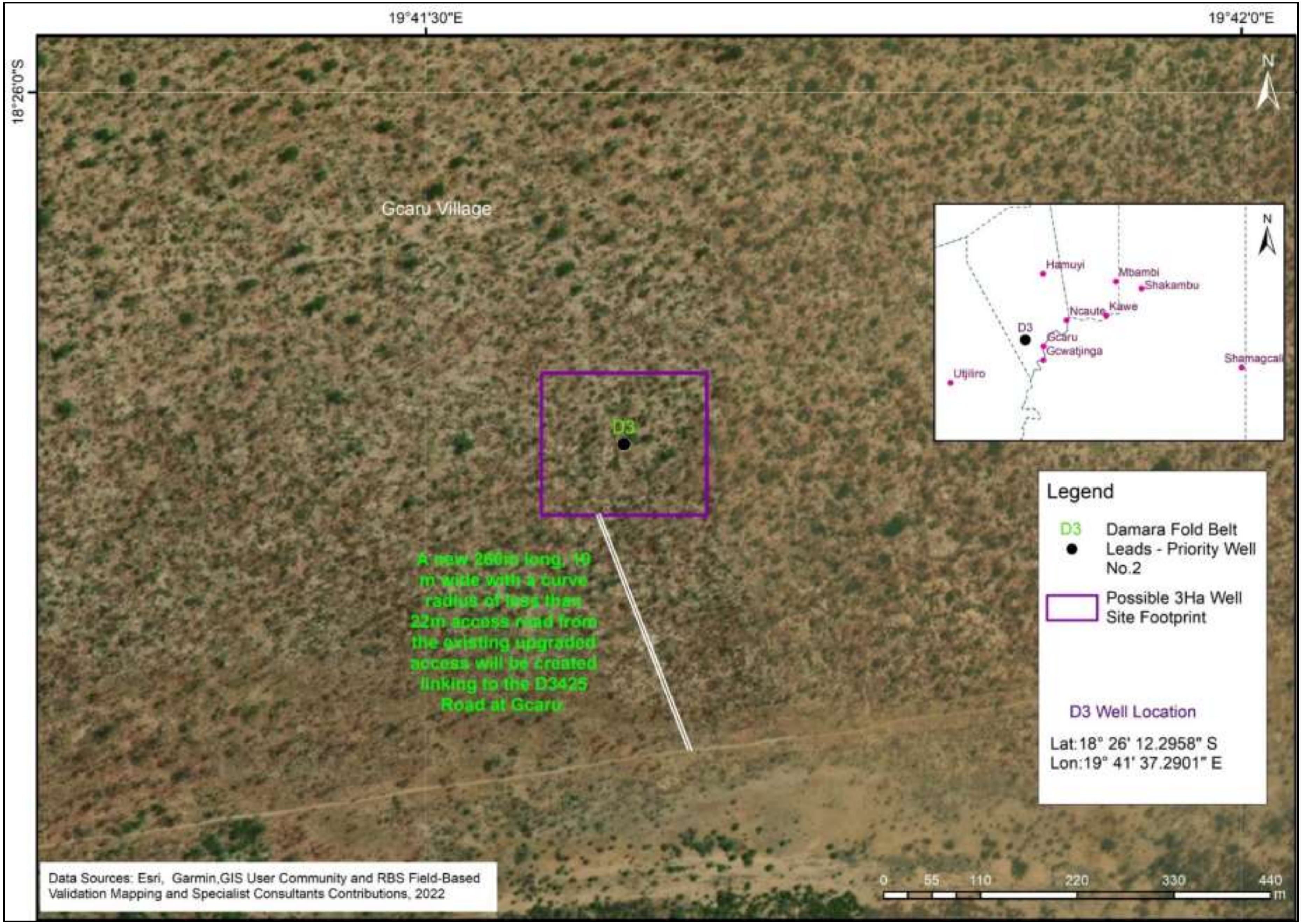


Figure 1.17: Detailed location of the priority 2 Damara Fold Belt Leads proposed exploration and appraisal well location No. D3 with current location situated about 7km west of Gcaru Village. A new 260m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created linking to the D3425 Road at Gcaru.

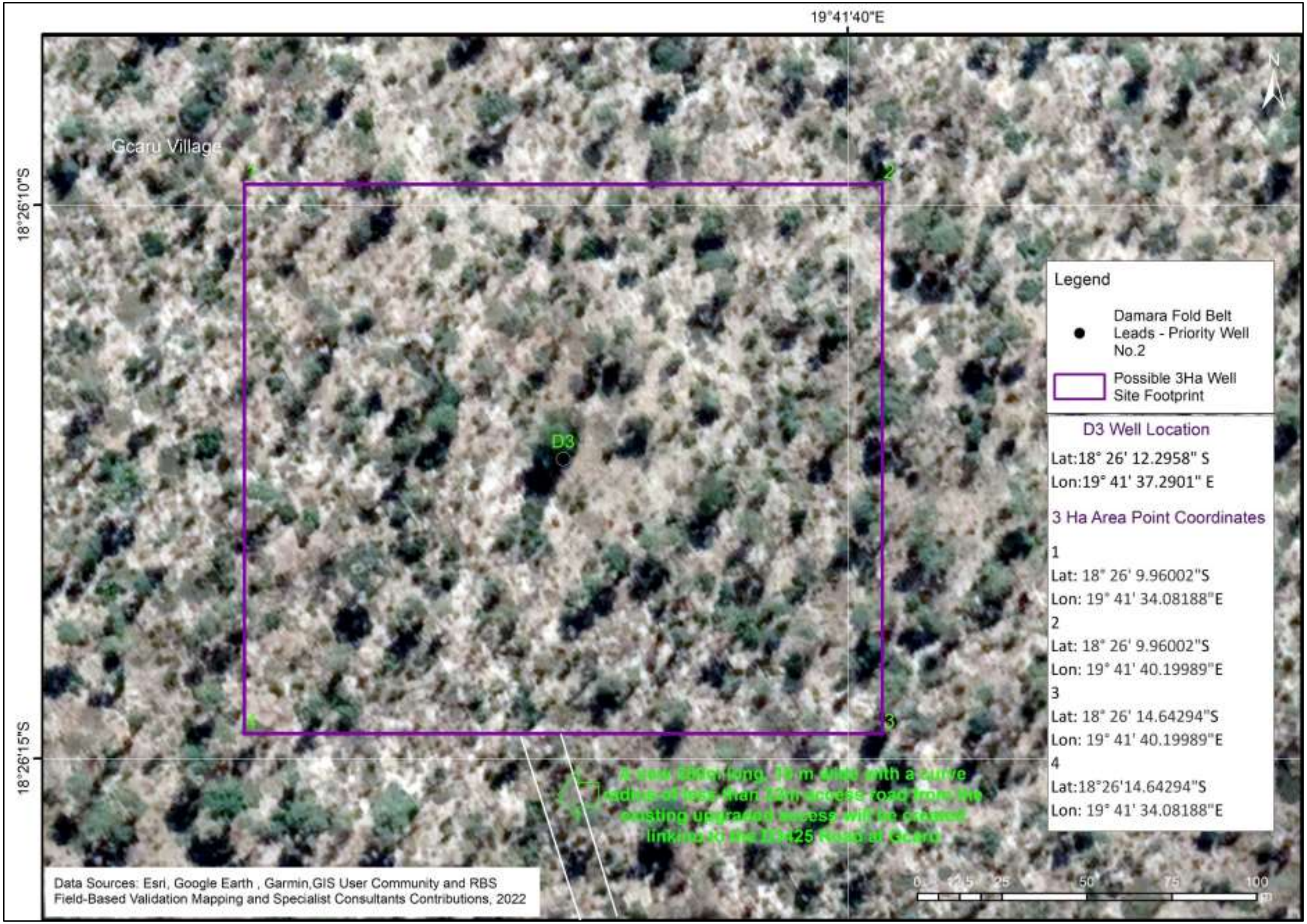


Figure 1.18: Detailed outline of the 3Ha area of the priority 2 Damara Fold Belt Leads proposed exploration and appraisal well location No. D3 with current location situated about 7km west of Gcaru Village. A new 260m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created linking to the D3425 Road at Gcaru.

Plate 1.4: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. D3 with existing access.

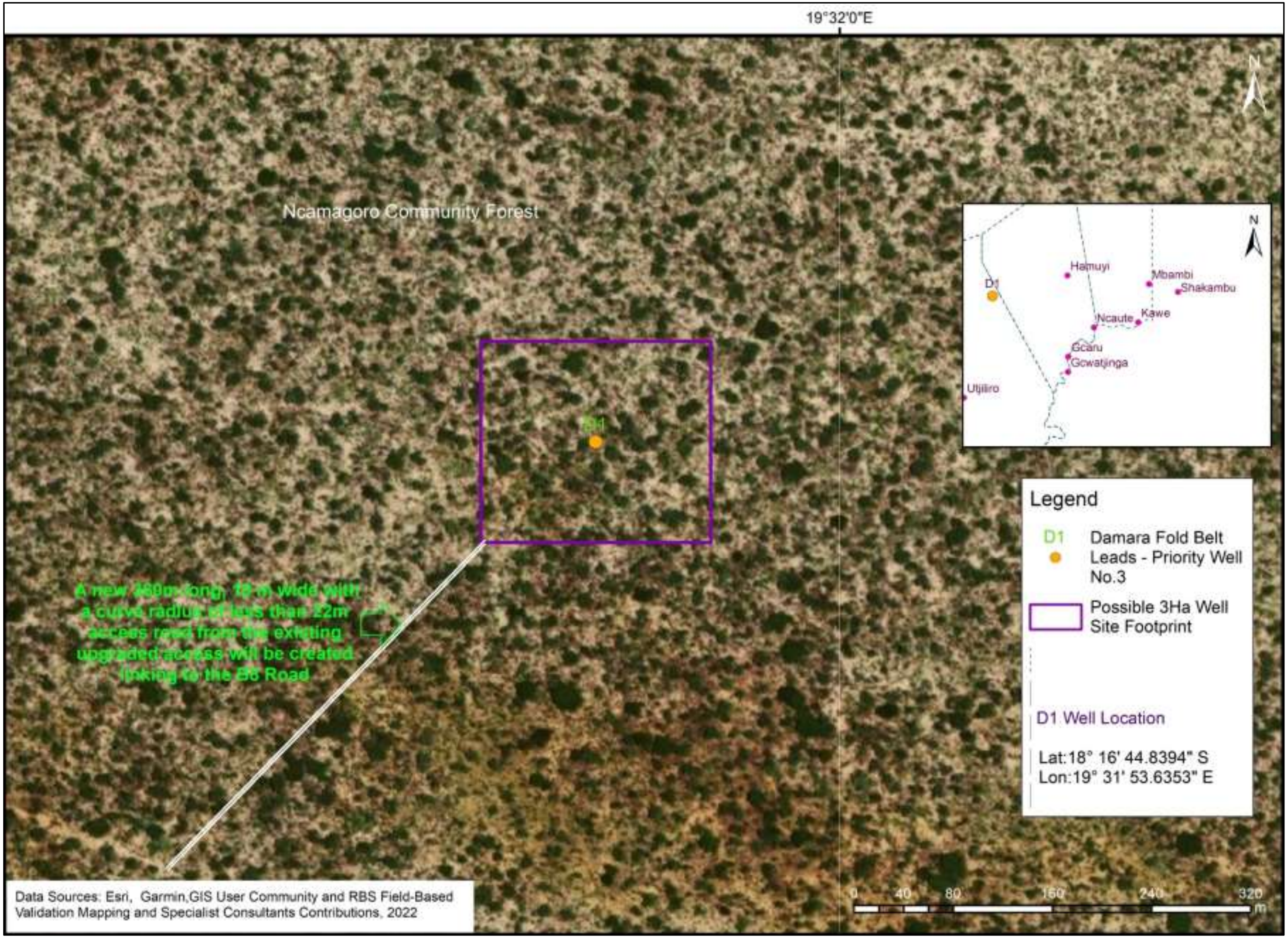


Figure 1.19: Detailed location of the priority 3 Damara Fold Belt Leads proposed exploration and appraisal well location No. D1 with current location falling within the Ncamagoro Community Forest boundary. A new 360m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created linking to the B8 Road.

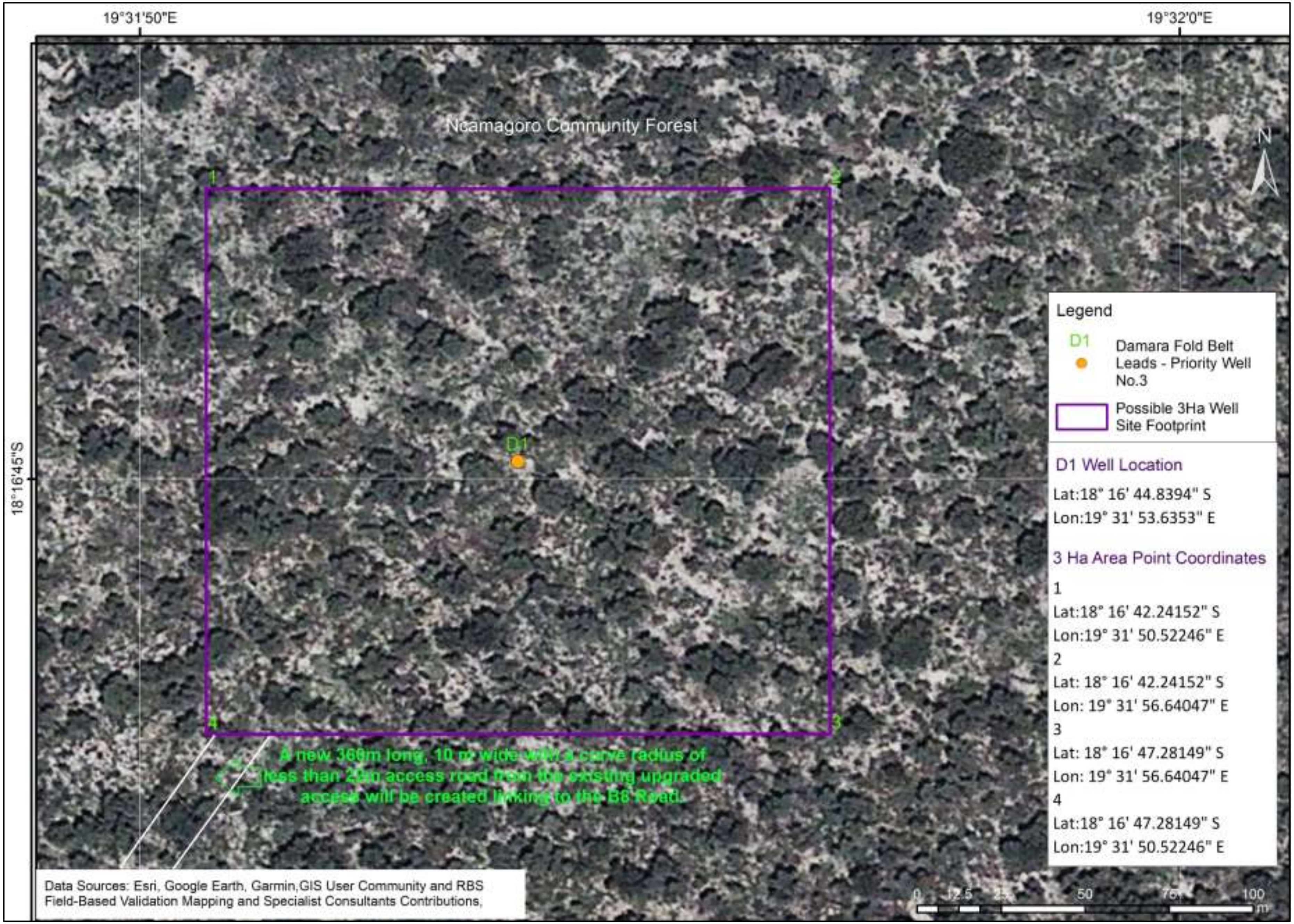


Figure 1.20: Detailed outline of the 3Ha area of the priority 3 Damara Fold Belt Leads proposed exploration and appraisal well location No. D1 with current location falling within the Ncamagoro Community Forest boundary. A new 360m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created linking to the B8 Road.

Plate 1.5: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. D1.

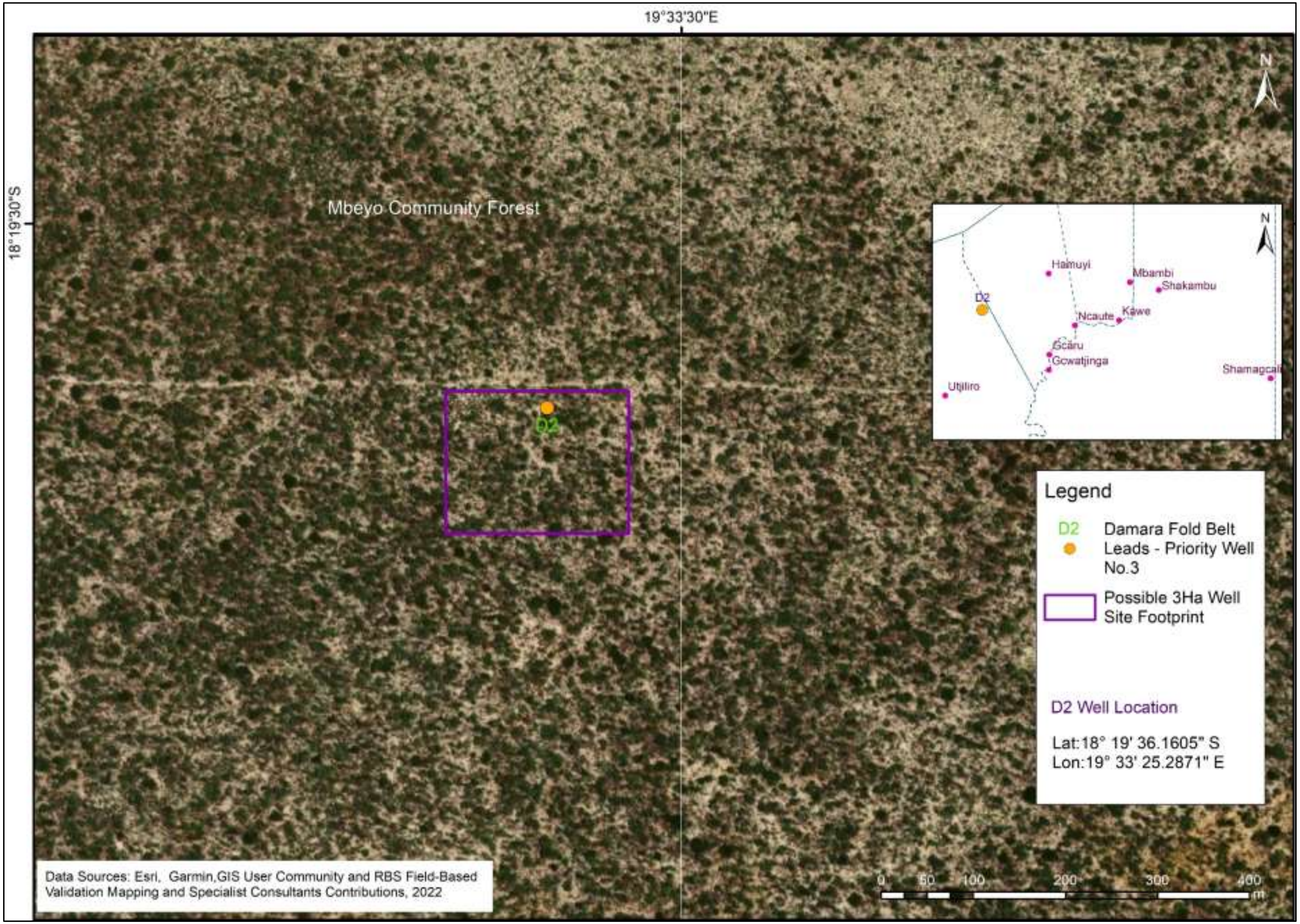


Figure 1.21: Detailed location of the priority 3 Damara Fold Belt Leads proposed exploration and appraisal well location No. D2 with current location falling within the Mbeyo Community Forest boundary. A new 20m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created linking to the B8 Road.

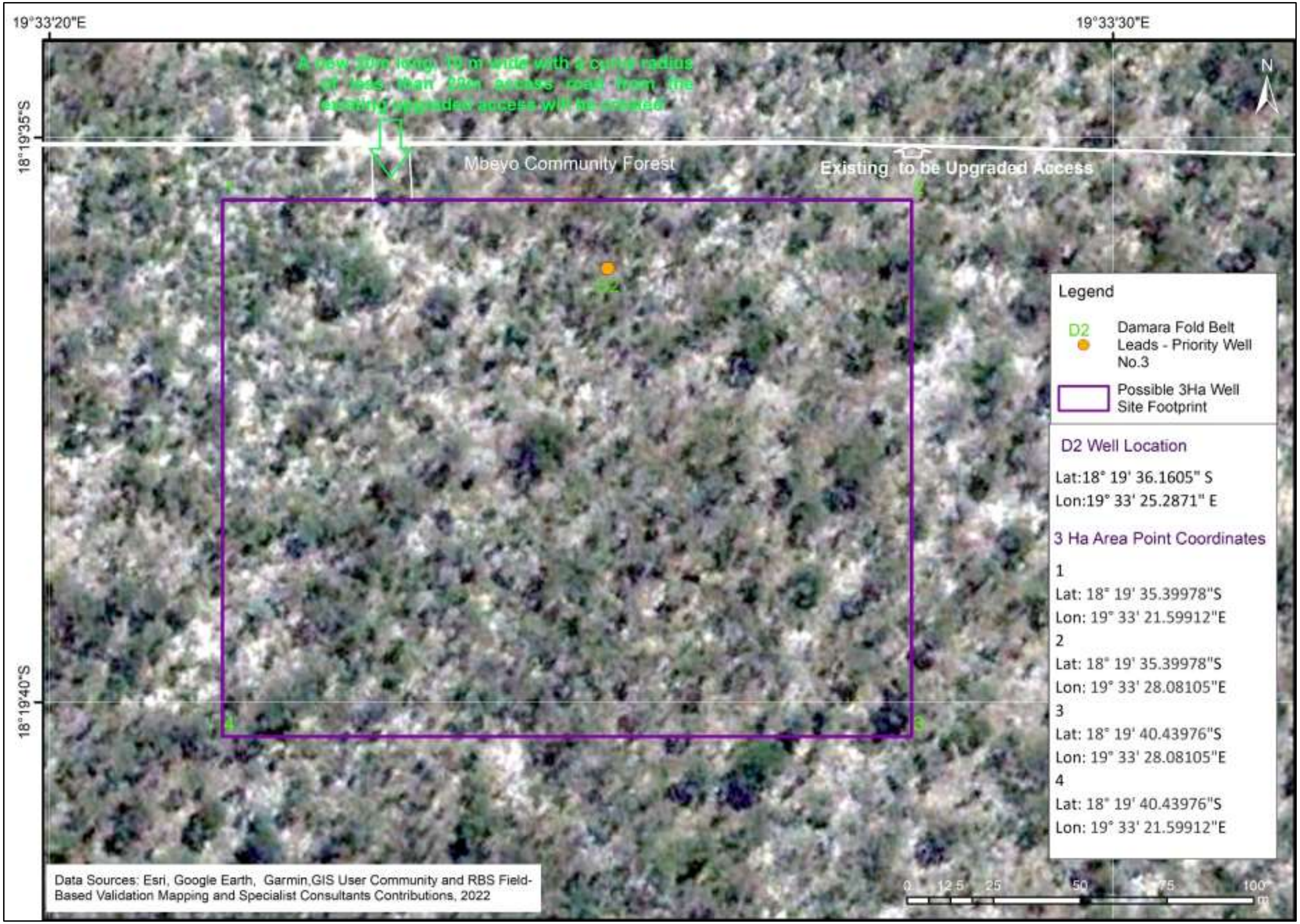


Figure 1.22 Detailed outline of the 3Ha area of the priority 3 Damara Fold Belt Leads proposed exploration and appraisal well location No. D2 with current location falling within the Mbeyo Community Forest boundary. A new 20m long, 10 m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created linking to the B8 Road.

Plate 1.6: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. D2 and existing access.

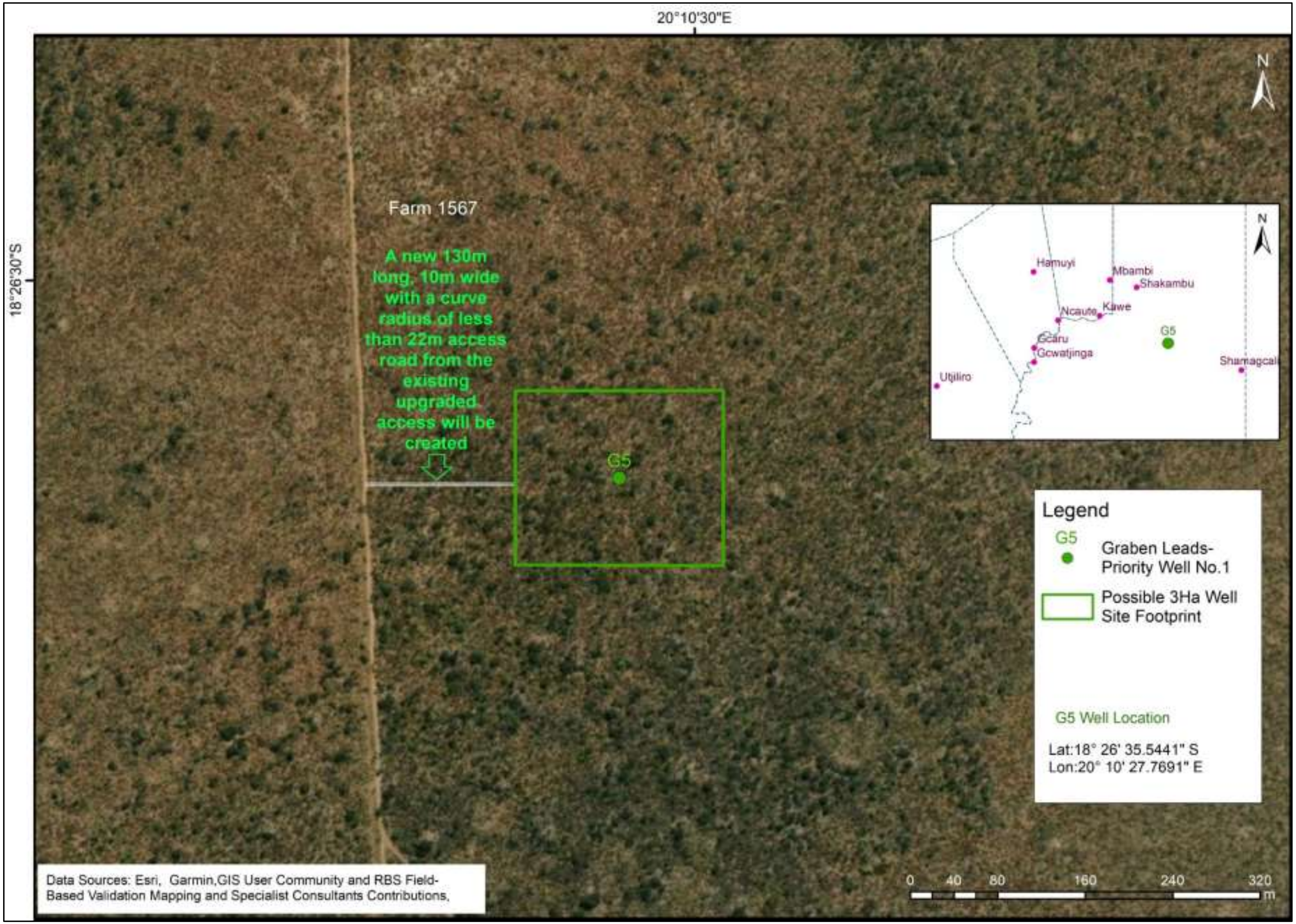


Figure 1.23: Detailed location of the priority 1 for the Graben Play covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G5 located on commercial farms on communal land, Farm No. 1567. A new 130m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Figure 1.24: Detailed outline of the 3Ha area of the priority 1 covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G5 located on commercial farms on communal land, Farm No. 1567. A new 130m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Plate 1.7: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. G5 and existing access.

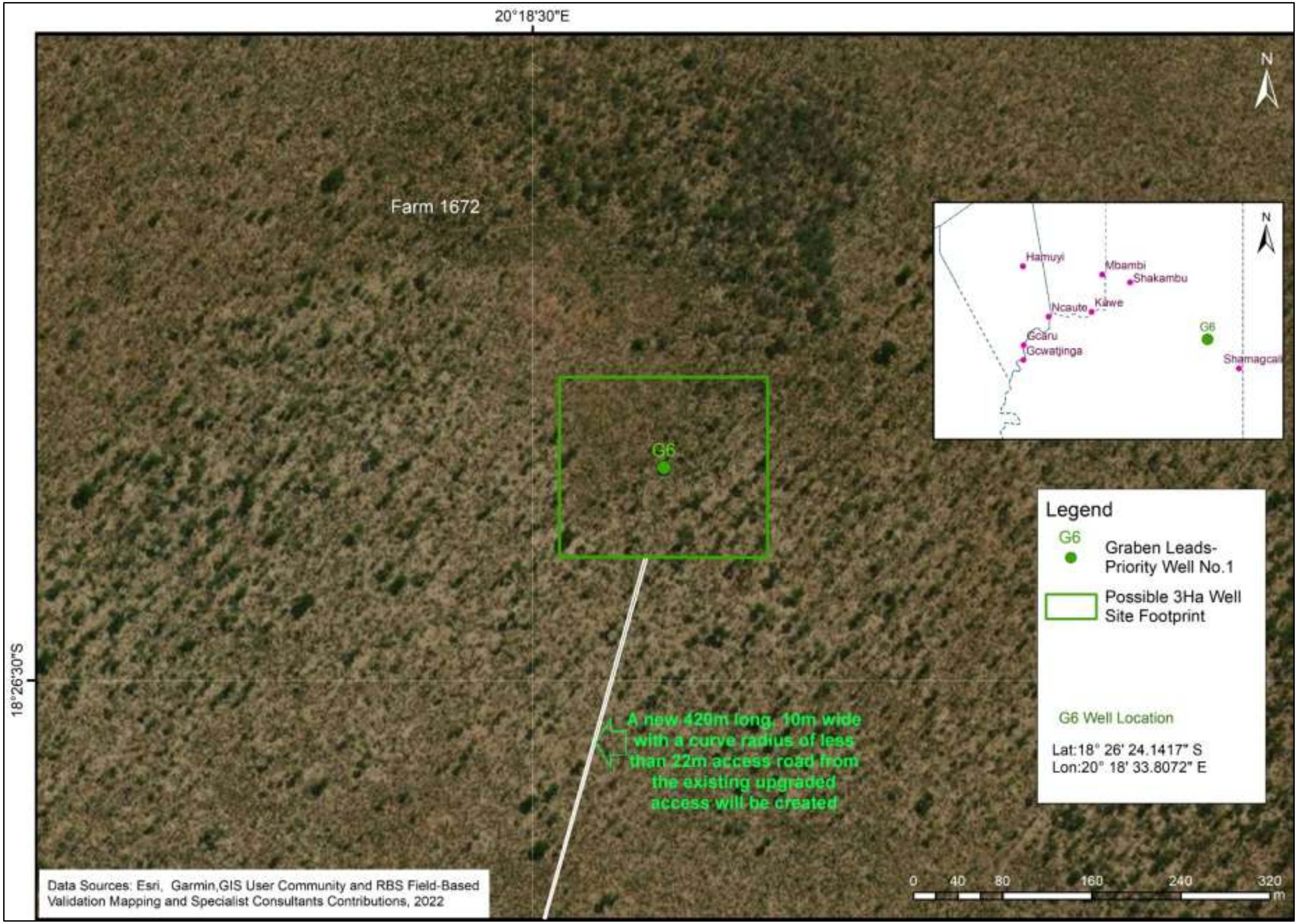


Figure 1.25: Detailed location of the priority 1 for the Graben Play covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G6 located on commercial farms on communal land, Farm No. 1672. A new 430m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Figure 1.26: Detailed outline of the 3Ha area of the priority 1 covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G6 located on commercial farms on communal land, Farm No. 1672. A new 430m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Plate 1.8: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. G6 and existing access.

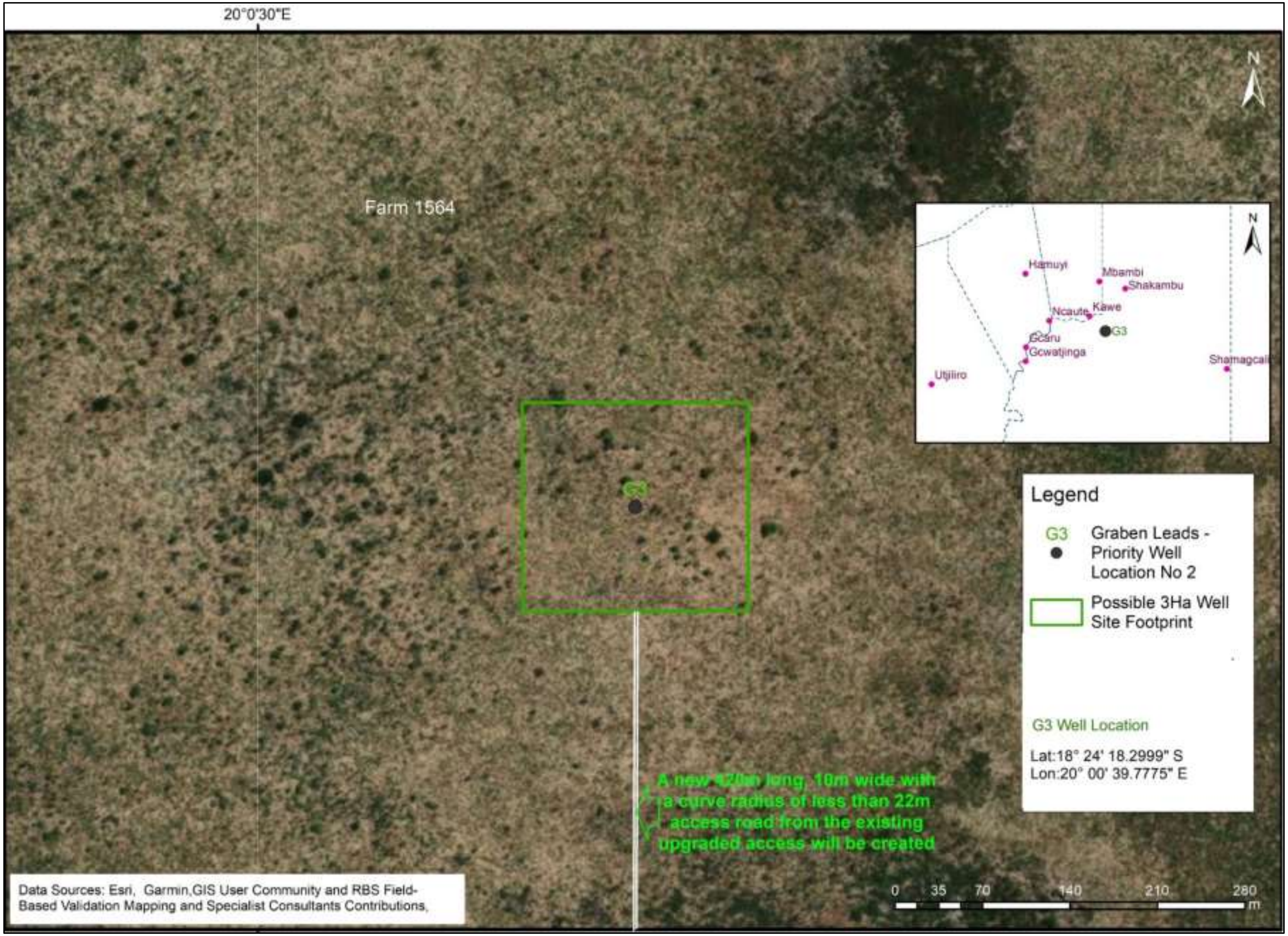


Figure 1.27: Detailed location of the priority 2 for the Graben Play covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G3 located on commercial farms on communal land, Farm No. 1564. A new 420m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Figure 1.28: Detailed outline of the 3Ha area of the priority 2 covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G3 located on commercial farms on communal land, Farm No. 1564. A new 420m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Plate 1.9: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. G3.

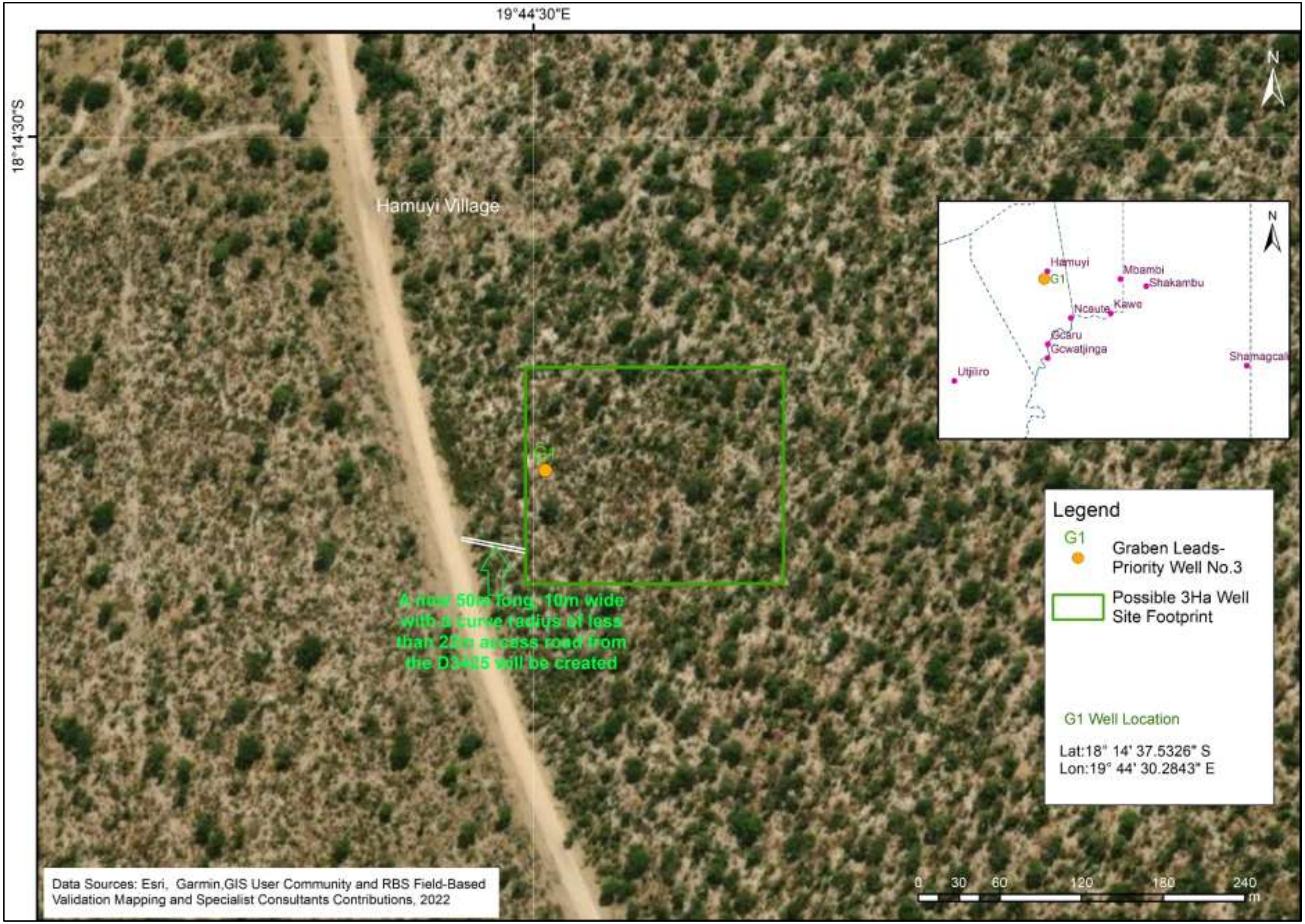


Figure 1.29 Detailed location of the priority 3 for the Graben Play covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G1 located at Hamweyi Village along the eastern side of the D3425 road linking Rundu to Ncaute. A new 50m long, 10m wide with a curve radius of less than 22m access road from D3425 will be created.

Figure 1.30: Detailed outline of the 3Ha area of the priority 3 for the Graben Play covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G1 located at Hamweyi Village along the eastern side of the D3425 road linking Rundu to Ncaute. A new 50m long, 10m wide with a curve radius of less than 22m access road from the D3425 will be created.

Plate 1.10: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. G1 and the D3425 Road.

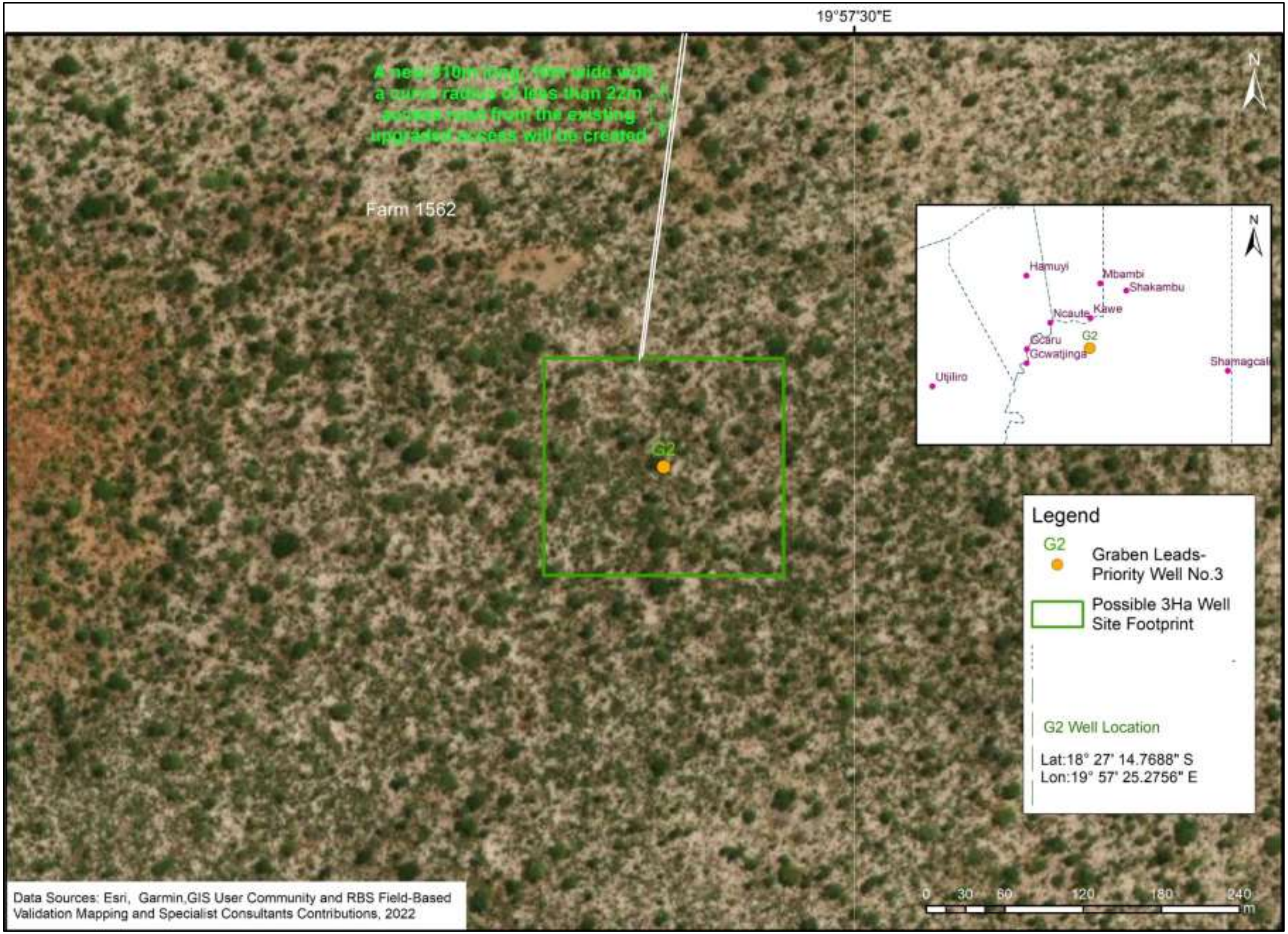


Figure 1.31: Detailed location of the priority 3 for the Graben Play covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G2 located on commercial farms on communal land, Farm No. 1562. A new 810m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

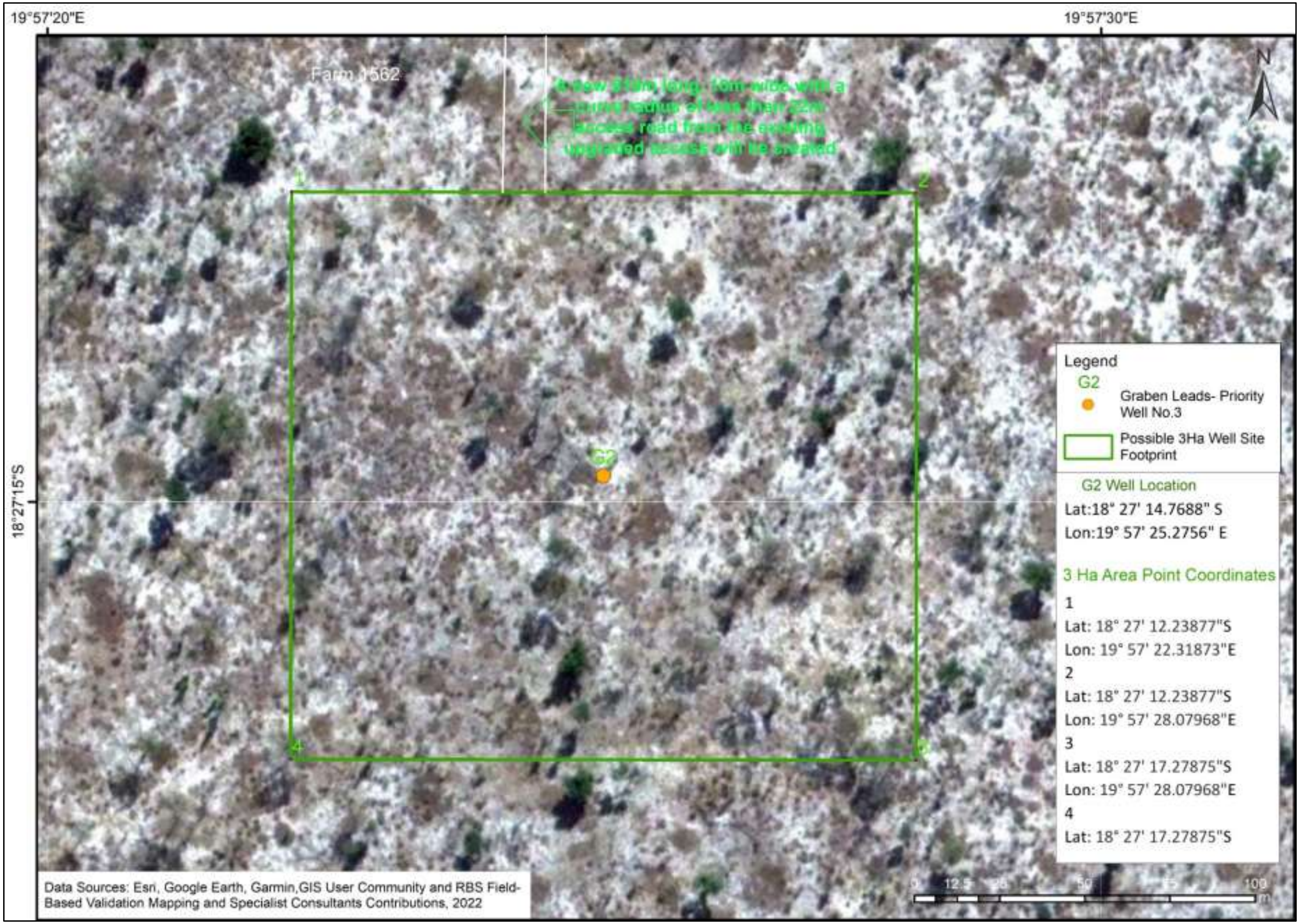


Figure 1.32: Detailed outline of the 3Ha area of the priority 3 covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G2 located on commercial farms on communal land, Farm No. 1562. A new 810m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Plate 1.11: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. G2 and existing access.

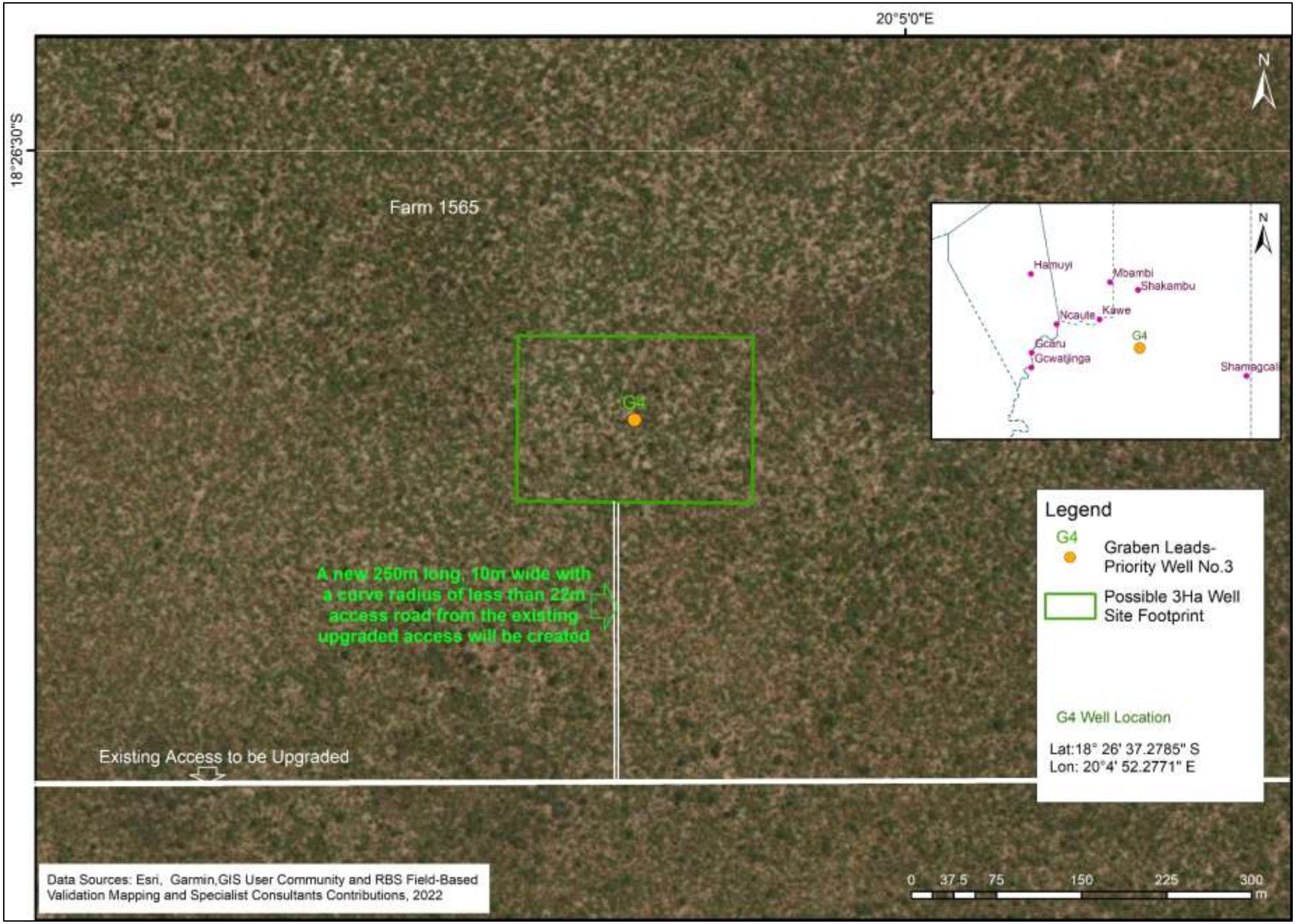


Figure 1.33: Detailed location of the priority 3 for the Graben Play covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G4 located on commercial farms on communal land, Farm No. 1565. A new 250m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

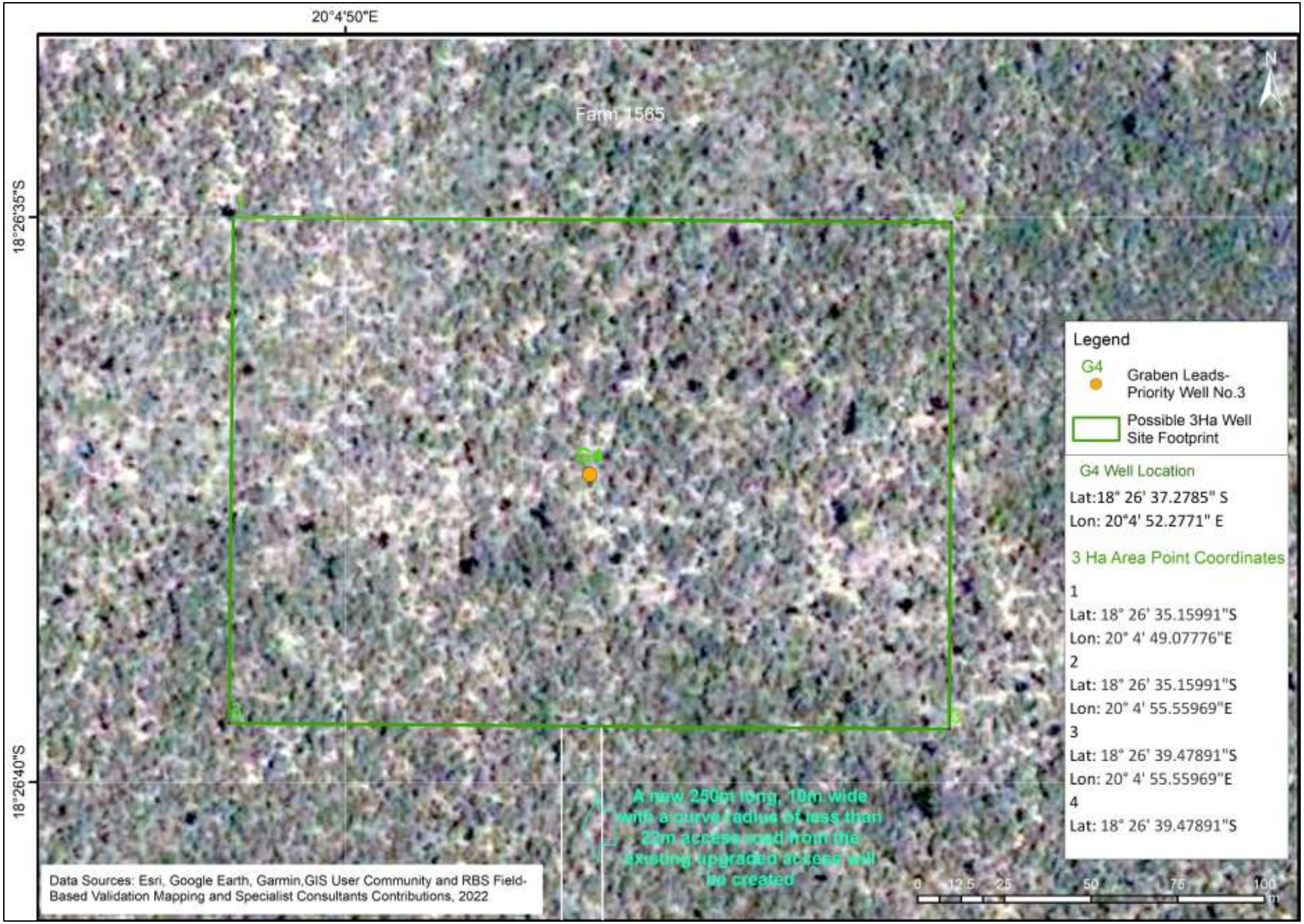


Figure 1.34: Detailed outline of the 3Ha area of the priority 3 covering the Karoo Rift Fill and Intra-Rift Fault Blocks Leads proposed exploration and appraisal well location No. G4 located on commercial farms on communal land, Farm No. 1565. A new 250m long, 10m wide with a curve radius of less than 22m access road from the existing upgraded access road will need to be created.

Plate 1.12: Drone image of the general surrounding area at the Damara Fold Belt Leads well location No. G4 and existing access.

2. BASIS FOR EMP AND MITIGATION MEASURES

2.1 Overview

The EMP framework described in this report is based on the results of the impact assessment process as detailed in the EIA Report for proposed drilling of the prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6. The impact assessment process took into considerations all the applicable national regulations, the corporate requirements of the Proponent, international best practices, public, stakeholders and local community inputs and sensitivity of the receiving environment (physical, biological, socioeconomic and ecosystem services and functions). This EMP Report provides detailed mitigation measures for the proposed drilling of the prioritised exploration and appraisal wells Nos. D1-D6 and G1-G6, inclusive of the supporting infrastructures such as the new access roads, the use of existing borrow pits and other associated services.

2.2 Summary on Oil and Gas Well Drilling Process and Drilling Rig

2.2.1 Drilling Process

Drilling itself occurs in two phases: Drilling down to below the water table and then encasing the well hole in cement to prevent groundwater and soil contamination, and then drilling to the required depth and taking the necessary steps to stimulate upward oil flow. To drill a well, a specialised piece of equipment called a drilling rig is used to bore a hole through many layers of rock into the subsurface to reach a targeted Total Depth (TD) (Fig. 2.1).

REN will be using the Crown 750 truck mounted drill rig to drill the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 in AOI in PEL No. 73 (Plates 2.1 and 2.2). Most drilling rigs today utilise rotary drilling, with drilling mud/fluid powering the drill string (Fig. 2.1 and Plate 2.1). The size of the borehole differs from well to well, but is generally around 12.5 to 90 centimetres in circumference. To cut through this rock, the drill is pushed down by the weight of the piping above it. This piping is used to pump a thick fluid known as drilling mud into the well.

The mud assists in the drilling process by maintaining the pressure below ground in the well as well as by collecting rock cuttings from the bottom of the well and bringing it up to the surface (Fig. 2.1 and Plate 2.1). As the drill digs deeper, sections of drilling piping are attached to lengthen the well. After the well is drilled it is completed and cased. The well casing is the lining that is inserted between the edge of the well and the well itself that helps to structurally support the well (Fig. 2.1 and Plate 2.1). In a closed hole well, concrete is poured into the space between the pipe and the borehole for stability and to prevent groundwater contamination from seepage. Subject to the outcomes of the drilling operations, various types of well testing / appraisal activities may be undertaken and may include the extraction of oil and / or gas and the burning (flaring) of the gas being produced for testing purposes.

2.2.2 Drilling Rig: The Crown 750 1000 HP

The Proponent will be using the Crown 750 drilling rig to drill the proposed D1-D6 and G1-G6 exploration and appraisal wells (Plates 2.1 and 2.2). The Crown 750 drilling rig was used in 2021 and 2022 to drill the 6-1 Mbambi and 6-2 Kawe and 8-2 Makandina wells respectively.

The same rig will also be used to drill the Wisdom 5-1 well to be spudded in February 2023. The Crown 750 drilling rig is a relatively small rig designed for mobility and drilling conventional wells only. The rig is truck mounted and designed for light impact and mobility across desert conditions. The Crown 750 was manufactured in the United States and is rated at 1,000 horsepower, equipped with two CAT 540 horsepower diesel engines. Combined with a 440,000-pound hook load, the rig is rated to drill 12,000 vertical feet. The following is general specifications of the Crown 750 as shown in Plates 2.1 and 2.2:

- ❖ HP Rating: 1,000 HP.
- ❖ Ambient Rating: 50ºC–55ºC.

- Powered By: 2 x C15 CAT Engines (540 BHP @ 2,100. RPM each); Allison 4700OFS Transmissions.

- Rig Type: Self-propelled, carrier mounted, 7-Axle (14 x 4), internally guyed Two Caterpillar model C15 ACERT packaged generator sets on three-point skid rated for 456/365 kVA, 365/292 kWe, 480/400 V, 0.8PF, 3-phase, 60 Hz prime power service.

- Generator building complete with MCC and generator synchronisation.

- Includes all necessary wiring and electrical rig-up from AC generators to MCC in generator/power control house.

- Lighting includes fluorescent, flood, and Crown lights for mast, carrier substructure, area lighting and S&S furnished building/equipment lighting.

- Rig intercom system includes 4 hazardous area telephones, one talk-back system and 2 wireless telephones, and.

- Lighting designed in accordance with API RP 500/505.

2.2.3 Technical Summary of the Key Drilling Operational Stages

The following is the summary of the key stages that are implemented for each of the proposed exploration and appraisal wells sites drilling operations:

1. Preconstruction and drilling requirements.

2. Construction phase.

3. Mobilisation and well spudding.

4. Conductor Casing.

5. Drilling surface / intermediate and setting casing and cementing process through up 900 m.

6. Drilling and continuous Coring from 900 meters (2953’) to 1900 m (6234’).

7. Drilling below 1900 meters to Total Depth (TD) of +/- 2800m (+/-8202’), and.

8. Well Test / Plug and Abandon Hole.

2.2.4 Possible Test to be Conducted During Drilling Operations

As part of the proposed drilling operations for each of the proposed key priority wells, the following test may be conducted subject to favourable well profiles conditions that may be encountered:

(i) Drill Stem Testing (DST) in open hole during drilling process.

(ii) DST in cased hole, after well is drilled, cased and cemented, and.

(iii) Other general tests that may be routinely undertaken or requested by the Partner or MME.

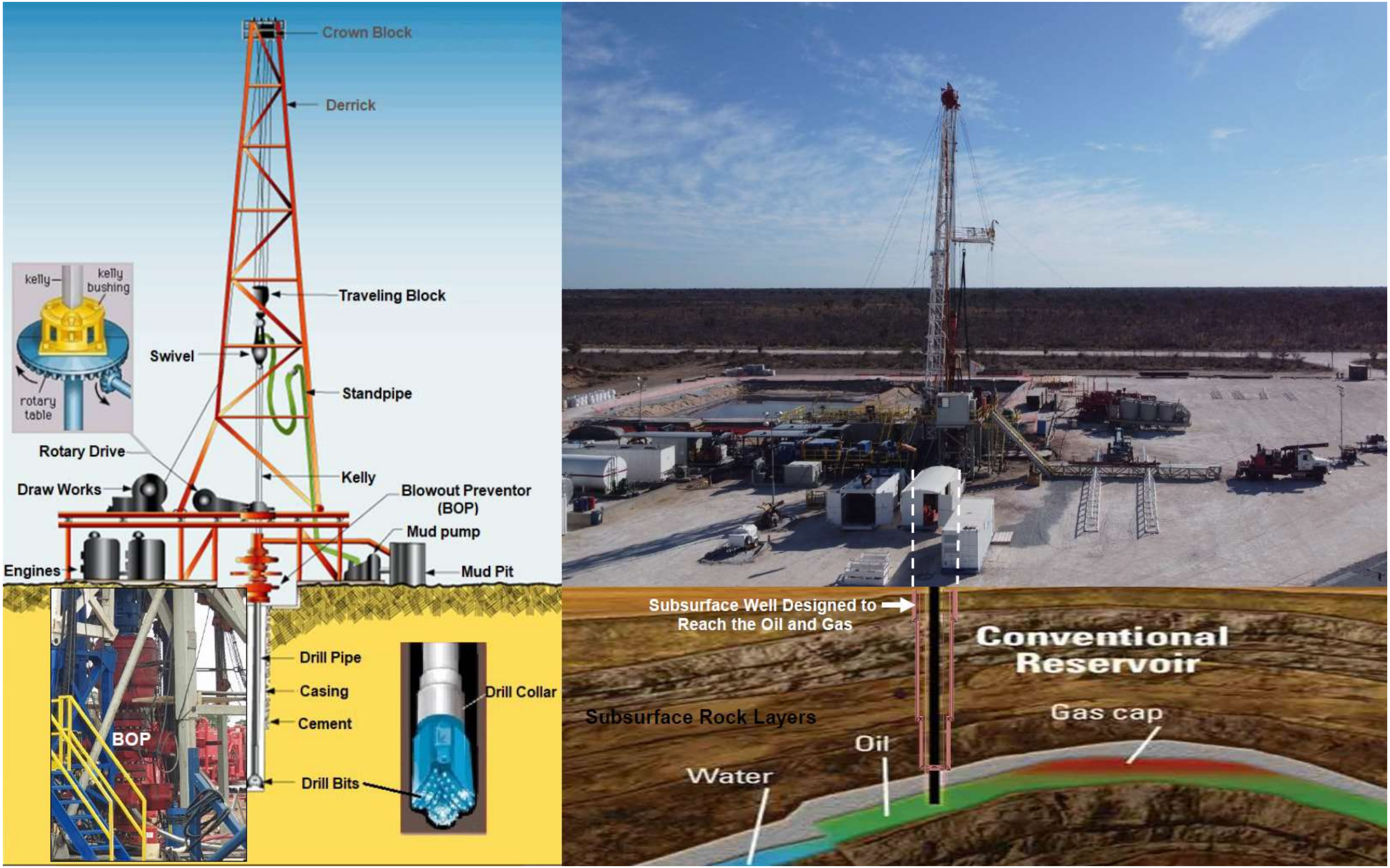


Figure 2.1: Illustration of the key components of an onshore Oil Rig (Sources: Right image modified from www.entranceconsulting.com bottom image extract and modified from www.slb.com with Photo by RBS, 2021).

Plate 2.1: The Crown 750 truck mounted drill rig used by REN to drill the stratigraphic wells and will be used to drill the proposed D1-D6 and G1-G6 exploration and appraisal wells in the AOI in PEL No. 73.

Plate 2.2: The Crown 750 truck mounted drill rig designed for light impact and mobility across desert conditions, is being used by REN to drill the stratigraphic wells and will be used to drill the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 in PEL No. 73.

2.2.5 Engineered Drilling Site Layout and Construction

A standard single well site for conventional onshore oil or gas drilling similar to the proposed exploration and appraisal wells sites in PEL No. 73, will typically affect a surface area measuring around 3Ha, a size of a typical homestead or subsistence agricultural field in rural Namibia (Figs. 2.2-2.4). The well site will typically hold the drilling rig and additional equipment along with supervisory accommodation and material storage (Figs. 2.3-2.4). A grader is used to upgrade and level the existing tracks to accommodate for the transportation of heavy truck-mounted drill rig as well as other supply truck that will support the proposed drilling operations. The construction of all the access and site supporting infrastructures such as the reserve pit follows strict engineered designs and engineering requirements managed by qualified and experienced specialist teams, engineers and contractors (Figs. 2.5-2.9).

A bulldozer and a grader combined with labour-based manpower where it exists, has been used to create new access roads to the drilling localities and around the actual drilling sites of Well Nos. 6-1 and 6-2 and the same approach will be used for the other wells to be drilled in PEL No. 73. Careful consideration will be given to the sensitivities of the local receiving environment including: Not cutting down of larger trees and protected flora as well as being on a look out for possible unexploded ordinances that may be buried. The scale and duration of site preparation is site-specific and may last for few hours to a couple of days, weeks or months.

Once drilling is completed, the affected area will be reclaimed to minimise surface disturbance or transformed into a local central community support area such as a community centre supported by a reforestation, garden and nursery projects or a multipurpose crush pen in support of the local farmers due to the presence of a water supply borehole. To prepare for the drilling operations, the existing access road will be upgraded and vegetation around the proposed well sites will be selectively cleared by preserving protected species and big trees and shrubs that do not need to be removed (Figs. 2.3-2.5).

2.2.6 Guiding Principles on Borrow Pits

Construction materials will be required for the proposed D1-D6 and G1-G6 exploration and appraisal well sites and the supporting infrastructure areas such as access roads. REN will not be operating its own owned borrow pit/s because all the existing or new borrow pits within AOI in Kavango East and West Regions, belong to the relevant traditional authority having jurisdiction over a given borrow pit area. All the required construction materials will be purchased from the relevant traditional authority through a purchase agreement to be signed between the construction contractor and the relevant traditional authority before construction materials can be obtained from any given borrow pit. The following is the summary of the key issues / guiding principles that shall be considered during the selection, operation, rehabilitation and restoration of a borrow pits area as authorised by the relevant traditional authority:

(i) Avoid working on borrow pit allocated areas that may results in conflict with the local community due to the site sensitivity or proximity to sensitive environmental resources such as villages, grave yard, or communal fields.

(ii) Management of surface water management, including erosion and sediment control, and airborne dust, and avoid areas which might affect groundwater levels where borrow pits intersect the water table

(iii) Avoid areas with mature and protected tress when clearing the vegetation and avoid creation of voids and unstable/steep landforms that may be unsafe for livestock or wildlife

(iv) Consider challenges and opportunities to the local site rehabilitation and restoration as well as revegetation establishment including post-rehabilitation livestock, fauna and feral animal access to the area often used as a water point source, and.

(v) The detailed rehabilitation management plan shall be prepared and shall include measures that are intended to achieve the nominated final use and landform for each site, such that they shall be with shall slopes, safe, stable, self-sustaining, non-polluting, and free-draining.

Figure 2.2: Example of a typical 3Ha footprint site coverage showing a general drilling site layout adopted for the drilling of multiple exploration and appraisal wells within the AOI in PEL No. 73.

Figure 2.3: Layout example of a typical 3Ha footprint created by an onshore drilling well site coverage superimposed on an actual drilling location and as adopted for the drilling of multiple exploration and appraisal wells within the AOI in PEL No. 73 (Drawn not to scale).

Figure 2.4: Example of an oil and gas well site layout showing a drone view of the 8-2 Makandina well site in Kavango East Region.

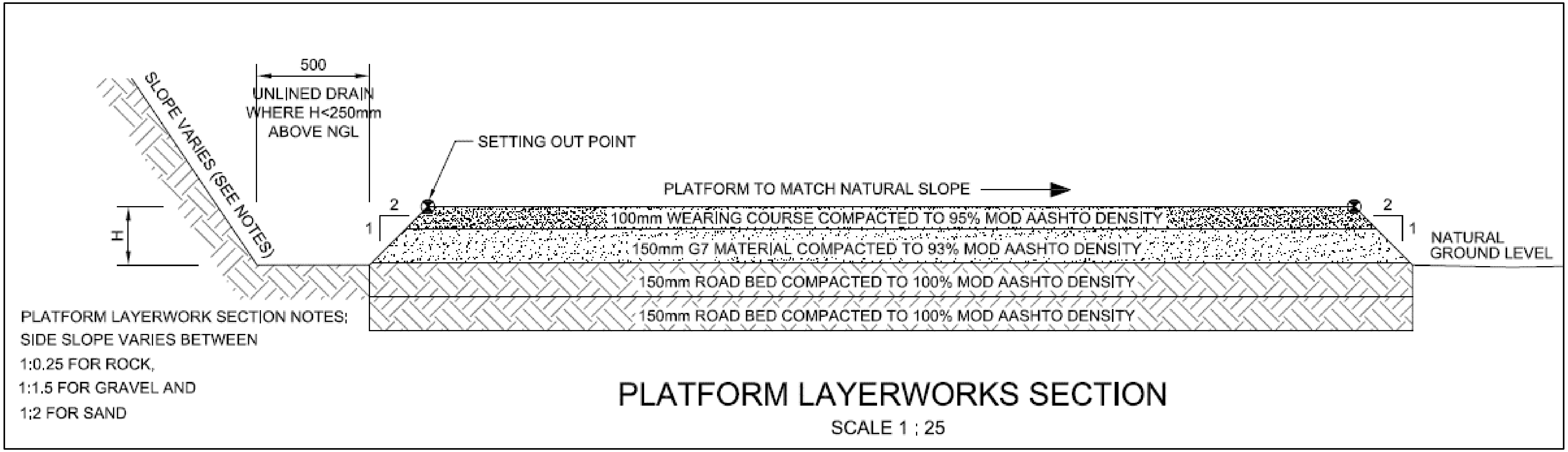


Figure 2.5: Rig platform drilling site engineering design example (Source: Preliminary Drawings by Burmeister & Partners for REN, 2022).

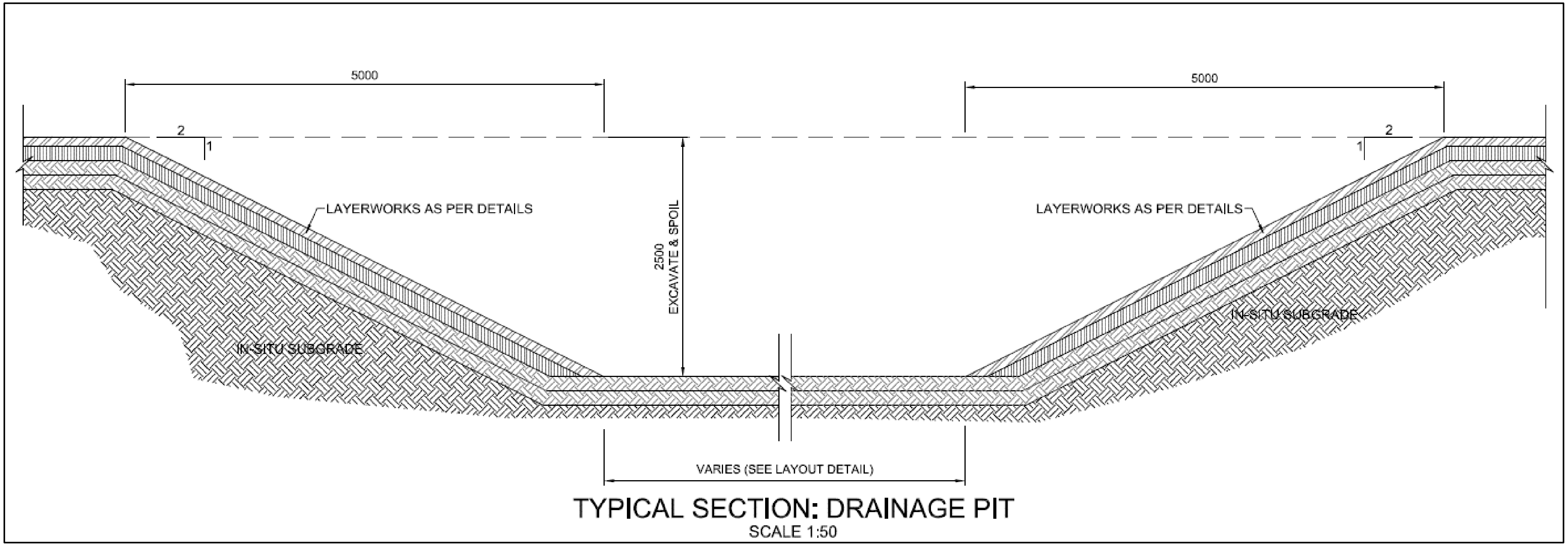


Figure 2.6: Drainage / reserve pit site engineering design example (Source: Preliminary Drawings by Burmeister & Partners for REN, 2022).

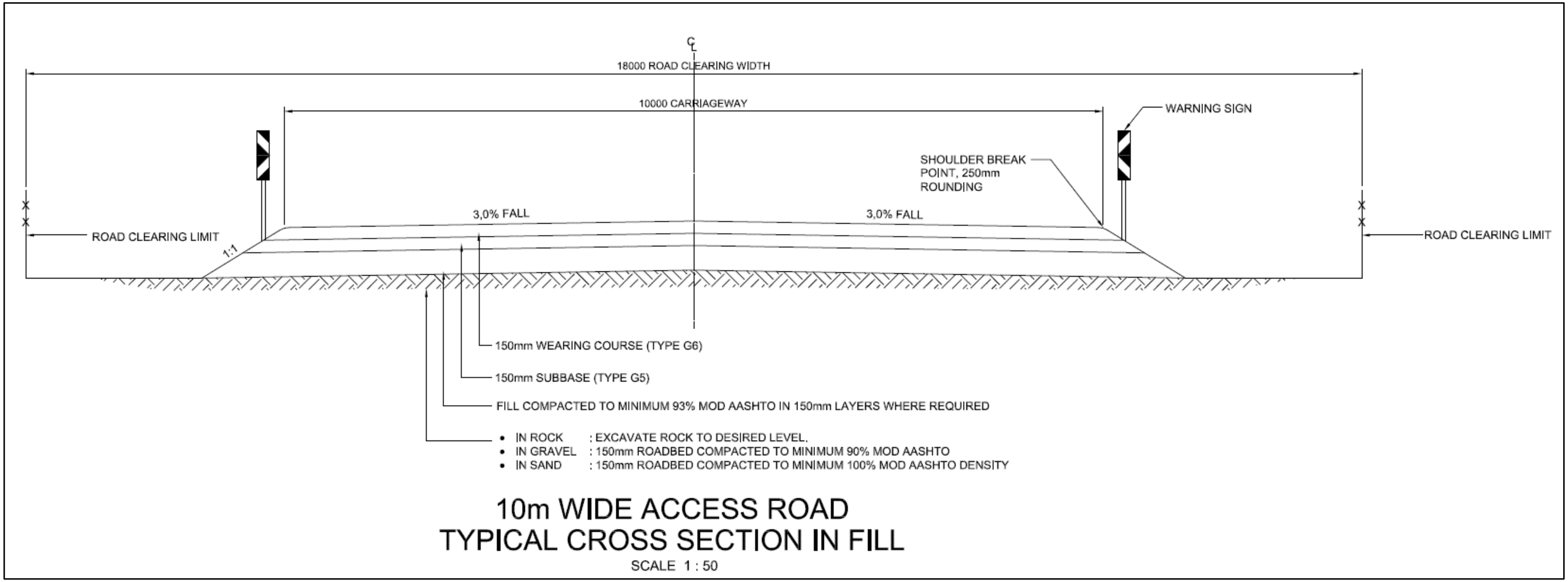


Figure 2.7: Access Road design fill drilling site engineering example (Source: Preliminary Drawings by Burmeister & Partners for REN, 2022).

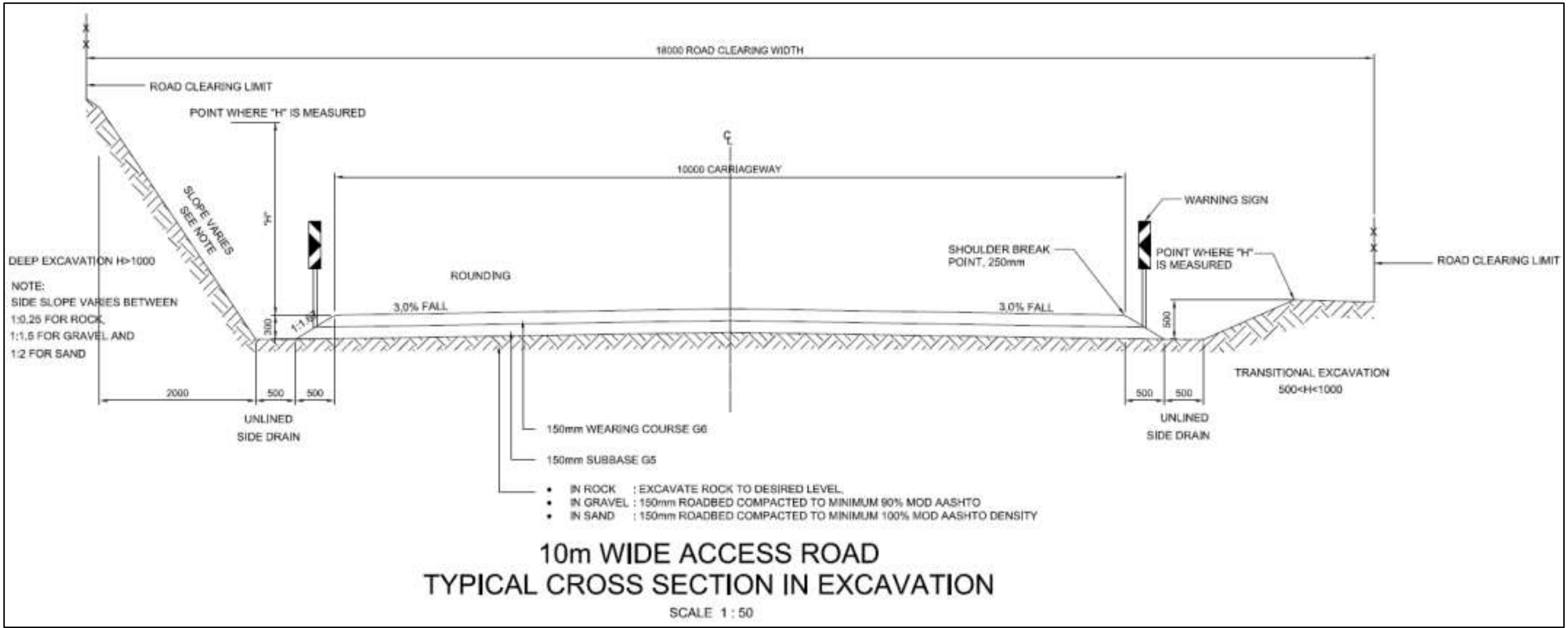


Figure 2.8: Access Road design excavation drilling site engineering example (Source: Preliminary Drawings by Burmeister & Partners for REN, 2022).

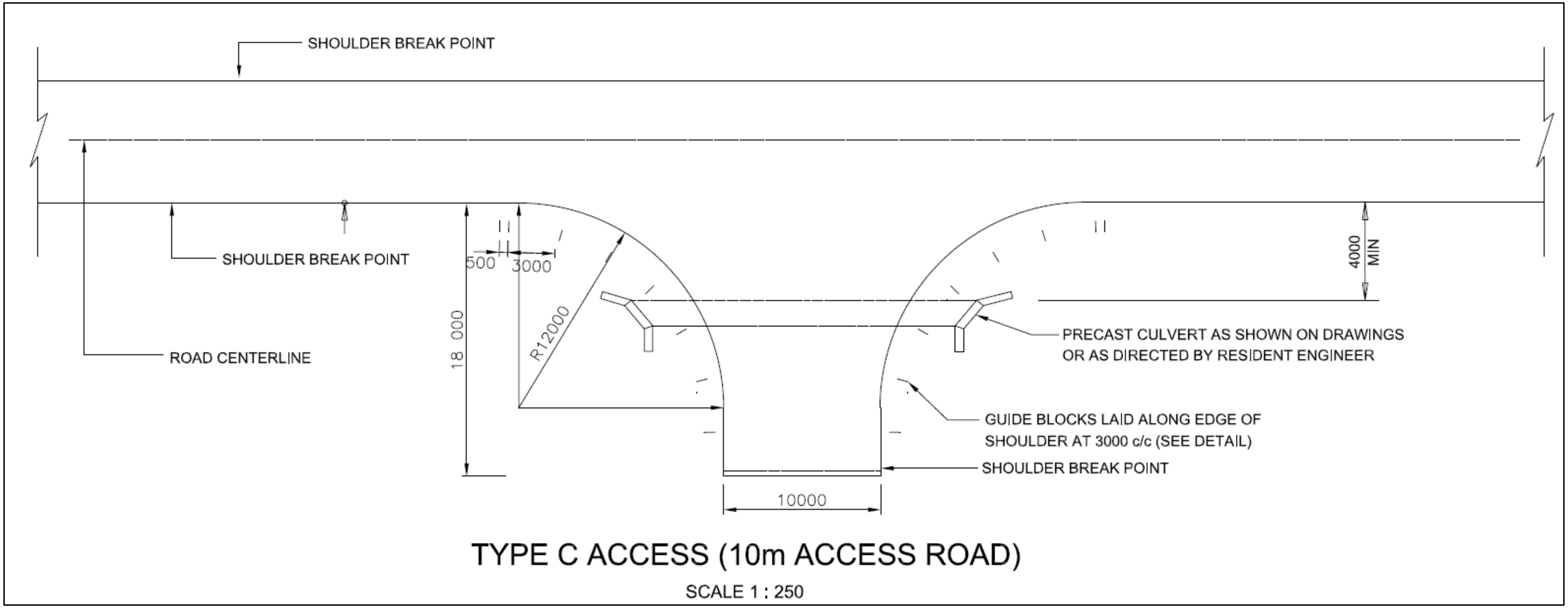


Figure 2.9: Type C access road design drilling site engineering example (Source: Preliminary Drawings by Burmeister & Partners for REN, 2022).

2.2.7 Oil Gas Well Drilling Fluid Systems

Drilling mud, also called drilling fluid, in petroleum engineering, a heavy, viscous fluid mixture that is used in oil and gas drilling operations to carry rock cuttings to the surface and also to lubricate and cool the drill bit (Fig. 2.1). Drilling fluid systems generally fall into the following three (3) categories:

(i) Water-based muds.

(ii) Oil-based muds, and.

(iii) Air drilling fluids, such as mist, foams, and stiff foams, used in only very specific, limited applications.

REN has chosen to use the latest, and most effective water-based drilling fluids for the proposed drilling operations. The company will be using the engineered organic and biodegradable water-based drilling fluid system that minimises environmental impacts.

This Polyamine/ Polymer/ partially-hydrolyzed polyacrylamide (PHPA) system uses freshwater as the base fluid. PHPA mud is a class of water muds that use partially-hydrolyzed polyacrylamide (PHPA) as a functional additive, either to control wellbore shales or to extend bentonite clay in a low-solids mud. As a shale-control mud, PHPA is believed to seal microfractures and coat shale surfaces with a film that retards dispersion and disintegration (Clark *et al*., 1976 and Fraser, 1987).

Potassium Chloride (KCl) is used as a shale inhibitor in most PHPA mud designs. In low-solids muds, PHPA interacts with minimal concentrations of bentonite to link particles together and improve rheology without increased colloidal solids loading. The following is the summary of the primary and secondary products descriptions:

(i) Primary product descriptions:

- Barite: Barium Sulphate is a high specific gravity mineral used to increase the weight of drilling fluids.
- Bentonite (Gel): Bentonite is used to increase the rheology of drilling fluids to help with hole cleaning and development of filter cakes.
- Caustic Soda: Sodium Hydroxide is used when it is necessary to increase the pH of the mud system.
- PHPA: Partially Hydrolyzed Polyacrylamide is used to enhance bentonite and encapsulate solids as well as provide viscosity to sweeps
- PAC LV: Polyanionic Cellulose is used to control fluid loss.
- GEL PA-D: This is the Fully Organic and Biodegradable Polyol inhibition product that will stabilize any reactive clays that would normally destabilize when introduced to water.
- Soda Ash: Sodium Carbonate is used to control hardness found in make-up water, and.
- XCD: Xanthan Gum is a high molecular weight bio polysaccharide.

(ii) Secondary product descriptions:

- Calcium Carbonate: Specifically, sized acid soluble Lost Circulation Material.
- Broad spectrum biocide used to control bacteria growth within stored water-based mud drilling fluids.

- Crushed walnut hulls that are used for clearing the bit of clays and Lost Circulation Material.

- Citric Acid: is used to control the pH of muds.

- Magma Fiber: specially formulated extrusion spun mineral fiber Lost Circulation Material that is acid soluble.

- Mica: sized grades of Muscovite Mica for Lost Circulation.

- Zinc Carbonate: H_2S scavenger for water base muds to protect tubular goods from corrosion.

The plant-based products added to the base fluid are created through organic processes and are biodegradable. The adopted water-based system is tested, proven safe, and environmentally sound. The system is approved for use by the most stringent regulatory regimes for projects around the world, from national oil companies to private operators. It is also the most expensive system to implement.

The drilling fluid system includes three main components: the drilling fluid system, the circulating/cleaning system, and the reserve pits (Fig. 2.10). The circulating system is part of the Crown 750 conventional drilling rig that is being used by REN in exploratory drilling operations. The system includes the drilling fluid pumps, distribution lines, separators and solids control. To further enhance safety, REN augmented the original two mud pumps on the rig with a third, more powerful pump.

The reserve pit is adjacent to the drilling rig and, along with storage tanks, is where the excess fluids and cuttings are managed (Fig. 2.10). Like most oil and gas wells, the rocks being drilled through for the three exploratory wells are environmentally benign (unlike mining operations) and any fluids encountered while drilling stay in the formation due to the equivalent circulating density of the drilling fluid system.

The cuttings from the well are also being captured and bagged, with half of the cuttings set aside for the Namibian Government for future study. REN is having the cuttings analysed by international and national-based environmentally focused laboratories.

An organic gel/clay barrier at the pit base prevents seepage into groundwater and soils (Fig. 2.10). This approach is better than polyurethane pit linings, which are easy to install but challenging to remove during reclamation, which can lead to shredding and leaks.

REN always has a full-time expert on-site, testing the reserve pit fluid properties on a regular basis. There are also experienced geologists on-site examining the cuttings every 3 metres to understand the formations that are being penetrated, to measure and monitor their properties. As expected, there has been no flows or losses of fluid into the ground from the pits at previous drilled well sites 6-1 (Kawe), 6-2 (Mbambi) and 8-2 Makandina wells.

Any remaining drilling fluid and cuttings will initially be used to fertilise soils around tested portions of the drilling site with the intention of then supplying this topsoil enhancement to the nearby farmers. REN is currently working with the local agricultural authorities to test this process. The drilling fluid products are organic and biodegradable, promoting nitrogen levels which are an essential nutrient for plant, crop, and grass growth.

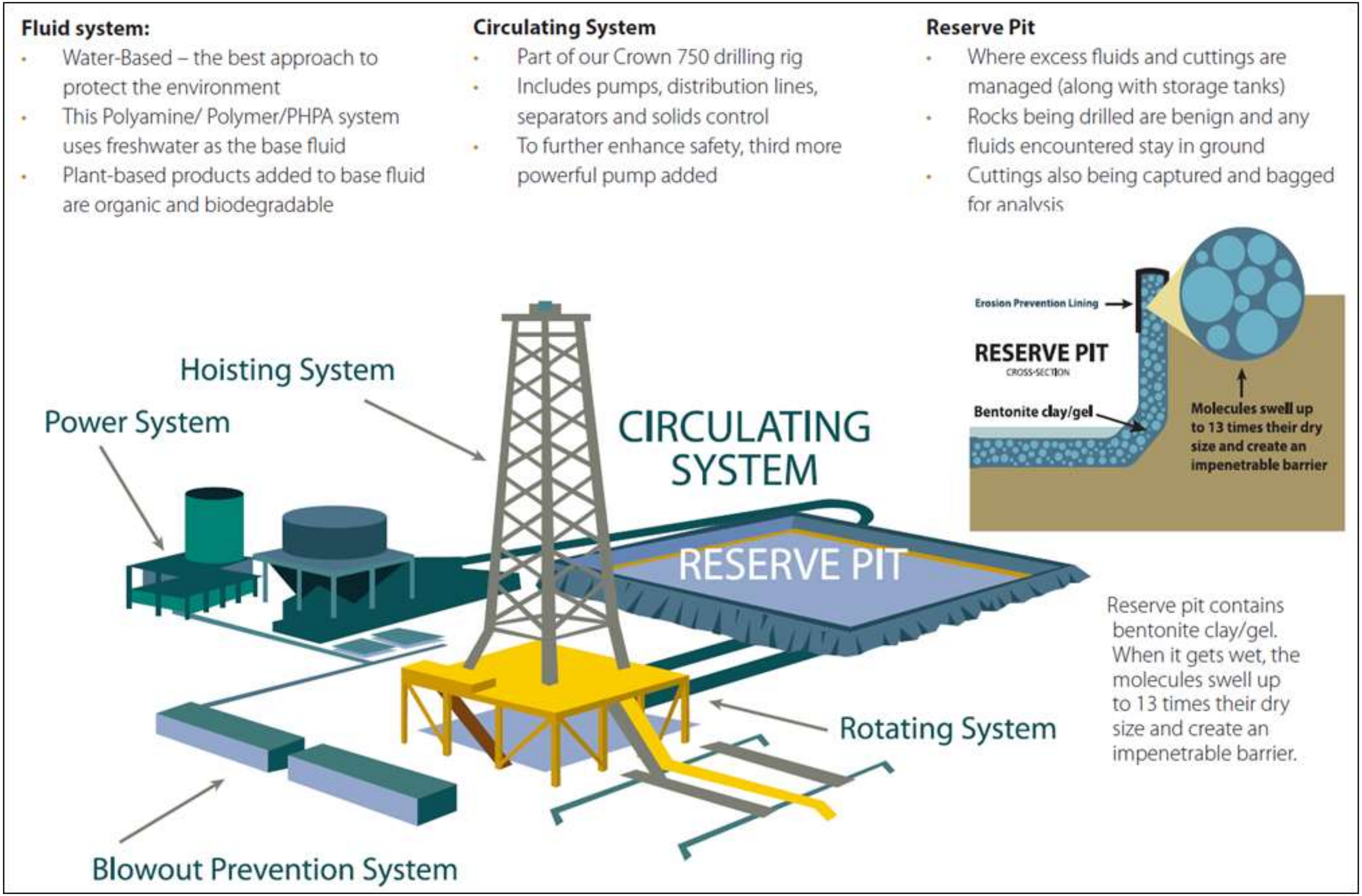


Figure 2.10: Illustration of the well site layout to be adopted for each well showing all the key engineered components that will be used to control well pressures and protect the receiving environment including surface and ground water resources (Source: REN, 2021).

2.2.8 Proposed Wells Engineered Design and Permitting

2.2.8.1 Basis for Well Design

The design of oil and gas wells, including the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 will be undertaken in line with international standards and regulatory requirements of the MME, the Competent Authority (Fig. 2.11).

Prior to the implementation of each of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6, the Basis for Well design documents must be approved by the Ministry of Mines and Energy together with the supporting documents such as the Emergency Response Plan (ER) and Oil Spill Contingency Plan (OSCP) complimented by a rig inspection. Well design addresses engineered well design requirements followed by well construction details in delivering the functional requirements to be achieved during the drilling process.

The well design specification as presented in Figs. 2.11 and 2.12, includes: Target formation(s) and geological prognosis, subsurface target location(s) and tolerances, fluid pressure and formation strength prognoses, logging, coring, and sampling.

The drilling program focuses on the planned hole and casing sizes, and setting depths, required drilling mud properties (weight, viscosity, etc.), planned well trajectory and directional drilling requirements, cement recipes and job specifications (rate, volume, etc.) and hole cleaning requirements prior to completion (Table 2.1).

The completion program addresses the final stages of the operations and covers the specification design for lower and upper completions, material specification for all completion components and procedures to be adopted.

2.2.8.2 Mud Logging Program, Sampling and Analysis

The mud logging program will focus on the following:

- ❖ 24 hour/day geological monitoring and evaluation at the wellsite with real-time and archival data presentation and distribution. Computer-plotted multiscale.

- ❖ Presentations compiling Rate of penetration (ROP), depth, lithology, oil, total hydrocarbon gas detection, Flame ionization detection (FID) gas chromatography, Carbon Dioxide (CO_2) and Hydrogen Sulphide (H_2S) Monitoring, complete lithology, and oil show descriptions.

- ❖ Drilling rig instrumentation data monitored, recorded, and presented (from Pason). All data available in LAS, ASCII, WITS and graphics (PDF, etc.) files on local network, internet (where connected), disk, e-mail, and.

- ❖ The Iso Tube Gas Sampling System will be used to capture and preserve gas samples. This rigid structure is far stronger than gas bags and less susceptible to leakage. Long-term testing shows virtually no chemical or isotopic degradation of gases stored for >3 years.

A wireline sidewall coring tool will be available to take samples from sites identified by wireline logging. The following core analysis will be performed:

- ❖ Palynology.

- ❖ Organic geochemistry.

- ❖ Standard core analysis (porosity, permeability, etc.).

- ❖ Rock physics, and.

- ❖ Special core analysis (if merited).

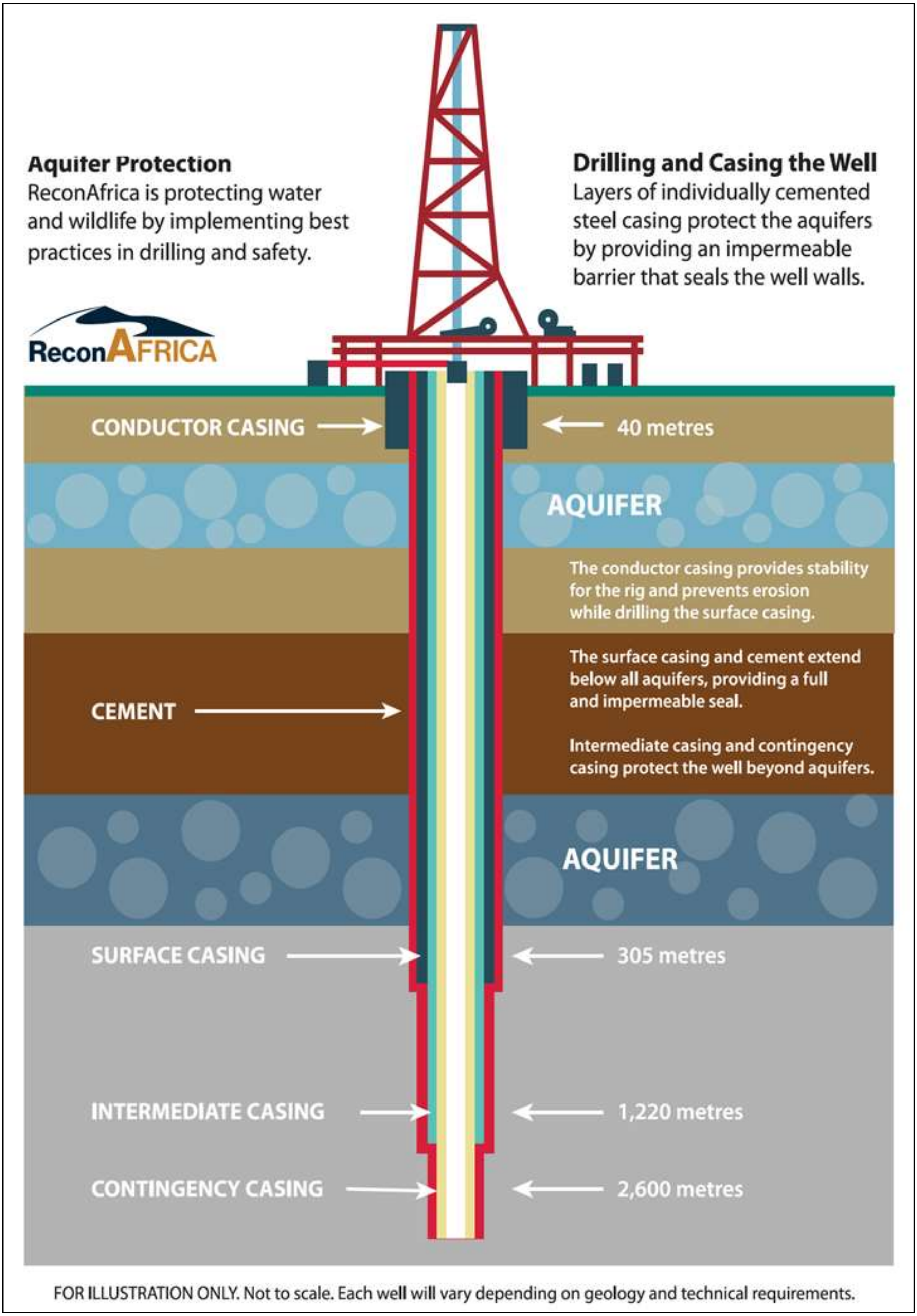


Figure 2.11: Illustration of the well design and engineering barriers that will fully isolate and protect groundwater resources with respect to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 (Source REN, 2022).

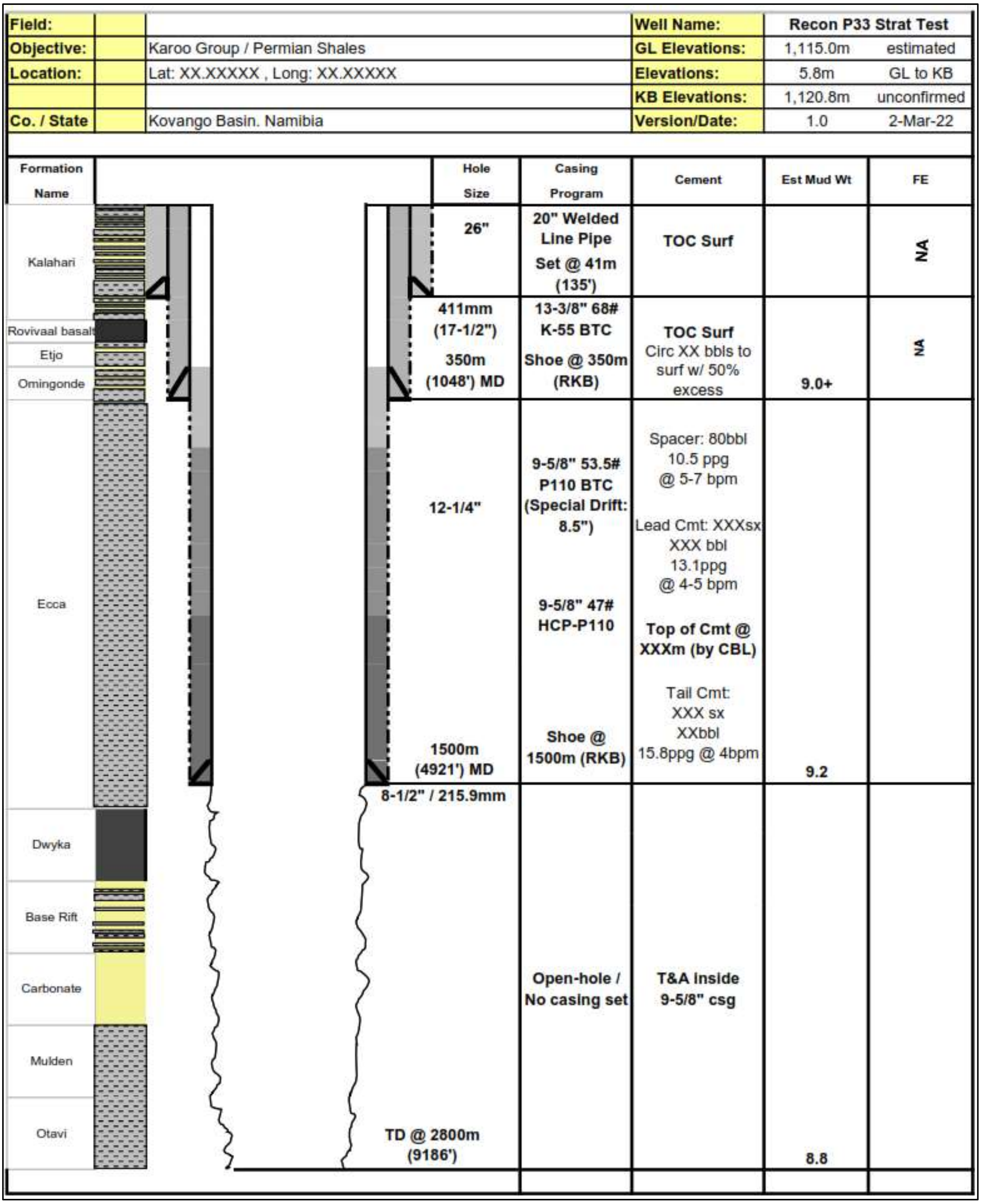


Figure 2.12: Example of Basis for well design wellbore schematic (Source REN, 2021).

Table 2.1: Casing and mud information.

Casing String	Hole Size	Casing O.D.	Depth (ft)	Mud Type	Max. MW, ppg
Conductor	26”	20”	130		
Surface	17-1/2”	13-3/8”	1,000	Hi-Viscosity	9.1
Intermediate	12-1/4”	9-5/8”	4,800	KCL/Polymer	9.1
Liner	8-1/2”	7-5/8”	8,500	KCL/Polymer/PHPA	9.5
Production	6-1/2”	4-1/2”	12,500	KCL/Polymer/PHPA	10.0

2.2.8.3 Expected Final Status

Well testing may be conducted to determine whether a formation will produce, or continue to produce, hydrocarbons at a rate that gives a reasonable return on the investments. Operators also use test data to determine the limits of the reservoir and to plan the most efficient methods for producing wells and operating the discovered fields. Well testing may be undertaken subject to the status of potential commerciality for each individual well to be drilled in PEL 73.

2.2.8.4 Perceived Drilling Hazards

The most prevalent drilling hazards are associated with abnormal pressures and Hydrogen Sulphides. These two (2) operational challenges and risks can be caused by various factors including: Geological faults and structures, pipe sticking and drill pipe failures, lost circulation, borehole deviation, pipe failures, borehole instability, formation contamination, hydrogen sulphide or other gas, hydraulic fracturing, buried valleys, and man-made features. The potential for encountering shallow gas is believed to be generally low based on the results from the well sites 6-1, 6-2 and 8-2 (Table 2.2).

Table 2.2: Perceived operating risks and mitigation (Source: REN, 2021).

Risk	Mitigation
Abnormal Pressures	1. No abnormal pressures are expected. 2. Obtain valid leak-off test (LOT) at each casing seat. 3. Consider drilling each hole section with maximum anticipated energy output available to minimise downtime due to wellbore strees imbalance.
Hydrogen Sulphide	1. No evidence of Hydrogen Sulphide (H_2S) in produced fluids within the Kavango Sedimentary Basin. However, due to low well density, the presence of H_2S cannot be entirely discounted. 2. H_2S scavenger will be available for mud system if required to remove H_2S from mud system. 3. Minimum mud pH will be 9.1 4. Mud logging unit will be equipped with H_2S detection.

2.2.8.5 Permitting and Approval of the Basis for Well Design

Permitting and approval of the basis for well design is regulated by MME under the Petroleum (Exploration and Production) Act, 1991 (Act 2 of 1991). Before a well can be drilled, a permit to drill is granted by the Petroleum Commissioner based on the submission of the basis for well design together with all the supporting documents. The Proponent is required to submit to MME a Pre-Drill Data Package (PDDP) including basis for well design, well data, diagrams / documents in line with the international well design and operations management, control, and barrier standards as well as casing and tubing design procedures for each well to be drilled.

Other supporting documents including: Copy of the Environmental Clearance Certificate (ECC), Environmental Impact Assessment (EIA) Report, Environmental Management Plan (EMP) Report, Oil Spill Contingency Planning (OSCP) and Emergence Response Plan (ERP) must also be submitted for review and approval as may be applicable. Rig inspection is often undertaken before the implementation of the drilling operations following the granting of the permit to drill. Drilling progress as well as well testing, abandonment, and drilling completion must be monitored and reported to the Petroleum Commissioner on the daily / weekly/ monthly basis or as may be applicable and provided for in the Petroleum Agreement. A drilling Health, Safety and Environment (HSE) monitoring closure report shall be prepared and submitted to MME and MEFT at the end of the drilling operations for each well approved for drilling.

2.2.9 Waste Management

2.2.9.1 Municipal Related Solid Waste Management

REN has hired a Rundu-based solid waste management contractor, Rent-A-Drum (RaD) to provide solid and liquid waste management support to the drilling of the proposed exploration and appraisal wells sites. RaD is a well experienced and resourced company which is responsible for collection of all the solid waste from the drilling site. Onsite solid waste collection facilities and storage/ transfer areas are provided. RaD has a good Health and Safety system and Emergency Response in place and the company tracks every man hour and every trip and every waste load including the safety of the vehicles. The waste collected from the drilling sites is sorted at RaD enclosed storage yard in Rundu. Plastics, cans, and paper are sorted, bailed and sent out to Windhoek. The contractor does keep records of all waste removed from the current stratigraphic well drilling sites and the similar waste management strategies will be applied for the proposed exploration and appraisal wells sites.

2.2.9.2 Hazardous Waste Management

RaD will also collects hazardous waste from the proposed exploration and appraisal wells sites. Hazardous waste such as used oil and grease will be collected and sent out to Tsumeb (±350 km West of Rundu) and used for various purposes for fuels or maintenance purposes especially in the minerals processing processes such as the smelter or cement plants. Unfortunately, the Town Council of Rundu operates more than 1 dumpsite with illegal dumping of solid waste common around the townlands. The Rundu Town Council waste solid waste disposal site is not a legally registered solid waste facility that can accept all types of solid wastes including hazardous waste. The site is poorly managed to accept any form of hazardous waste from the ongoing oil and gas drilling operations. This solid waste disposal site will require some site upgrades to be able to receive hazardous solid waste from the ongoing oil and gas drilling operations in PEL 73.

2.2.9.3 Liquid Waste Management

Waste water management (sewage) is using a combination of an onsite mobile French Drain and chemical toilets as may be applicable. RaD does provide sewage waste management support to REN drilling sites. Collected sewage waste will be transported to Ndama Sewage works in Rundu managed by the Town Council. The contractor shall keep and track records of how much waste water (sewage) is being removed from each individual drilling sites.

2.3 Key Regulatory Agencies and Permitting Requirements

2.3.1 National Legislation Governing Petroleum Operations in Namibia

The national legislation governing petroleum operations in Namibia falls within the authority of the Ministry of Mines and Energy (MME) as the Competent Authority (CA) responsible for granting authorisations, permits, licenses, concerts, compliances as may be applicable to a petroleum exploration project. The legislative framework governing upstream oil and gas operations in Namibia is modern and well developed, and has been specially formulated for the international oil industry covering the following:

(i) Petroleum (Exploration and Production) Act, 1991 (Act 2 of 1991).

(ii) Petroleum Laws Amendment Act, 1998(Act 24 of 1998).

(iii) Petroleum Taxation Act, 1991 (Act 3 of 1991), and.

(iv) Model Petroleum Agreement (MPA), 2007.

The following is the summary of the important legislative that may be applicable to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73:

- ❖ Namibian Constitution Articles 91(c) and 95.
- ❖ Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991).
- ❖ Environmental Management Act (No. 7 of 2007) and Regulations (2012).
- ❖ Water Act, 1956, Act No. 54 of 1956.

- ❖ Atomic Energy and Radiation Protection Act (Act No. 5 of 2005).
- ❖ Immigration Control Act 7 of 1993.
- ❖ Customs and Excise Act 20 of 1998.
- ❖ Regional Councils Act, 1992, (Act 22 of 1992) as amended.
- ❖ Local Authorities Act, 1992, (Act 23 of 1992) as amended.
- ❖ Hazardous Substances Ordinance (1974).
- ❖ Public and Environmental Health Act, 2015 (Act No. 1 of 2015)
- ❖ Health Act (No. 21 of 1988).
- ❖ Air Quality Act (No. 39 of 2004).
- ❖ Atmospheric Pollution Prevention Act (No. 45 of 1965).
- ❖ Communal Land Act (No. 10 of 2002).
- ❖ Communal Land Reform Amendment Act (No. 13 of 2013).
- ❖ Forestry Act (No. 12 of 2001) and Forest Amendment Act (No. 13 of 2005).
- ❖ The Labour Act, 1992, Act No. 6 of 1992 as amended in the Labour Act, 2007 (Act No. 11 of 2007).
- ❖ Labour Act (No. 11 of 2004) – Health & Safety Regulations (1997).
- ❖ National Heritage Act (No. 27 of 2004).
- ❖ Nature Conservation Amendment Act (No. 5 of 1996).
- ❖ Nature Conservation Ordinance (No. 4 of 1975).
- ❖ Soil Conservation Act (No. 70 of 1969), and.
- ❖ Traditional Authorities Act (No. 17 of 1995).

Government agencies with permits responsibilities over the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 are shown in Table 2.3.

2.3.2 Permitting Requirements

Table 2.4 shows the relevant permits / licenses required with respect to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73. Namibia has standards and guidelines with respect to the freshwater and wastewater and lacks gaseous and noise limits as well as oil and gas industry specific standards and guidelines. The drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 will require the mobilisation of equipment, limited specialist personnel and tools from abroad. The current global Coronavirus (COVID-19) pandemic and the associated State of Emergencies and health restrictions globally will result in some delays and logistical disruptions.

Locally, Namibia might have a State of Health Emergency on top of the current escalating health restrictions under the Public and Environmental Health Act, 2015 (Act No. 1 of 2015) that may also affect not only the equipment, tools, and specialist workforce mobilisation but also the actual field implementation of the project. The local COVID 19 health restrictions will affect the field campsite set-up, vehicles passengers and all aspects of the project. The Proponent through the Contractor and subcontractors shall adhere to all the international, regional, and local COVID 19 health restrictions and protocols that may be in place at the time of drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73.

Table 2.3: Government agencies with permits responsibilities over the drilling of multiple exploration and appraisal wells within the AOI in PEL No. 73.

AUTHORITY	TYPE OF AUTHORISATION
Office of the Environmental Commissioner (OEC), Ministry of Environment, Forestry and Tourism	Issue of Environmental Clearance Certificate (ECC) based on the review of the Environmental Assessments (EA) Reports prepared in accordance with the Environmental Management Act (2007) and the Environmental Impact Assessment Regulations, 2012. The Directorate of Forestry (DOF) is responsible for issuing of forestry permits with respect to harvest, transport, and export or market forest resources.
Directorate of Forestry Ministry of Environment, Forestry and Tourism (MEFT)	Issues the following permits under the Forest Act (Act 12 of 2001) and the Regulations, 2015: ❖ A Harvesting Permit is required for any tree cutting and/or harvesting of wood in an area greater than 15 hectares per annum as stated under Section 22 (1), 23 (1), 24 (2&3) and 33 (1&2) of the Forest Act (Act 12 of 2001). The permit is issued by a Licensing Officer, and stipulates conditions of the harvesting on the reverse side of the permit. Inspection of an area to be harvested is done before the permit is issued, and when an application for renewal is made every 3 months. ❖ A Transport Permit is required to convey any wood or wood products (e.g., droppers, planks, charcoal, and firewood). It is obtainable from any Forestry Office, and is valid for 7 days. ❖ An Export Permit is required to send any wood or wood products outside Namibia. It is obtainable from any Forestry Office, and is valid for 7 days. ❖ A Marketing permit is required to enable the producer to sell his/her products to any other party. The permit is valid for 3 months in commercial areas while in communal areas the permit is valid for 1 month only. The National Botanical Research Institute's (NBRI) mandate is to study the flora and vegetation of Namibia, to promote the understanding, conservation and sustainable use of Namibia's plants for the benefit of all.
Ministry of Mines and Energy (MME)	Competent Authority overseeing all matters related to petroleum exploration and production activities in Namibia. MME is responsible for issuing of all types of Petroleum Licenses / Authorisation.
Ministry of Agriculture, Water and Land Reform	The Directorate of Resource Management within the Department of Water Affairs (DWA) at the MAWLR is currently the lead agency responsible for management of surface and groundwater utilisation through the issuing of permit for water borehole drilling, abstraction permits and waste water disposal permits. DWA is also the Government agency responsible for water quality monitoring and reporting.
Ministry of Health and Social Services (MHSS)	National Radiation Protection Authority (NRPA) falling under the MHSS is responsible for granting radioactive authorisation (Import and Export Permits) for tools with radioactive sources used for logging during the drilling process
Ministry of Home Affairs, Immigration, Safety and Security (MHAISS)	The Inspector General Explosive Control Division Namibian Police Force under the MHAISS is responsible for granting explosive permits (Import and Export) for tools with explosive charges used to support the drilling process
Kavango West and East Regional Councils	Overall responsibility of management of regional land resources and communal land surface user rights through the Communal Land Boards as may be required by the proposed project.
Kavango West and East Regions Traditional Authorities	Traditional authorities in Namibia are the custodians of State land falling within authority of the respective tribal land. With the approval of the Regional Land Boards, traditional authorities through the local structures of headmen and headwomen as well as Village Development Communities (VDCs) are responsible for allocation of communal land surface user rights to the local communities.

Table 2.4: Summary of the permit register with respect to drilling of multiple exploration and appraisal wells in AOI in PEL No. 73.

Type of Permit	Authorising / Institution	Legal Framework
1. Environmental Clearance Certificate (ECC)	Office of the Environmental Commissioner, Ministry of Environment, Forestry and Tourism (MEFT)	Environmental Impact Assessment (EIA) Regulations and Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007)
2. Harvesting Permit for cutting down trees	Directorate of Forestry Ministry of Environment, Forestry and Tourism	Forest Act (Act 12 of 2001
3. Freshwater Abstraction Permit, Waste Water Discharge Permit, Water Borehole Drilling Permits and Exploration and Appraisal Well Drilling Permit for drilling through a Groundwater Aquifer	Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR)	Water Act 54 of 1956, Government Gazette No 217 dated 5 April 1962 and Water Resources Management Act, 2004, (Act No. 24 of 2004).
4. Oil Spill Contingency Plan (OSCP)	Approved / Endorsed by the Ministry of Mines and Energy (MME) – Office of the Petroleum Commissioner	Petroleum (Exploration and Production) Act, 1991 and Associated Regulations
5. Emergency Response Plan (ERP)		
6. Radioactive Authorisation (Import, Storage, Transport, Use and Export Permits) of radioactive sources for logging	Authorisation Issued by the National Radiation Protection Authority (NRPA), Ministry of Health and Social Services (MHSS)	Atomic Energy & Radiation Protection Act (Act No 5 of 2005) and Radiation Protection & Waste Disposal Regulations (No 221 of 2011)
7. Explosive Permit (Import, Storage, Transport, Use and Export Permits) of Explosives equipment in drilling (Downhole equipment recovery) and well testing (Perforating steel casing, cement and formation rock) stages	The Inspector General Explosive Control Division Namibian Police Force, Ministry of Home Affairs, Immigration, Safety and Security	Explosives Act, 1956 (Act 26 of 1956, as amended) and Regulations (GNR 1604 of 8 September 1972, as amended)
8. Oil and Gas Well Drilling Permit / Consent / Permit to Drill with Basis for Well Design	Ministry of Mines and Energy – Office of the Petroleum Commissioner	Petroleum (Exploration and Production) Act, 1991 and Petroleum Regulations as Amended
9. Surface User Rights Consent, Endorsement, Leasehold or Permission to Occupy (PTO)	Chief's Council, Traditional Authority, Regional Land Boards and Regional Councils or Long-term Leasehold Land Owner	Communal Land Act (No. 10 of 2002), Communal Land Reform Amendment Act (No. 13 of 2013) and Regional Councils Act, 1992, (Act 22 of 1992) as amended and applicable

2.4 Regional and Local Environmental Settings

2.4.1 Climate and Topography

The climate of the project area is warm – hot for most of the year. Summer temperatures on average range between a minimum temperature of 20°C to maximum day temperatures of 30-35°C for months October to March. Winter temperatures on average, range between minimums of 6-10°C to a maximum day time temperature of 26°C. Winters are from June to August. Rainfall mostly falls during summer with no rainfall of significance between May to August. Rain occurs between December to March, with the highest rainfall peaking in January and February. Annual rainfall figures are variable with the lowest rainfall recorded at 221mm/annum and the highest rainfall of 1204mm/annum. The highest rainfall in one day was 190mm, measured at Rupara. Rainfall in the Kavango East and West Regions, like the rest of Namibia, is highly variable spatially and temporally. The mean annual rainfall is highly variable between 400 and 600 mm per year. The distribution of rainfall is extremely seasonal with all the rain falling in summer from October to April and characterised by heavy occasional thunderstorms. The mean annual gross evaporation is between 2600-2800 mm.

The landscape around the proposed exploration and appraisal wells sites is characterised by gentle undulating sandy topography of the forested / vegetated sandy Kalahari Dune Belt. The Kalahari Group sediments that dominate the surficial topographic features of the Kavango Sedimentary Basin form part of the greater Kalahari Basin stretching into Angola, Zambia, Zimbabwe, Botswana, and South Africa (Fig. 2.13). The AOI is a flat gently sloping landscape formed by a sea of windblown sands. The only positive relief are undulating, east-west striking, permanent dunes prominent in the west of the Omatako Omuramba and further east, closer to Botswana (Figs. 2.14- 2.16). Dune crests are approximately between 10-15m high with interstitial dune valleys between 1-2km wide. The terrain, from east to west, has a height difference of approximately 100m over a 300km distance, with heights of approximately 1200 metres above mean sea level (mamsl) in the west falling to approximately 1080 mamsl in the east at the border with Botswana (Figs. 2.14- 2.16). The general topographic profile of the project area from south to north has heights of 1200 mamsl in the south falling to 1070 mamsl in the north close to and beyond the Okavango River.

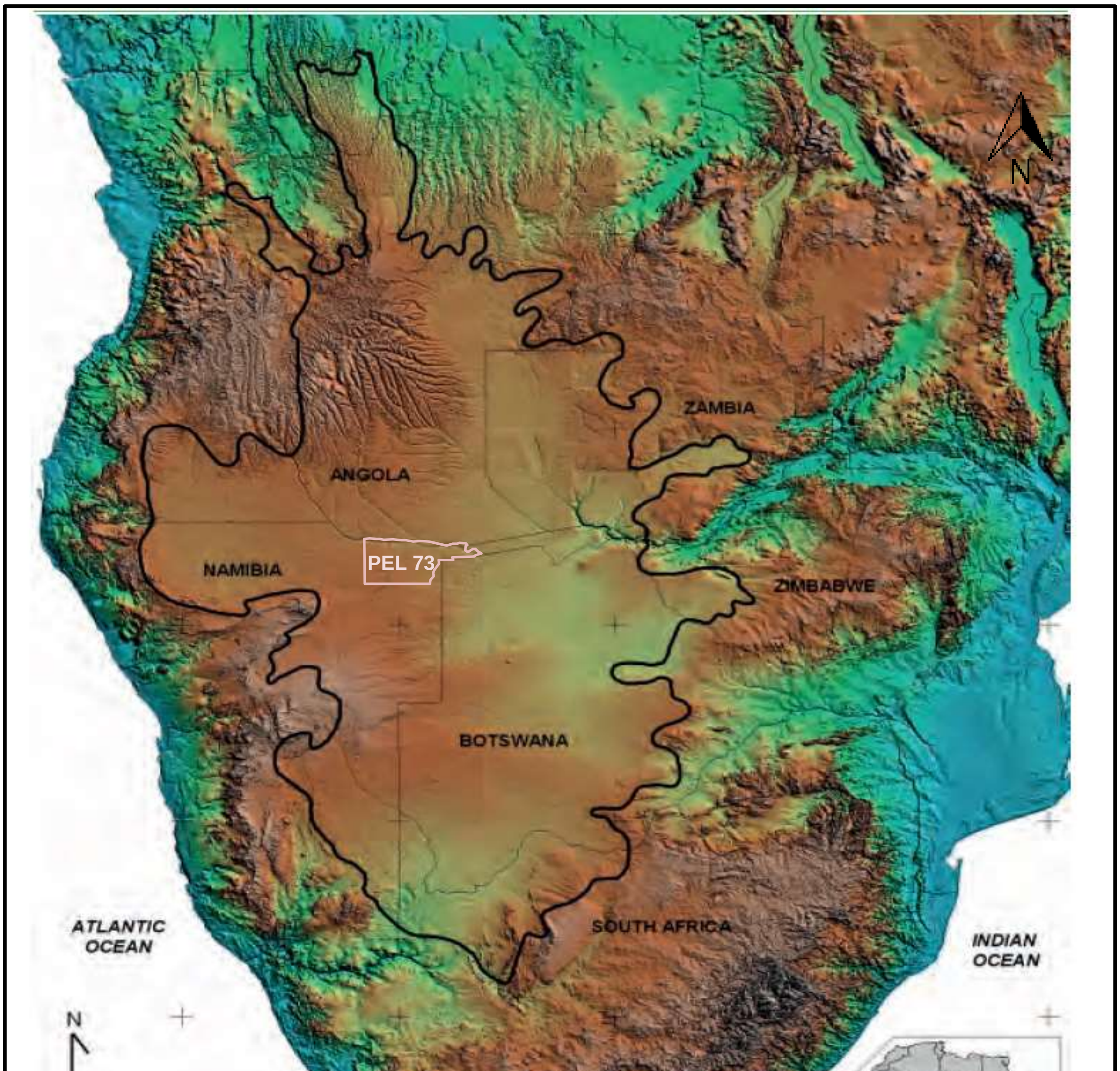


Figure 2.13: Lateral extent of Kalahari Group sediments showing the regional location of PEL No. 73 covering Blocks 1719, 1720, 1721, 1819, 1820 and 1821 falling within the newly discovered Kavango Sedimentary Basin forming part of the greater Kalahari Basin stretching into Angola, Zambia, Zimbabwe, Botswana, and South Africa (Modified Source: Haddon, 2005).

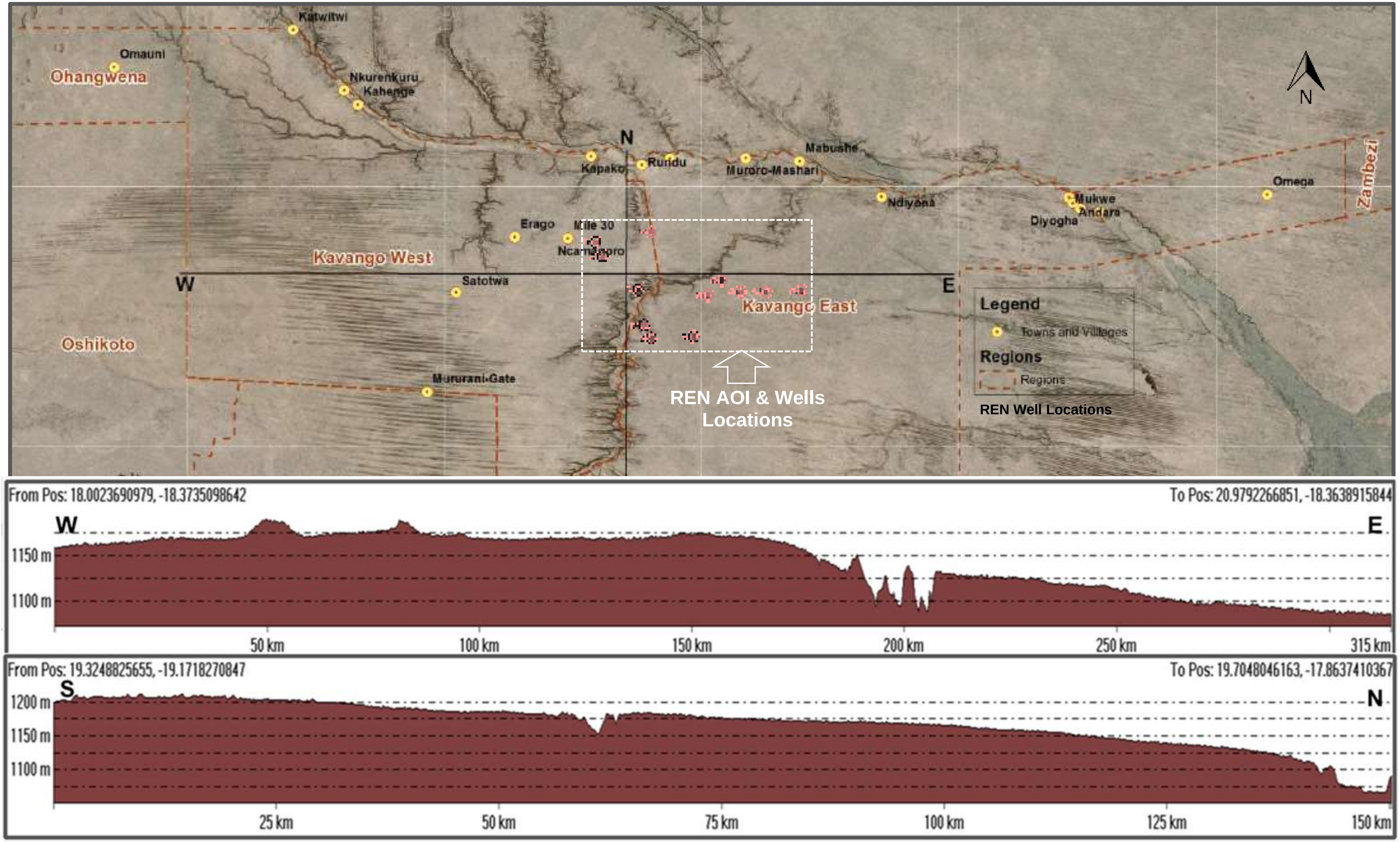


Figure 2.14: Location of the proposed exploration and appraisal wells with respect to the general topography the project area with relief features such as the Omatako Omuramba valley and other smaller river valleys joining the Okavango River from the south (Julius, 2021).

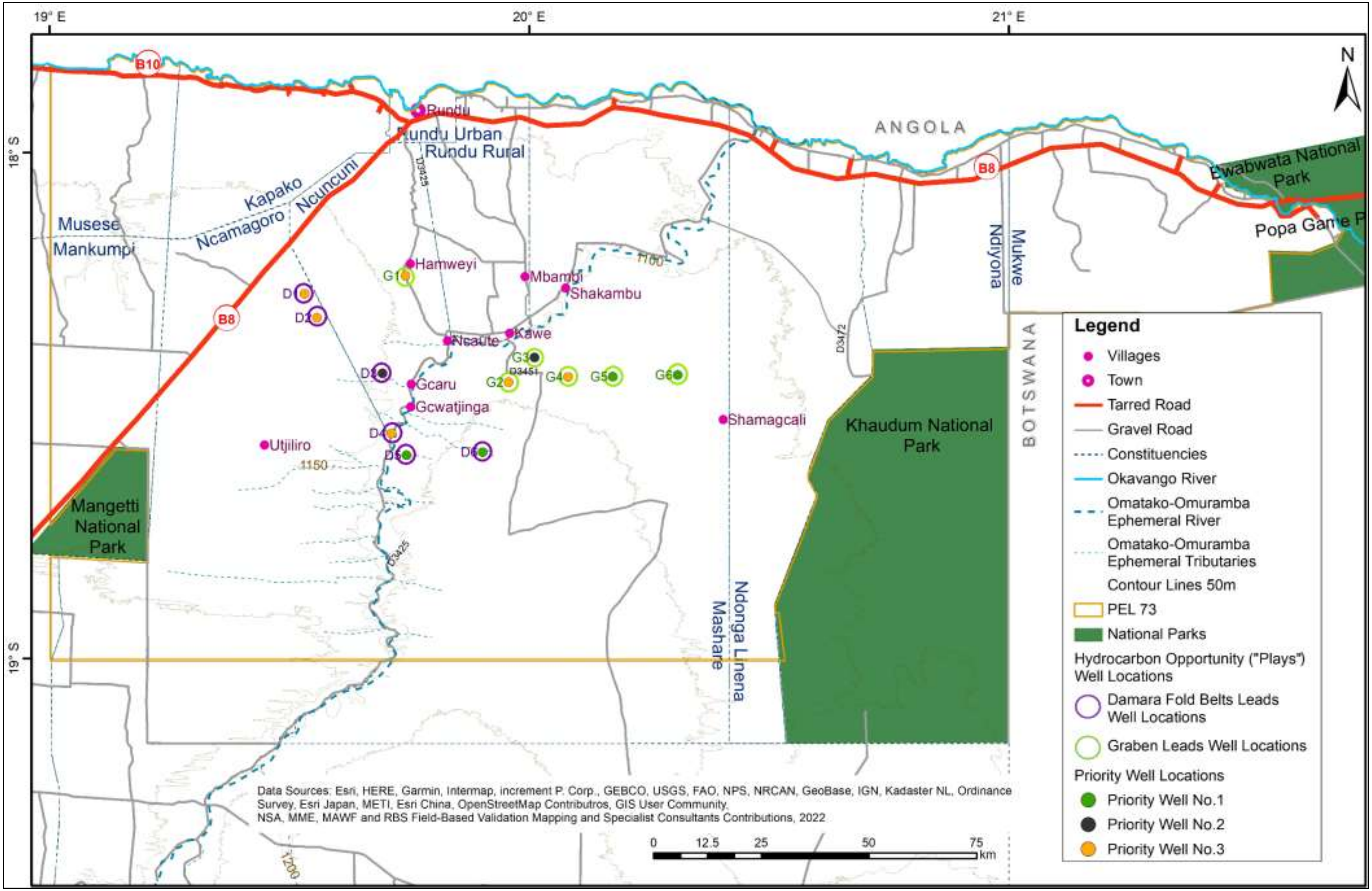


Figure 2.15 Regional topographic setting around PEL No. 73 with respect to the proposed exploration and appraisal wells locations.

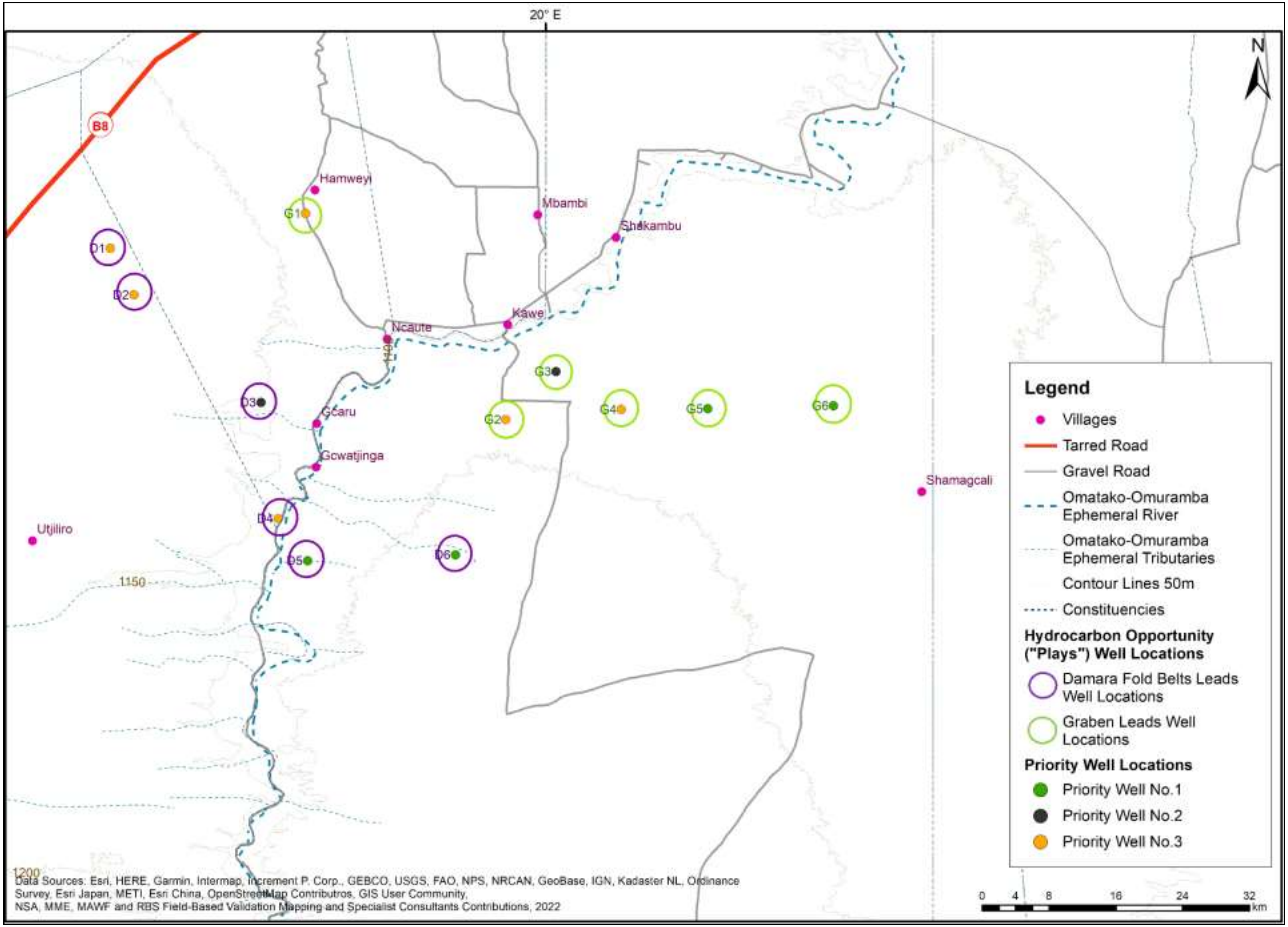


Figure 2.16: Local topographic setting around the AOI with respect to the proposed exploration and appraisal wells locations.

2.4.2 Regional and Local Land Uses

2.4.2.1 Regional Land Use

The well locations fall within the greater Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) initiative (Fig. 2.17). The Kavango Sedimentary Basin and all the delineated sub-basins fall within the Kavango West and East Regions communal lands and not on the banks of the Okavango River, not related to the Okavango Delta, do not cover the archaeological sites of the Tsodilo Hills which are in Botswana and do not fall in the legally proclaimed national parks within the Republic of Namibia (Fig. 2.18). The KAZA TFCA initiative covering Angola, Botswana, Namibia, Zambia, and Zimbabwe was created in cooperation with Peace Parks Foundation and the World-Wide Fund for Nature.In July 2006, the KAZA TFCA was endorsed as a Southern Africa Development Community (SADC) project, and on 7th December 2006 the Ministers of Environment and Tourism of the five partner countries signed a Memorandum of Understanding at Victoria Falls, Zimbabwe, providing for work towards the establishment of the KAZA TFCA initiative. KAZA TFCA is a multiple land use regional transboundary conservation initiative with a common vision of promoting and supporting sustainable livelihoods through coexistence and utilisation of multiple resource and resources areas including National Parks, Game Reserves, Forest Reserves, Conservancies, Game/Wildlife Management Areas and Communal lands (Fig. 2.17). The overall vision of KAZA TFCA is still a working progress because the rightful beneficiaries who are the rural local communities continue to languish in inherited generational poverty right at the doorsteps of KAZA, as seen around the local villages in Kavango West and East Regions such as Ncaute, Kawe, Mbambi, Makandina, Mutwegombahe, Mbambi, Ncuncuni, Cuma, Hamweyi , Ncaute, Gcauru Sivaradi, Shakambu, Cumezawo and as well as at Masambo, Omega 1 in Bwabwata National Park, Western Zambezi Region situated right in the core of the KAZA TFCA. As part of the socioeconomic profile of the AOI in PEL No. 73, extensive consultations, meetings, and interviews with the local communities regarding various local socioeconomic opportunities including the role of KAZA TFCA, have been conducted since January 2021 and continue to be undertaken to this day.

2.4.2.2 Land Use of the D1-D6 and G1-G6 Well Sites AOI

The overall AOI and the proposed exploration and appraisal wells locations Nos. D1-D6 and G1-G6 well locations fall in the communal areas of the Ncamangoro, and Ncuncuni Constituencies of Kavango West Region and Mashare Constituency of Kavango East Region. Formal proclaimed national parks within the general area of the AOI and PEL No. 73 are: Bwabwata, Khaudum and Mangetti National Parks (Figs. 2.17-2.22). Ncamangoro, and Ncuncuni Constituencies fall within the boundaries of the Mbunza traditional authority while the Mashare Constituency falls within the Sambyu Traditional Authority (Figs. 2.19-2.22). Each of the proposed exploration and appraisal wells to be drilled will cover a footprint area of less than 3Ha within the AOI and not the entire PEL 73 or the entire AOI.

According to the Namibian Association of CBNRM Support Organisations (NACSO), there are 2 community forests in Kavango West (Kahengu and Katope community forests) and 10 community forests in Kavango East (Ncumacara, Ncamagoro, Mbeyo, Gcwatjinga, Ncaute, Cuma, Likwaterera, Hans Kanyinga, George Mukoya and Muduva Nyangana community forests) (Figs. 2.19 and 2.20). George Mukoya and Kapinga Kamwalye are the two (2) community conservancies situated to the eastern boundary and central parts of the AOI (Figs. 2.19 and 2.20). George Mukoya Conservancy is located on the northern border of Khaudum National Park, adjacent to Muduva Nyangana Conservancy. The Kapinga kaMwalye Conservancy is situated in the Shambyu tribal district and falls into the two political constituencies of Mashare and Rundu Rural in the Kavango East Region. The communal conservancy covers an area of 1301 km^2 and is situated approximately 20 km east of Rundu. The southern parts of the targeted AOI are fenced under the communal land use / government resettlement programme (Figs. Figs. 2.21 and 2.22). The land uses in the general area is mainly communal / subsistence farming comprising cattle, donkeys and seasonal crop farming which sometimes involves slash and burn practices and clearing of larger tracks of pristine forestry. Subsistence seasonal (January to April) crop farming of sorghum, millet and maize are centred on widely spaced communal villages situated along the Omatako- Omuramba Ephemeral River Channel (Plates 2.3- 2.5). Increasingly, local areas are being cleared for both agriculture and new settlements with villages centred around communal water points where water is readily available (Plates 2.2-2.5).

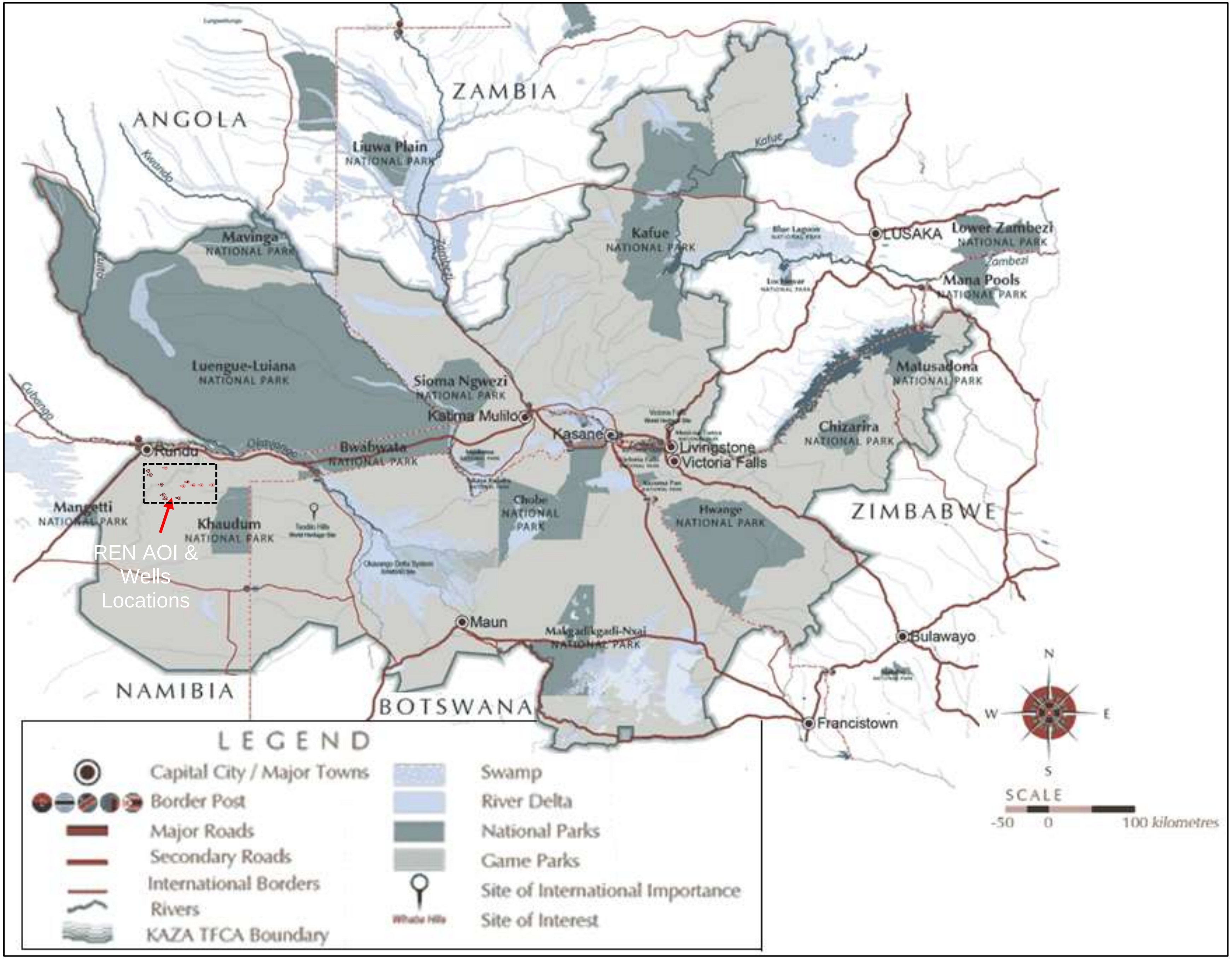


Figure 2.17: The Transboundary Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) initiative and location of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 (www.kavangozambezi.org/en/).

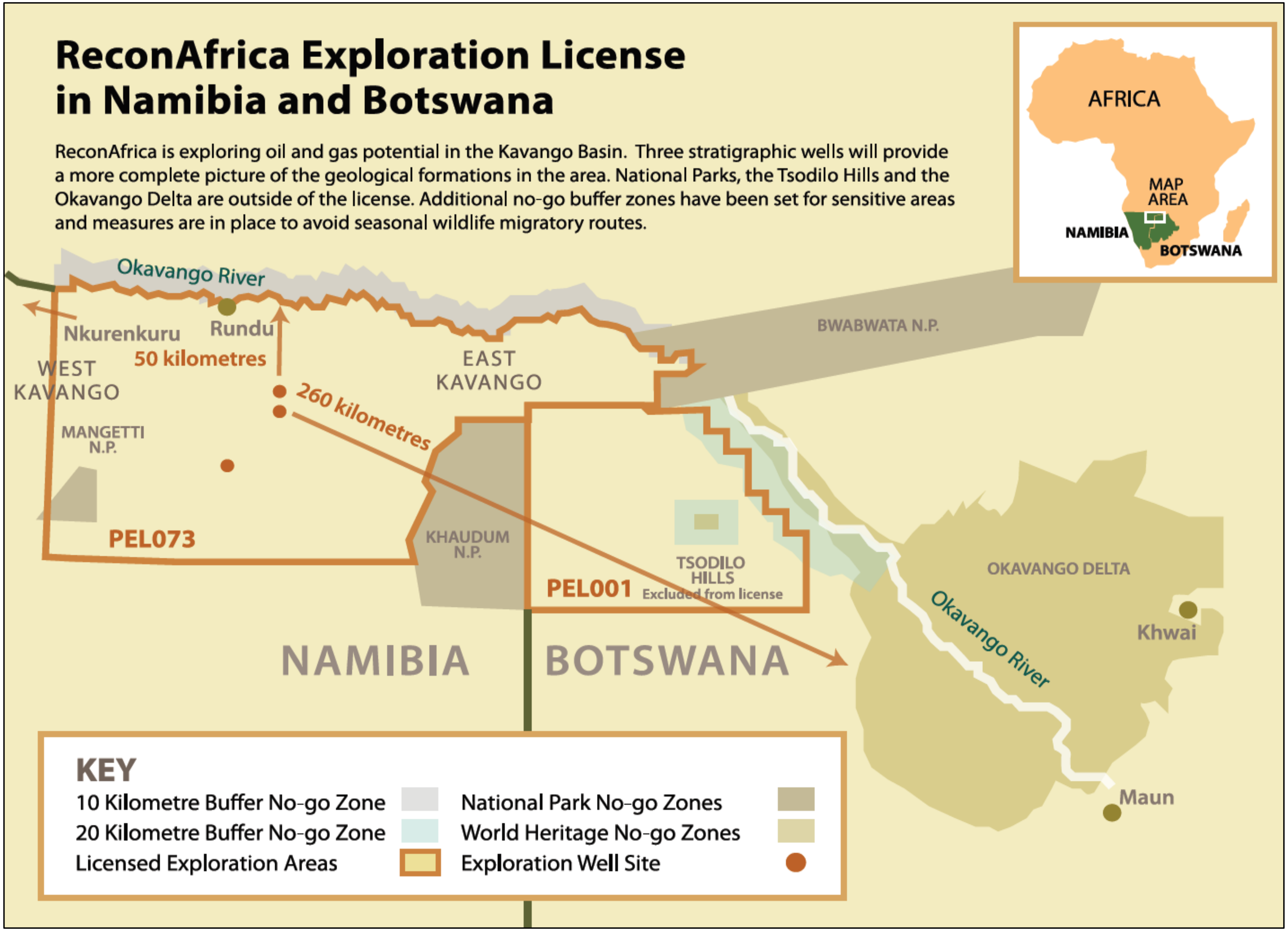


Figure 2.18: REN exploration license in Namibia with respect to key sensitive areas and neighbouring Botswana (Source: https://reconafrica.com).

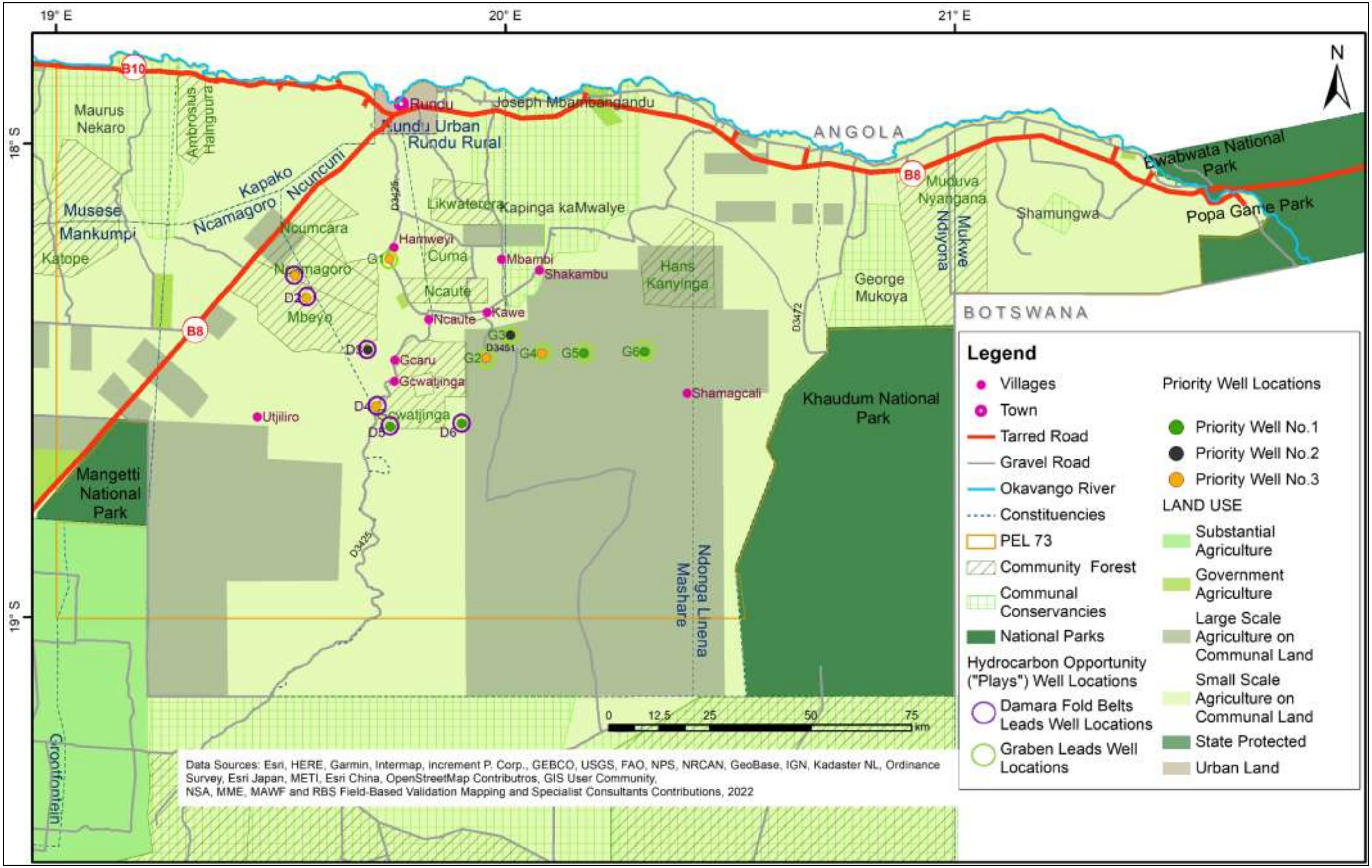


Figure 2.19: Regional land use around PEL No. 73 with respect to the proposed new exploration and appraisal wells sites.

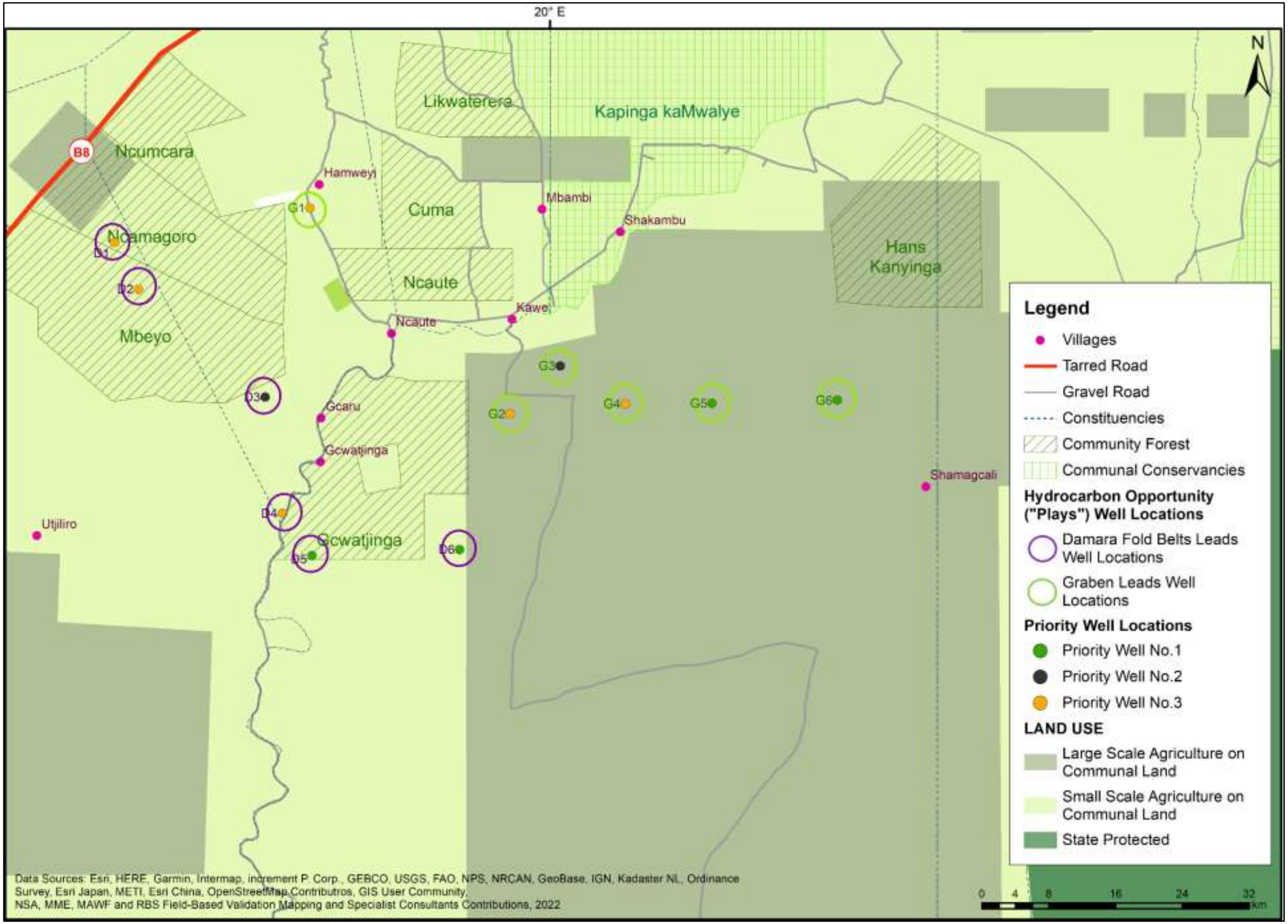


Figure 2.20: Local land use around the AOI with respect to the proposed new exploration and appraisal wells sites.

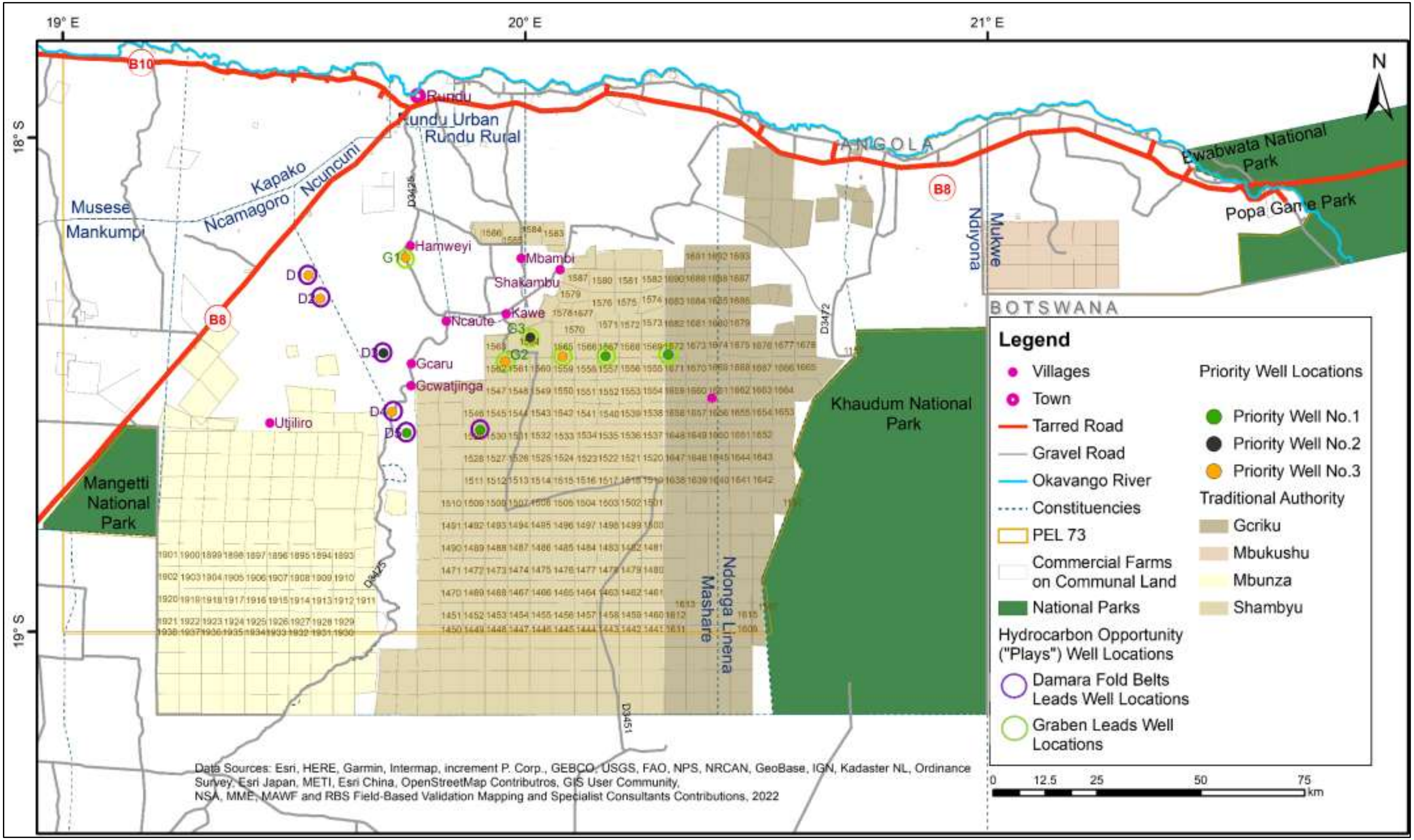


Figure 2.21: Commercial farms on communal land and traditional authority boundaries around PEL 73 with respect to the proposed new exploration and appraisal wells sites.

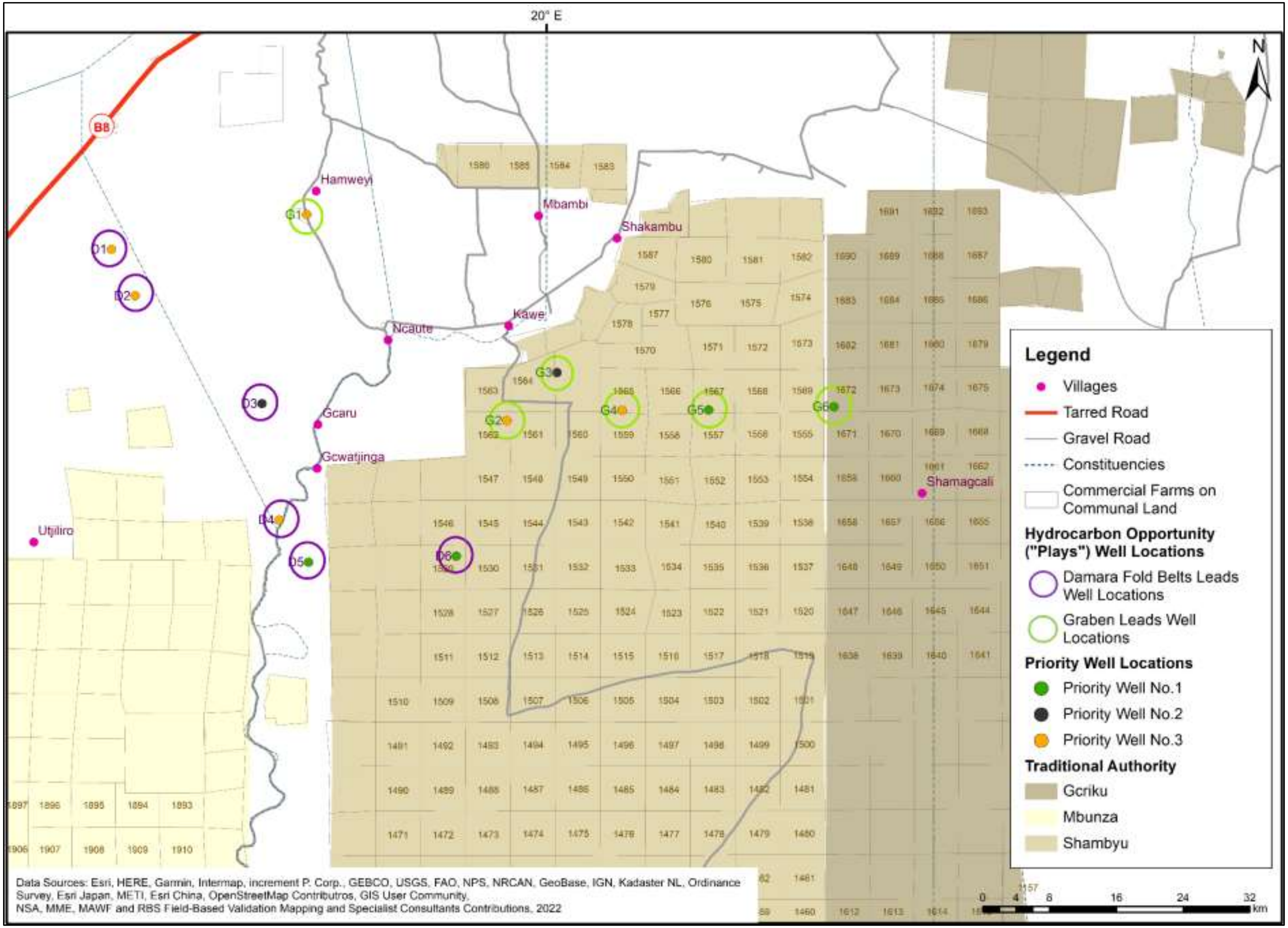


Figure 2.22: Commercial farms on communal land and traditional authority boundaries around the AOI with respect to the proposed new exploration and appraisal wells sites.

Plate 2.3: Drone view to the southeast at Makandina showing the extensive forest clearing and fossilised Omatako–Omuramba Ephemeral Channel cleared and fully cultivated for subsistence crop production.

Plate 2.4: Drone view to the southwest at Makandina showing the extensive forest clearing and fossilised Omatako–Omuramba Ephemeral Channel cleared and fully cultivated for subsistence crop production between Makandina and Ncaute.

Plate 2.5: Drone view to the south at Kawe showing extensive forest clearing and fossilised Omatako–Omuramba Ephemeral Channel cleared for settlements and subsistence crop production commonly found around proposed D1-D6 and G1-G6 exploration and appraisal wells sites.

2.4.3 Local Environmental Settings Proposed Well Sites

2.4.3.1 Reptiles

The most important species within the AOI are viewed as the 2 endemics (*Ichnotropis grandiceps* and *Lygodactylus bradfieldi*), 3 species classified as rare (*Lycophidion multimaculatum*, *Psammophis jallae*, *Causus rhombeatus*) and 6 species classified as vulnerable (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Kinixys spekii, Python natalensis*, *Varanus albigularis*, *Varanus niloticus*) (Annex 4).

Furthermore, *Ichnotropis grandiceps*, is also classified as data deficient by the IUCN (2021), supporting its importance.

2.4.3.2 Amphibians

The most important species within the AOI is the giant bullfrog (*Pyxicephalus adspersus*) with "population is decreasing" according to the IUCN (2021) as it is consumed as food throughout its range (Annex 4).

2.4.3.3 Mammals

The most important species within the AOI are probably those classified as rare (*Nycteris hispida*, *Kerivoula argentata*, *Kerivoula lanosa*, *Mastomys shortridgei*, *Civittictis civetta*, *Paracynictis selousi*) and endangered (*Lycaon pictus*, *Lutra maculicollis*, *Equus (burchellii) quagga*) under Namibian legislation and those classified by the IUCN (2021) as endangered (*Lycaon pictus*), vulnerable (*Loxodonta africana*, *Smutsia (Manis) temminckii*, *Acinonyx jubatus*, *Panthera pardus*, *Panthera leo*, *Hippopotamus amphibious*, *Giraffa camelopardalis*) and near threatened (*Hipposideros vittatus*). However, some of the above species – e.g. other, hippo, etc. – are only associated with the Okavango River.

The most important species expected to occur in the general area would be the African wild dog (*Lycaon pictus*) and pangolin (*Smutsia (Manis) temminckii*).

2.4.3.4 Birds

The most important species with the AOI are viewed as those classified as endangered (hooded vulture, white-backed vulture, tawny eagle, martial eagle, bateleur, southern ground-hornbill), vulnerable (secretarybird, white-headed vulture, lappet-faced vulture and) and near threatened (marabou stork, peregrine falcon, kori bustard) from Namibia (Simmons *et al.* 2015) as well as those classified by the IUCN (2021) as critically endangered (hooded vulture, white-headed vulture, white-backed vulture), endangered (lappet-faced vulture), 4 vulnerable (secretarybird, tawny eagle, martial eagle, southern ground-hornbill) and near threatened (bateleur, kori bustard) (Annex 4).

2.4.3.5 Trees/shrubs

At least 10 species of conservation concern – i.e. red data species within the AOI of which 3 species are endemic, 4 species as near threatened (*Baikiaea plurijuga*, *Cromidon pusillum*, *Eulophia leachii*, *Pterocarpus angolensis*), 5 species protected by the Nature Conservation Ordinance No. 4 of 1975 and 4 species viewed as least concern while 4 species is listed by CITES as Appendix 2 (Table 2.5 and Annex 4). However, except for *B. plurijuga* and *P. angolensis* the majority of the other species are all associated with "moist/wet" areas such as pans/Omuramba, etc. and not expected to occur in the dry sandy areas devoid of surface water.

Imported and protected trees found around the proposed D1-D6 and G1-G6 exploration and appraisal wells sites and associated access areas have been mapped (Figs. 2.23-2.34) and marked with red and white danger tape for each individual site as demonstrated in Plate 2.6. The marked trees shall either be avoided and protected or retained or permitted through the MEFT Forestry Department before they can be removed.

Table 2.5: Important species – i.e. red data spp. – known to occur in the general area according to Loots (2005).

Species: Scientific name	Conservation status
Baikiaea plurijuga	NT
Brachystelma schinzii	Endemic; LC
Ceropegia stenantha	NC; LC
Cromidon pusillum	Endemic; NT
Eulophia hereroensis	NC; C2; LC
Eulophia leachii	NC; C2; NT
Eulophia livingstoniana	NC, C2
Habenaria epipactidea	NC; C2
Hygrophila gracillima	Endemic; LC
Pterocarpus angolensis	NT

***NC**: Nature Conservation Ordinance No. 4 of 1975*
Endemic; NT – Near Threatened; LC – Least Concern (Loots 2005)
***C2:** CITES Appendix 2 species*
***Source:** Loots (2005)*

2.4.3.6 Grass

The grasses commonly used for thatching are: *Eragrostis pallens*, *Hyperthelia dissoluta* and *Cymbopogon* species – which also have economic value, are the important grasses within the AOI (Annex 4).

Except for the general ecological role of grasses (e.g., stabilising the soil, fodder/grazing value, etc.) none of the grasses are viewed as exceptionally unique in the area.

2.4.3.7 Summary of Important Habitats

The most important habitats in the general wider / regional area around the proposed D1-D6 and G1-G6 well locations are:

1) Perennial Okavango River: The Okavango River is viewed as a site of special ecological importance in Namibia due to its biotic richness, threatened plants and insects (Curtis and Barnard 1998). The river is situated more than 50 km from the nearest proposed well site.

2) Fossilised Ephemeral Omuramba Omatako: Ephemeral rivers are viewed as sites of special ecological importance in Namibia due to its biotic richness, large mammals, high value for human subsistence and tourism (Curtis and Barnard 1998).

3) Ephemeral Pans: Ephemeral pans are viewed as sites of special ecological importance in Namibia due to its biotic richness, endemic crustacean, Red Data birds, habitat and resource for humans and wildlife (Curtis and Barnard 1998). Although important larger pans such as Nyae Nyae, etc. fall outside the general area, all other smaller pans are also viewed as important habitat.

4) Khaudum National Park: The Khaudum NP falls within the North-Eastern Kalahari Woodlands vegetation type with omurambas which act as ideal routes for wildlife. Dominant trees include: Acacia erioloba, Adansonia digitata, Baikiaea plurijuga, Combretum imberbe, Guibourtia coleosperma and Spirostachys africana. Important wildlife includes: African wild dog, leopard, lion, spotted hyaena, side-striped jackal, elephant, giraffe, blue wildebeest, eland, kudu, oryx, red hartebeest reedbuck, roan, tsessebe and warthog. Important birds include: Abdim's stork, African golden oriole, African hobby falcon, Bradfield's hornbill, ground hornbill, lesser spotted eagle, racket-tailed roller, steppe eagle and yellow-billed kite (www.meft.gov.na).

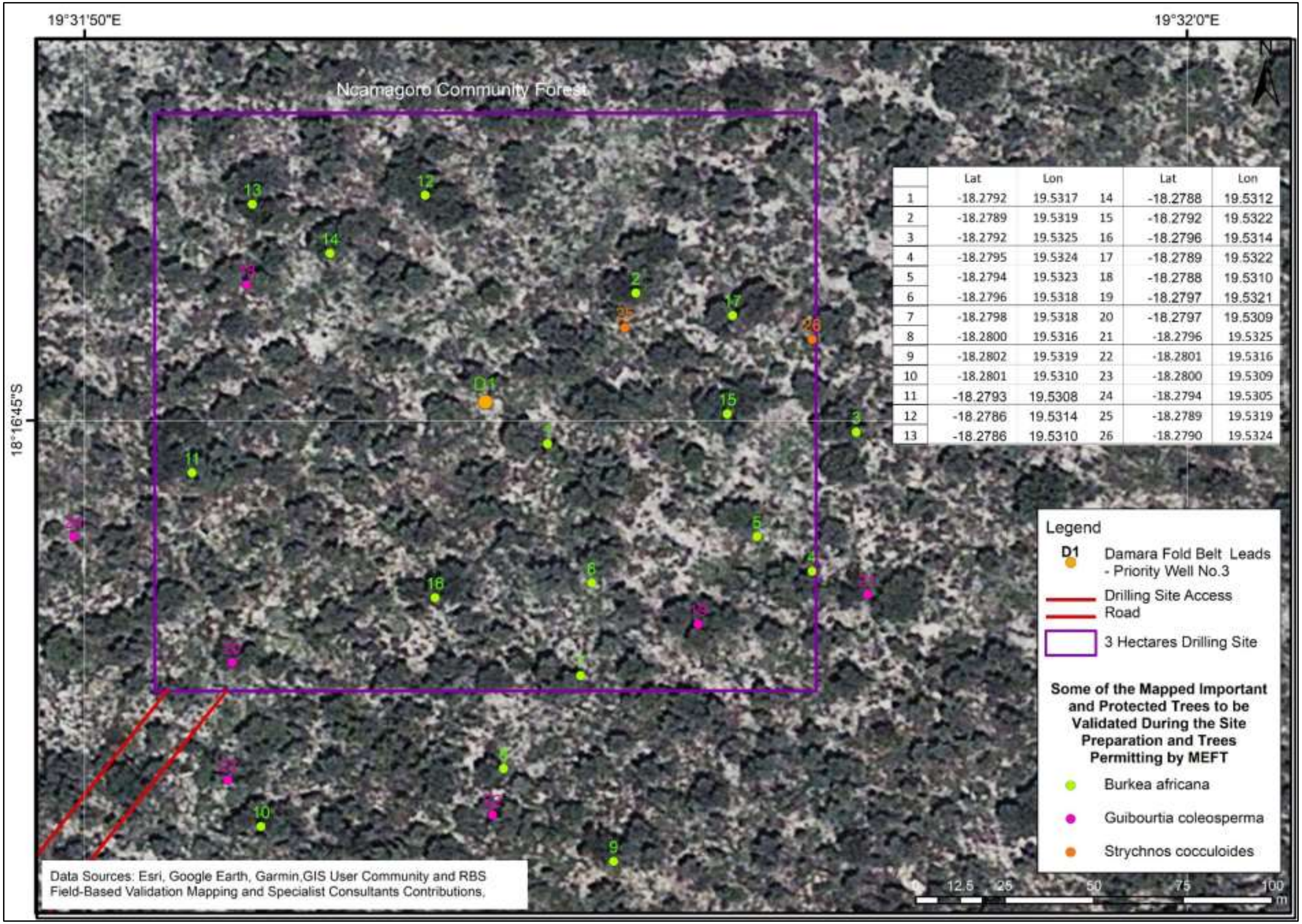
5) Mangetti National Park: The Mangetti NP falls within the North-Eastern Kalahari Woodlands vegetation type with the vegetation on the dune crests markedly different to that in dune valleys – i.e. Kalahari woodland vegetation dominates the dune crests, whereas mixed acacia

savannah vegetation characterises the dune valleys. Dominant trees include: Acacia erioloba, Acacia mellifera, Combretum collinum, Commiphora species, Schinziophyton rautanenii and Terminalia sericea. Important wildlife includes: African wild cat, leopard, spotted hyaena, blue wildebeest, common duiker, kudu, oryx, sable, steenbok and occasional elephant and wild dog. Important birds include: bateleur, lapped-faced vulture, tawny eagle, Meyer's parrot, and striped kingfisher (www.meft.gov.na).

6) Undisturbed areas and protected flora species: The general area is not pristine anymore due to prolonged human impact (e.g. settlements, slash-and-burn farming practices, unseasonal fires, etc.), especially along the perennial Okavango and Fossilised Omuramba Omatako ephemeral River Channels, and more recently along the various tracks and roads throughout the area. However, there are some areas far from the rivers and tracks/roads which have less human impact (albeit not pristine), and viewed as more important. Creating new tracks in these areas would result in the destruction of numerous protected tree species as well as result in access to these areas leading to further settlements as well as illegal harvesting and poaching and overall environmental destruction.

7) Kapinga Kamwalye Conservancy: The Kapinga Kamwalye Conservancy is the closest conservancy to the proposed development area, and viewed as important to the local communities in the area (MEFT/NACSO 2021, www.nacso.org.na), and.

8) Community Forests: Various Community Forests occur in the general area and include Ncumcara, Ncamagoro, Mbeyo, Cuma and Ncaute, all viewed as important to the local communities in the area (MEFT/NACSO 2021, www.nacso.org.na).



	Lat	Lon		Lat	Lon
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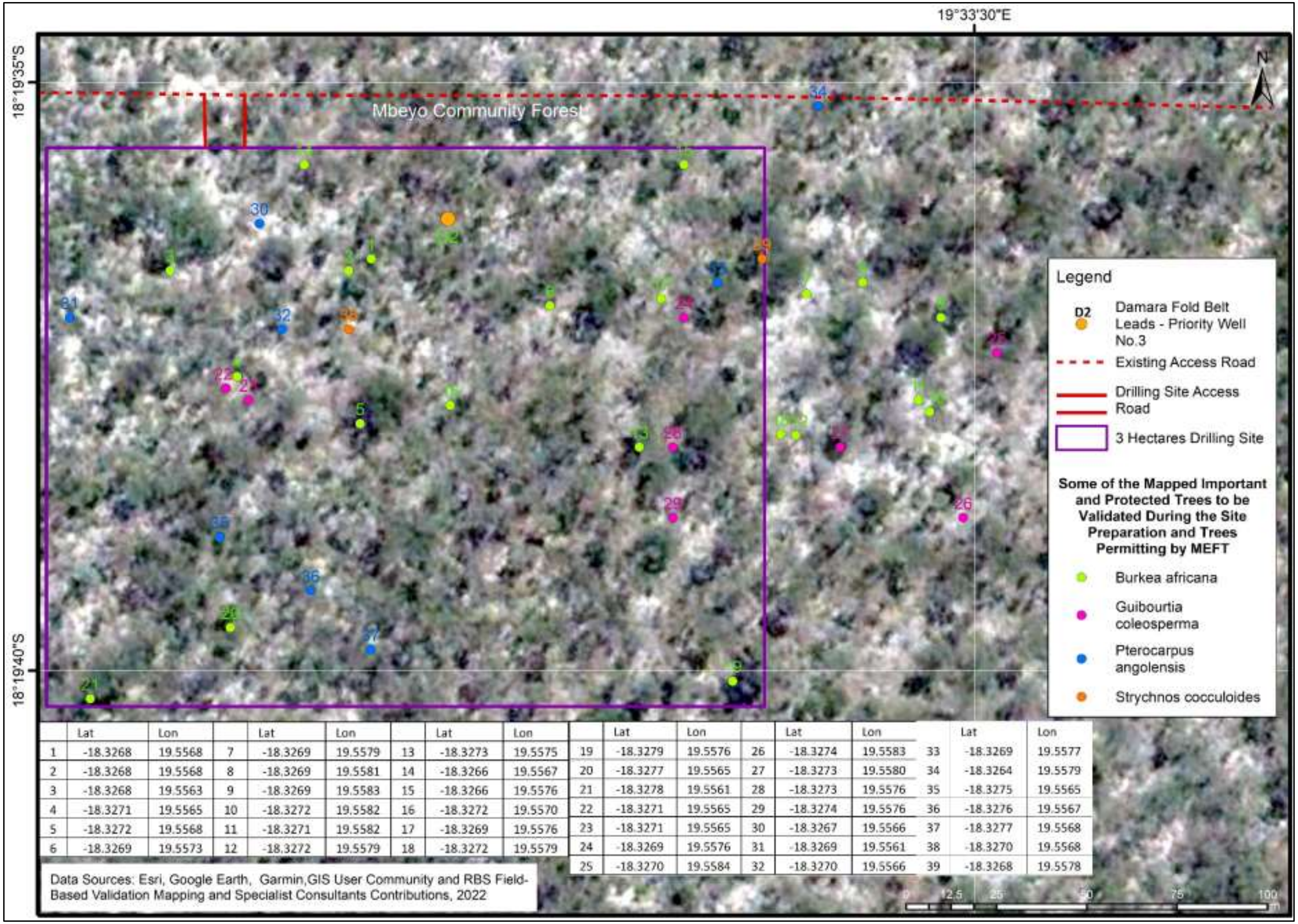
2	-18.2789	19.5319	15	-18.2792	19.5322
3	-18.2792	19.5325	16	-18.2796	19.5314
4	-18.2795	19.5324	17	-18.2789	19.5322
5	-18.2794	19.5323	18	-18.2788	19.5310
6	-18.2796	19.5318	19	-18.2797	19.5321
7	-18.2798	19.5318	20	-18.2797	19.5309
8	-18.2800	19.5316	21	-18.2796	19.5325
9	-18.2802	19.5319	22	-18.2801	19.5316
10	-18.2801	19.5310	23	-18.2800	19.5309
11	-18.2793	19.5308	24	-18.2794	19.5305
12	-18.2786	19.5314	25	-18.2789	19.5319
13	-18.2786	19.5310	26	-18.2790	19.5324

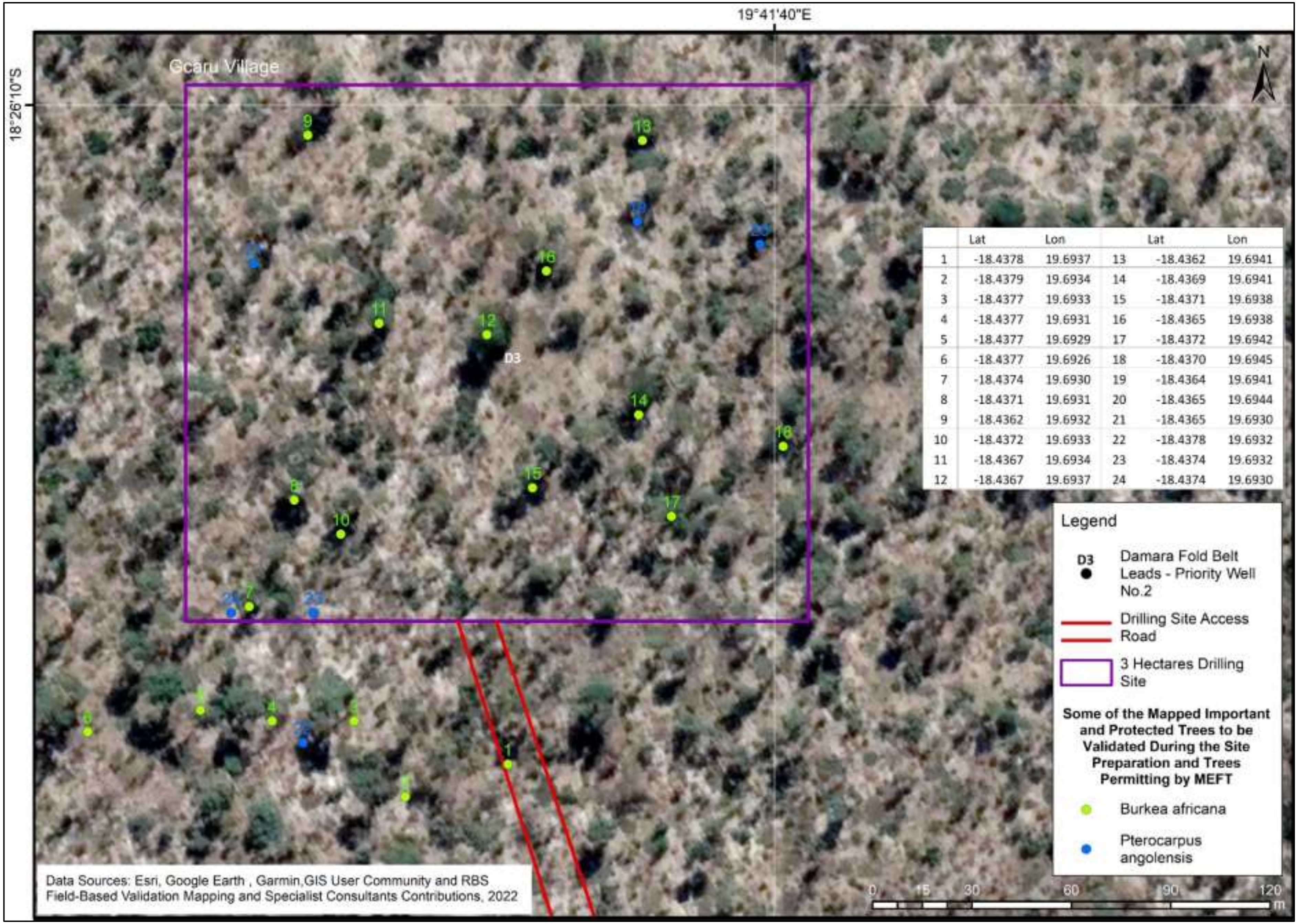
Figure 2.23: Some of the mapped important and protected trees around the proposed D1 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon		Lat	Lon
1	-18.3268	19.5568	7	-18.3269	19.5579	13	-18.3273	19.5575
2	-18.3268	19.5568	8	-18.3269	19.5581	14	-18.3266	19.5567
3	-18.3268	19.5563	9	-18.3269	19.5583	15	-18.3266	19.5576
4	-18.3271	19.5565	10	-18.3272	19.5582	16	-18.3272	19.5570
5	-18.3272	19.5568	11	-18.3271	19.5582	17	-18.3269	19.5576
6	-18.3269	19.5573	12	-18.3272	19.5579	18	-18.3272	19.5579

	Lat	Lon		Lat	Lon		Lat	Lon
19	-18.3279	19.5576	26	-18.3274	19.5583	33	-18.3269	19.5577
20	-18.3277	19.5565	27	-18.3273	19.5580	34	-18.3264	19.5579
21	-18.3278	19.5561	28	-18.3273	19.5576	35	-18.3275	19.5565
22	-18.3271	19.5565	29	-18.3274	19.5576	36	-18.3276	19.5567
23	-18.3271	19.5565	30	-18.3267	19.5566	37	-18.3277	19.5568
24	-18.3269	19.5576	31	-18.3269	19.5561	38	-18.3270	19.5568
25	-18.3270	19.5584	32	-18.3270	19.5566	39	-18.3268	19.5578

Figure 2.24: Some of the mapped important and protected trees around the proposed D2 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon
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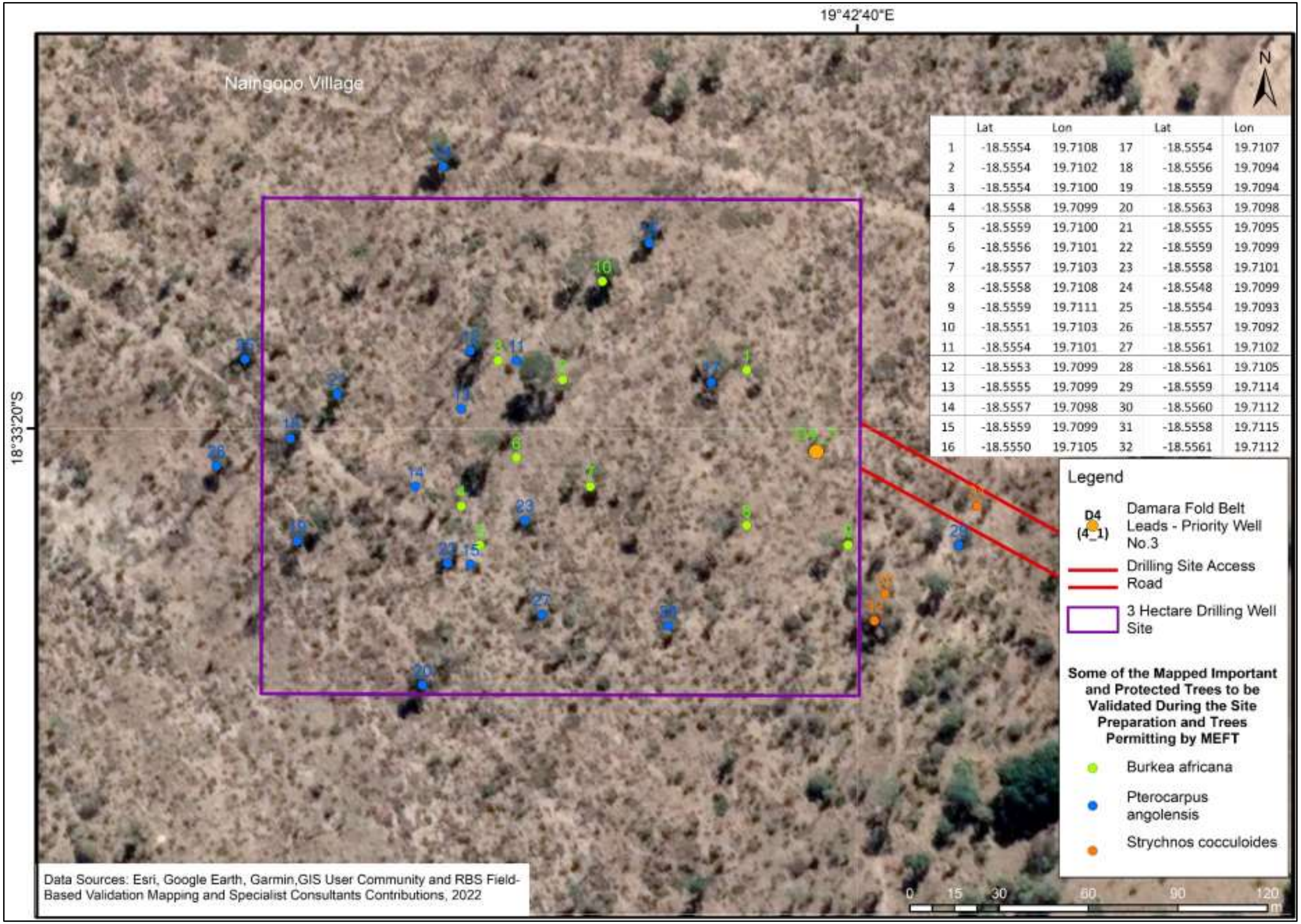
2	-18.4379	19.6934	14	-18.4369	19.6941
3	-18.4377	19.6933	15	-18.4371	19.6938
4	-18.4377	19.6931	16	-18.4365	19.6938
5	-18.4377	19.6929	17	-18.4372	19.6942
6	-18.4377	19.6926	18	-18.4370	19.6945
7	-18.4374	19.6930	19	-18.4364	19.6941
8	-18.4371	19.6931	20	-18.4365	19.6944
9	-18.4362	19.6932	21	-18.4365	19.6930
10	-18.4372	19.6933	22	-18.4378	19.6932
11	-18.4367	19.6934	23	-18.4374	19.6932
12	-18.4367	19.6937	24	-18.4374	19.6930

Figure 2.25: Some of the mapped important and protected trees around the proposed D3 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon
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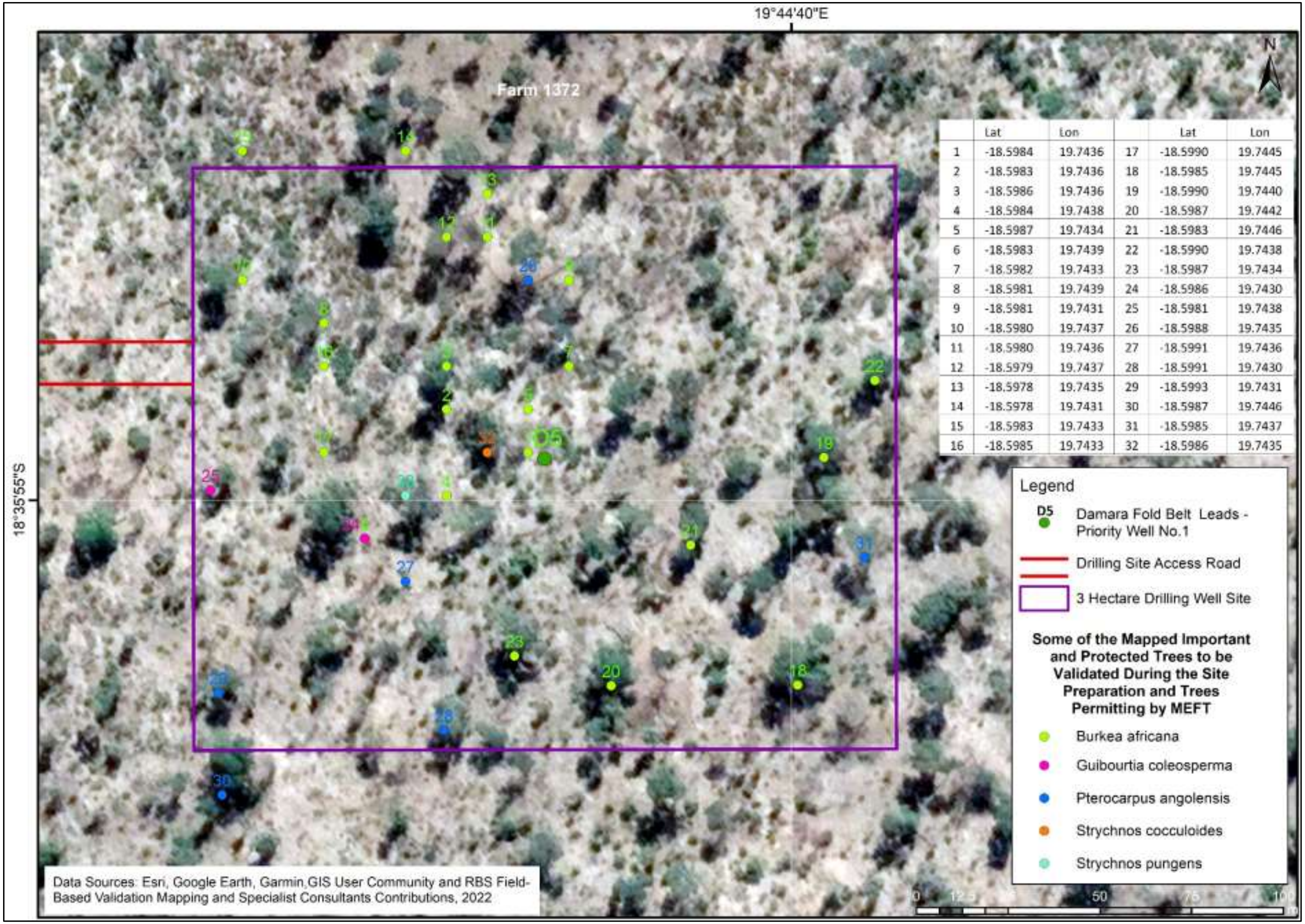
2	-18.5554	19.7102	18	-18.5556	19.7094
3	-18.5554	19.7100	19	-18.5559	19.7094
4	-18.5558	19.7099	20	-18.5563	19.7098
5	-18.5559	19.7100	21	-18.5555	19.7095
6	-18.5556	19.7101	22	-18.5559	19.7099
7	-18.5557	19.7103	23	-18.5558	19.7101
8	-18.5558	19.7108	24	-18.5548	19.7099
9	-18.5559	19.7111	25	-18.5554	19.7093
10	-18.5551	19.7103	26	-18.5557	19.7092
11	-18.5554	19.7101	27	-18.5561	19.7102
12	-18.5553	19.7099	28	-18.5561	19.7105
13	-18.5555	19.7099	29	-18.5559	19.7114
14	-18.5557	19.7098	30	-18.5560	19.7112
15	-18.5559	19.7099	31	-18.5558	19.7115
16	-18.5550	19.7105	32	-18.5561	19.7112

Figure 2.26: Some of the mapped important and protected trees around the proposed D4 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon
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2	-18.5983	19.7436	18	-18.5985	19.7445
3	-18.5986	19.7436	19	-18.5990	19.7440
4	-18.5984	19.7438	20	-18.5987	19.7442
5	-18.5987	19.7434	21	-18.5983	19.7446
6	-18.5983	19.7439	22	-18.5990	19.7438
7	-18.5982	19.7433	23	-18.5987	19.7434
8	-18.5981	19.7439	24	-18.5986	19.7430
9	-18.5981	19.7431	25	-18.5981	19.7438
10	-18.5980	19.7437	26	-18.5988	19.7435
11	-18.5980	19.7436	27	-18.5991	19.7436
12	-18.5979	19.7437	28	-18.5991	19.7430
13	-18.5978	19.7435	29	-18.5993	19.7431
14	-18.5978	19.7431	30	-18.5987	19.7446
15	-18.5983	19.7433	31	-18.5985	19.7437
16	-18.5985	19.7433	32	-18.5986	19.7435

Figure 2.27: Some of the mapped important and protected trees around the proposed D5 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.

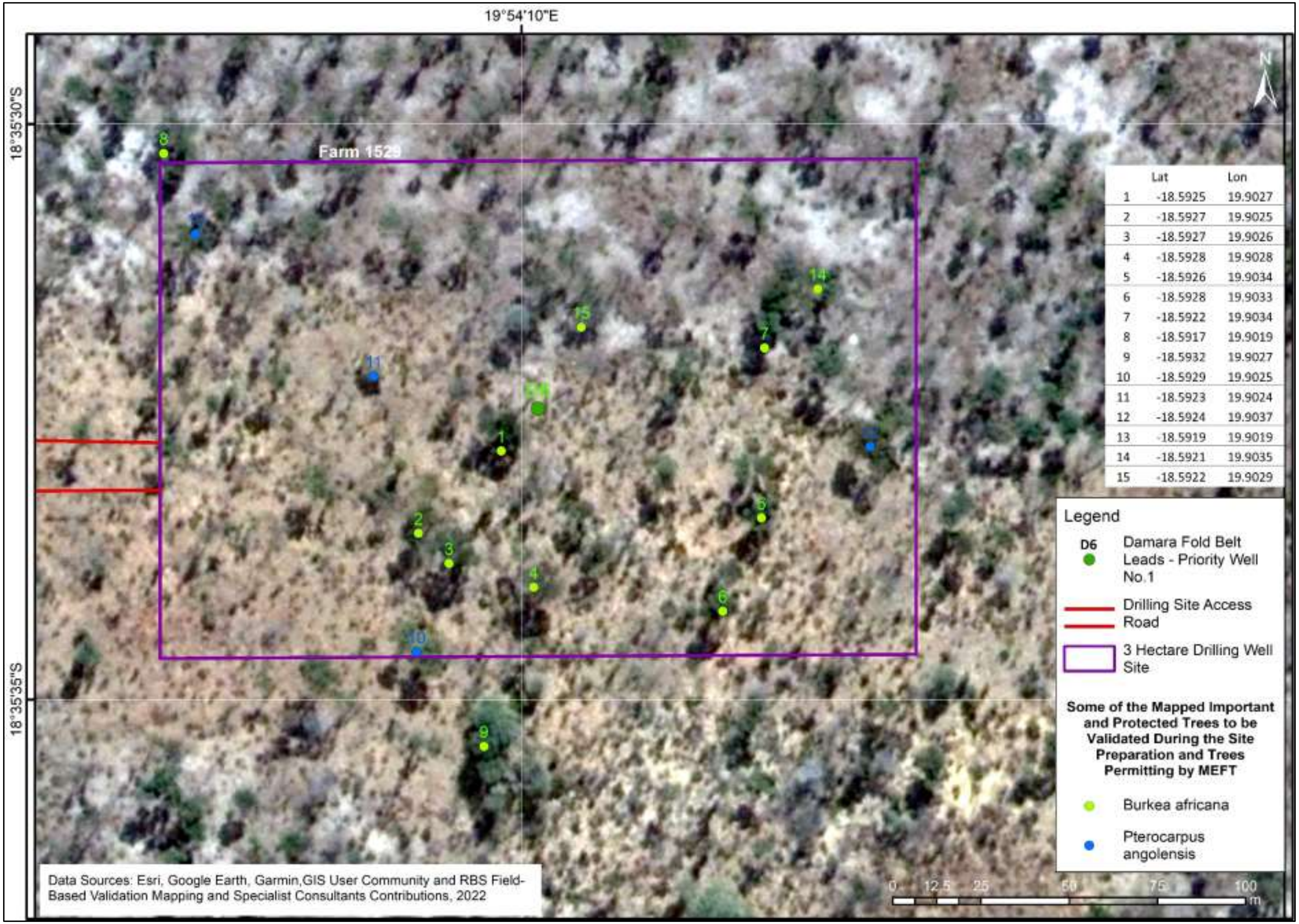
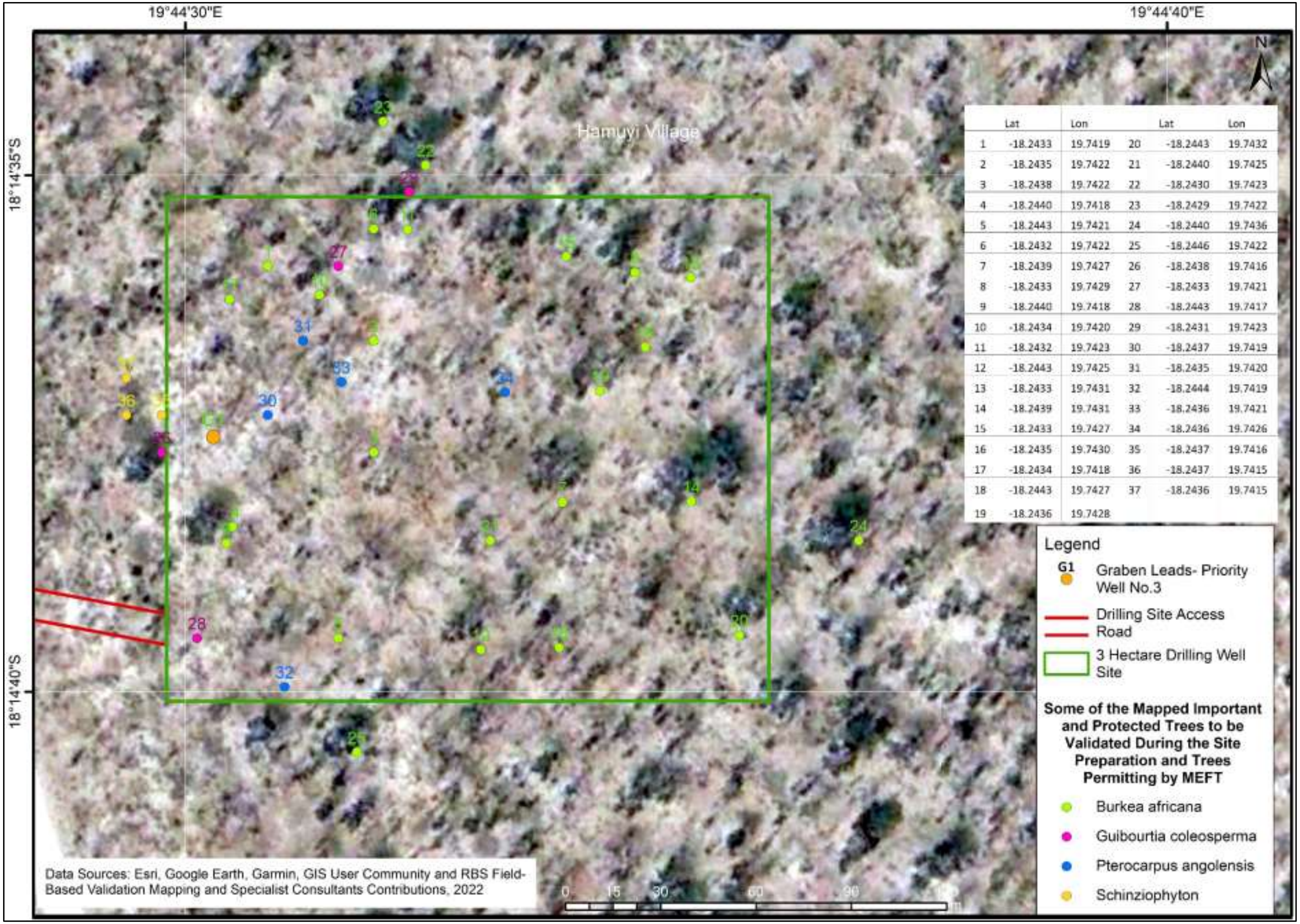


Figure 2.28: Some of the mapped important and protected trees around the proposed D6 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon
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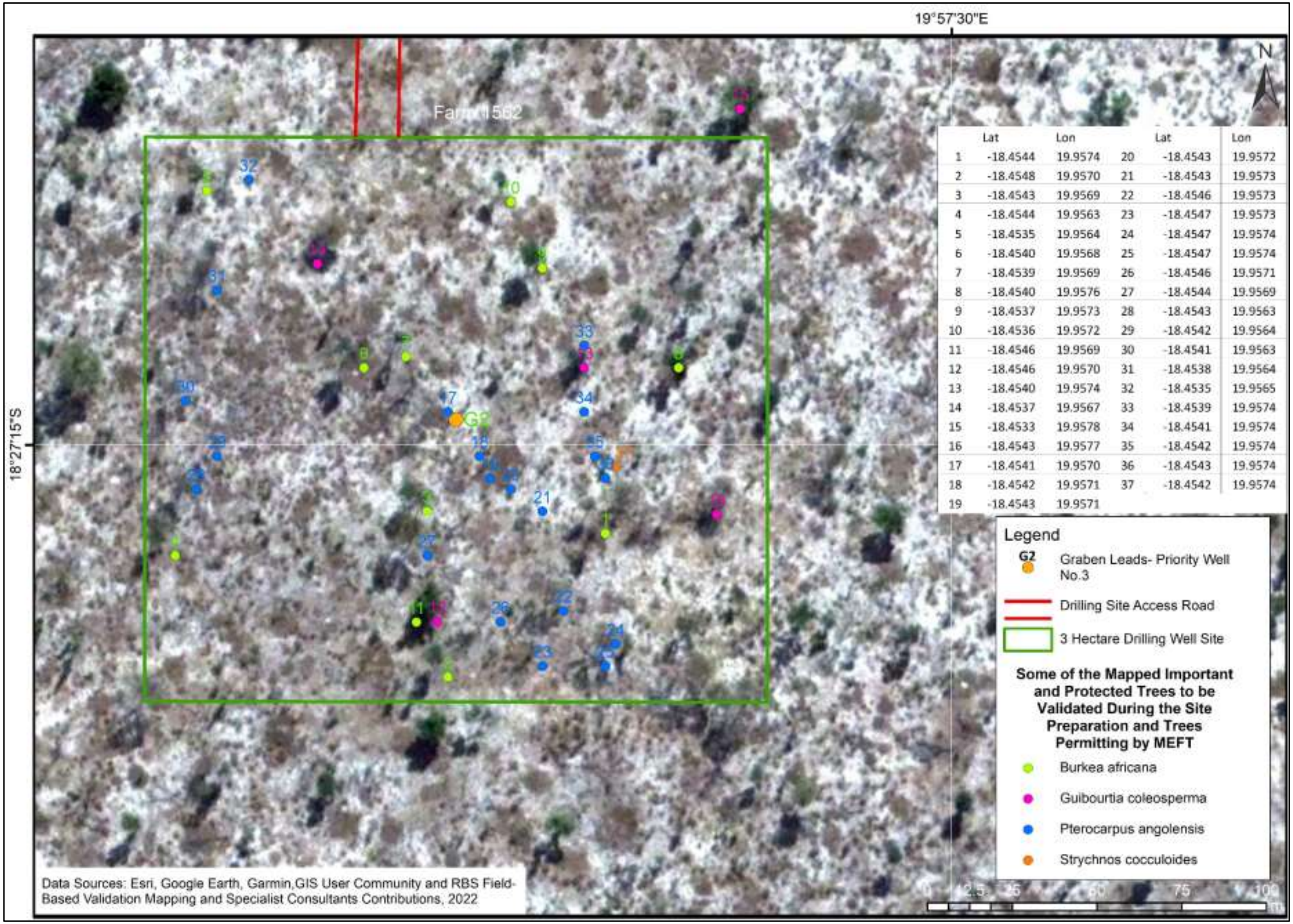
2	-18.2435	19.7422	21	-18.2440	19.7425
3	-18.2438	19.7422	22	-18.2430	19.7423
4	-18.2440	19.7418	23	-18.2429	19.7422
5	-18.2443	19.7421	24	-18.2440	19.7436
6	-18.2432	19.7422	25	-18.2446	19.7422
7	-18.2439	19.7427	26	-18.2438	19.7416
8	-18.2433	19.7429	27	-18.2433	19.7421
9	-18.2440	19.7418	28	-18.2443	19.7417
10	-18.2434	19.7420	29	-18.2431	19.7423
11	-18.2432	19.7423	30	-18.2437	19.7419
12	-18.2443	19.7425	31	-18.2435	19.7420
13	-18.2433	19.7431	32	-18.2444	19.7419
14	-18.2439	19.7431	33	-18.2436	19.7421
15	-18.2433	19.7427	34	-18.2436	19.7426
16	-18.2435	19.7430	35	-18.2437	19.7416
17	-18.2434	19.7418	36	-18.2437	19.7415
18	-18.2443	19.7427	37	-18.2436	19.7415
19	-18.2436	19.7428			

Figure 2.29: Some of the mapped important and protected trees around the proposed G1 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon
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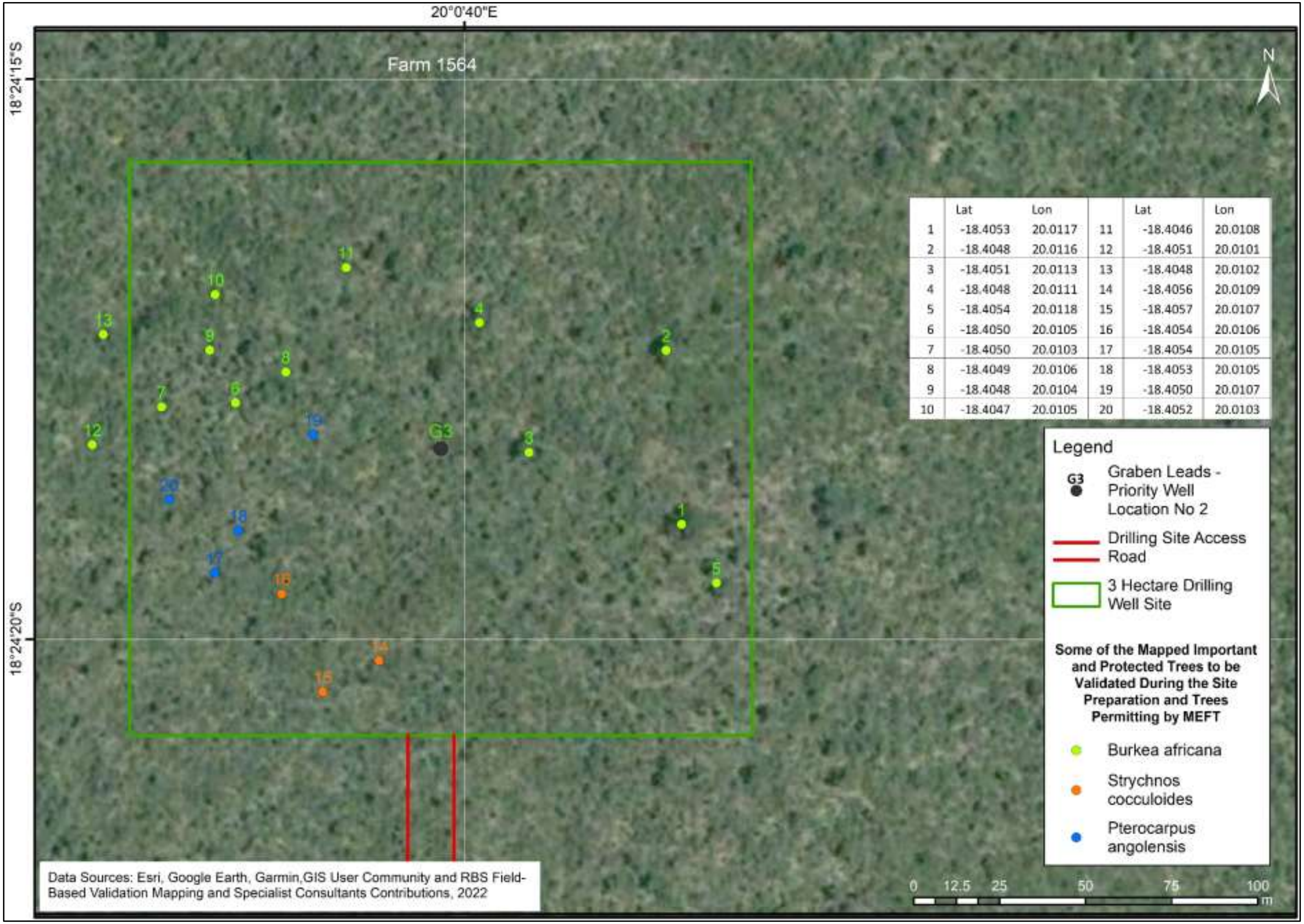
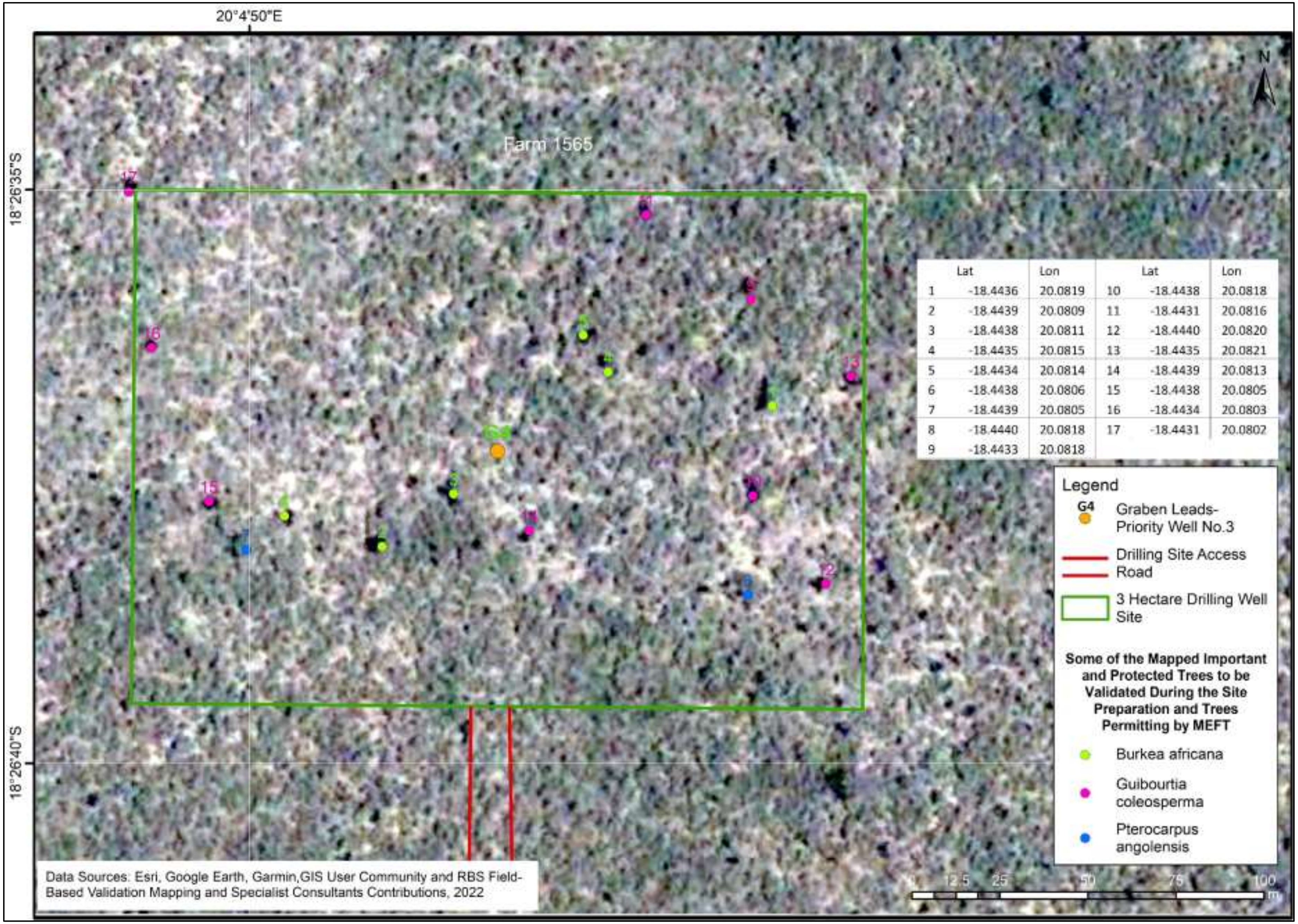
3	-18.4543	19.9569	22	-18.4546	19.9573
4	-18.4544	19.9563	23	-18.4547	19.9573
5	-18.4535	19.9564	24	-18.4547	19.9574
6	-18.4540	19.9568	25	-18.4547	19.9574
7	-18.4539	19.9569	26	-18.4546	19.9571
8	-18.4540	19.9576	27	-18.4544	19.9569
9	-18.4537	19.9573	28	-18.4543	19.9563
10	-18.4536	19.9572	29	-18.4542	19.9564
11	-18.4546	19.9569	30	-18.4541	19.9563
12	-18.4546	19.9570	31	-18.4538	19.9564
13	-18.4540	19.9574	32	-18.4535	19.9565
14	-18.4537	19.9567	33	-18.4539	19.9574
15	-18.4533	19.9578	34	-18.4541	19.9574
16	-18.4543	19.9577	35	-18.4542	19.9574
17	-18.4541	19.9570	36	-18.4543	19.9574
18	-18.4542	19.9571	37	-18.4542	19.9574
19	-18.4543	19.9571			

Figure 2.30: Some of the mapped important and protected trees around the proposed G2 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



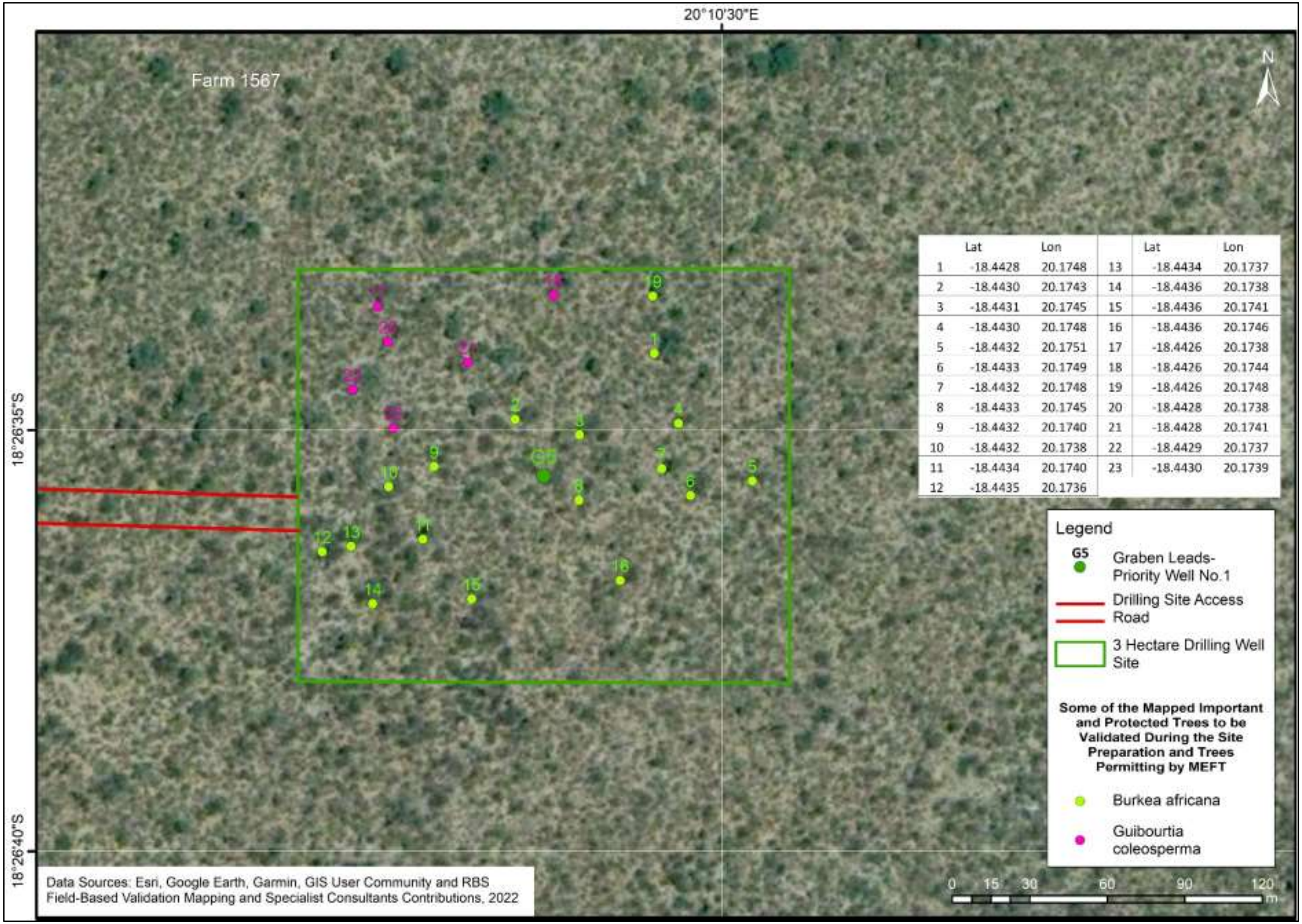
	Lat	Lon		Lat	Lon
1	-18.4053	20.0117	11	-18.4046	20.0108
2	-18.4048	20.0116	12	-18.4051	20.0101
3	-18.4051	20.0113	13	-18.4048	20.0102
4	-18.4048	20.0111	14	-18.4056	20.0109
5	-18.4054	20.0118	15	-18.4057	20.0107
6	-18.4050	20.0105	16	-18.4054	20.0106
7	-18.4050	20.0103	17	-18.4054	20.0105
8	-18.4049	20.0106	18	-18.4053	20.0105
9	-18.4048	20.0104	19	-18.4050	20.0107
10	-18.4047	20.0105	20	-18.4052	20.0103

Figure 2.31: Some of the mapped important and protected trees around the proposed G3 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon
1	-18.4436	20.0819	10	-18.4438	20.0818
2	-18.4439	20.0809	11	-18.4431	20.0816
3	-18.4438	20.0811	12	-18.4440	20.0820
4	-18.4435	20.0815	13	-18.4435	20.0821
5	-18.4434	20.0814	14	-18.4439	20.0813
6	-18.4438	20.0806	15	-18.4438	20.0805
7	-18.4439	20.0805	16	-18.4434	20.0803
8	-18.4440	20.0818	17	-18.4431	20.0802
9	-18.4433	20.0818			

Figure 2.32: Some of the mapped important and protected trees around the proposed G4 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.



	Lat	Lon		Lat	Lon
1	-18.4428	20.1748	13	-18.4434	20.1737
2	-18.4430	20.1743	14	-18.4436	20.1738
3	-18.4431	20.1745	15	-18.4436	20.1741
4	-18.4430	20.1748	16	-18.4436	20.1746
5	-18.4432	20.1751	17	-18.4426	20.1738
6	-18.4433	20.1749	18	-18.4426	20.1744
7	-18.4432	20.1748	19	-18.4426	20.1748
8	-18.4433	20.1745	20	-18.4428	20.1738
9	-18.4432	20.1740	21	-18.4428	20.1741
10	-18.4432	20.1738	22	-18.4429	20.1737
11	-18.4434	20.1740	23	-18.4430	20.1739
12	-18.4435	20.1736			

Figure 2.33: Some of the mapped important and protected trees around the proposed G5 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.

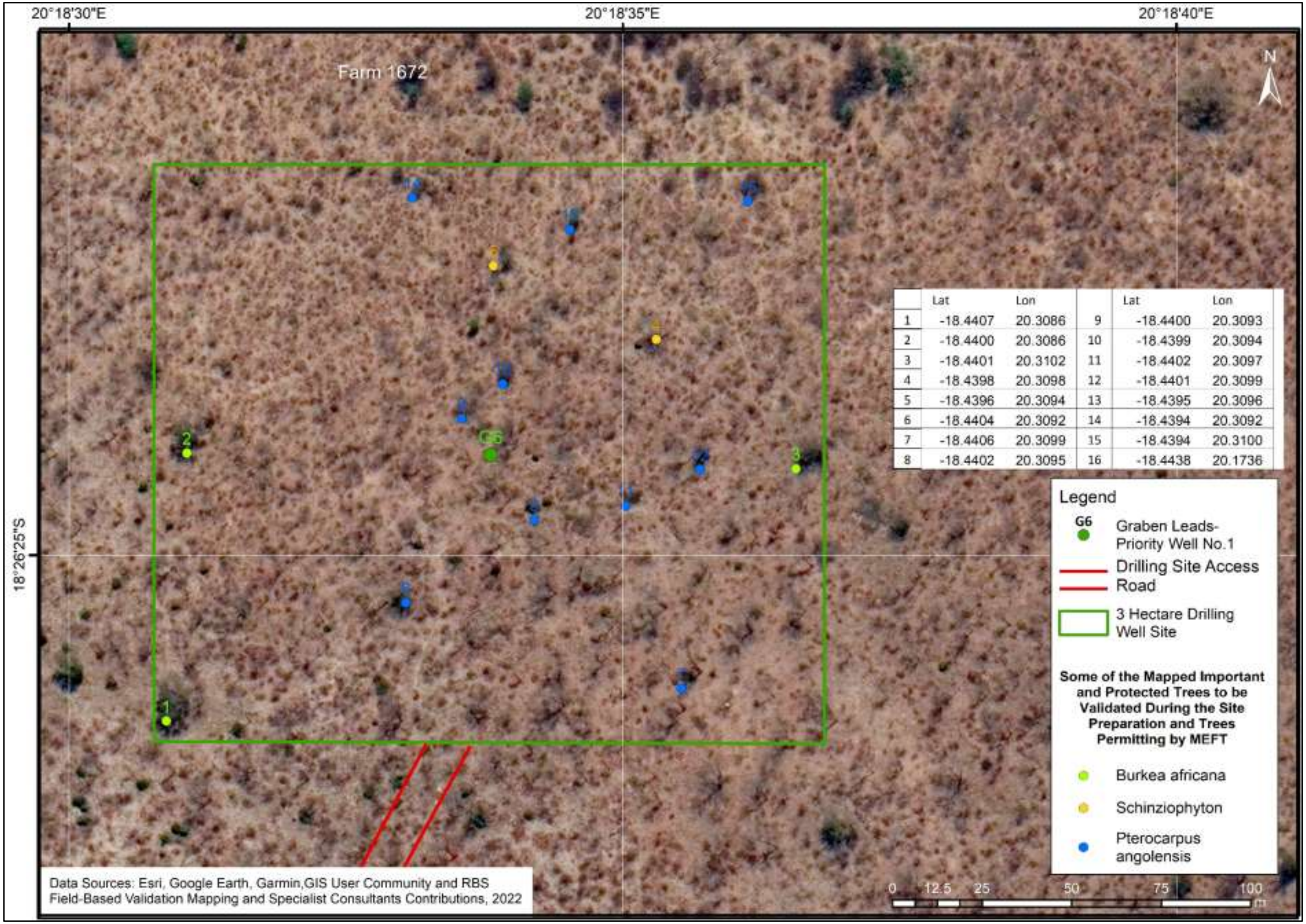


Figure 2.34: Some of the mapped important and protected trees around the proposed G6 well site and access areas that shall be protected or permitted before being removed during the site preparation if this site is going to be drilled.

Plate 2.6: Some of the mapped important and protected trees around the proposed D1-D6 and G1-G6 wells sites and access areas that shall be avoided and/or retained or permitted by the Department of Forestry in the MEFT before they can be removed.

2.4.4 Socioeconomic Profile Summary of Conclusions

The following is the socioeconomic summary of the Kavango East and West Regions where the AOI and the proposed D1-D6 and G1-G6 well sites and supporting infrastructures are located:

- There are 148466 people in Kavango East Region (3.8% of the total population of Namibia) and 89313 people in Kavango West (6.4% of the total population of Namibia). The growth rate of population is positive, yet at a slow paste, particularly for Kavango West – 0.6% which is the second lowest in the country. The growth rate for Kavango East is 1.6%.

- Female population lager than male population, Kavango East Region - 53.5% and Kavango West – 52.7%. At the constituency level female population differ - Kavango East constituencies have greater percentage of female population than Kavango West constituencies.

- The population of the area is youthful. Around 41.4% of people in Kavango East and 46.5% of people in Kavango West are youth from 0 to 14 years which is above national average for this age group (36.4%).

- People of working-age group (15-59 years) is smaller than the national average. Kavango East - 52.7% and Kavango West 47.2% are people of working-age group.

- Kavango Regions have highest child mortality rates <5 (CMR) in the country - 112 deaths per 1000 live births (Namibia - 69 deaths per 1000 live birth).

- Kavango regions have the lowest life expectancy in Namibia - 43.9 years for male and 52.8 years for female.

- High proportion of persons with disabilities, particularly high in Kavango West (7.6%) which is the highest rate in Namibia. Kavango East has 6.0% of persons with disabilities.

- High percent of orphans aged 18 years and below, particularly in Kavango East - 15.9%. Kavango West - 14% of orphans in this age group. The national average stands at 12.5%.

- Kavango West region has the highest percentage of population without birth certificate (32.2%) followed by Kavango East with 19.9%. This limits people accessing social services, such as social grants and educational services.

- Population densities differ between Kavango East and Kavango West Regions. Kavango East - 6.2 people per km^2 and Kavango West - 3.6 people per km^2.

- Long-term migration trend is negative. More people are migrating out than migrating in Kavango East and Kavango West Regions. Lack of employment leads to the high migration rate to other regions, particularly for men.

- Within the area of interest there are three traditional (tribal) authorities - Shambyu, Gciruku and Mbukushu in the Kavango East, and Kwangali and Mbunza traditional authorities in the Kavango West Region

- Rukavango-speaking people constitute the largest language group - 79.4% of the population. San constitute around 0.4% of the regions' population.

- The literacy rates for the Kavango East (82.3%) and Kavango West (82.9%) are below the national average. Male literacy rate slightly higher than female.

- High unemployment rate, for Kavango East (48.2%) which is highest in the country with youth unemployment is particularly severe in Kavango East where more than half of youth (62.5%) are unemployed.

- ❖ Kavango West Region has the highest percentage of informal employments (91.8%), Kavango East - 78.8%.

- ❖ Farming is the main source of household income. Large share of people depends also on the old-age pensions, cash remittances, retirement fund, orphan or disability grants.

- ❖ Kavango regions have highest incidence of poverty, 53% of population. Poverty is defined as the number of households who are unable to afford sufficient resources to satisfy their basic needs. Within the region the highest poverty incidence is recorded in Kapako, Kahenge, Mashare, Mpungu constituencies.

- ❖ Traditional dwellings are the most common type of housing, accounting for 72.9 % of all households in Kavango regions. Kavango East has a large percent distribution of improvised housing units/shacks - 46.7% of all households.

- ❖ The Kavango West and East regions are relatively well covered with a network of roads; unfortunately, most of these roads are gravel or sandy roads that make travel difficult. Kavango East Region has one airport (Rundu) that accommodates national flights. Several smaller airstrips cater for the tourism sector especially in the eastern part of the region.

- ❖ People living deeper in the interior areas are distant from social infrastructure, thus access to education and medical treatment is difficult.

- ❖ Communities living in the northern part of the Kavango West and Kavango East regions along the road from Nkurenkuru to Rundu and Rundu to Divundu road are relatively well connected to the national electricity grid. The remainder of the rural communities situated away from the river and the main road are connected mostly with off-grid facilities.

- ❖ Okavango River is the main source of water for the people living along the river, whereas villages away from river depend entirely on groundwater from boreholes supplied by MAWF and in some cases from seasonal pans. The urban areas - settlements and towns are provided with water by the NamWater.

- ❖ The main economic activities are agriculture, mainly small-scale mahangu farming, providing some food self-sufficiency but little food security; aquaculture; timber harvesting; tourism, particularly in Kavango East Region.

- ❖ There is a number of community forests within the Kavango East and Kavango West regions. Two community forests in Kavango West and ten community forests in Kavango East. Illegal harvesting of timber is on rise, mainly attributed to the high demand for timber worldwide and low incomes of local communities, and.

- ❖ Tourism is mainly in Kavango East, but limited and undeveloped in Kavango West Region Tourism is mostly focused on the eastern part of the region around Divundu, to some extent in the central part of the region next to the Kavango River and in Rundu. This is associated with the fact that most of the biodiversity, wildlife and scenic areas are found in the eastern part of the region. Kavango East Region falls within the Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA).

2.4.5 Regional Geology and Petroleum System

PEL 73 and the REN delineated Kavango Sedimentary Basin falls within the greater Kalahari Basin of Southern Africa. The Kalahari Basin comprises Kalahari Group sediments (Figs. 2.35-2.37). The Kalahari Group sediments consists of conglomerate and gravel, marl, sandstone, alluvium and lacustrine deposits, Kalahari Sand, and duricrusts (mainly calcrete and silcrete) intersected in the drilling of the Kawe 6-2, Mbambi 6-1 and Makandina 8-2 Stratigraphic wells by REN. A generalised illustration of the stratigraphic column for the Rift Graben areas of the Kavango Sedimentary Basin is shown in Fig. 2.36. Six potential reservoirs and four potential source rock intervals have been identified in the rift trend and intra-rift fault blocks. The integrated interpretation has established the following three (3) groups of hydrocarbon opportunities ("Plays"), Primary: Karoo Rift Fill (Light Oil), Secondary: Intra-Rift Fault Blocks (Light Oil), and Secondary: Damara Fold Belt (New Play, Gas/Gas Condensate). A new petroleum system ("Play") for KSB, the Damara Fold Belt, has been established based on the interpretation of the seismic data acquired since 2021 (Figs. 2.36-2.39).

2.4.6 Surface Water (Hydrology) and Drainage Basins

The well locations and AOI are not situated in the active catchment areas of the Okavango River but falls in the fossilised channels of the Omatako–Omuramba Ephemeral Rivers (Figs. 2.40 and 2.41). This Ephemeral River network has not contributed to runoff to the Okavango for over 50 years (Oldeland *et. al.,* 2013). The proposed D1-D6 and G1-G6 exploration and appraisal wells sites fall within the graben structure of the Omatako Drainage Basin bordered by Kavango Drainage Basin (Fig. 2.42). In the Kavango Drainage Basin streams essentially flow south-north into the Okavango River; deviating from the regional slope and probably emphasizing local structural control, whereas in the Omatako Drainage Basin the Omatako Ephemeral River flows north east into the Okavango River (Fig. 2.42). The present drainage within the general surrounding areas of the proposed D1-D6 and G1-G6 exploration and appraisal wells sites, although largely ephemeral apart from the Okavango River are exorheic, meaning that it allows flow into other external bodies of water for example rivers, swamps, and lakes. In this context they all drain into the greater Okavango River. This is true except for the Fumbe Stream which is endorheic (allows no flow into other external body of water) (Fig. 2.42).

2.4.7 Summary of the groundwater characteristics

The following is summary of the groundwater characteristics of PEL 73 inclusive of the proposed prioritised D1-D6 and G1-G6 exploration and appraisal wells sites areas (Figs. 2.43 and 2.44):

(i) Aquifers prevalent in the area are primary aquifers of saturated Kalahari Group sediments and secondary aquifers are fractured/weathered bedrock, fault zones cutting a cross basement geology, and Kalahari sediments and recent faults visible at surface. Overall groundwater potential is moderate to low.

(ii) Aquifers present along the rivers are saline artesian aquifers overlain by alluvium aquifers of paleo-channels of the Okavango River.

(iii) The main sources of groundwater are abstracted from hand dug wells and boreholes.

(iv) The depth to groundwater is deeper in the west than in the east.

(v) Groundwater flow is controlled by faulting found in the area, with a low-gentle gradient.

(vi) Most boreholes have yields between 2-4m^3/h, with yields of 8m^3/h on average.

(vii) Most boreholes have water of a good quality with TDS levels of 500-1000mg/l.

(viii) Boreholes with poor quality water are high in sodium salts and are associated with stagnant waters.

(ix) Groundwater quality is maintained with each recharge episode.

(x) Average borehole depth is slightly above 90m, with average water strikes at 51m and saturated thickness at 43m.

(xi) Access to clean drinking water is a major challenge for many rural communities in Kavango West and East Regions (Plates 6.9 and 6.10).

(xii) Borehole yields are sufficient to fulfil the water requirements of the proposed project, and.

(xiii) A Groundwater monitoring and management plan are tools of effective groundwater management that the Proponent will continue to implement.

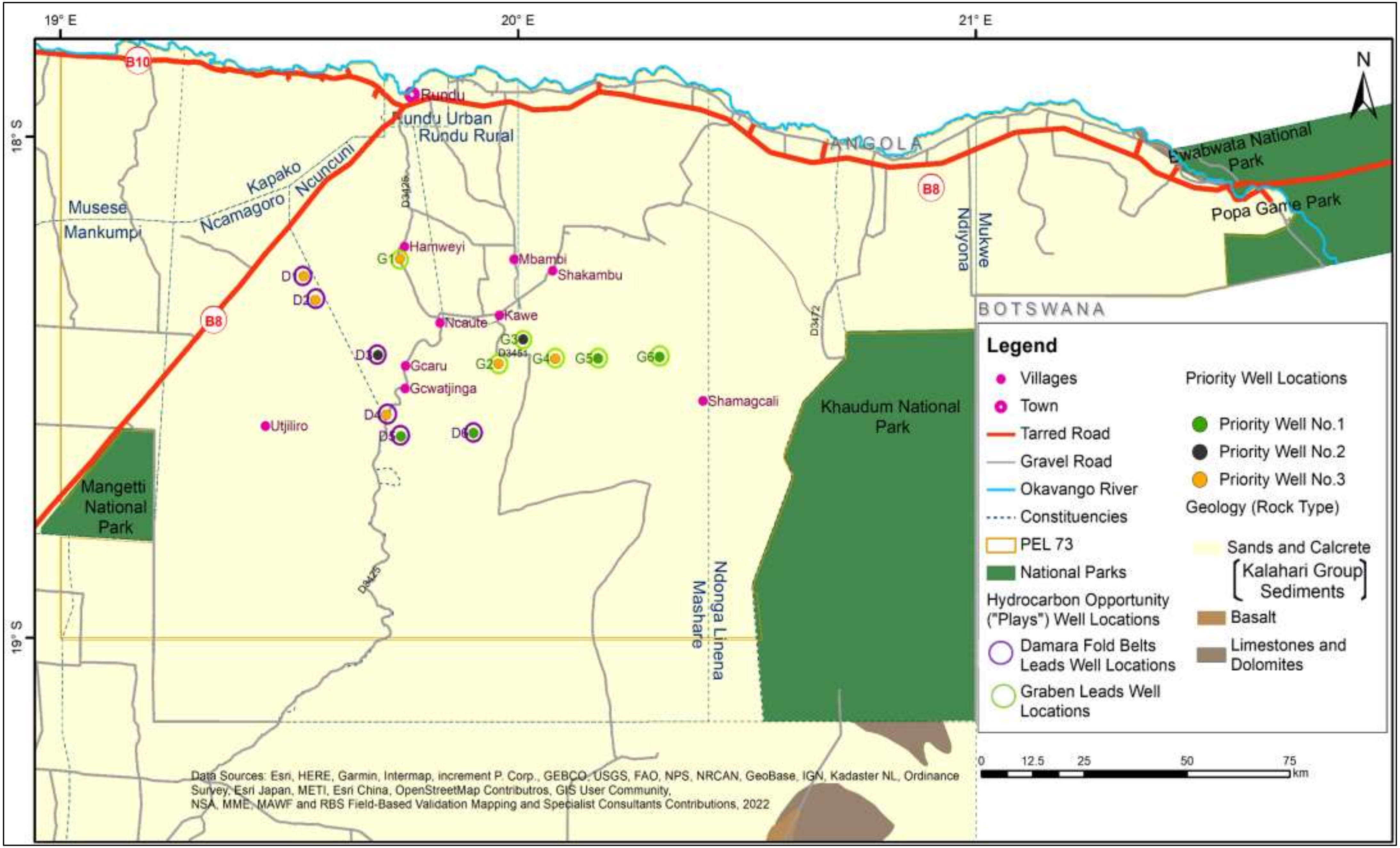


Figure 2.35: Surficial geology around the PEL 73 and proposed D1-D6 and G1-G6 exploration and appraisal wells sites.

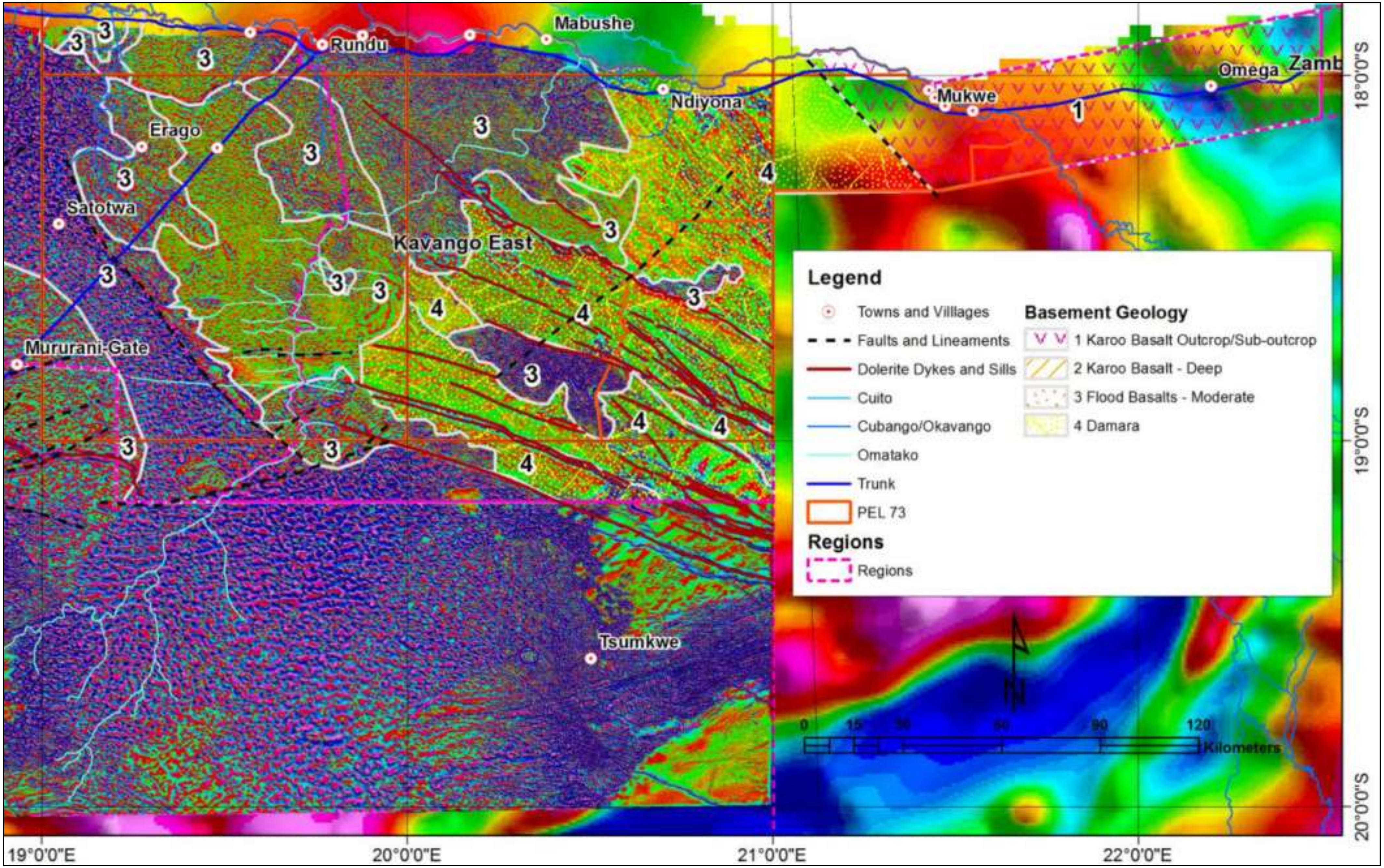


Figure 2.36: Basement geology of the Kavango Sedimentary Basin (Julius, 2021).

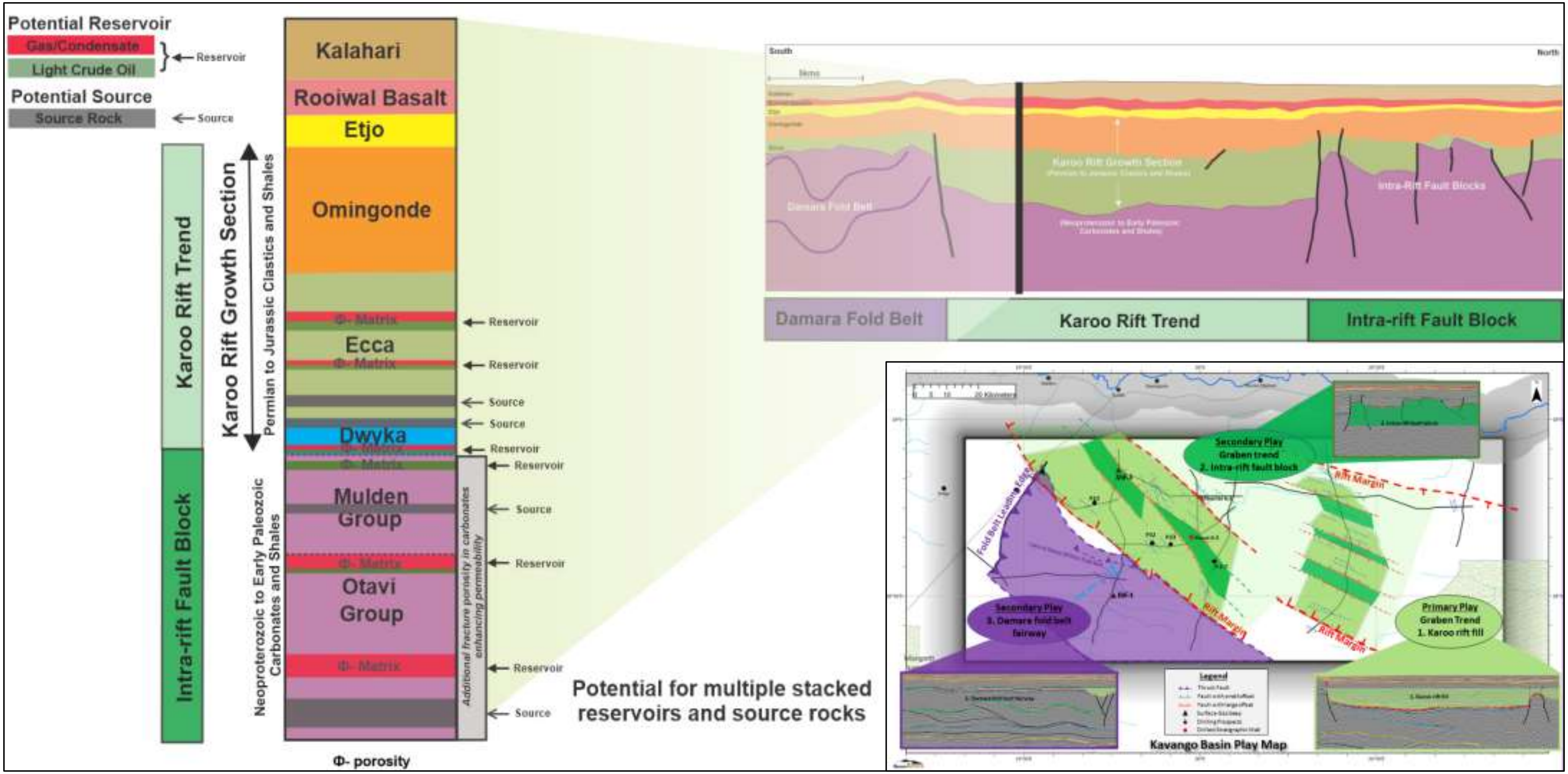


Figure 2.37: Generalised stratigraphic column for the Rift Graben areas of the Kavango basin. Six potential reservoirs and four potential source rock intervals have been identified in the rift trend and intra-rift fault blocks (Source: REN, 2022).

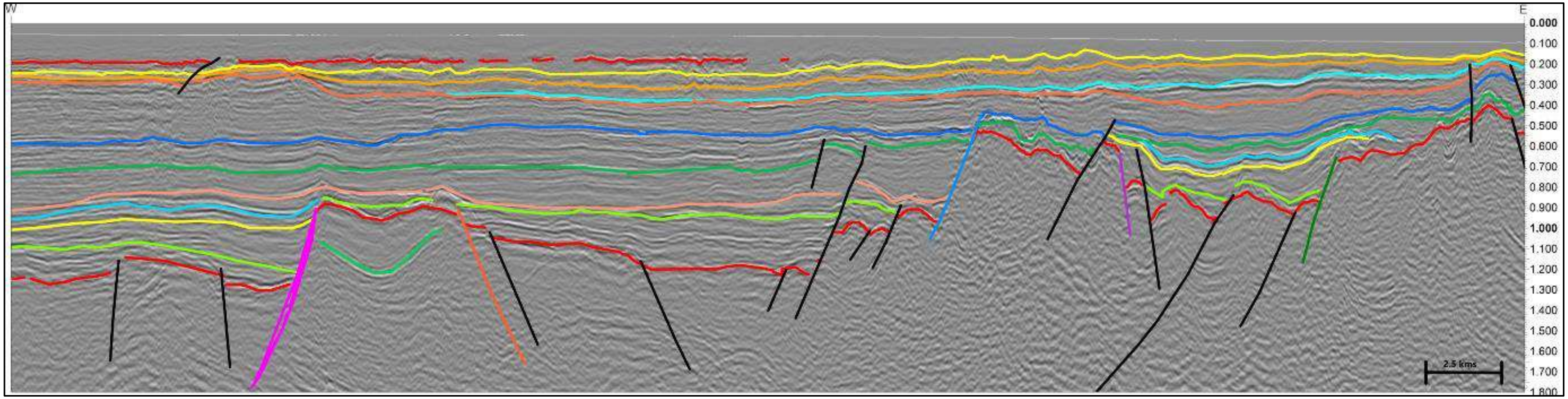


Figure 2.38: Seismic section through the Karoo Rift Basin showing the main and perched grabens (rift valleys); note the series of normal faults controlling the rift basin architecture and depositional stratigraphy (Source: REN, 2023).

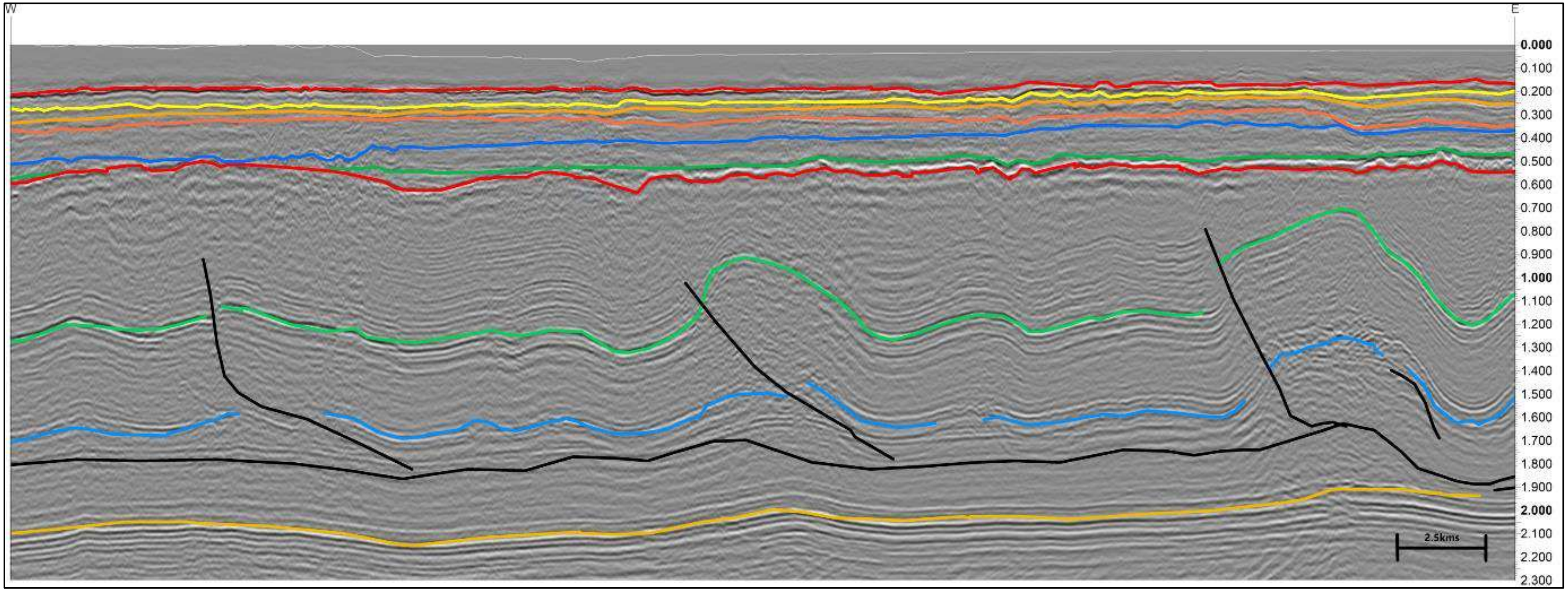
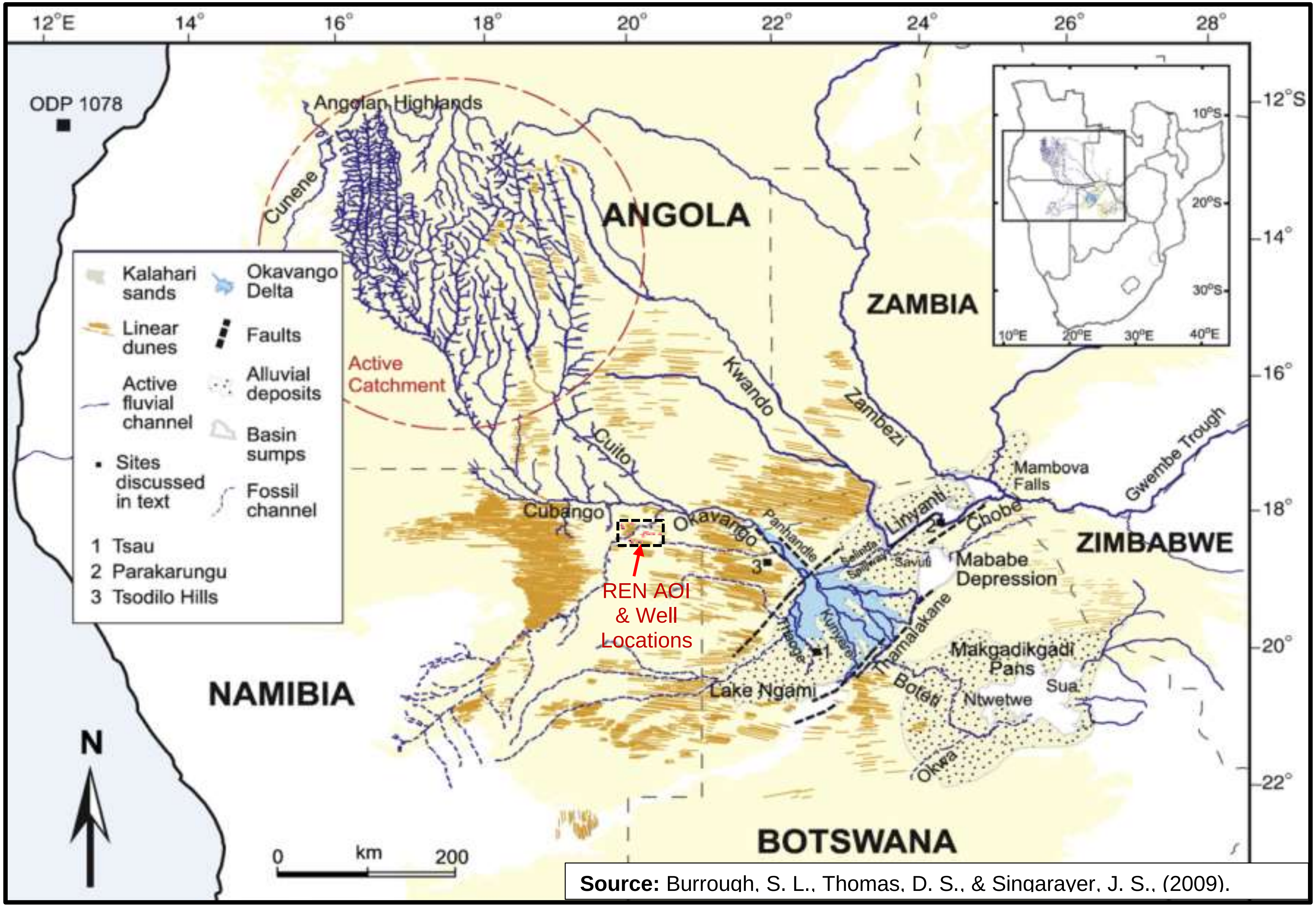


Figure 2.39: Damara Fold Belt Seismic line 2 (Source: REN, 20223).



Source: Burrough, S. L., Thomas, D. S., & Singarayer, J. S., (2009).

Figure 2.40: Regional map of the Middle Kalahari and the hydrological systems of the Okavango, Kwando, and Zambezi catchments in relation to the sump basins (Lake Ngami, the Mababe Depression and the Makgadikgadi pans). The proposed exploration and appraisal wells sites are not situated in the active catchment areas but in fossil channels of the Omatako–Omuramba Ephemeral rivers. According to Oldeland et. al., (2013), the Omatako Ephemeral River has not contributed to runoff from the Okavango for over 50 years.

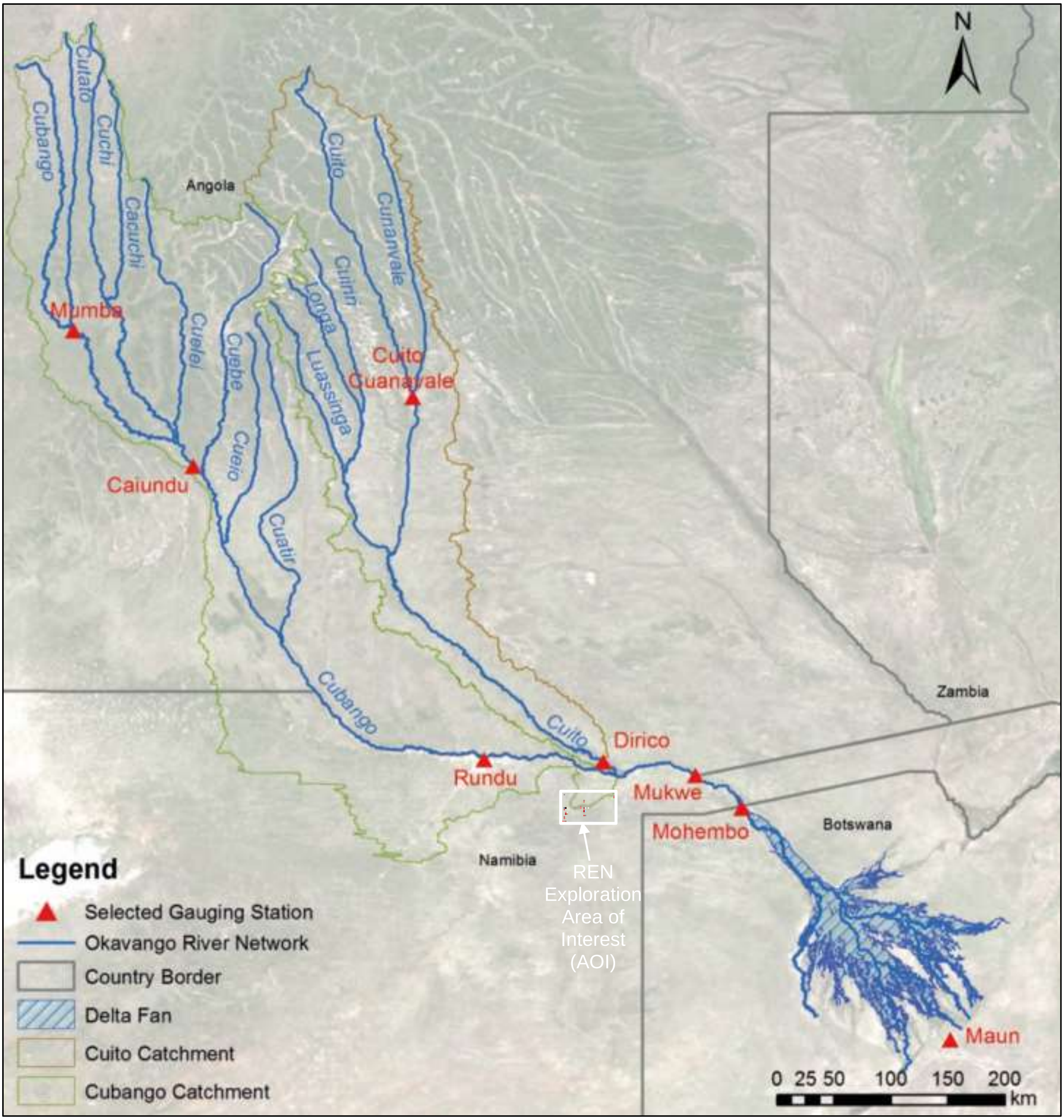


Figure 2.41: Okavango River Basin including all main tributaries and the Okavango Delta with its entrance at Mohembo gauging station and outlet at Maun with respect to REN exploration area of interest (Source: Oldeland *et, al.* 2013).

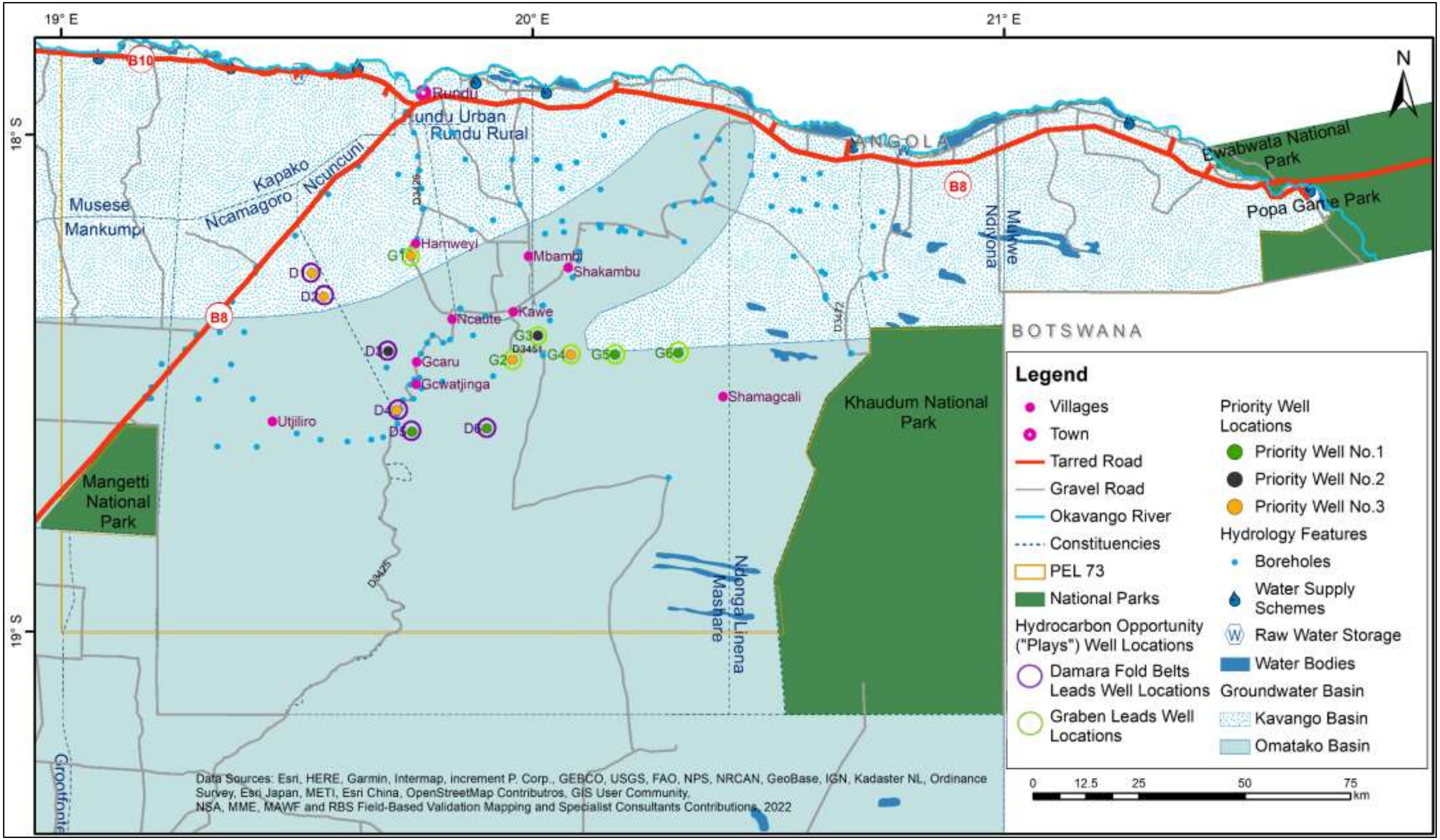


Figure 2.42: Omatako and Kavango Drainage Basins and the proposed D1-D6 and G1-G6 exploration and appraisal wells sites.

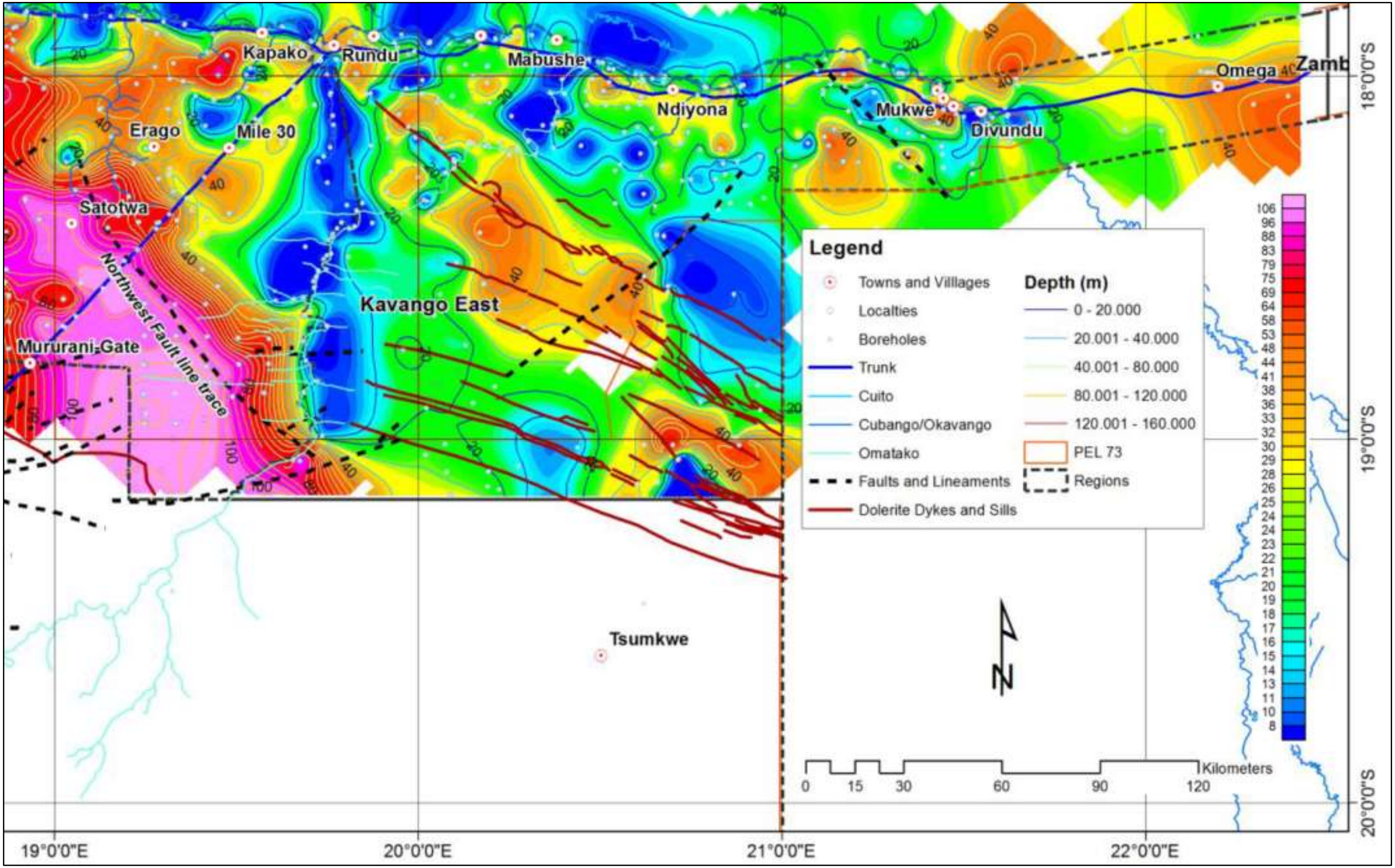


Figure 2.43 Depth to groundwater map for PEL 73 (Source: Annex 5).

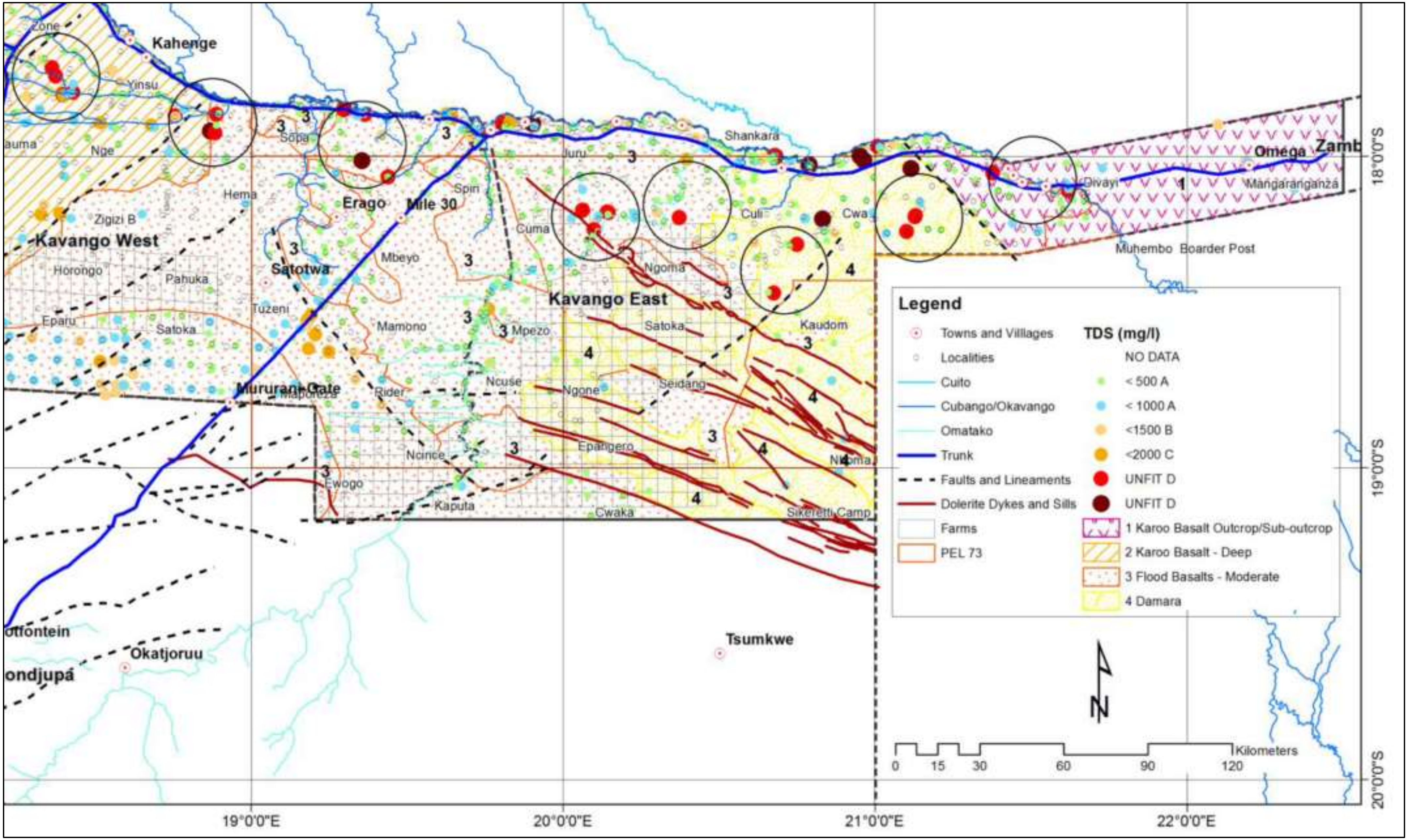


Figure 2.44: Water Quality (TDS) map of PEL 73 (Source: Annex 5).

2.5 Summary of the Impact Assessment Results

2.5.1 KBSMM Impact and Risk Assessment System Methodology

Knowledge-Based System Model Methodology (KBSMM) is an expert system rule-based artificial intelligence (AI) that captures the knowledge of human experts to support decision-making centred on the source-pathway-target /receptor risk assessment regulatory, standards, and engineering boundary conditions. The knowledge-based risk assessment methodology adopted for the impact assessment process has been based on the matrix interaction of characterised climatic, environmental, and ground model datasets as inputs data components (Knowledge-Base) in the evaluation of the positive and negative impacts or influences on the receiving environment as results of the proposed activities (Drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells in the AOI in PEL No. 73) (Fig. 2.45).

The KBSMM system methodology took into consideration the interactions of the proposed activities with respect to the source-pathway-receptor / target of the characterised climatic, environmental, and ground model datasets of the receiving environment (physical, biological, socioeconomic and ecosystem services and functions) (Figs. 2.45-2.47). The Knowledge-Base (KB) created during the Scoping, EIA and EMP phases has been based on the influence assessments of the characterised components of the environment built during the desktop and field-based general and specialist studies inputs to the overall impact assessment process (Figs. 2.46 and 2.47).

The impact / influence and risk assessment boundary conditions were provided by the national regulatory, standards, limits, engineering, environmental and sector-specific protocols for drilling of the exploration and appraisal wells and the applicable international best industry practices which are based on the Best Practicable Environmental Option (BPEO) (Figs. 2.45-2.47).

The KBSMM model inputs variables for the EIA and EMP process will cover the source-pathway-receptor / target characterised climatic, environmental, and ground model datasets. Source-pathway-receptor / target risk assessment looping approach has been used to determine or validate the influence (impact assessment), and ultimate likely harm that may be linked to the various phased activities of each of the various stages of the proposed drilling of the exploration and appraisal wells Nos. D1-D6 and G1-G6 inclusive of the supporting infrastructures such as the new access roads to each of the proposed new well sites within the AOI in PEL No. 73 (Figs. 2.47 and 2.48).

2.5.2 KBSMM Climatic Knowledge Base

The climatic data sets used in the regional and local site-specific desktop and field-based assessment process comprised precipitation, temperature, evapotranspiration, and wind data sets. The following is the summary explanation of the roles that climatic data sets may have with the activities of the proposed D1-D6 and G1-G6 exploration and appraisal wells (Figs. 2.45 and 2.46):

(i) Temperature: Temperature has a direct influence on the fluids that may influence the operation of each site by supporting evapotranspiration. It also has an influence on the operation and design of the site.

(ii) Rainfall: Rainfall is one of the data sets used in water balance assessments with respect to potential fluids, leachate or contaminant mobilisation and flash flood occurrences. The data sets had some influence on site design and type of lining used and overall site operations.

(iii) Evapotranspiration: This combined effect of evaporation and transpiration is important in water balance assessments with direct influences on site operations, and aftercare stages, and.

(iv) Wind Direction and Speed: The direction and speed of the prevailing winds was critical to the site operations and determination of the optimum location. The data had a direct influence on the site operations including dust and noise management.

2.5.3 KBSMM Environmental Knowledge Base

The regional or local environmental data sets comprised the economic activities (drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure) and coordination support available in the region or area, types and amounts of waste generated, likely contaminants from waste generated / activities undertaken, ecological, habitats and ecosystems including fauna and flora as well as community considerations such, land ownership, social, health and safety, archaeological, cultural, and political issues.

The following is the summary explanation of the roles of the environmental data sets may have on the drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure (Fig. 2.46):

(i) Economic activities and logistic support (Drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6): The types of economic activities and logistical support services and infrastructure for drilling the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 forms a key component of the environmental data sets and the determination of the likely positive or negative impacts.

(ii) Types and amount of waste: Understanding the characteristics of the liquid and solid waste streams to be handled is vital in the evaluation of the hazard exposure in terms of the overall risk assessment and design engineered barriers and determination of the monitoring strategy. The footprint and volume size of the proposed well sites may have an influence on the selection and operation of each site with respect to the land availability in the local areas.

(iii) Likely contaminants: The state (solid, gas, liquid, or vapour) of any likely contaminants that may be associated with the drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure.

(iv) Ecological, habitats, ecosystems, fauna, flora, and local, regional, or global Climate Change influences: Namibia is home to several unique and protected habitats, ecosystems, fauna, and flora that are highly vital as they support other sectors of the national economy such as tourism, agriculture, conservation, food security and services. Understanding the likely level of sensitivity of the regional or local drilled sites was important to the successful development and determination of the monitoring and reporting strategy, and.

(v) Community considerations: Proposed drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure may influence or be influenced by local community issues and acceptability of oil and gas exploration. Other key components of the community considerations included: Land ownership (state or private land), local social settings, labour, natural capital, human rights, public and workers health and safety, archaeological, cultural, political, and civil society influences.

As part of the data desktop and field-based collection, evaluation, influence / impact and risk assessments processes for the final sites-specific ranking and determination of the mitigation measures and monitoring and reporting strategies, conducted specialist studies provided additional specific subject matter such as flora, fauna, water, and archaeology assessment results, recommendations and mitigations measures.

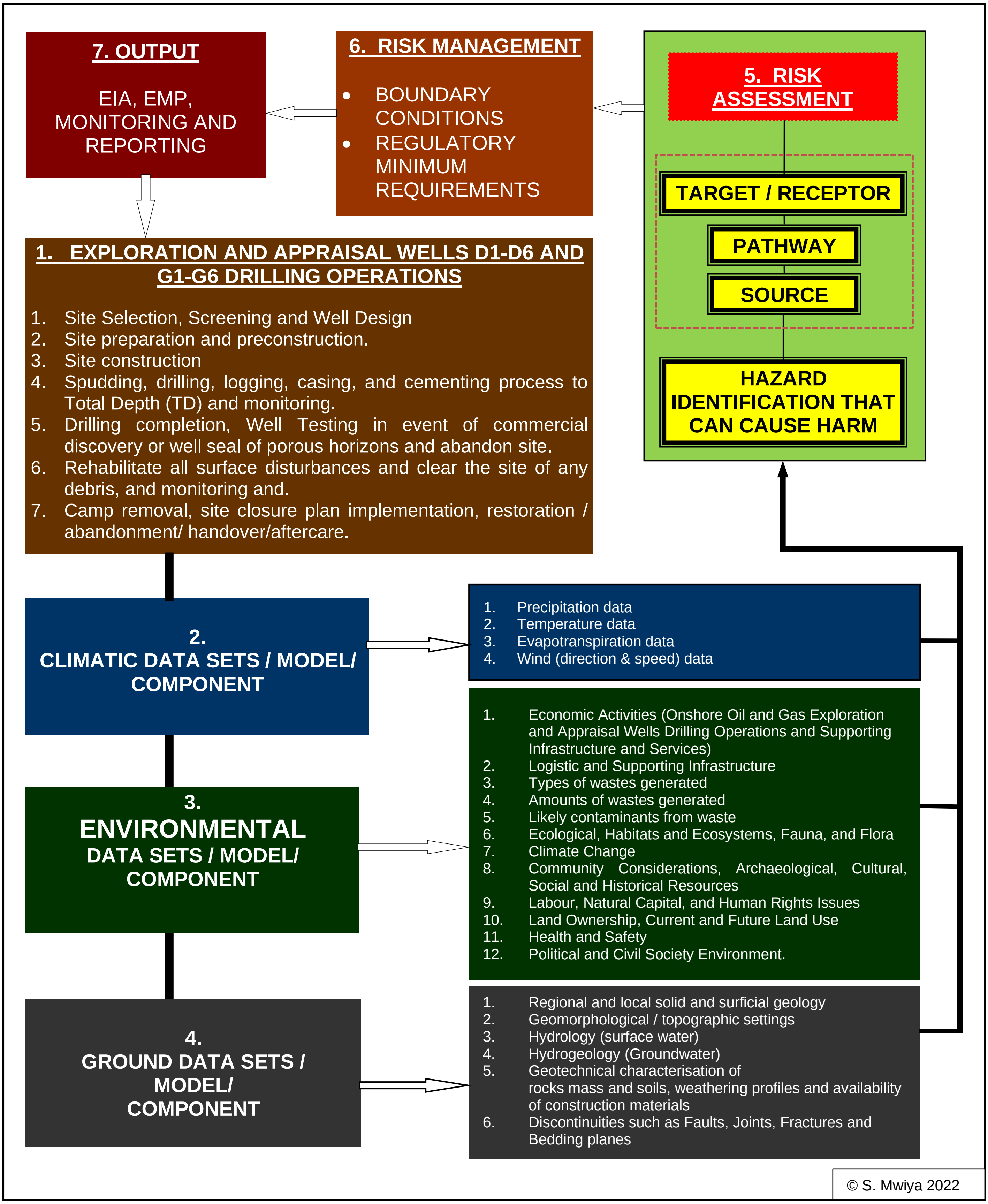


Figure 2.45: Detailed outline of the technical methodology based on a complete looped Knowledge-Based System Model Methodology (KBSMM) used during the EIA and EMP process desktop and field-based knowledge-based impact assessment, risk assessment and determination of the monitoring and reporting strategy. The system model methodology has a built-in looping that allows for the evaluation of a full exploration and appraisal well drilling project lifecycle.

2.5.3 KBSMM Ground Knowledge Base

The ground data sets covered regional/local solid and surficial geology, geomorphological / topographic settings, hydrology (surface water), hydrogeology groundwater), geotechnical characterisation of rocks and soils, weathering profiles and availability of construction materials, and discontinuities such as faults, joints, fractures, and bedding planes of the drilled sites (Fig. 2.46). The geology (solid and superficial) and water (surface and groundwater) resources are all potential targets and pathways that are linked to the drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure. Other ground components which include the local terrain (geomorphology and topographic features), discontinuities, geotechnical as well as the mineralogy will aid the influence of sources in causing or minimising the impacts to be controlled through favourable engineering designs fully supported by the ground components (Fig. 2.46). Regional/local solid and surficial geology, geomorphological and topographic settings also linked directly to the availability of local construction and operational materials in support of the drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure project lifecycle (Fig. 2.46).

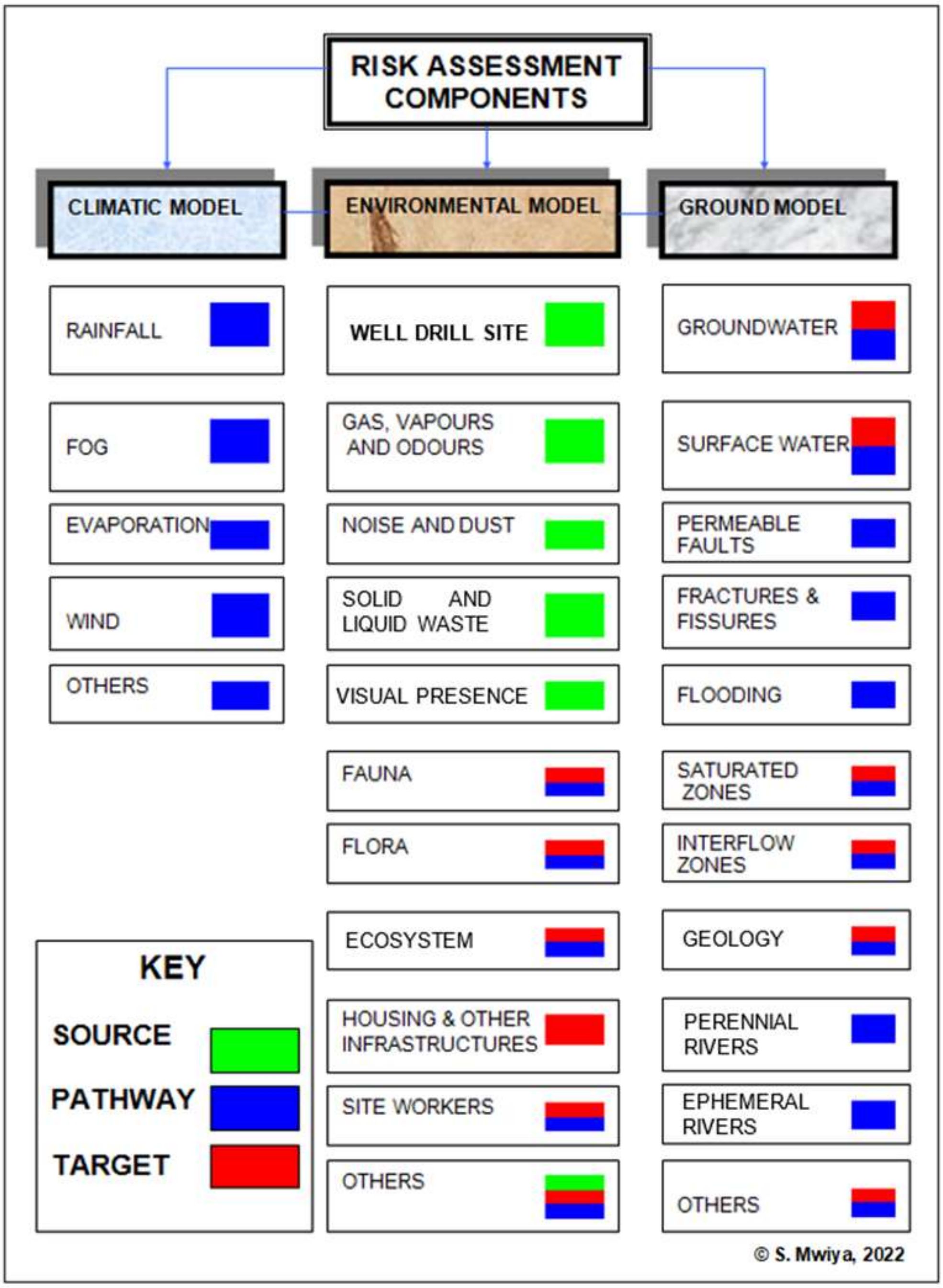


Figure 2.46: A Knowledge-Based System Model Methodology (KBSMM) interactive characterised inputs risk assessment factors for onshore oil and gas exploration and appraisal wells drilling operations.

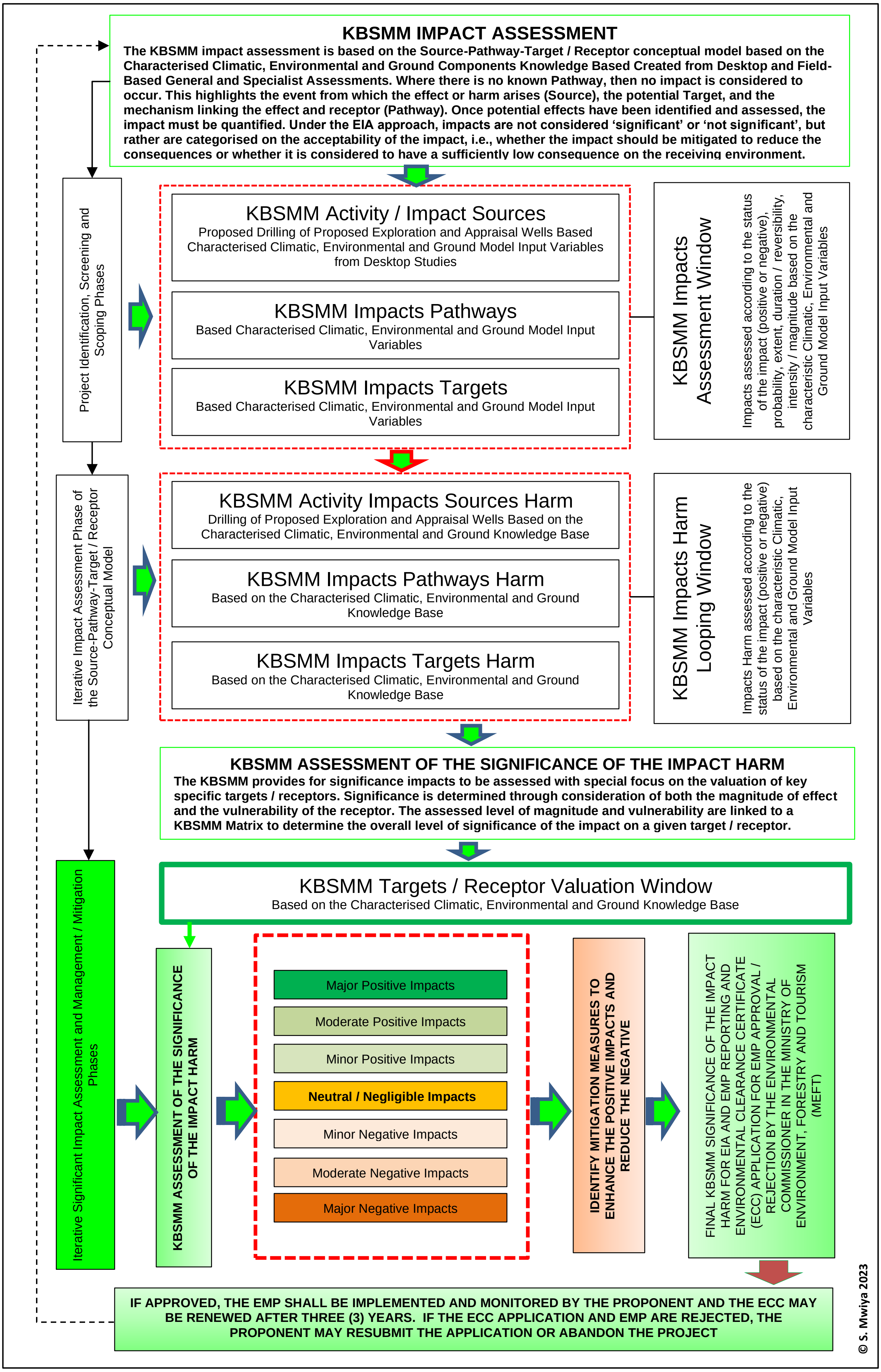


Figure 2.47: KBSMM logic interactive system methodology used in the impact assessment and assessment of significance of the impact harm linked to the EMP.

2.5.4 Source-Pathway-Receptor Risk Assessment Chain, Harm and Mitigation

To evaluate the level of influence, risk, and harm that the drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure may have on the receiving environment, the EIA assessment process has focused on the climatic, environmental, and ground model data set characterised into sources, pathways, and targets / receptors chains (Figs. 2.45-2.47). It is important to note that in the absence of any of the sources, pathways, or targets/ receptors there is no impact, harm, or risk to mitigate or monitor or manage (Figs. Figs. 2.45-2.48). The following the summary of the key definitions of the KBSMM Source-Pathway-Receptor risk assessment chain, and resultant harm requiring mitigation (Figs. 2.45-2.48):

(i) The risk source/s refers to knowledge-based identified potential impact hazards that may be present and can cause harm to the exposed target/s / receptors.

(ii) The risk pathway refers to the route direct or indirect through which the risk source/s may be transferred and exposed to a target/s of concern, and.

(iii) The risk target/s or receptor/s refers to the destination (area point of exposure) at which the source/s may cause harm to the various components of the receiving environment.

The characterisation of source/s, pathway/s and target/s chain has been undertaken for climatic, environmental and ground model data components with respect to the drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells including all the supporting infrastructure.

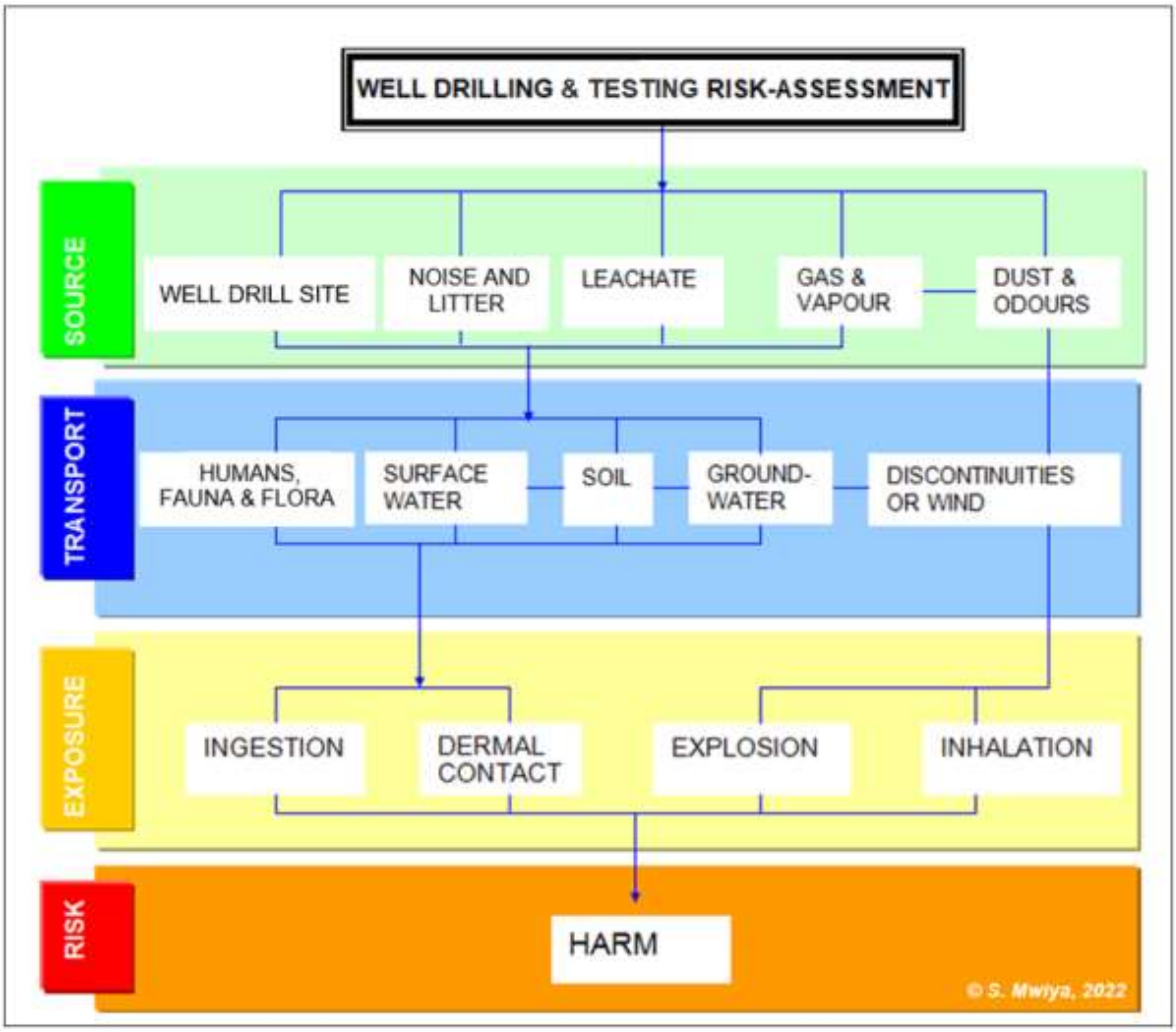


Figure 2.48: A Knowledge-Based System Model Methodology (KBSMM) risk consequences (harm) pathways to the receiving target/receptors windows for onshore oil and gas exploration and appraisal wells drilling operations.

2.5.5 Identification and Characterisation of Likely Impacts

2.5.5.1 Characterisation of Likely Sources Impacts

Based on the KBSMM framework, the likely key sources of negative impacts on to the receiving environment (physical, biological, and socioeconomic/cultural/ archaeological) are divided into the following two (2) main categories:

1) **Routine and physical presence operational activities:**

   (i) Pre-construction and onsite assessment of the drilling requirements.

   (ii) Site construction and preparation including clearing, ground levelling and compactions.

   (iii) Mobilisation, equipment installation and testing.

   (iv) Spudding and conductor casing.

   (v) Drilling surface / intermediate and setting casing and cementing process through up 900 m or top section of the well as per the well design.

   (vi) Drilling and continuous coring from 900 meters (2953') to 1900 meters (6234') or as per the specific well design.

   (vii) Drilling below 1900 meters to total depth, estimated at 2500 meters (+/-8202') or as per the specific well design.

   (viii) Well testing / appraisal and equip the well for possible production support if a commercial discovery.

   (ix) Plug and abandon hole if dry.

   (x) Rehabilitate all surface disturbances and clear the site of any debris, and.

   (xi) Camp removal, site closure / abandonment, and.

   (xii) Site restoration into a local community site equipped with water supply and associated supporting infrastructure as may be applicable.

2) **Unplanned accidental events:**

   1) Major land accidental incidence such as diesel / oil spill / fire / explosion.

2.5.5.2 Characterisation of Likely Positive Impacts

Based on the results of the EIA Report, the following is the summary of the key characterised positive impacts that the proposed drilling of multiple exploration and appraisal wells in the AOI within PEL No. 73 will have on the local (AOI), regional (Kavango East and West Regions) and national (Namibia) receiving environment:

1. Payment of the annual license rental fees to the Central Government averaging N$ 1.5 million per year and this is vital revenue streams for the State paid by all petroleum exploration companies in Namibia and for the benefit of all Namibians.

2. Minimum of USD 70, 000.00 annual contributions to the Petroleum Training and Education Fund (PETROFUND) paid by all petroleum exploration companies in Namibia. The PetroFund provides local, regional and international bursaries and scholarships to seventy (70) Namibians annually.

3. Expansion of the subsurface knowledge-base: The deep subsurface wells data to be generated will be highly useful in the search for other subsurface resources such as minerals, water, geothermal and general geoscience research, and development.

4. Contribution to the development of local infrastructures such as rural water supply through current ongoing initiatives under the Corporate Social Responsibility (CSR) and ESG Projects such as the rural water supply, reforestation, nursery, wildlife monitoring, game counting and assessment of wildlife migratory corridors between Mangetti and Khaudum National Parks chocked by the current fenced commercial farmlands on communal land.

5. The need for site clearing, pruning and opening-up of some of the inaccessible sections of the tracks and roads to be used for the proposed drilling operations will provide temporary employment opportunities for the local people.

6. The pruning and opening-up of some of the inaccessible sections of the tracks and roads to be used for the proposed drilling operations will improve access and connect local communities, and.

7. The pruning and levelling of the tracks and roads running along the boundaries of the large-scale agricultural commercial farming units on communal land will improve access to the farming units and greatly benefit the local farmers in their quest to reach markets for their livestock and produce and increase their productivity.

2.5.6 Knowledge-Based Impact Assessment Criteria

2.5.6.1 Knowledge-Based Evaluation of Impacts

KBSMM characterised sources of potential positive or negative impacts and the sensitivity of the receiving environment have been evaluated as part of the EIA and EMP process for the proposed drilling of the priority multiple exploration and appraisal wells D1-D6 and G1-G6, inclusive of the supporting infrastructures such as borrow pits and access roads within the AOI in PEL No. 73.

For each negative impact of high or medium significance, mitigation objectives are set (i.e., ways of reducing negative impacts), and attainable management actions have been provided in the EMP Report. Without mitigation, monitoring and impact management, these impacts would either breach statutory limits or be unacceptable to statutory authorities or to the local communities / stakeholders, as they would result in a significant deterioration of one or more environmental resources or component of the receiving regional or local receiving environment.

2.5.6.2 Knowledge-Based Environmental Impact Assessment Rankings

To ensure consistency in the evaluation of environmental impacts associated with the proposed drilling of the priority multiple exploration and appraisal wells D1-D6 and G1-G6, inclusive of the supporting infrastructures such as borrow pits and access roads within the AOI in PEL No. 73, the rating criteria for the impact assessment were standardised to include a set of definition applied in the qualitative and semi-quantitative risk assessment loop (Table 2.6).

To the extent possible, allocation to rank categories has been based on quantifiable criteria which can be measured as detailed in Table 2.6.

Furthermore, when evaluating impacts, the allocated ranks refer to the resultant *impact* (e.g., habitat area affected, or time that the result of the impact will last), and not of the *cause* thereof (e.g., time of active impact). Each activity has been assessed with respect to the type of effect that the aspect will have on the relevant component of the receiving environment and included “what will be affected and how?”

The criteria used in the determination of the significance rating of the impact(s) is detailed in Table 2.7.

Table 2.6: Definition of impact categories and the KBSMM boundary conditions.

Rating	Definition of Rating
Status of the Impact – in terms of meeting the objective of maintaining a healthy environment.	
Positive	The impact benefits the environment
Negative	The impact results in a cost to the environment
Neutral	The impact has no effect
Probability – the likelihood of the impact occurring	
Negligible	Possibility negligible
Improbable	Possibility very low
Probable	Distinct possibility
Highly Probable	Most likely
Definite	Impact will occur regardless of preventive measures
Degree of confidence in predictions – in terms of basing the assessment on available information	
Low	Assessment based on extrapolated data
Medium	Information base available but lacking
High	Information base comparatively reliable
Extent – the area over which the impact will be experienced	
Site specific	Confined to within < 1 km of the project
Local	Confined to the study area or within 5 km of the project
Regional	Confined to the region, i.e. > 5 km but < National
National	Nationally
International	Beyond the borders of Namibia
Duration – the time frame for which the impact will be experienced	
Very short	Less than 2 years
Short-term	2 to 5 years
Medium-term	6 to 15 years
Long-term	More than 15 years
Permanent	Generations
Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment	
Negligible	Natural functions and processes are negligibly altered due to adaptation by the receptor(s) to high natural environmental variability
Mild	Natural functions and processes continue albeit in a modified way that **does not** appear to have a significant disruptive effect (i.e. changes are temporary)
Moderate	Natural functions and processes continue albeit in a modified way that **does** appear to have a noticeable disruptive effect (i.e. changes are permanent)
Severe	Natural functions or processes are altered to the extent that they temporarily cease resulting in severe deterioration of the impacted environment
Very Severe	Natural functions or processes permanently cease or are completely disrupted

Table 2.7: The criteria used to determine the significance rating of the impact(s) and the KBSMM boundary conditions.

Low	Where the impact will have a negligible influence on the environment and no modifications or mitigations are necessary for the given project description. This would be allocated to impacts of any severity/ magnitude, if at a local scale/ extent and of temporary duration/time.
Medium	Where the impact could have an influence on the environment, which will require modification of the project design and/or alternative mitigation. This would be allocated to impacts of moderate severity, locally to regionally, and in the short term.
High	Where the impact could have a significant influence on the environment and, in the event of a negative impact, the activity(ies) causing it should not be permitted without substantial mitigation and management, and pro-active rehabilitation commitments (i.e., there could be a ‘no-go’ implication for the project). This would be allocated to impacts of severe magnitude, locally over the medium-term, and/or of severe magnitude regionally and beyond.

2.5.7 Overall Component and Significant Impact Assessment

2.5.7.1 Overall Component Impact Assessment

The overall component impact assessment took into considerations the activities of proposed drilling of the priority multiple exploration and appraisal wells D1-D6 and G1-G6, inclusive of the supporting infrastructures such as borrow pits and access roads within the AOI in PEL No. 73 as the overall source of impact.

The various components of the receiving environment have been considered as the receptor / target that may be impacted positively or negatively by the proposed drilling of multiple exploration and appraisal wells activities.

The components of the receiving environment encompassed the following:

- Physical Conditions / Natural Environment – Air, noise, water, green space, climate change, built environment – houses, roads, transport systems, buildings, infrastructure, etc.

- Biological Conditions: fauna, flora, habitats, and ecosystem - services, function, use values and non-use etc., and.

- Socioeconomic Conditions: Social, economic, labour, gender, human rights, natural and social capital, archaeological, cultural resources, and cultural issues

In evaluating the degree of potential negative impacts, the following factors have been taken into consideration:

- Impact Severity: The severity of an impact is a function of a range of considerations, and.

- Likelihood of Occurrence (Probability): How likely is the impact to occur?

In evaluating the severity of potential negative environmental impacts, the following factors have been taken into consideration:

- Receptor/ Resource Characteristics: The nature, importance, and sensitivity to change of the receptors / target or resources that could be affected.

- Impact Magnitude: The magnitude of the change that is induced.

- Impact Duration: The time over which the impact is expected to last.

- Impact Extent: The geographical extent of the induced change, and.

- Regulations, Standards and Guidelines: The status of the impact in relation to regulations (eg. discharge limits), standards (eg. environmental quality criteria) and guidelines.

The overall impact severity has been categorised using a semi-quantitative KBSMM scale as shown in Table 2.8 for magnitude, Table 2.9 for duration and Table 2.10 for extent.

Table 2.8 KBSMM boundary conditions scored on a scale from 0 to 5 for impact magnitude.

SCALE (-) or (+)		DESCRIPTION
0		no observable effect
1		low effect
2		tolerable effect
3		medium high effect
4		high effect
5		very high effect (devastation)

Table 2.9: KBSMM boundary conditions scored time over which the impact is expected to last and its reversibility.

SCALE (-) or (+)		DESCRIPTION
T		Temporary
P		Permanent

Table 2.10: KBSMM boundary conditions scored geographical extent of the induced change.

SCALE (-) or (+)		DESCRIPTION
L		limited impact on location
O		impact of importance for municipality.
R		impact of regional character
N		impact of national character
M		impact of cross-border character

The likelihood (probability) of the pre-identified events occurring has been qualified using a qualitative scale of probability categories (in increasing order of likelihood) as shown in Table 2.11. Likelihood is estimated on the basis of experience and/ or evidence that such an outcome has previously occurred. Impacts resulting from routine/planned events are classified under category (E).

Table 2.11: KBSMM boundary conditions scored scale of probability categories (in increasing order of likelihood).

SCALE (-) or (+)		DESCRIPTION
A		Extremely unlikely (e.g., never heard of in the industry)
B		Unlikely (e.g., heard of in the industry but considered unlikely)
C		Low likelihood (e.g., such incidents/impacts have occurred but are uncommon)
D		Medium likelihood (e.g., such incidents/impacts occur several times per year within the industry)
E		High likelihood (e.g., such incidents/impacts occur several times per year at each location where such works are undertaken)

2.5.7.2 Overall Impact Individual Components Assessment Results

The overall impact assessment of the individual components of the receiving environment covering the magnitude, duration, extent, and probability of the potential negative impacts occurring due to the drilling of the proposed prioritised D1-D6 and G1-G6 exploration and appraisal wells sites within the AOI in PEL No. 73 interacting with the various components of the receiving environment is presented in form of a matrix table shown in Table 2.12.

The overall negative assessment as shown in Table 2.12 is based on the grading of the positive and negative impact assessment results of the individual components of the receiving environment as shown in the EIA Report, Tables 6.9-6.14 and 6.15-6.43, respectively.

The overall severity of potential environmental impacts of drilling of the proposed prioritised D1-D6 and G1-G6 exploration and appraisal wells sites within the AOI in PEL No. 73 on the receiving environment will be of low magnitude, temporally duration, localised extent (3Ha footprint), and low probability of occurrence due to the limited scope of the proposed activities and the adoption of step-by-step progression approach in advancing exploration process.

The standard resources step by step approach to exploration will allow the Proponent to continuously review and update the various components / baseline of the receiving environment as may be applicable against the results of exploration success.

The implementation of the subsequent stage/s of exploration will be subject to the positive outcomes of previous activities as graded and will require separate environmental assessment process and permits as may be applicable.

2.5.7.3 Assessment Results of the Overall Significant Impacts

The assessment results of the overall significant impacts depended upon the degree to which the process of drilling of the proposed prioritised D1-D6 and G1-G6 exploration and appraisal wells sites within the AOI in PEL No. 73 is likely to result in unwanted consequences on the receptor / various component of the receiving environment.

Overall, the assessment of significant impacts has focused on the ecosystem-based approach that considers potential negative impacts to the local (drill site), regional (Kavango East and West Regions), national (Namibia), transboundary (KAZA TFCA) and global interconnected ecosystems.

The main key sources of impacts that have been used in the determination of significant impacts are all the activities associated with the drilling of the proposed prioritised D1-D6 and G1-G6 exploration and appraisal wells sites within the AOI in PEL No. 73.

Each of the key source area/ step of negative impact have been identified and assessed as follows:

- ❖ Positive impacts are classified under a single category; they are then evaluated qualitatively with a view to their enhancement, if practical.

- ❖ Negligible or low impacts will require little or no additional management or mitigation measures (on the basis that the magnitude of the impact is sufficiently small, or that the receptor is of low sensitivity), and.

- ❖ Medium or high impacts require the adoption of management or mitigation measures to limit or reduce the impact to an acceptable level.

Overall, the results of the significant impact assessment for the drilling of the proposed prioritised D1-D6 and G1-G6 exploration and appraisal wells sites within the AOI in PEL No. 73 are shown in Table 2.13.

It is important to note that the assessment of the likely negative impacts on the receiving environment as shown in the EIA Report, Tables 6.15-6.41, have been considered without the implementation of mitigation measures detailed in the separate EMP Report.

The need for implementation of the appropriate mitigation measures as presented in this EMP Report have been determined based on the results of the positive (EIA Report, Tables 6.9-6.14) and negative impact assessment (EIA Report, Tables 6.15-6.42) and the overall significant impacts assessment results as detailed in Table 2.12.

Table 2.12: Summary results of the overall likely impacts of drilling the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 on the individual components of the receiving environment with respect to duration, geographical extent, and probability occurrence.

SENSITIVITY

SENSITIVITY RATING		CRITERIA
1	Negligible	The receptor or resource is resistant to change or is of little environmental value.
2	Low	The receptor or resource is tolerant of change without detriment to its character, is of low environmental or social value, or is of local importance.
3	Medium	The receptor or resource has low capacity to absorb change without fundamentally altering its present character, is of high environmental or social value, or is of national importance
4	High	The receptor or resource has moderate capacity to absorb change without significantly altering its present character, has some environmental or social value, or is of district/regional importance.
5	Very High	The receptor or resource has little or no capacity to absorb change without fundamentally altering its present character, is of very high environmental or social value, or is of international importance.

				PHYSICAL ENVIRONMENT						BIOLOGICAL ENVIRONMENT					SOCIOECONOMIC, CULTURAL, AND ARCHAEOLOGICAL ENVIRONMENT				
				Water Quality	Physical infrastructure and Resources	Air Quality, Noise and Dust	Landscape Topography	Soil Quality	Climate Change Influences	Habitat	Protected Areas	Flora	Fauna	Ecosystem functions, services, use values and non-Use or passive use	Local, regional, and national socioeconomic settings	Subsistence Agriculture	Community Forestry	Tourism and Recreation	Cultural, Biological and Archaeological Resources
SOURCES OF POTENTIAL IMPACT	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1.	Preconstruction and drilling requirements	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		2.	Construction phase	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		3.	Mobilisation	-1	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	+4	-2	-2	-2	-2
		4.	Spudding and Conductor casing	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		5.	Drilling surface / intermediate and setting casing and cementing process through up 900 m	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		6.	Drilling and continuous coring from 900 meters (2953') to 1900 meters (6234')	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		7.	Drilling below 1900 meters to total depth, estimated at 2500 meters (+/-8202')	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		8.	Plug and abandon hole	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		9.	Rehabilitate all surface disturbances and clear the site of any debris	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
		10.	Camp removal, site closure and restoration / abandonment	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	+4	-2	-2	-2	-2
	UNPLANNED ACCIDENTAL EVENTS	11.	Major land accidental incidence such as diesel / oil spill/ fire / explosion (Note: Well Control arrangements and related Emergency Response Plan (ERP) are designed to bring the risk of any unplanned accidental event to ALARP (As Low As Reasonably Practicable) and tolerable	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2

Table 2.13: Summary results of the overall likely significant impacts that the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 will have on the components of the receiving environment with respect to duration, geographical extent, and probability occurrence.

IMPACT SEVERITY (Magnitude, Duration, Extent, Probability)	RECEPTOR CHARACTERISTICS (SENSITIVITY)				
	Very High (5)	High(4)	Medium (3)	Low (2)	Negligible (1)
Very High (5)	Major [5/5]	Major [4/5[	Moderate [3/5]	Moderate [2 /5]	Minor 1/5
High (4)	Major [5/4]	Major [4/4]	Moderate [3/4]	Moderate [2/4]	Minor[1/4]
Medium (3)	Major [5/3]	Moderate[4/3]	Moderate[3/3]	Minor[2/3]	None[1/3]
Low (2)	Moderate [5/2]	Moderate[4/2]	Minor[3/2]	None[2/2]	None[1/2]
Negligible (1)	Minor [5/1]	Minor [4/1]	None [3/1]	None [2/1]	None [1/1]

SOURCES OF POTENTIAL IMPACT		No.	Activity	PHYSICAL ENVIRONMENT: Water Quality	Physical infrastructure and Resources	Air Quality, Noise and Dust	Landscape Topography	Soil Quality	Climate Change Influences	BIOLOGICAL ENVIRONMENT: Habitat	Protected Areas	Flora	Fauna	Ecosystem functions, services, use values and non-Use or passive use	SOCIOECONOMIC, CULTURAL, AND ARCHAEOLOGICAL ENVIRONMENT: Local, regional, and national socioeconomic settings	Subsistence Agriculture	Community Forestry	Tourism and Recreation	Cultural, Biological and Archaeological Resources
SOURCES OF POTENTIAL IMPACT	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1.	Preconstruction and drilling requirements	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		2.	Construction phase	-3/2	-3/2	-3/2	-3/2	-3/2	-1/1	-3/2	-1/1	-3/2	-3/2	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		3.	Mobilisation	-3/2	-3/2	-3/2	-3/2	-3/2	-1/1	-3/2	-1/1	-3/2	-3/2	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		4.	Spudding and conductor casing	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		5.	Drilling surface / intermediate and setting casing and cementing process through up 900 m	-3/2	-1/1	-3/2	-3/2	-3/2	-3/2	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		6.	Drilling and continuous coring from 900 meters (2953') to 1900 meters (6234')	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		7.	Drilling below 1900 meters to total depth, estimated at 2500 meters (+/-8202')	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		8.	Plug and abandon hole	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		9.	Rehabilitate all surface disturbances and clear the site of any debris	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
		10.	Camp removal, site closure, restoration / abandonment	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+4/4	-1/1	-1/1	-1/1	-1/1
	UNPLANNED ACCIDENTAL EVENTS	11.	Major land accidental incidence such as diesel / oil spill/ fire / explosion	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	-1/1	+1/1	-1/1	-1/1	-1/1	-1/1

2.6 Implementation of this EMP

2.6.1 Objectives of this EMP

This EMP Report provides a detailed plan of action required in the implementation of the mitigation measures for minimising and maximising the identified negative and positive impacts respectively. The EMP gives commitments including financial and human resources provisions for effective management of the likely environmental liabilities during and after the exploration. Regular assessments and evaluation of the environmental liabilities during the exploration will need to be undertaken and will ensure adequate provision of the necessary resources towards good environmental management at various stages of the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6.

2.6.2 Roles and Responsibilities

2.6.2.1 Overview

This EMP report identifies the activity groups / environmental elements, the aspects / targets, the indicators, the schedule for implementation and who should be responsible for the management to prevent major impacts that the different stages of the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 may have on the receiving environment (physical, biological, and socioeconomic, cultural, and archaeological). The roles and responsibilities of all various teams responsible for the implementation of this EMP shall run for the entire duration of drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73.

2.6.2.2 Proponent’s Representative (PR) / Project Manager (PM)

The Proponent is to appoint a **Proponent’s Representative (PR) / Project Manager (PM)** with overall project management responsibilities and EMP implementation, monitoring and reporting not limited to the following as may be applicable:

- Act as the site project manager and implementing agent.
- Ensure that the Proponent’s responsibilities are executed in compliance with the relevant legislation.
- Ensure that all the necessary environmental authorisations and permits have been obtained.
- Assist the project team and contractor/s in finding environmentally responsible solutions to challenges that may arise.
- Should the PR believe a serious threat to, or impact on the environment may be caused by the ongoing activities, he/she may stop work. The Proponent shall be informed of the reasons for the stoppage as soon as possible.
- The ER or as may be contractually delegated, has the authority to institute disciplinary proceedings in accordance with the provisions of the national laws for transgressions of basic conduct rules and/or contravention of the EMP.
- Should the Contractor or his/her employees fail to show adequate consideration for the environmental aspects related to the EMP, the ER can have person(s) and/or equipment removed from the site or work suspended until the matter is remedied.
- Report to the Employer on the implementation of this EMP on site (with input from the HSE and Environmental Social Governance (ESG) / EMP Coordinators and/or independent environmental auditor).
- Maintain open and direct lines of communication between the Employer, ESG/ EMP Coordinators, Contractor, and stakeholders with regards to environmental matters, and.

- Attend regular site meetings and inspections.

2.6.2.3 Project Health, Safety and Environment (Project HSE)

The Proponent is to appoint a Project Health, Safety and Environment (Project HSE) with responsibilities not limited to the following as may be applicable and with respect to the EMP implementation, monitoring and reporting:

- Manage the site HSE day to day issues.

- Assist the PR and Contractor in finding environmentally responsible solutions to challenges that may arise.

- Carry out regular site inspections (on average once per week) of all exploration areas with regards to compliance with the EMP and document any non-compliance(s) and report to the PR as soon as possible.

- Support external HSE regulatory inspections / audits as may be required.

- Continuously review the site HSE requirements and recommend additions and/or changes to the EMP and other documents.

- Monitor the Contractor's HSE awareness training for all new personnel coming onto site.

- Keep records of all activities related to HSE control and monitoring. the latter to include a photographic record of the site preparation, construction, drilling operations / activities, rehabilitation process, and a register of all major incidents, and.

- Attend regular site meetings / debriefing and training.

2.6.2.4 Environmental Social Governance (ESG) / EMP Coordinator/s

The **Environmental Social Governance (ESG) / EMP Coordinator/s** shall have responsibilities not limited to the following as may be applicable and with respect to the EMP implementation, monitoring and reporting:

- Provide guidance on the implementation of this EMP and Environmental Social Governance (ESG) requirements.

- Coordinates, implement and monitor all the Corporate Social Responsibilities (CSRs) projects.

- Assist the project team in ensuring that the necessary environmental authorisations and permits are in place and valid.

- Assist the project team in finding environmentally responsible solutions to challenges that may arise.

- Conduct internal environmental review / monitoring as per EMP requirements.
- Oversee basic EMP conduct rules/ protocols and/or contraventions.

- Advise the PM / Proponent on the removal of person(s) and/or equipment not complying with the specifications of the EMP.

- Carry out regular site inspections / reviews (on average once per week) of all operations project areas with regards to compliance with the EMP provisions and report any non-compliance(s) to the PM as soon as possible.

- Support regulatory / inspections on the implementation of and compliance to the EMP.

- ❖ Organise and support regular independent environmental monitoring as may be required.

- ❖ Continuously review the EMP and recommend additions and/or changes to the EMP document as may be applicable.

- ❖ Monitor the environmental awareness training for all new personnel coming onto site.

- ❖ Keep records of all activities related to environmental control and monitoring. the latter to include a photographic record of the construction and environmental control and rehabilitation process, and a register of all major incidents, and.

- ❖ Attend site and community/ stakeholders engagements or consultations meetings as may be required.

2.6.2.5 Contractors and Subcontractors

The responsibilities of the **Contractors and Subcontractors** that may be appointed by the Proponent to undertake certain field-based activities related to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 include:

- ❖ Comply with the relevant legislation and the EMP provision.

- ❖ Preparation and submission to the Proponent through the Project HSE of the following Management Plans: Environmental awareness training and inductions, emergency preparedness and response, waste management, and HSE.

- ❖ Ensure adequate environmental awareness training for senior site personnel.

- ❖ Environmental awareness presentations (inductions) to be given to all site personnel prior to work commencement. the Project HSE is to provide the course content and the following topics, at least but not limited to, should be covered:

    - o The importance of complying with the EMP provisions.

    - o Roles and responsibilities, including emergency preparedness.

    - o Basic rules of conduct (Do's and Don'ts).

    - o EMP: aspects, impacts and mitigation.

    - o Disciplinary actions to be taken for failure to adhere to the EMP, and.

    - o Health and safety requirements.

- ❖ Record keeping of all environmental awareness training and induction presentations, and.

- ❖ Attend regular site meetings and environmental inspections.

3. SPECIFIC MITIGATION MEASURES

3.1 Hierarchy of Mitigation Measures Implementation

A hierarchy of methods for mitigating significant adverse effects has been adopted in order of preference and as follows:

(i) Enhancement, e.g. provision of new habitats.

(ii) Avoidance, e.g. sensitive design to avoid effects on ecological receptors.

(iii) Reduction, e.g. limitation of effects on receptors through design changes, and.

(iv) Compensation, e.g. community benefits.

3.2 Mitigated Project Phases

Based on the findings of the impact assessment process as described in the EIA Report, Table 3.1–3.21 provides the detailed specific mitigations measures to be implemented by the Proponent with respect to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 covering the following project phases:

1) Permitting and planning

2) Site preparation, preconstruction and construction stages

3) Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD)

4) Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing, and.

5) Rehabilitation, site closure, restoration, and handover to community / land owner.

Major land accidental incidences such as diesel / oil spill/ fire / explosion are provided for within the framework of the primary, secondary, and tertiary well control systems and arrangements linked to the Emergency Response Plan (ERP) and Oil Spill Contingency Plan (OSCP) developed to bring the risk of any unplanned accidental event to As Low As Reasonably Practicable (ALARP) and tolerable.

3.3 Mitigation Measures, Objectives, Scheduling and Responsibilities

The following is the summary of the key permitting, positive and negative impacts to which mitigation measures have been provided as detailed in Tables 3.1-3.21 with respect to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73:

1) Management of likely negative impacts of project planning and permitting noncompliance.

2) Measures to enhance positive socioeconomic impacts.

3) Management of likely negative impacts associated with the initial implementation of the proposed project activities.

4) Management of likely negative impacts through the EMP implementation, compliance monitoring and reporting with clear roles and responsibilities with resources allocation.

5) Management of stakeholders relations, continuous community engagements and regulatory reporting.

6) Management of likely negative impacts associated with the lack of awareness on all matters related to the environment management at all the operational sites.

7) Management of likely negative impacts with respect to the development and operation of the supporting infrastructure linked to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73.

8) Management of likely negative impacts on flora around the general operational, drill sites and supporting infrastructure areas.

9) Management of likely negative impacts on fauna around the general operational, drill sites and supporting infrastructure areas.

10) Management of likely negative impacts on local, AOI and PEL 73 habitat and ecosystems.

11) Management of likely negative impacts on water resources and water supply infrastructure.

12) Management of likely negative impacts on general water usage.

13) Management of likely negative impacts socioeconomic impacts.

14) Management of likely negative impacts health and safety impacts.

15) Management of likely negative impacts visual impacts.

16) Management of likely negative impacts associated with the traffic and equipment movements and management.

17) Management of likely negative impacts associated with equipment / vehicles noise, vibrations, emissions influence on air quality and Climate Change.

18) Management of likely negative impacts of dust and influence on air quality / health receiving environment.

19) Management of likely negative impacts of operational spillages or fuel leaks.

20) Management of likely negative impacts of waste (solid and liquid) generation.

21) Management of likely negative impacts of major accidental / emergency scenarios.

22) Management of likely negative impacts of drilled sites rehabilitation, restoration, and closure management plan.

23) Management of likely negative impacts and environment performance monitoring indicators linked to the closure, rehabilitation and restoration of the proposed D1-D6 and G1-G6 exploration and appraisal wells sites inclusive supporting infrastructures such as access roads and borrow pits and site handover to the original land owner.

24) Management and consideration of the drill sites restoration options in consultation with the local community, village development committees, community headperson (foreman/forewoman), traditional authority and local councillor representing the regional council, and.

25) Management, monitoring and monthly, bi-annual and annual compliance performance monitoring reporting of the overall likely positive and negative impacts of the proposed project activities.

Table 3.1: Management of likely negative impacts of project planning and permitting noncompliance.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
Obtained the following applicable permits, authorisations and consents before the start of the project activities on each of the proposed drilling locations (D1-D6 and G1-G6): 1. Environmental Clearance Certificate (ECC) issued by the Environmental Commissioner in the Ministry of Environment, Forestry and Tourism (MEFT) 2. Trees Harvesting Permit for cutting down protected and important big trees and shrubs issued by the Director of Forestry in the Ministry of Environment, Forestry and Tourism (MEFT) 3. Freshwater Abstraction Permit issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 4. Waste Water Discharge Permit issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 5. Water Borehole Drilling Permits issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 6. Exploration and appraisal well drilling permit for drilling through a groundwater aquifer issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 7. Oil and Gas Well Drilling Permit / Consent / Permit to Drill with Basis for Well Design issued by the Ministry of Mines and Energy (MME) – Office of the Petroleum Commissioner 8. Oil Spill Contingency Plan (OSCP) approved by the Ministry of Mines and Energy (MME) – Office of the Petroleum Commissioner 9. Emergency Response Plan (ERP) approved by the Ministry of Mines and Energy (MME) – Office of the Petroleum Commissioner 10. Radioactive Authorisation (Import, Storage, Transport, Use and Export Permits) of radioactive sources for logging and authorisation issued by the National Radiation Protection Authority (NRPA), Ministry of Health and Social Services (MHSS) 11. Explosive Permit (Import, Storage, Transport, Use and Export Permits) of Explosives equipment in drilling (Downhole equipment recovery) and well testing (Perforating steel casing, cement and formation rock) stages issued by the Inspector General Explosive Control Division Namibian Police Force, Ministry of Home Affairs, Immigration, Safety and Security 12. Surface user rights consent, endorsement, leasehold or permission to occupy (PTO) form the land owner, headperson, Chief's Council, Traditional Authority, Regional Land Boards and Regional Councils as may be applicable.	Compliance to all national legislation, regulations and permits, authorisations, consents and international best practices	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.2: Measures to enhance positive socioeconomic impacts.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Proponent continue to pay license rental fees and contributions to the PetroFund as well as delivering on ESG and CSR especially on rural water supply and access to safe clean drinking water for the rural local communities 2. Stipulate a preference for local contractors in its tender policy. Preference to local contractors should be based on competitive business principles and salaries and payment to local service providers should still be competitive. 3. Develop a database of local businesses and people that qualify for providing service and invite them to the tender process. 4. Stipulate that resident from the local villages near the drilling sites should be employed for temporary unskilled/skilled and where possible in permanent unskilled/skilled positions as they would reinvest in the local economy. 5. Ensure that potential employees are from the local area or Kavango East of West Regions by recruiting with the help of the traditional authority as may be applicable 6. Ensure that contractors and subcontractors adhere to Namibian Affirmative Action, Labour and Social Security, Health and Safety laws. 7. Ensure that contractor and subcontractor paying minimum wages to the workers 8. Labour hire agents must not be allowed and the Proponent/ Contractor/ Subcontractor shall employ workers directly, not through a third-party	Promote effective management of socioeconomic benefits form the proposed project activities within the AOI in PEL No. 73 with direct links to Environmental and Social Governance (ESG) and Corporate Social Responsibility (CSR)	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.3: Management of likely negative impacts associated with the initial implementation of the proposed project activities.

MITIGATION MEASURE	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Conduct drill and supporting infrastructure sites verifications and inspections with the support of the environmental, ESG, HSE, and all key specialist teams before the start of site activities 2. Develop site operational rules, protocols and guidelines to be adopted at all time at all areas of operations 3. Define site roles and responsibilities in terms of the EMP implementation, monitoring and reporting to make sure that all personnel, contractors and subcontractors are aware of their roles and responsibilities to ensure compliance with the EMP provisions. 4. Monitor compliance of the EMP provisions 5. Develop and implement an EMP monitoring reporting mechanisms	Provide for the implementation and compliance monitoring of the EMP provisions	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.4: Management of likely negative impacts through the EMP implementation, compliance monitoring and reporting with clear roles and responsibilities with resources allocation.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Provide resources (Human and Financial) for EMP implementation, Environmental Social Governance (ESG), Environmental, Safety, Health, awareness and training for internal and external environmental monitoring costs as well as for site rehabilitation and restoration costs that may arise. 2. Appoint senior and experienced persons as the Proponent's Representative (PR), Project Manager (PM) and Project HSE, Environmental Social Governance (ESG) Coordinator and or EMP Coordinators to assume responsibility for all environmental, health, safety, social, economic and ESG issues. 3. Develop an Environmental Policy linked to the provisions of the EMP. 4. Include the EMP provisions and Environmental Policy in all Tender Documents to all Contractors.	Compliance to all national legislation, regulations and permits, authorisations, consents and international best practices	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.5: Management of stakeholders relations, continuous community engagements and regulatory reporting.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Prior to the project team going to each of the drilling locations consents shall be obtained from the local community / land owners 2. Project implementation updates shall be provided to the Competent Authority (MME) (Petroleum Commissioner), and all other Regulatory Authorities, Kavango West and East Regional Governors and Councillors as well as Traditional Authority and local community / land owners as may be applicable 3. All applicable permits, certifications and consents shall be obtained before project implementations.	Maintain sound stakeholder relations local community, land owners, traditional authority, Kavango East and West Regions Regional Councils, Key Line Ministries / Regulatory Authorities and other I&APs	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.6: Management of likely negative impacts associated with the lack of awareness on all matters related to the environment management at all the operational sites.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Every senior/supervisory member of the project team shall familiarise themselves with the contents of this EMP and HSE requirements. They shall understand their roles and responsibilities regarding personnel and project compliance with the EMP provisions and HSE Project requirements 2. Proponent shall develop HSE materials and conduct regular awareness debriefing and training to all the workers. 3. All visitors to any operational site shall always be given HSE debriefing 4. Subject to agreement of the parties, the HSE, ESG or EMP Coordinator shall hold regular Environmental Awareness Briefing meeting, which shall be attended by all contractors. 5. Briefings on the HSE, EMP, Environmental Policy and Best Practices shall be discussed as well as the potential dangers to the environment of the following activities: Public relations / communications, littering, off-road driving, trip authorisation, waste management, poaching and plant theft etc. The need to preserve soil, conserve water and implement water saving measures, reuse and recycling measures.	Promote effective Health, Safety and Environment (HSE) working environment at all the operational sites	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.7: Management of likely negative impacts with respect to the development and operation of the supporting infrastructure linked to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Ensure that all the applicable permits, authorisations and consents have been obtained before the implementation of the activities of the supporting infrastructure linked to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 1. Obtain consent from the local land owner/s / surface rights holder/s 2. Do not cut down protected and tagged tresses / bushes during site clearing / preparation before permitted by MEFT Forestry Department 3. Always develop structures on already disturbed areas and with least disturbance to the environment and within the non-sensitive areas such as unused cleared fields and old tracks and widen existing paths for site access 4. Onsite infrastructure (e.g., water tanks, sewage tanks, solid waste transfer station), chemical toilets or French Drain shall be situated within the demarcated 3Ha drilling site footprint 2. No littering signage around the drilling sites, other operational areas such as existing borrow pits and along access, gates and main roads	Compliance with the provisions of this EMP linked to the national legislation, regulations and permits, authorisations, consents and international best practices	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.8: Management of likely negative impacts on flora around the general operational, drill sites and supporting infrastructure areas.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
General Operational Areas: 1. Limit the development to actual tracks/roads to be cleared and avoid affecting adjacent areas, especially the Omaramba Omatako and other ephemeral drainage lines and pans, throughout the entire area. 2. Avoid development & associated infrastructure in sensitive areas – e.g., Okavango River; Omaramba Omatako; other ephemeral drainage lines and pans and undeveloped areas. This would minimise the negative effect on the local environment especially unique features serving as habitat to various flora species. 3. Remove unique and sensitive flora (e.g., all *Aloe* spp., etc.) before commencing with the development activities and relocate to a less sensitive/disturbed site in the immediate area. 4. Prevent and discourage the collecting of firewood as dead wood has an important ecological role – especially during the during the track/road building phase(s). Such collecting of firewood, especially for economic reasons, often leads to abuses – e.g., chopping down of live and/or protected tree species such as *Baikiaea plurijuga*, *Burkea africana*, *Guibourtia coleosperma*, etc. which are good quality wood. 5. Attempt to avoid the removal of bigger trees during the access route upgrading phase(s) as these serve as habitat for a myriad of fauna. Avoid the destruction of larger trees associated with the ephemeral drainage lines. 6. Prevent and discourage fires – especially during the access route upgrading phase(s) – as this could easily cause runaway veld fires causing problems (e.g. loss of grazing & domestic stock mortalities, etc.) for the neighbouring communities. 7. Rehabilitation of the disturbed areas – i.e. initial development access route “scars” and associated tracks as well as temporary camp sites. Preferably workers should be transported in/out to the track/road clearing sites on a daily basis to avoid excess damage to the local environment (e.g. fires, wood collection, poaching, etc.). Such rehabilitation would not only confirm the company’s environmental integrity, but also show true local commitment to the environment. 8. Eradicate – destroy – all invasive alien plants should these be encountered on site – e.g. *Eucalyptus*, *Opuntia* & *Sisal* spp., etc. This would ensure that the spread is limited and show environmental commitment. 9. Educate/inform contractors and staff on protected species (Annex 4) to avoid and the consequences of illegal collection of such species. 10. Investigate the idea of employing an Environmental Officer during the track/road building phase(s) to ensure compliance and minimise the overall impact on the flora and the environment. 11. Liaises with MEFT officials throughout the entire project.	Prevent flora and ecosystem destruction and promote conservation with links to the relevant ESG initiatives	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent’s Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.8: *Cont.*

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
Access Roads: 1. Avoid placing tracks/roads through sensitive areas – e.g., along ephemeral drainage lines and pans. Use the existing access route. This would minimise the effect on localised potentially sensitive habitats/flora in the area. 2. Avoid felling protected tree species (especially large specimens and indigenous fruit trees – i.e., follow a meandering approach which avoids such species rather than straight lines); avoid dead trees (habitat to a variety of cavity dwellers – e.g., bats, geckos, hornbills, red-billed oxpeckers, etc.); avoid ephemeral pan areas; avoid vehicle activity within the ephemeral drainage lines, etc. as much as possible. 3. Prune overhanging branches, that may affect vehicle access, rather than removing the entire tree, especially for protected and fruit tree species. 4. Avoid driving randomly through the area (i.e., "track discipline"), but rather stick to permanently placed tracks/roads. This would minimise the effect on localised potentially sensitive habitats/flora in the area. 5. Stick to speed limits of maximum 30km/h as this would result in less dust pollution. 6. Implement erosion control. – i.e., avoid constructing tracks within ephemeral drainage lines and pans; incorporate erosion furrows (runoff sites) and humps along tracks to channel water off the tracks to minimise erosion problems; cross drainage lines at right angles, etc. The area(s) towards & adjacent the drainage line(s) are easily eroded and further development may exacerbate this problem. Avoid construction within 100m of the main drainage line(s) to minimise erosion problems as well as preserving the riparian associated flora and fauna. **Well Drill Sites:** 1. Limit development within the proposed well drill site – see Section 3.9 – and do not clear fell the entire area, but attempt to incorporate the larger (marked) protected tree species within the site layout. Furthermore, these trees would serve as "parent" trees and assist with rehabilitating the area naturally over time. 2. Avoid felling the protected trees identified in Table 8 within/around the proposed "open" area as far as possible – i.e., include marked trees in drill site layout. These identified trees are larger specimens which often have cavities, etc. and serve as habitat to a variety of fauna. 3. Establish a small on-site nursery to propagate indigenous tree species, especially fruit tree species (e.g., *Guibourtia coleosperma*, *Strychnos* spp., etc.), to replace protected tree species destroyed. 4. Liaise with the relevant Traditional Authority; Conservancy and Community Forest members to prevent people (camp followers) from temporarily settling adjacent the drill site as this could lead to collateral habitat/flora destruction.	Prevent flora and ecosystem destruction and promote conservation with links to the relevant ESG initiatives	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.9: Management of likely negative impacts on fauna around the general operational, drill sites and supporting infrastructure areas.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
General 1. Limit the development to actual access route to be upgraded and avoid affecting adjacent areas, especially the Omaramba Omatako and other ephemeral drainage lines and pans, throughout the entire area. 2. Avoid development & associated infrastructure in sensitive areas – e.g. Okavango River; Omaramba Omatako; other ephemeral drainage lines and pans and undeveloped areas (See 3.9). This would minimise the negative effect on the local environment especially unique features serving as habitat to various vertebrate fauna species. 3. Remove (e.g. capture) unique fauna and sensitive fauna (e.g. tortoises, monitor lizard) before commencing with the development activities and/or species serendipitously located during this period and relocate to undisturbed sites in the immediate area. 4. Prevent and discourage the setting of snares (poaching), illegal collecting of veld foods (e.g. tortoises, etc.), indiscriminate killing of perceived dangerous species (e.g. snakes, etc.) and collecting of wood as this would diminish and negatively affect the local fauna – especially during the fieldwork phase(s). 5. Attempt to avoid the removal of bigger trees during the access route upgrade phase(s) as these serve as habitat for a myriad of fauna. Rather prune branches affecting access only. 6. Prevent and discourage fires – especially during the access route clearing phase(s) – as this could easily cause runaway veld fires affecting the local fauna, but also causing problems (e.g. loss of grazing & domestic stock mortalities, etc.) for the neighbouring communities. 7. Rehabilitation of the disturbed areas – i.e. initial development access route "scars" and associated tracks as well as temporary camp sites. Preferably workers should be transported in/out to the track clearing sites on a daily basis to avoid excess damage to the local environment (e.g. fires, wood collection, poaching, etc.). Such rehabilitation would not only confirm the company's environmental integrity, but also show true local commitment to the environment. 8. Prevent domestic pets – e.g. cats & dogs – accompanying the workers during the access route upgrade and drill site ground development phase(s) as cats decimate the local fauna and interbreed & transmit diseases to the indigenous African wildcat found in the area. Dogs often cause problems when bonding on hunting expeditions thus negatively affecting the local fauna. The indiscriminate and wanton killing of the local fauna by such pets should be avoided at all costs. 9. Initiate a suitable waste removal system (i.e. remove to Rundu and not store on site) as this often attracts wildlife – e.g. jackals, crows, etc. – which may result in human-wildlife conflict issues. 10. Educate/inform contractors and staff on protected species to avoid and the consequences of illegal collection of such species. 11. Investigate the idea of employing an Environmental Officer and Wildlife Monitoring Specialist during the access route and drill site ground development phase(s) to ensure compliance and minimise the overall impact on the fauna and the environment. 12. Liaises with MEFT officials throughout the entire project.	Prevent fauna and ecosystem destruction and promote conservation with links to the relevant ESG wildlife monitoring initiatives	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.9: *Cont*.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
Access Route 1. Avoid placing tracks/roads through sensitive areas – e.g., along ephemeral drainage lines and pans. Use the existing access route. This would minimise the effect on localised potentially sensitive habitats/fauna in the area. 2. Avoid felling protected tree species (especially large specimens and indigenous fruit trees – i.e., follow a meandering approach which avoids such species rather than straight lines); avoid dead trees (habitat to a variety of cavity dwellers – e.g., bats, geckos, hornbills, red-billed oxpeckers, etc.); avoid ephemeral pan areas; avoid vehicle activity within the ephemeral drainage lines, etc. as much as possible. 3. Prune overhanging branches, that may affect vehicle access, rather than removing the entire tree, especially for protected and fruit tree species. 4. Avoid driving randomly through the area (i.e., "track discipline"), but rather stick to permanently placed tracks/roads. This would minimise the effect on localised potentially sensitive habitats/fauna in the area. 5. Stick to speed limits of maximum 30km/h as this would result in fewer faunal road mortalities. Lower speeds would also minimise dust pollution. 6. Implement erosion control. – i.e., avoid constructing tracks within ephemeral drainage lines and pans; incorporate erosion furrows (runoff sites) and humps along tracks to channel water off the tracks to minimise erosion problems; cross drainage lines at right angles, etc. The area(s) towards & adjacent the drainage line(s) are easily eroded and further development may exacerbate this problem. Avoid construction within 100m of the main drainage line(s) to minimise erosion problems as well as preserving the riparian associated flora and fauna. **Well Drill Site** 1. Limit development within the proposed surveyed areas such for each proposed well site 2. Avoid felling the protected trees identified at each well site as far as possible – i.e., include marked trees in drill site layout. These identified trees are larger specimens which often have cavities, etc. and serve as habitat to a variety of fauna. 3. Liaise with the relevant Traditional Authority and Community Forest members to prevent people (camp followers) from temporarily settling adjacent the drill site as this could lead to collateral habitat/fauna destruction.	Prevent fauna and ecosystem destruction and promote conservation with links to the relevant ESG wildlife monitoring initiatives	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors 8. Subcontractors

Table 3.10: Management of likely negative impacts on local, AOI and PEL 73 habitat and ecosystems.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Select drilling site and access with care and with support of the specialist consultants – i.e., avoid important habitats (e.g., raptor breeding sites, pans). 2. Use portable chemical toilets or French Drain systems or suitable portable system to avoid faecal pollution at the drilling location. 3. Use portable chemical toilets to avoid faecal pollution at temporary any other operations area/ site such as a borrow pit. 4. Initiate a suitable and appropriate refuse removal policy littering could result in certain animals becoming accustomed to humans and associated activity and result in typical problem animal scenarios for the local community and visitors– e.g., baboon, black-backed jackal, crows, etc. 5. Avoid and/or limit the use of unnecessary extremely brighter spot lights at the drill and other operational sites as this could influence and/or affect various nocturnal species – e.g., bats and owls, etc. Use focused lighting for least effect. 6. Prevent the killing of species viewed as dangerous – e.g., various snakes – when found any around the AOI or licence area. 7. Prevent the setting of snares for ungulates (i.e., poaching) or collection of veld foods (e.g., tortoises, monitor lizard) and unique plants (e.g., *Harpagophytum procumbens*) or any form of illegal hunting activities. 8. Avoid introducing dogs and cats as pets to the drill site or any other operational area as these can cause significant mortalities to local fauna (cats) and even stock losses (dogs). 9. Remove and relocate slow moving vertebrate fauna (e.g., tortoises, chameleon, snakes, etc.) to suitable habitat elsewhere in the general area. 10. Avoid the removal and/or damaging of protected flora potentially occurring in the general area – e.g., various *Baikiaea plurijuga*, *Pterocarpus angolensis*, etc. Removal of protected plants can only be done with permission from the Department of Forestry in the MEFT 11. Avoid introducing ornamental plants, especially potential invasive alien species, as part of the landscaping or temporal storage, etc., but rather use localised indigenous species, should landscaping be attempted, which would also require less maintenance (e.g., water). 12. Remove all invasive alien species wherever encountered – e.g., *Prosopis* spp. This would not only indicate environmental commitment, but actively contribute to a better landscape. 13. Rehabilitate all areas disturbed by the exploration activities – i.e., campsites, tracks and existing borrow pits and any other operational area. 14. Ensure that adequate firefighting equipment (e.g., fire beaters. extinguishers, etc.) is available at drill site and other operational site to manage any accidental fires. 15. Liaises with MEFT officials and conservancy / community forestry members whilst working close to the Mangetti and Khaudum National Parks, conservancy or community forestry 16. Employ an independent environmental consultant to ensure compliance, especially of the rehabilitation of all the affected areas.	Promotion of conservation and effective environmental management through preservation of the receiving environment around the drilling sites, temporary layover sites and along access roads	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.11: Management of likely negative impacts on water resources and water supply infrastructure.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Conduct hydro-census, which will form the baseline of groundwater data for the study area prior to the implementation of the drilling operations for each well. Typical groundwater information will be collected and includes rest water levels, pumping regimes, water demand, rate of abstraction and of course water quality. To have greater transparency on the water monitoring activities, the affected landowners / farmers/ local community shall be given access to the results of the water monitoring analyses. 2. Implement a Groundwater monitoring network: Several strategically located boreholes shall be selected form part of the groundwater monitoring network. These boreholes will be monitored over time to determine the impact of operations on the surrounding water resources. 3. Adopt best practices with respect to the drilling operations covering well design, drilling fluids, casing, cement works, cutting pit design, management and restoration all aimed at protecting groundwater resource in local area, AOI and PEL 73 4. Limit the operation to a specific site and avoid sensitive areas and in particular the Ephemeral River Channels. This would sacrifice the actual area for other adjacent Ephemeral Rivers areas and thus minimise any likely negative effects on water resources. 5. Disposal of wastewater into any public stream is prohibited. 6. Lined pits for management of domestic, sanitary and industrial effluents should be sited with the knowledge of the geology and hydrogeological characteristics of the area and not too close to the water supply borehole/s or Ephemeral River Channels 7. Provide 200-400m buffer zone distances between the drilling locations and existing community water sources / supply facilities. 8. Spill kits for equipment servicing and vehicles refuelling shall be used at all times and site workers must be trained and debriefed regularly on the use of spill skits and management of site oil spills. 9. Ensure that all vehicles and machinery are properly serviced and maintained not to have any oil spills / leaks that could contaminate the soils and local groundwater resources. 10. Ensure that all drivers and technicians are familiar with drip-tray and spill kit use through daily tool-box talks.	Protection and monitoring of water resources and water supply infrastructure in the local drill sites, AOI and PEL 73	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.12: Management of likely negative impacts on general water usage.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. The Proponent shall obtain permission from the land owner/s / community before utilising any water resources or any associated water infrastructure near the drill sites, layover sites or at any other operational site. 2. Always use as little water as possible. 3. Reduce, Reuse and Re-Cycle (3Rs) water where possible. 4. All leaking pipes / taps shall be repaired immediately they are noticed. 5. Never leave taps running. 6. Close taps after using them. 7. Immediately report to the Contractor or Environmental Control Officer / Site Manager when noticing overflowing water or unhygienic conditions at the ablution facilities. 8. No washing of vehicles, equipment and machinery, containers, and other surfaces at the drill site or supporting infrastructure areas.	Promote effective use and management of local water resources	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.13: Management of likely negative impacts socioeconomic impacts.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Address unrealistic expectations about large numbers of jobs that would be created before project implementation. 2. Providing information such as the number and types of jobs available 3. The employment of local residents and local companies should be a priority. To ensure that potential employees are from the area through working with the traditional authorities and village headmen/ women / foremen/ ladies. 4. Drill sites, layover sites and implementation of any operational site or access should must only be done after consultation with the land owners and affected local community to avoid any conflicts. 5. When contracts of employees outside the local area are terminated or not renewed, contractors should transport the employees out of the local area to their hometowns within two days of their contracts ending. 6. Tender documents could stipulate that contractor have COVID-19 and HIV/Aids workplace policies and programmes in place and proof of implementation should be submitted with invoicing to the Proponent. 7. Develop strategies in coordination with local health officers and NGOs to protect the local communities, especially young girls from being exploited by workers. 8. Contract companies could submit a code of conduct, stipulating disciplinary actions where employees are guilty of criminal activities in and around the vicinity of the drilling sites, other operational areas such as existing borrow pits and access roads. Disciplinary actions should be in accordance with Namibian legislation. 9. Contract companies could implement a no-tolerance policy regarding the use of alcohol and workers should submit to a breathalyser test upon reporting for duty daily as may be applicable and especially for all drivers. 10. Ensure that drivers adhere to speed limits and that speed limits are strictly enforced. 11. Ensure that vehicles are road worthy and drivers are qualified. 12. Train drivers in potential safety issues to avoid accidents that may create conflicts with the local communities.	Manage unrealistic employment expectations, in-flux of job seekers, social friction with local people, increase in crime, protect family structures, reduce Covid-19 and other diseases, and reduce pressure on local resources (land, water and shelter etc)	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.14: Management of likely negative impacts health and safety impacts.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Apply best practices in oil and gas drilling operations 2. Develop a COVID -19 and HIV and AIDS policy 3. Request the Roads Authority for permission to erect warning signs of heavy equipment vehicles on affected public roads. 4. An onsite ambulance, qualified medical practitioner and essential medical kits shall always be available around the drill site. Any other operational site shall have an onsite medical kit. 5. Physical hazards: Follow national and international regulatory and guidelines provisions, always use of correct Personal Proactive Equipment (PPE), training programme, as well as the implementation of Health and Safety Programmes in accordance with the Labour Act. 6. All equipment shall be in good working condition and services accordingly. 7. Ensure that all workers can be identified by staff uniform and badges where applicable. 8. Access control to drill site and certain restricted operational areas of the operations shall be always enforced. 9. The drill site shall be temporally secured and the type of fencing to be used would, however, be dependent on the impact on the visual resources and/or cost. 10. Notice or information boards relating to COVID-19 requirements, public safety hazards and emergency contact details to be put up at the drill site gate(s) and on key support field vehicles as well as restricted operational areas. 11. Rubber gloves and masks must always be used in case of an accident to reduce the risk of contracting HIV/AIDS or COVID-19 12. Al workers shall be made aware and given instructions concerning the dangers of dehydration or hyperthermia. Encourage all to drink plenty of clean water not directly from the surface water bodies or unknow water wells. 13. No person under the influence of alcohol or drugs shall be allowed at the drilling sites, other operational areas, or access roads. 14. Ensures compliance with the requirements of the relevant Namibian Labour, Health and Safety Regulations always. 15. Dangerous or protected / sensitive areas shall be clearly marked and access to these areas shall be controlled or restricted. 16. Due care shall be taken when driving any vehicles on any roads particularly the gravel roads. ALL Drivers must drive with their headlights switched on when travelling on the gravel roads (day and night). 17. Persons driving a vehicle shall be in possession of a valid driver's license 18. Awareness on HIV/AIDS and COVID-19 among workers is raised	Promotion of health and safe working environment in line with national Labour, Health and Safety Regulations and international best practices for oil and gas drilling operations	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.15: Management of likely negative impacts visual impacts.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Consider the landscape character and the visual impacts of the drill sites and any other operational sites from all relevant viewing angles, particularly from public roads / community settlements / villages. 2. Always use the existing roads, tracks, paths, disturbed cleared fields / areas for creation of new access, drill sites, or any other operational sites such as a borrow pit 3. Always use vegetation screening when selecting a drill site or any other operational sites such as a borrow pit. 4. DO NOT cut down vegetation unnecessary around the drill site, any other operational sites such as a borrow pit and use it for site screening as may be applicable. 5. Avoid the use of very high fencing around the drill sites. 6. Minimise the creation or widening of access roads and no off-road that could result in land scarring. 7. Minimise the presence of secondary structures: remove inoperative support structures. 8. Littering at drill site or any other operational sites such as a borrow pit or nay place within the license area is strictly prohibited 9. Remove all infrastructure and reclaim, or rehabilitate and clean the any other operational sites such as a borrow pit on completion of the operations. **NOTE: All borrow pits belong to the traditional authorities and construction materials must be purchased from the relevant traditional authority having jurisdiction over a given borrow pit area and a purchase agreement must be signed before construction materials can be obtained from any given borrow pit in Kavango East and West Regions**	Preserve the landscape character in the development of supporting infrastructure and choice of visual screening	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.16: Management of likely negative impacts associated with the traffic and equipment movements and management.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Adhere to the site and national public roads speed limits. 2. Adhere to all the Road Authority Road restrictions requirements 3. Adhere site equipment / vehicles movement procedures and trip protocols / operational manuals. 4. Ensure safety of traffic movement, trip schedule should be advised for all scheduled heavy-duty vehicles, all drivers should be in possession of valid driver's licence, speed limits should be adhered to. 5. The use of traffic and safety warning signs and flag persons to warn and control traffic should be advised where required. 6. Always drivers and support teams shall be on a lookout for people on roads / tracks, wild animals, domestic animals, and other obstacles such as fallen trees	Management of any likely increase traffic and equipment movements around the drill site or any other operational sites such as a borrow pit	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.17: Management of likely negative impacts associated with equipment / vehicles noise, vibrations, emissions influence on air quality and Climate Change.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Drill site delivery of materials, consumables and equipment to sites shall be scheduled to avoid pick traffic hours around the public roads to minimise congestion 2. Always adhere to equipment / vehicles noise and other emissions management procedures 3. Adhere to the project buffer zones established for the drill site (300m) from the nearest village, school, clinic, or sensitive infrastructure as may be applicable. 4. Equipment / vehicles engines must be maintaining properly to minimise the noise emissions. 5. At drill site, use silent generators where available 6. Use noise screens if required 7. Neighbours shall be alerted of operations that are likely to produce excessive noise, vibrations, and other emissions 8. Personal Protective Equipment shall be used at all times. 9. Clean fuels such as Liquefied Petroleum Gas (LPG) and electric vehicles / equipment should be used. LPG is non-toxic, non-corrosive, and free of tetra-ethyl lead or additives, it burns more cleanly than petrol.	Minimise the noise, vibrations, and other emissions associated with the drilling equipment / vehicles movements	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.18: Management of likely negative impacts of dust and influence on air quality / health receiving environment.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
• Adhere to the site / public roads and as per Road Authority Road restrictions requirements speed limits. • Adhere to the drill site operations speed limit • Temporary measure: Use high pressure water dust control spray system with manual or automated, high frequency, light watering of materials to prevent dust lift off around the drill site. • Workers must always use Personal Protective Clothing / Equipment. • If there is excessive dust being generated along a specific road and affecting nearby villages / communities or sensitives environment or infrastructure likely to be negatively impacted, the use a water tanker to wet the specific section of road surface may be considered if the issue is evaluated to be causing severe negative impacts	Management of any likely site dust that may be generated around the drill site and other operational areas,	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.19: Management of likely negative impacts of operational spillages or fuel leaks.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
• Always adhere to site management procedures to prevent and manage spillages. 1. Ensure that drill site refuelling or maintenance is performed in a bunded area or while using a drip tray with a spill-kit available. 2. Refuelling areas shall be underlain with spill-proof hardstanding or bund, with spill kits readily available and operatives trained in their use only. 3. All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures. 4. All refuelling operations to be carefully overseen and managed by trained personnel. • Ensure that the integrity of any storage medium and its associated delivery point are inspected on a regular basis. • The personnel designated to receive deliveries of materials/fuel/ should receive practical training on how to prevent and respond to a spill • The designated personnel should also be aware of any potential areas in their vicinity that are at risk of contamination, such as fauna, flora, Ephemeral River Channels, or water supply borehole. • Clean up any site spillages and no spills shall be allowed to enter the environment / soak into the ground.	Spill management with respect to trucks, and earthmoving equipment	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.20: Management of likely negative impacts of waste (solid and liquid) generation.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Burial of waste on anywhere within the PEL area, AOI, drill site or nay other area of operations such as a borrow pit is prohibited and all generated solid waste shall be stored onsite, collected by Rend– A- Drum (Waste Management Contractor based in Rundu) and taken to a recycling facility in Rundu for sorting and processing. 2. French Drain / chemical toilet and ablution facilities shall be provided at the drill site and should not be located close to Ephemeral Rivers or water supply borehole. Once the onsite sewage system is full, it must be drained by waste management contractor (Rend-A-Drum based in Rundu) and taken to the Rundu Town Council sewage management facility 3. Provide site information on the difference between the two main types of waste with clearly marked containers for: • General Waste, and • Hazardous Waste. 4. Sealed containers, bins, drums, or bags for the different types of wastes shall be provided by the water management contractor. Never dispose hazardous waste in the bins or skips intended for general waste. 5. All solid and liquid wastes generated at all the operational areas shall be reduced, reused, or recycled to the maximum extent practicable. 6. Trash may not be burned or buried, except at approved sites under controlled conditions in accordance with the national and municipal regulations. 7. Never overfill any waste container, drum, bin, or bag. Inform your Contractor or the Environmental Control Officer / Site Manager if the containers, drums, bins, or skips are nearly full. 8. Never litter or throwaway any waste on the site, along any road. No illegal dumping. 9. Littering is prohibited. 10. Latrines and French drains built >100m from watercourses or pans to avoid pollution of primary and secondary aquifers. 11. Chemical toilets or suitable waste water management system shall be provided on site and around the camp as may be required. 12. A waste management plan documenting the waste strategy, storage (including facilities and locations), handling procedures and means of disposal should be developed and should include a clear waste-tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location in compliance with the national and municipal regulations.	Promotion of effective waste (solid and liquid) management through the adoption of sound and hierarchical approach to waste management, which would include waste minimisation, re-use, recovery, recycling, treatment, and proper disposal.	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.21: Management of likely negative impacts of major accidental / emergency scenarios.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. REN to prepare an Emergency Response Plan (ERP) approved by MME 2. REN to prepare Oil Spill Contingency Plan (OSCP) approved by MME 3. REN to provide resources for the implementation and monitoring of both the ERP and OSCP 4. REN to provide for ERP and OSCP response organisational and operational structures covering the following: ○ ERP and OSCP organisation and duties ○ Procedures for the notification and reporting of an emergency including large oil / chemical spills ○ Contact details of all relevant organisations requiring notification of an emergency including tier 3 spill ○ Emergency response strategies and oil spill clean-up guidelines for most probable and worst-case emergency /spill scenarios ○ Procedures for clean-up during the alert and action phase ○ Environmental sensitivity information such as villages, water supply, protected areas and resources in the vicinity of the well location ○ Available resources / facilities for an emergency / spill response.	Management of operational emergencies such as a major oil or fire	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.22: Management of likely negative impacts of drilled sites rehabilitation, restoration, and closure management plan.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. Following project approval, a detailed rehabilitation, restoration, and closure management plan shall be developed. The administrative considerations shall include: roles and responsibilities, training, specification of success criteria, reporting and review, audit, adaptive management and financial provisioning. 2. The following summary of the general rehabilitation actions are practiced: (i) Rehabilitate all drill site scars such as cutting pit and other site excavations. (ii) Litter from the site shall all be collected by the contractor. (iii) Debris, scrap metal, etc shall be removed before moving to a new site or closure of the operations. (iv) Water tanks are dismantled and removed if not need for after use. (v) Tracks on site and the access road are rehabilitated by smoothing the 'middle mannetjie' (middle ridge between the tracks) and raking the surface. 3. The following should be undertaken at all disturbed areas that require further rehabilitation (i) If applicable the stockpiled subsoil to be replaced (spread) and/or the site is neatly contoured to establish effective wind supported landscape patterns, and. (ii) Replace the stored topsoil seed bank layer. 4. Drilling sites rehabilitation and restoration activities specific to the reserve pit closure: (i) Creation of the storm water erosion and sediment control. (ii) Cuttings and all the solid remains after the evaporation of the water including site walls liners removed before site backfilling with the original material stockpiled onsite. (iii) Surface soil contamination cleaned and removed from site and disposed off at Rundu Solid Waste Disposal facility. (iv) Reserve pit filled / backfilled with native materials and restored as close to the original contours as possible, and. (v) Surface of the pit closure been graded to prevent future water accumulation in line with the planned after use of the area. 5. The following is the summary of the key specific rehabilitation approaches to be adopted for both the industrial and domestic waste water management areas: (i) Industrial waste water management facilities covering the reserve-pit and supporting pipes shall be rehabilitated by first allowing the waste water to evaporate and removing and stockpiling the remaining solids to be used for soil conditioning purposes for the ongoing community gardens and nursery projects. The reserve pit area shall be backfilled with the original soil that was removed and stockpiled on site for the rehabilitation purposes, and. (ii) Domestic waste water infrastructure such as the holding tanks and pipes shall be removed by the wastewater management Contractor.	Contributions toward environmental preservation and sustainability through rehabilitation of all disturbed areas such as drill site, access, and all other operational areas such as borrow pit and remove all unwanted part of the fixtures and restore the sites to close an approximation of the pristine state, after use / closure plan as is technically, environmentally, financially, and reasonably possible.	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.23: Management of likely negative impacts and environment performance monitoring indicators linked to the closure, rehabilitation and restoration of the proposed D1-D6 and G1-G6 exploration and appraisal wells sites inclusive supporting infrastructures such as access roads and borrow pits and site handover to the original land owner.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
1. The following is summary of the key environment performance monitoring indicators linked to the closure, rehabilitation and restoration of the proposed D1-D6 and G1-G6 exploration and appraisal wells sites inclusive supporting infrastructures such as access roads and borrow pits: (i) Ensure that disturbed areas are to be rehabilitated as close as reasonably practicable to their pre-disturbance condition or otherwise as agreed with the landholder. (ii) Ensure a final landform is produced that is safe, stable and non-polluting, as well as free draining and compatible with the post construction phase land use. (iii) Ensure topsoil and subsoil are managed to conserve the seedbank, nutrients, and to encourage the establishment of proposed revegetation. (iv) Ensure that rehabilitation works comply with and are undertaken as per relevant regulatory requirements from MME and MEFT. (v) Establish a set of indicators and a rehabilitation monitoring program to ensure successful rehabilitation. (vi) Establish agreed criteria where rehabilitation is deemed successful by relevant authorities and key stakeholders. 2. Implement a monitoring programme consisting of an initial two-year maintenance and establishment period will be implemented at the conclusion of the rehabilitation and restoration works. 3. Monitoring programme shall track the progress of the above performance indicators. At the conclusion of the two-year maintenance and establishment period, the need for a further monitoring period shall be assessed, the duration of which shall be determined at that time. 4. If required, the further two-year monitoring period shall track the continuing progress of the performance indicators to ensure a positive trend, until the completion criteria are met as agreed with the regulators, traditional authority, landowner or local communities.	Contributions toward environmental preservation and sustainability through rehabilitation of all disturbed areas such as drill site, access, and all other operational areas such as borrow pit and remove all unwanted part of the fixtures and restore the sites to close an approximation of the pristine state, after use / closure plan as is technically, environmentally, financially, and reasonably possible.	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.24: Management and consideration of the drill sites restoration options in consultation with the local community, village development committees, community headperson (foreman/forewoman), traditional authority and local councillor representing the regional council.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
The rehabilitation of each of the operational site shall focus on establishing common local community facilities that can support local community social activities such as meetings and local business / market areas. Each of the drilling sites will be equipped with supporting infrastructure such as road access, water supply boreholes and sanitation facilities. The following is the summary of the examples of the local community site usages that shall be evaluated and implemented in consultation with the local community, Village Development Committees, Community Headperson (Foreman/Forewoman), Traditional Authority and Local Councillor representing the Regional Council: (i) Common local community meeting and market centre to be equipped with a simple shade structure made up of zinc sheets and steel upright poles. (ii) Handling pen / facilities for cattle and small stock to be equipped with handling facilities such as loading ramp, dip, scale, neck clamp, calf crush and other associated facilities as may be necessary and requested by the community. (iii) Sanitation facilities. (iv) Community garden and nursery centre. (v) Other facilities as may be applicable and / or requested by the local community.	Establishment of sustainable local community livelihoods and social activities facilities centred / anchored on the availability of water supply and initiated ESG projects initiatives.	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

Table 3.25: Management, monitoring and monthly, bi-annual and annual compliance performance monitoring reporting of the overall likely positive and negative impacts of the proposed project activities.

MITIGATION MEASURES	OBJECTIVE	SCHEDULE	RESPONSIBILITY
Prepare monthly, bi-annual and annual compliance performance monitoring reports for the following permits, authorisations and consents with respect to the proposed drilling of the Well Sites Nos. D1-D6 and G1-G6 as they may be permitted. 1. Environmental Clearance Certificate (ECC) issued by the Environmental Commissioner in the Ministry of Environment, Forestry and Tourism (MEFT) 2. Freshwater Abstraction Permit issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 3. Waste Water Discharge Permit issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 4. Water Borehole Drilling Permits issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 5. Exploration and appraisal well drilling permit for drilling through a groundwater aquifer issued by the Department of Water Affairs (DWA), Ministry of Agriculture, Water and Land Reform (MAWLR) 6. Oil and Gas Well Drilling Permit / Consent / Permit to Drill with Basis for Well Design issued by the Ministry of Mines and Energy (MME) – Office of the Petroleum Commissioner 7. Oil Spill Contingency Plan (OSCP) approved by the Ministry of Mines and Energy (MME) – Office of the Petroleum Commissioner 8. Emergency Response Plan (ERP) approved by the Ministry of Mines and Energy (MME) – Office of the Petroleum Commissioner 9. Radioactive Authorisation (Import, Storage, Transport, Use and Export Permits) of radioactive sources for logging and authorisation issued by the National Radiation Protection Authority (NRPA), Ministry of Health and Social Services (MHSS) 10. Explosive Permit (Import, Storage, Transport, Use and Export Permits) of Explosives equipment in drilling (Downhole equipment recovery) and well testing (Perforating steel casing, cement and formation rock) stages issued by the Inspector General Explosive Control Division Namibian Police Force, Ministry of Home Affairs, Immigration, Safety and Security 11. Surface user rights consent, endorsement, leasehold or permission to occupy (PTO) form the land owner, headperson, Chief's Council, Traditional Authority, Regional Land Boards and Regional Councils as may be applicable.	Collect data that will add value to the ESG programme, environmental monitoring process and reporting to the regulators as well as general scientific and geographic knowledge of the environment in which the exploration process is taking place.	1. Permitting and planning 2. Site preparation, preconstruction and construction stages 3. Spudding, drilling, logging / well testing, casing, and cementing process to Total Depth (TD) 4. Well testing, drilling completion, well plug / seal of porous horizons and abandon hole / re-enter for side tracking / well testing 5. Rehabilitation, site closure, restoration, and handover to community / land owner	1. Proponent's Representative (PR) 2. Project Manager (PM) 3. Project HSE 4. Wildlife Monitoring Specialist 5. Environmental Social Governance (ESG) Coordinator 6. EMP Coordinator 7. Contractors Subcontractors

3.4 REN Operational Best Practices Summary

3.4.1 Best Practices: Environment, Social & Corporate Governance (ESG)

REN Corporate Social Responsibility (CSR) policy is designed to ensure that the company conduct its business activities responsibly and aligns its operations with the expectations of communities, governments, and other stakeholders. The Environmental, Social and Governance (ESG) criteria provide a basis for measuring the corporate performance against the highest global standards. The ESG Best Practices as detailed in Annex 1 covers the following components:

(i) Environmental protection.

(ii) Our health and safety commitment.

(iii) Local economic development.

(iv) Community outreach, and.

(v) Consultation and engagement.

3.4.2 Best Practices: Exploratory Drilling

REN is licensed to under oil and gas exploration operations in the Kavango Sedimentary Basin and the company is using proven, safe, effective technologies and applying rigorous safety and environmental protection standards in all aspects of drilling operations in Namibia. This means the company is committed to protecting wildlife, aquifers, and watercourses by implementing best practices in drilling operations covering the following key areas as presented in the Annex 2 exploration drilling best practices:

(i) Exploratory drilling sites not located near migratory routes nor any other area that would adversely impact wildlife. The current multiple stratigraphic drilling sites are located approximately 40 km from the boundary of the Khaudum National Park, 55 km south of Rundu, 50 km south of the Kavango River, and about 260 km from the Okavango Delta in Botswana. Additionally, the project has set no-go buffer zones to protect the environment.

(ii) REN using the Crown 750 conventional drilling rig rated to drill up to approximately 3,960 metres (13,000 feet) and has been outfitted with a best-in-class top-drive system (for better drilling rates) and additional equipment to ensure safe operations in the Kalahari Desert

(iii) Drilling and casing the well with multiple layers of cement and steel casing to provide for structural integrity necessary to prevent fluids from escaping the well walls, and.

(iv) Use of conventional 100% organic drilling fluid system used to cool the drill bit and carry the rock cuttings to the surface. This system incorporates the latest biodegradable water-based technologies for both safe drilling and surface/subsurface environmental protection. This system is the most expensive of water-based approaches.

3.4.3 Best Practices: Water-Based Drilling Fluid Systems

REN brings the latest, most effective technologies to its projects, including an engineered organic and biodegradable water-based drilling fluid systems that minimise environmental impacts. The company has intentionally avoided less technically advanced drilling fluids systems that present environmental challenges during the reclamation phase. The water-based system is tested, proven safe, and environmentally sound. The system is approved for use by the most stringent regulatory regimes for projects around the world, from national oil companies to private operators. It is also the most expensive system to implement.

The water-based drilling fluid systems best practices as detailed in Annex 3 is based on system design that includes the following three main components.

(i) Fluid system: Drilling fluid systems generally fall into two categories: oil based and water based. ReconAfrica is using the best and most expensive approach available to protect the environment – a water-based system. This Polyamine/ Polymer/PHPA system uses freshwater as the base fluid. The plant-based products added to the base fluid are created through organic processes and are biodegradable.

(ii) Circulating system: The circulating system is part of the Crown 750 conventional drilling rig that is being used by REN in exploratory drilling operations. The system includes the drilling fluid pumps, distribution lines, separators and solids control. To further enhance safety, REN augmented the original two mud pumps on the rig with a third, more powerful pump, and.

(iii) Reserve Pit: The reserve pit is adjacent to the drilling rig and, along with storage tanks, is where the excess fluids and cuttings are managed. Like most oil and gas wells, the rocks being drilled through for the three exploratory wells are environmentally benign and any fluids encountered while drilling stay in the formation due to the equivalent circulating density of the drilling fluid system. The cuttings from the well are also being captured and bagged, with half of the cuttings set aside for the Namibian government for future study. REN is having the cuttings analysed by international and nationally-based environmentally focused laboratories. An organic gel/clay barrier at the pit base prevents seepage into groundwater and soils. This approach is better than polyurethane pit linings, which are easy to install but challenging to remove during reclamation, which can lead to shredding and leaks.

3.4.4 Best Practices: Water

REN is committed to protecting the environment, avoiding environmentally sensitive areas and minimising impacts and disturbances. That includes protecting the water resources of Kavango East and Werst Regions and contributing to access to potable drinking water capacity to help improve livelihoods for rural communities.

REN is implementing the most advanced drilling practices available to protect the environment above and below the surface. The company is avoiding ecologically sensitive and national preserve areas – and working collaboratively with government, using the company's drilling expertise to provide potable water from the region's considerable aquifer systems. REN best practices on water are centred on the following (Annex 4):

(i) Water-management plan.

(ii) Technology to protect aquifers and surface water.

(iii) A 100% organic drilling fluid system.

(iv) Avoiding waterbodies and Ephemeral Rivers that may be linked to the Okavango River which eventually ends-up in the Okavango Delta, and.

(v) Technology and expertise bringing access to water for rural communities of Kavango West and East Regions.

3.4.5 Best Practices: Wildlife, Flora, and Habitats

REN is committed to sustainable development and employs industry best practices wherever it operates to protect the environment, including policies and protocols to support wildlife, flora, and habitats conservation efforts in Namibia (Annex 5). REN is committed to protecting the region's wildlife, flora, and habitats and as part of this commitment, the company is implementing the most advanced drilling practices available. Ecologically sensitive areas, migratory routes and national preserve areas are all been excluded from the ongoing petroleum exploration operation in the Kavango Sedimentary Basin.
Furthermore, the company is working closely with local communities, businesses, tourism, government authorities and multi-national African conservation groups to protect wildlife, flora, and habitats. The

company has also appointed a team of environmental experts including a wildlife monitoring experts dedicated to working with the local communities and all other stakeholders.

3.5 General Awareness and Training Guidance

3.5.1 Overview

The following is the summary of the general awareness and training guidance materials with respect to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73:

1. General mitigation guidance.
2. Natural environmental management guidance.
3. Vehicle use and access guidance.
4. Control of gust guidance.
5. Health and safety guidance.
6. Preventing pollution and dangerous working conditions guidance.
7. Saving water guidance.
8. Disposal of waste guidance.
9. Religious, cultural, historical, and archaeological objects guidance.
10. Dealing with environmental complaints guidance.

3.5.2 General Mitigation Guidance

Based on the Environmental Assessment undertaken, the following is the summary of the general mitigation measures in terms of applicability of the EMP, disciplinary process, meaning of environment and procedures if one does not understand the provisions of the this EMP:

(i) The Environmental Rules apply to everybody. This includes all permanent, contract, or temporary workers as well as any other person who visits the operations base. Any person who visits the operations base will be required to adhere to the company Environmental Code of Conduct.

(ii) The Site Manager will issue warnings and will discipline any person who breaks anyone of the environmental rules and procedures. Repeated and continued breaking of the Rules and Procedures will result in a disciplinary hearing and which may result in that person being asked to leave the site permanently.

(iii) The environment means the whole surroundings around us. The environment is made-up of the soil, water, air, plants, and animals. and those characteristics of the soil, water, air, plant, and animal life that influence human health and wellbeing.

(iv) If any member of the work force does not understand, or does not know how to keep any of environmental rule or procedure, that person must seek advice from the Environmental Control Officer (ECO), Site Manager or Contractor. The person that does not understand must keep asking until she/he is able to keep to the all the Environmental Rules and Procedures.

3.5.3 Natural Environmental Management Guidance

1. Never feed, tease, or play with, hunt, kill, destroy, or set devices to trap any wild animal (including birds, reptiles, and mammals), livestock or pets. Do not bring any wild animal or pet to the area.

2. Do not pick any plant or take any animal out of the areas. You will be prosecuted and asked to leave the project area.

3. Never leave rubbish where it will attract animals, birds, or insects. Rubbish must be thrown into the correct rubbish bins or bags provided.

4. Protect the surface material by not driving over it unnecessarily.

5. Do not drive over sensitive habitats for plants and animals.

6. Do not cut down any part of living trees / bushes for firewood.

7. Do not destroy bird nest, dens, animals borrow pits, termite hills etc or any other natural objects in the area.

3.5.4 Vehicle Use and Access Guidance

1. Never drive any vehicle without a valid licence for that vehicle and do not drive any vehicle that appears not to be road-worthy.

2. Never drive any vehicle when under the influence of alcohol or drugs.

3. Do Not make any new routes or roads without permission. Stay within permitted routes.

4. Avoid U-Turns and large turning circles. 3-point turns are encouraged. Do not ever drive in communal fields / ephemeral rivers, stick to the existing roads.

5. Stay on the road, do not make a second set of tracks and do not cut corners.

6. Do Not Speed - keep to 30 km per hour around the operational areas.

7. No off-road driving is allowed.

8. Vehicles may only drive on demarcated roads.

9. Adhere to speed limits and drive with headlights switched at all times.

3.5.5 Control of Dust Guidance

1. Do not make new roads or clear any vegetation unless instructed to do so by your Contractor or the Environmental Control Officer / Site Manager.

2. Try to disturb the surface of the natural landscape as little as possible.

3.5.6 Health and Safety Guidance

1. Drink lots of water every day, but only from the fresh water supplies.

2. Take the necessary precautions to avoid contracting the HIV/AIDS virus or COVID-19.

3. Only enter or exit the operations area at the demarcated areas.

4. Always keep the access area as you found them.

5. Any damage to any existing infrastructure in the area must be report to the Environmental Control Officer / Project Manager who will then inform the owner of any damage with all the repairs done to the satisfaction of the owner or Environmental Control Officer.

6. Never enter any area that is out of bounds, or demarcated as dangerous or wander off without informing or permission of team leader.

7. Report to your Contractor or the Site Manager if you see a stranger or unauthorised person in the operations areas.

8. Do not remove any vehicle, machinery, equipment, or any other object from the operations areas /sites without permission of your Contractor or the Site Manager.

9. Wear protective clothing and equipment required and according to instructions from your Contractor or the Site Manager.

10. Never enter or work in the operations areas when under the influence of alcohol or drugs.

3.5.7 Preventing Pollution and Dangerous Working Conditions Guidance

1. Never throw any hazardous substance such as fuel, oil, solvents, etc. into streams or onto the ground.

2. Never allow any hazardous substance to soak into the soil.

3. Immediately tell your Contractor or Environmental Control Officer / Site Manager when you spill, or notice any hazardous substance being spilled anywhere in the operations areas.

4. Report to your Contractor or Environmental Control Officer / Site Manager when you notice any container, which may hold a hazardous substance, overflow, leak, or drip.

5. Immediately report to your Contractor or Environmental Control Officer / Site Manager when you notice overflowing problems or unhygienic conditions at the ablution facilities.

6. Vehicles, equipment and machinery, containers and other surfaces shall be washed at areas designated by the Contractor or Environmental Control Officer/ Site Manager.

7. If you are not sure how to transport, use, store or dispose any hazardous substance - Ask your Contractor or Environmental Control Officer / Site Manager for advice.

3.5.8 Saving Water Guidance

1. Always use as little water as possible. Reduce, reuse and re-cycle water where possible.

2. Report any dripping or leaking taps and pipes to your Contractor or Environmental Control Officer or Site Manager.

3. Never leave taps running. Close taps after you have finished using them.

3.5.9 Waste Management (Solid and Liquid Waste)

1. All generated solid waste must be disposed at the local municipal waste disposal site.

2. Use toilets and ablution facilities provided on site.

3. Learn to know the difference between the two main types of waste, namely:

- General Waste. and
- Hazardous Waste.

4. Learn how to identify the containers, bins, drums, or bags for the different types of wastes. Never dispose of hazardous waste in the bins or skips intended for general waste or rubble / contaminated soil.

5. Never burn or bury any waste around the operations areas.

6. Never overfill any waste container, drum, bin, or bag. Inform your Contractor or the Environmental Control Officer / Site Manager if the containers, drums, bins, or skips are nearly full.

7. Never litter or throwaway any waste on the site, in the field or along any road. No illegal dumping.

8. Littering is prohibited.

3.5.10 Religious, Cultural, Historical and Archaeological Objects Guidance

1. If you find any suspected religious, cultural, historical, or archeologically object or site around the operations areas, you must immediately notify your Contractor or Environmental Control Officer **/** Site Manager.

2. Never remove, destroy, interfere with, or disturb any religious, cultural, historical, or archaeological object or site around the operations areas.

3.5.11 Dealing with Environmental Complaints Guidance

1. If you have any complaint about dangerous working conditions or potential pollution to the environment, immediately report this to your Contractor or the Environmental Control Officer **/** Site Manager.

2. If any person complains to you about vibrations, dust, noise, lights, littering, pollution, or any other harmful or dangerous condition, immediately report this to your Contractor or the Environmental Control Officer / the Site Manager.

4. ERP, OSCP, MONITORING AND REHABILITATION

4.1 Emergency Response Plan (ERP)

REN has prepared a separate Emergency Response Plan (ERP) document approved by MME and contains basic information on the key locations and facilities with respect to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73. The ERP document has been prepared in accordance with the provisions of the Petroleum (Exploration and Production) Act, 1991 (Act 2 of 1991). The purpose of the ERP is:

- To define tasks this should be carried out in an emergency together with adequate guidance on priorities.
- To establish the assignment of such tasks and the appropriate delegation of authority, and.
- To establish communication lines ensuring efficient response to and control of an emergency.

The ERP document is linked to project specific Bridging Documentations and for cases where lead or major emergency response role (‘Primacy’) resides with a contractor and in these cases Reconnaissance Energy Namibia will act in support to the contractor.

The following is the summary of the key operational areas that may be associated with an emergency event detailed in the ERP:

- Drilling locations operational area.
- Rundu Operations base, and.
- Logistic route between Rundu and the drilling location.

The drilling rig is the principal installation of this project and shall met the technical performance and environmental standards required by REN and Government regulations. The rig, Rundu Operations Base or the logistic route will implement, in case of emergency, the ERP actions for emergency event control and containment / recovery as may be applicable.

The emergency response facilities including staff rooms that will be based at each of the drilling locations and the Rundu operations base shall have a detailed site plan layout and rig components including the following:

- Clear site layout with marked storage facilities and list type of materials stored in each area in terms of the hazard rating.
- List of inventories drilling supplies including lifesaving equipment.
- Drilling programme and well designs.
- Forms and check lists.
- Emergence Response documents.
- Clear outline of the emergency reporting and communication procedures.
- This Environmental Management Plan (EMP) and Environmental Impact Assessment (EIA) and reports with copies of all permits, certifications, authorisations, endorsements, and consents covering the drilling operations.
- List of the type of communication systems.
- Computers / Laptops/ printers, and.

- Telephone lists and directories.

The following is the summary of Emergency scenarios that have been covered in the ERP document:

- Explosion or fire.
- Hydrocarbon or chemical release.
- Well control incident.
- Riser / Pipeline Incident.
- Medical Emergency.
- Installation abandonment.
- Notification of fatality.
- Aircraft Accident.
- Road accident Windhoek to Rundu or Rundu to drilling site.
- Person / Vehicle Overdue.
- Natural disaster.
- Non-Governmental Organisation (NGO) activities / demonstrations.
- Serious crime.
- Arrest of employee.
- Kidnap, ransom, extortion.
- Bomb threat.
- Civil unrest, and.
- Country evacuation.

4.2 Oil Spill Contingency Plan (OSCP)

4.2.1 Scope and Purpose of the OSCP

In accordance with the provisions of the Petroleum (Exploration and Production) Act, 1991 (Act 2 of 1991, REN has prepared a separate Oil Spill Contingency Plan (OSCP) document approved by MME. The OSCP provides for hydrocarbon spills arising from the drilling activities of a single drilling rig within the AOI in PEL No. 73. The OSCP also provides for other potential oil spills associated with a fuelling tanker truck overturning between Rundu and the drilling location.

The OSCP document establishes and defines information, strategies, procedures, and the structure for responding to emergencies involving oil spills, with the purpose to stop or minimise any accidental discharge of hydrocarbons, and to mitigate negative effects. The OSCP is applicable to any oil spill scenarios involving Reconnaissance Energy Namibia and its contractors, including the drilling rig, and all other companies working on the Kavango Basin onshore drilling campaign in Namibia.

Oil spill prevention is built on well engineering and well primary and secondary control measures. Primary well control measures such as hydrostatic pressure and secondary measures such as the use of Blow-Out Preventers (BOPs) include several preventative dual barriers between the well and the external environment to avoid a loss of well control, with several elements included to ensure a robust series of primary and secondary barriers. Tertiary well control is applied in the highly unlikely situation in which all primary and secondary barriers fail sequentially.

4.2.2 Well Assurance

REN will implement a series of strict internal and external well engineering and construction assurance mechanisms. A basis of well design will be prepared and approved by MME prior to the spudding of each of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 as part of the well assurance requirements. Well assurance includes the technical well design, which is engineered to the highest industry standards and verified by an independent external expert well examiner. The well is designed to substantially exceed the maximum anticipated formation pressures which could be expected to be encountered. In addition, procedures and management systems are put in place to ensure responsibilities and management is clear throughout the drilling activities in response to an oil spill and as per the provisions of the OSCP.

4.2.3 Primary Well Control

The primary well control barrier is provided by the weight of the drilling fluid column (or hydrostatic pressure) inside the wellbore. This barrier is maintained by keeping a wellbore fluid column with a higher pressure inside the wellbore than the pressure in the formations penetrated by the wellbore. Weighting agents are added to the drilling fluid to increase the density of the fluid inside the wellbore when required, and subsequently maintain a higher fluid (hydrostatic) pressure.

A number of Loss Control Materials (LCM) materials will be retained onsite for use in the event that hazards (predominantly associated with downhole mud losses and borehole stability issues) are encountered during drilling. Under some circumstances the mud weight required to stabilise the borehole can effectively fracture the rock and result in downhole drilling fluid losses into the underground formations. When this occurs Loss Control Materials (LCM) can be added to the mud system to help reduce the loss rate.

4.2.4 Secondary Well Control

The drill rig will be equipped with the Blow-Out Preventer (BOP) as shown in Fig. 4.1 with key components shown in Plate 4.1. The BOP is fully suitable for drilling of drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73. This key equipment will provide the secondary well control barrier. The annular preventers can be closed and will seal on any size of drilling tool passing through it and the pipe rams are designed to seal on drill pipe of a variety of sizes.

The shear rams will shear drill pipe and casing respectively. The BOP is pressure tested prior to well deployment and routinely re-tested after installation with no longer than 21 days between tests (as per API Recommended Practice S53: Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells).

If the primary fluid barrier fails and it is observed that the well is flowing, an Annular Preventer and a set of BOP rams will be manually functioned to close in the well and stop any further flowing of the well, thereby regaining control. Under such circumstances the well is said to have “kicked.” It would be expected that after closing in a “kick,” pressure would build up below the BOP. The magnitude of the pressure provides an accurate indication of the pressure of the formation fluid that is present in the rock that has been drilled.

In the event of a kick, after closing the well in, it is necessary to circulate out any formation fluid that has entered the wellbore in a controlled manner, whilst keeping the BOP closed. To do this the contents of the well will be circulated by pumping fresh drilling fluid down the drill string. Once all the influx is out of the well, circulation will continue with drilling fluid which has been increased in density until this new mud has returned to the surface and the well is full of the new denser fluid. With that stage completed equilibrium is once again reached with the hydrostatic pressure within the well bore exceeding the pressure of the formation fluid present in the pore spaces within the rock. That way the well is once again said to be overbalanced and under primary control. At that point the BOP can then be opened and drilling resumed.

The BOP control system uses hydraulic operating fluids to actuate the BOP valves, which is largely comprised of water, with a small quantity of a biodegradable additive (1-5% by volume) that prevents bacterial growth and improves lubricity.

4.2.5 Tertiary Well Control

Tertiary well control describes the third line of defence, where the formation cannot be controlled by the primary or secondary well controls described above. The following are some examples of methods of applying tertiary well control:

- Drill a relief well to intercept the flowing well and kill it with heavy mud.
- Rapid pumping of heavy mud to control the well with equivalent circulating density – termed a dynamic kill.
- Pump barite or heavy weighting agents to plug the wellbore to stop flowing.
- Pump cement to plug the wellbore, and.
- Deployment of a capping stack and containment systems.

REN will have contingency plans in place prior to implementation of the drilling to allow execution of any of the above methods of tertiary well control to be implemented in case of the unlikely event that both primary and secondary well controls are lost.

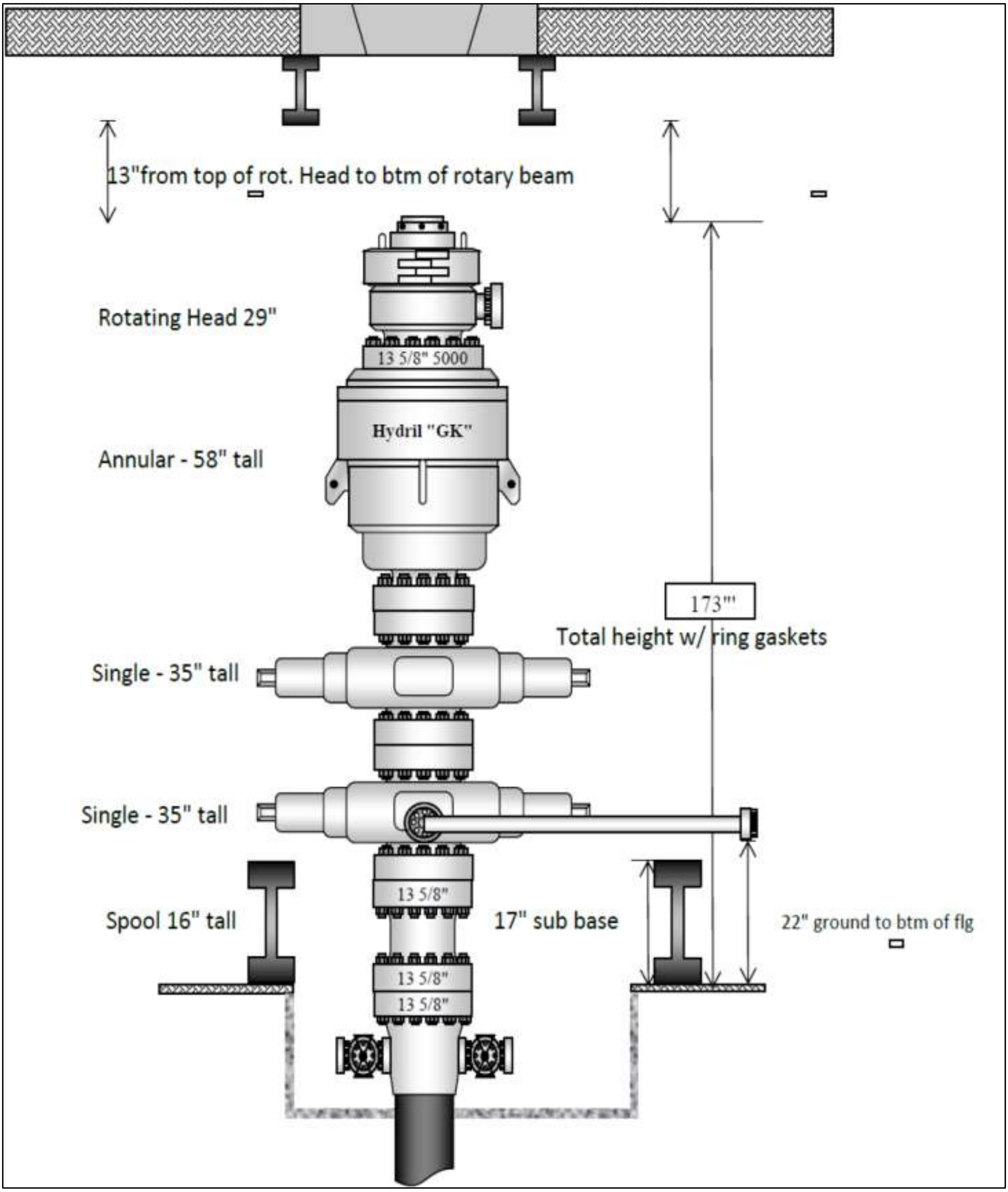


Figure 4.1: BOP stack used in the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 (Source: REN, 2021).

Plate 4.1: BOP stack used in the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73.

4.3 Emergency Response and Oil Spill Organisational Structure

4.3.1 REN Strategic Reporting Procedure to the Government

REN shall ensure that the relevant Namibian authorities are notified of an emergency associated with the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73. The notification chain is as-per the diagram shown in Fig. 4.2.

In the event of an emergency, the Managing Director or the member of the Command Staff designated for this purpose, shall contact the Petroleum Commissioner in the Ministry of Mines and Energy (MME) and notify him / her that such an event has occurred and at the same time liaise with the other elements of the Namibian and external authorities (Fig. 4.2). The Petroleum Commissioner shall notify and liaise with all key Government Ministries and Emergency Response Coordinator.

Notification of the Namibian authorities, specifically the Ministry of Mines and Energy (MME), Ministry of Environment, Forestry and Tourism (MEFT), Ministry of Agriculture, Water and Land Reform (MAWLR), Namcor and Kavango West and East Regions Governors is the responsibility of the REN Managing Director / delegate based in Windhoek, Namibia under direction of the Incident Commander / Project Manager heading the Emergency Management Team (EMT) in Namibia as shown in Fig. 4.3.

If a press release or other media statement is to be made, the Incident Commander will prepare a draft statement and agree to its contents prior to forwarding it to the Duty Manager to get approval. After approval from External Communications part of the Crisis Management Team in Canada, the statement could be simultaneously released in Namibia and Canada for release to the international media, if the gravity of the situation is such that a worldwide release is necessary.

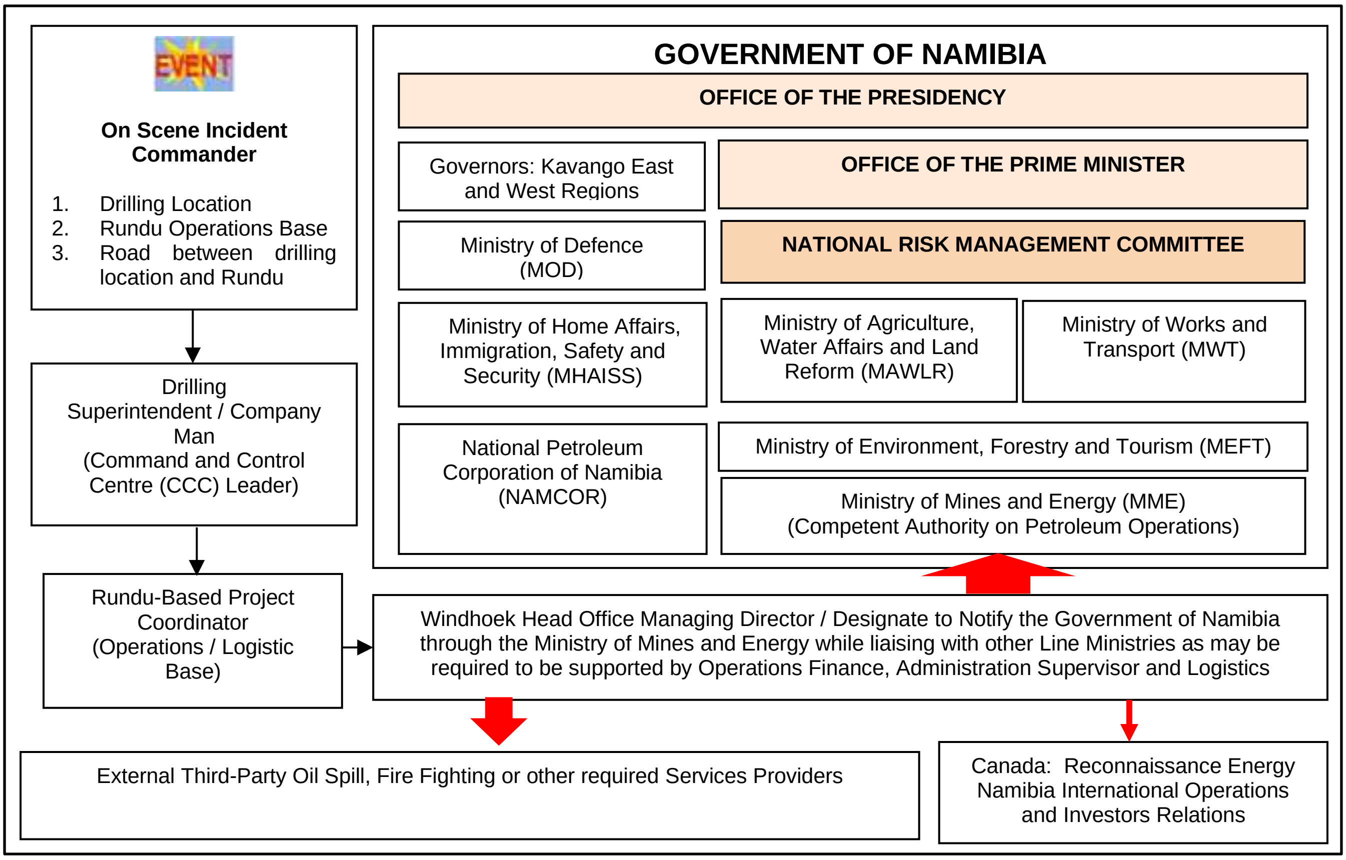


Figure 4.2: REN oil spill and emergency response organisational response plan for the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73.

4.3.2 REN Emergency Response Structure

The REN emergency response structure including oil spill emergency response is outlined in Figs. 4.2-4.4 with detailed response level and appropriate management response provided in Fig. 4.5. In line with international best practise, Incident Command System (ICS) has been used to provide a basis for the response structure (Figs. 4.3 and 4.4). Under the leadership of the Incident Commander / project manager, the Emergency Management Team (EMT) in Namibia acts in a support capacity to the Tactical Response Team (TRT) on the ground.

It is the responsibility of the EMT to provide such personnel, resources, equipment and facilities as may be required by the TRT to bring the emergency under control or mitigate effects of the event. The EMT also undertakes a planning function, anticipating possible consequences or potential escalation of the event and then undertaking appropriate actions to control or otherwise mitigate these consequences.

The EMT acts as a key communications link in any response, passing and receiving information from both the TRT and Crisis Management Team (Figs. 4.3 and 4.4).

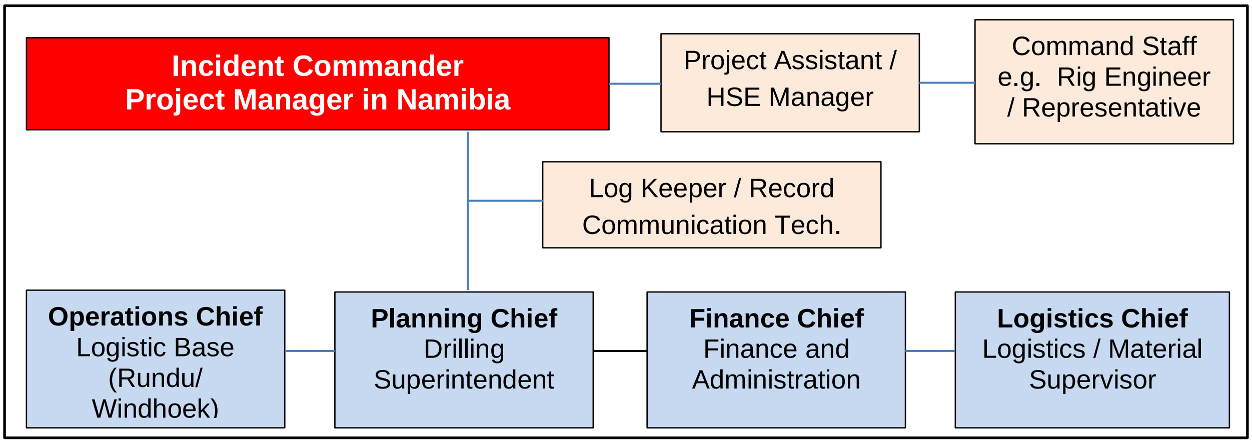


Figure 4.3: Basic structure and composition of Emergency Management Team (EMT) in Namibia.

The following is the summary functions of the Emergency Management Team (EMT) in Namibia headed by the Project Manager:

- Managing the top strategic level of the event.
- Making strategic emergency management decisions.
- Providing assistance when required by Tactical Response Team (TRT) on the ground.
- Additional source of support resources in emergency response, and.
- Acting as communication link receiving and sending information from and to Tactical Response Team.

The Crisis Management Team (CMT) under the leadership of the Crisis Management Team Leader (CEO of REN) in Canada, addresses the higher-level, strategic issues resulting from the event (Fig. 4.4). It also serves as an additional source of support in responding to the emergency, providing such assistance as may be requested by the EMT.

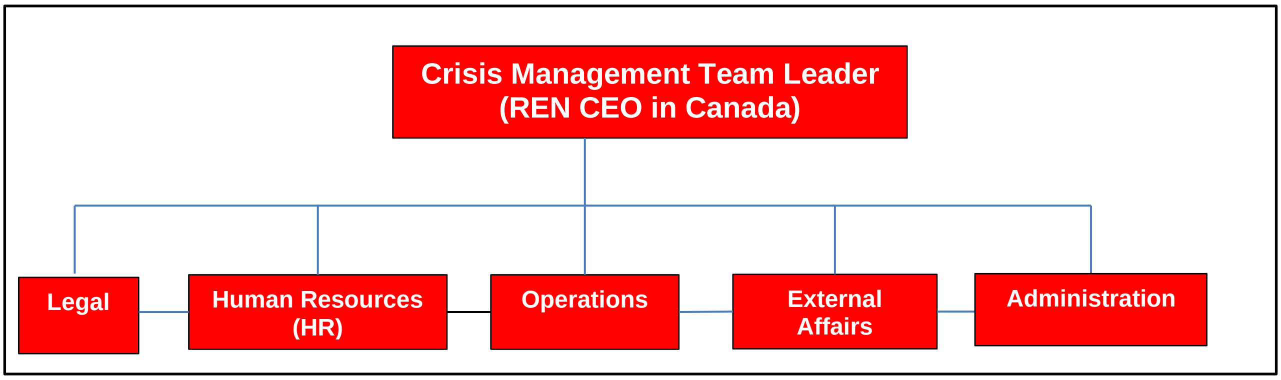


Figure 4.4: Basic structure and composition of Crisis Management Team (CMT) to be based in Canada.

Incident Command System (ICS) driven by the Emergency Management Team (EMT) in Namibia allows for a response organisation to be scaled up or down accordingly, reflecting the growing requirements from a Tier 1 to a Tier 3 response through to final demobilisation (Fig. 4.5). To achieve these objectives REN ERP involves the following three (3) levels of response as shown in Fig. 4.5:

- **LEVEL I** - **Operational Response**: Managed by the incident facility/site, using the resources available on site.

- **LEVEL II** - **Onshore Tactical Response**: Supporting the decisions and actions taken by the Level I response teams; and provide the additional resources needed for emergency control. The Emergency Management Team, are responsible for issues such as, persons on site reconciliation, contractor liaison, logistical support, information gathering for corporate public relations and initial statutory notifications etc, and.

- **LEVEL III – Onshore Strategic Response:** Supporting and monitoring the actions and effectiveness of the Level II Emergency Management Team, the Level III Crisis Management Team shall concentrate on the long-term strategic implications of the emergency. The legal and reputational issues created by the emergency, and long-term recovery issues.

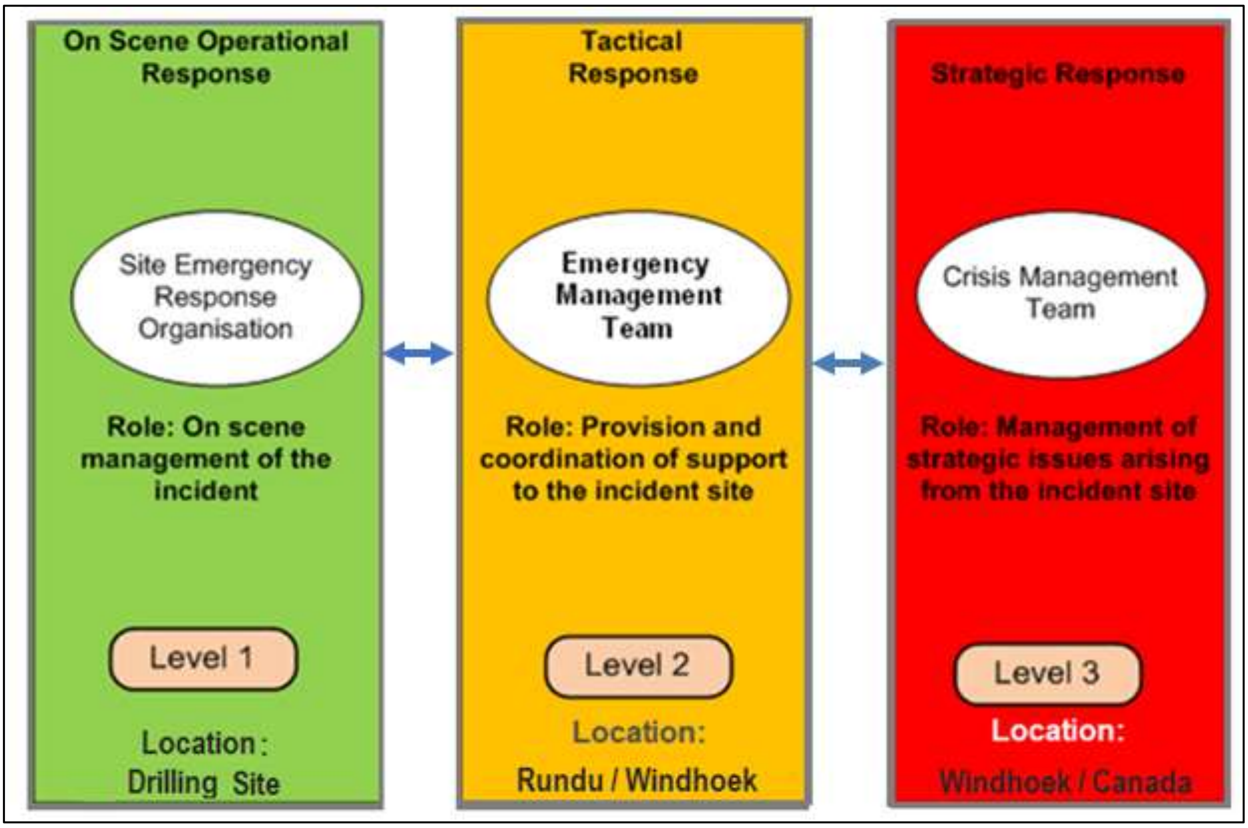


Figure 4.5: Detailed response level and appropriate management response.

4.4 Types of Events and Response Actions

4.4.1 Well Location Oil Spills

On being informed that an oil spill has occurred around the well location, the following oil spill response actions shall be activated:

- ❖ The person reporting oil spill, if aware of location of leakage and finds it controllable will shut the relevant valves.
- ❖ The responsible On-Site Commander shall notify the Company Man/ Project Manager.
- ❖ The On-Site Commander supported by the Health and Safety (HSE) Team shall ensure that all hot work in the nearby area is stopped and power cut off and the area is marked off by hazard tape, lights etc.
- ❖ If On-Site Commander observes that the oil spill could pose hazard to personnel or equipment, the Company Man should be informed and driller shall be instructed to secure the well as per standard operating practice. And spill control team shall be informed.
- ❖ The team shall ensure that upstream and downstream valves of the leakage are closed and the system depressurised.
- ❖ If the oil spill could pose hazards to personnel from poisonous or combustible gases, the area shall be evacuated by moving all personnel to the upwind assembly point.
- ❖ The spill control team shall construct temporary bund around the oil and use the available absorbent or equivalent quick clean up material to collect the spilled oil in the containers / if the quantity is very less.
- ❖ In case the quantity of oil is large; pump shall be used to collect the spilled oil and available absorbent used to collect the remaining spillage.
- ❖ In case the oil has spilled into land and spill control team shall remove the contaminated soil and collect the same in drums / container for disposal.
- ❖ The spill control procedure will be followed by the safe storage and final disposal of the absorbent / water if any generated during the process.
- ❖ HSE Officer shall record the incident in incident report, and.
- ❖ The HSE Team shall prepare incident report for submission to the Company Man who shall send the incident report to the Ministry of Mines and Energy through the Managing Director / delegated personnel as per the project notification channels.

4.4.2 D3425 Road, Rundu Operations Base or Well Location Diesel Spill

Once a spill has occurred either along the along the D3425, at Rundu Operations Base or at well location, the following response actions shall be activated:

- ❖ The tanker driver/ On-Site Commander shall notify the Company Man / HSE Team about the incident with respect to the following:
    - o Location of tanker.
    - o Nature of emergency (only spill or spill with fire).
    - o If there is any injury or fatality.

- Inform the worker / nearby inhabitant's roadside e/ villagers to move away from the tanker / spill area.

- The Company Man / HSE Team shall inform the nearest police station to ensure that the area is secured from external personnel, to carry out the spill control and for the safety of the other road / site users.

- Guards shall be posted to warn approaching vehicles until barriers and signs are erected. In the case of the presence of poisonous gases, guards and barriers must be placed at greater distances accounting for wind direction. Ensure that all sources of ignition are stopped.

- Personnel in the vicinity of the spill should be made aware that there may be hazardous situation. Possible dangers may include toxic gases, explosive or combustible gases, unstable structures, mechanical damage, threat to adjacent facilities and installations etc.

- Company Man / HSE Team shall provide the necessary equipment such as pumps, vacuum truck, crude tankers/ barrel, transporters, dump trucks piping barrier etc, to carry out spill control.

- The residual oil accumulated shall be pumped and collected in the crude tanks, absorbent or equivalent quick clean up material shall be used to absorb the surface oil spill and is collected in drums.

- The excavator is used to clear the soil and collected in dumper for proper disposal.

- The spill control procedure shall be followed for disposal of the absorbent / water if any generated during the process.

- The HSE Team shall prepare an incident report for submission to the Company Man who shall send the incident report to the Ministry of Mines and Energy through the Managing Director / delegated personnel as per the project notification channels.

4.4.3 D3425 Road, Rundu Operations Base or Well Location Chemical Spill

On being informed that a chemical spill has occurred along the D3425 Road, Rundu Operations Base or well location, the following response actions shall be activated:

- In the event of chemical spill that could be hazardous to personnel or equipment, the first person at site (On-Site Commander) shall inform the HSE Team and Company Man.

- The HSE Team and Company Man shall assemble the spill control team.

- The spill control team shall immediately identify the source of the chemical spill, type of chemical and quantity (volume).

- The spill area shall be separated and marked off by hazard tape or lights etc.

- Chemical spillage onto roads and vehicle access ways should be similarly marked off at a good distance and suitable position to allow for vehicles to slow down and stop as may be required.

- In case the chemical spill poses a hazard and may be poisonous or combustible gases, self-contained breathing apparatus, personal protective equipment must be in the process of containing the chemical spill.

- The procedure for chemical spill control shall be followed to mitigate the situation.

- If any of the crew personnel is injured, communication coordinator shall inform the medical officer so that the injured are given immediate first aid.

- The On-Site Commander shall provide the company man with information concerning the requirement of necessary equipment such as vacuum trucks, pumps, crude tanks, transporters, loaders, dump trucks, piping barriers etc.

- The on-site spill team shall isolate the source, basic containment of the chemical spill and remove any possible ignition sources.

- The On-Site Commander shall declare end of the emergency in consultation with the Company Man once:
    - The chemical spill has been removed from the site, and.
    - There is no immediate possibility of further chemical spillage

- The HSE Team shall prepare incident report for submission to the Company Man who shall send the incident report to the Ministry of Mines and Energy through the Managing Director / delegated personnel as per the project notification channels.

4.4.4 Oil Spill Alert, Notifications and Response

The summarised outline of the Government alert / notification procedures shown in Fig. 4.2 with detailed key notification focal points provided in Table 4.1. This structure should be applied to small or large-scale oil spill (Tier 1, 2 and 3) emergencies. Spill scenarios, risks, and response assessment guidance is provided in Table 4.2 with internal OSCP oil spill alert / notification procedures provided in Fig. 4.6.

Table 4.1: Detailed key notification focal points.

SPILL FOCAL POINT	NOTIFICATION TO	TELEPHONE
Spill Observer	A person who has responsibility of managing an incident (Onshore Installation Manager (OIM) / (REN Company Man)	On site at Drilling Location
Onshore Installation Manager (OIM) (REN Company Man) (Incident / On Site Commander)	**Drilling Superintendent and Command and Control Centre – Leader on Site**	
Command and Control Centre (CCC) on Site	**Command and Control Centre Members onsite, Rundu and Windhoek including Logistics and Finance**	Immediate notification followed by written report and regular updates Contact Details Contained in the Emergency Project Telephone Directorate
CCC Leader in Rundu	**Rundu and Windhoek HSE Department Headed by the Managing Director of REN**	
CCC Leader in Windhoek	Continue to Liaise with Onsite Commander and regular updates to the Windhoek HSE Department Headed by the Managing Director / delegate of REN	
Reconnaissance Energy Namibia Managing / delegate Director in Windhoek [HEAD OF HSE DEPARTMENT]	**MME**	+264 61 284 8111 +264 61 2848209
	MEFT	+264 064 404 576 +264 064 404 576 +264 061 249 015 +264 063 202 811
	MAWLR	+264 61 208 7266 +264 61 208 7158
	NAMCOR	+264 61 204 5000 +264 061 204 5053

Table 4.2: Spill scenarios, risks, and response assessment.

No.	Source and Location	Event	Oil Type	Volume	Impact	Level Impacts	Level Impacts	Risk	Response Strategies	Tiered Resources
1	Drilling Location	Minor operational spill during fuel transfer	Diesel, Lube oil, hydraulic oil, oil contaminated drilling mud etc.	<1 m³	Rig deck spill unlikely to reach surrounding operational site areas	B	1	Low	Deck / local area cleanup expected to be undertaken for a spill of this size	Appropriate Tier 1 resources such as the on-board spill kit. This will include sorbents, sand, plastic sheeting, PPE, shovels, rakes and buckets.
2		Full bore release of diesel due to transfer hose rupture Fitted at either end of hose so worst-case scenario would be loss of entire capacity hose	Diesel	>1 m³						
3	Drilling Location, Rundu Operations Base or D3425 Logistic Road Between Rundu and Drilling location	Loss of all diesel / fuel from a single tank	Crude / Diesel, Lube oil, hydraulic oil, oil contaminated drilling mud	>100 m³	Local site spillage likely to reach only immediate surrounding site areas	B	2	Low	Containment and recovery of oil where possible. Shoreline clean-up operations and continual aerial surveillance.	All available Tier 1 resources Consider Tier 2: As may be required subject to event escalation
4	Drilling Location	Major loss of well control during operations resulting in a release of oil until the primary well has been exhausted.	Crude	>500 m^3/day	Deck spill likely to reach surrounding beyond the operational site areas and habitats impacted Government and national media interest guaranteed	B	3	Low	Extensive containment and recovery, clean-up and continual surveillance	All available Tier 1 and Tier 2 as well as Tier 3 Third-Party Services Providers External Resources such as Oil Spill Response Ltd (OSRL) in the UK with Oil spill equipment stockpiles in Malabo Equatorial Guinea and Cape Town South Africa

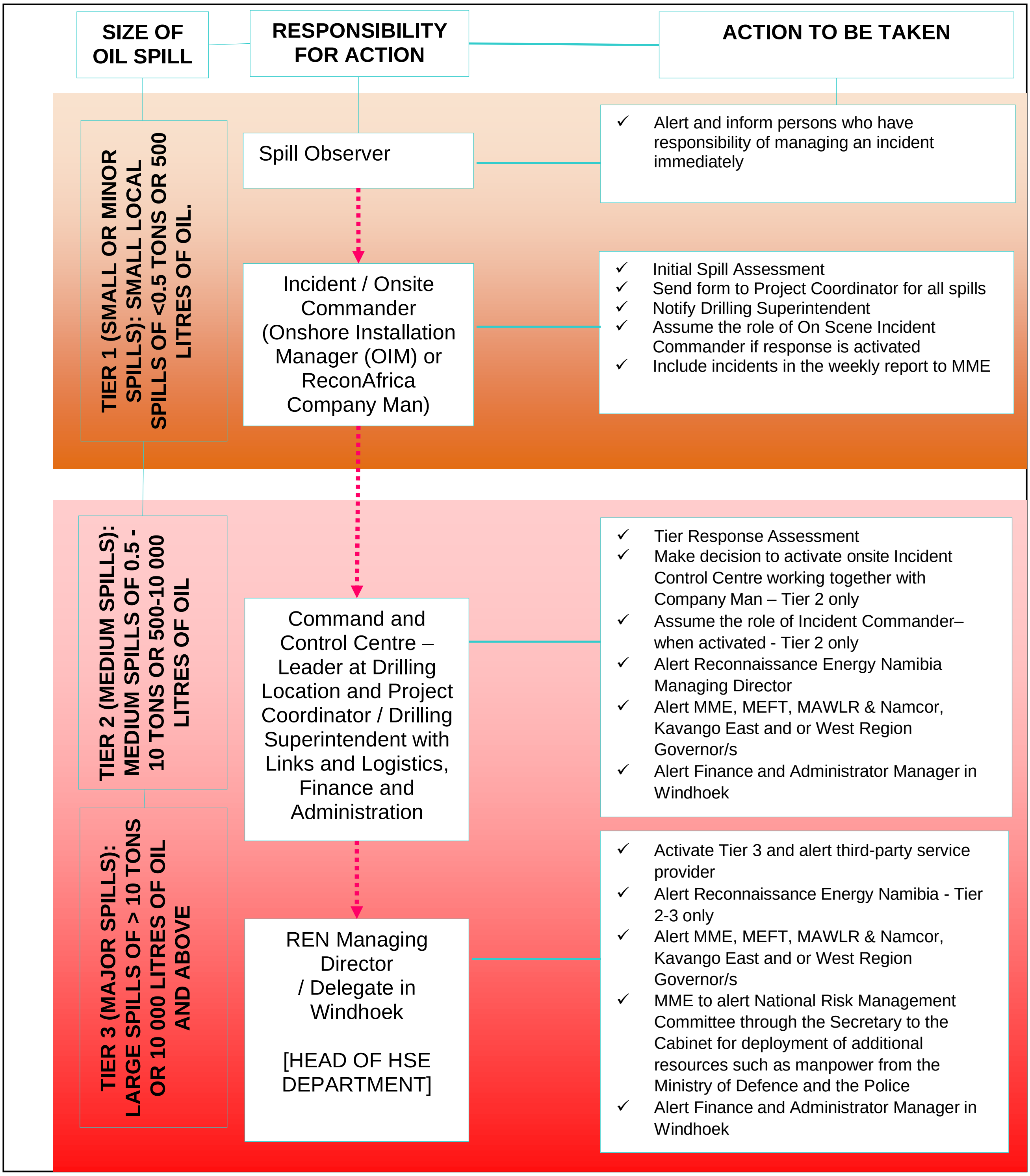


Figure 4.6: A summarised outline of the internal OSCP oil spill alert / notification procedures.

4.4.5 Summary of the Overall Potential Emergency Events

The ERP approved by MME provides for the overall emergency response with initial actions, ongoing aims and contacts and further info provisions for the following emergency events:

1. Explosion or fire.
2. Hydrocarbon or chemical release.
3. Well control incident.

4. Riser / pipeline incident.
5. Medical Emergency.
6. Installation abandonment.
7. Notification of fatality.
8. Aircraft or road accident Windhoek to Rundu or Rundu to drilling site.
9. Person / vehicle overdue.
10. Natural disaster.
11. Non-Governmental Organisation (NGO) activities / demonstrations.
12. Serious crime including arrest of employee.
13. Kidnap, ransom, extortion, and.
14. Bomb threat, civil unrest, or country evacuation.

4.5 ESG and Environmental Performance Monitoring and Reporting

The monitoring of the environmental performance programmes for drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 are divided into the following two (2) parts:

(i) Routine daily monitoring activities to be undertaken by the Project HSE Officer with the support of the Environmental Social Governance (ESG) / EMP Coordinator/s or external specialist consultants as may be required, and.

(ii) Preparation of the ongoing ESG requirements, regulatory environmental monitoring requirements as per the ECC provisions and final regulatory Environmental Closure reports covering all activities related to the implementation of the EMP and overall project operations.

The Proponent will be required to report regularly (twice in a year or as the case may be) to the Environmental Commissioner in the Ministry of Environment, Forestry and Tourism (MEFT), the environmental performances as part of the ongoing environmental monitoring programme. Environmental monitoring programme is part of the EMP performances assessments and will need to be compiled and submitted as determined by the Environmental Commissioner. The process of undertaking appropriate monitoring as per specific topic (such as fauna and flora) and tracking performances against the objectives and documenting all environmental activities is part of internal and external auditing to be coordinated by the ESG Coordinator, Project HSE Officer, EMP coordinator and external consultants as required and as per specific topic such as water, wildlife, flora, stakeholders and community consultations and engagements (Tables 4.1- 4.9).

The second part of the monitoring of the EMP performance will require a report outlining all the activities related to effectiveness of the EMP at the end of the drilling operations for each of the proposed wells and to be undertaken by the ESG Coordinator, Project HSE Officer, EMP coordinator and external consultants as required. The objectives will be to ensure that lesson leaned are documented, corrective actions are reviewed and steps are taken to ensure compliance with future EIA and EMP implementation for oil and gas exploration in PEL No. 73. The report shall outline the status of the environment and any likely environmental liability after the completion of the drilling operations. The report shall be submitted to the Environmental Commissioner through the Petroleum Commissioner in MME (Competent Authority) in the MEFT and will represent the final closure and fulfilment of the conditions of the Environmental Clearance Certificate (ECC) issued by the Environmental Commissioner.

Table 4.3: Monitoring of environmental performance implementation / environmental awareness training.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
Is there an Environmental awareness training programme?					
How many people have been given environmental awareness training?					
Is a copy of the EMP and all relevant documents and permits on site?					
How effective is the awareness training? Do people understand the contents of the EMP? Where are the weaknesses? Ask 3 people at random various questions about the EMP.					

Table 4.4: Monitoring of environmental performance for the temporal and permanent structures.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
Are the temporal and permanent structures positioned to avoid sensitive potential sensitive sites?					
Has new infrastructure been created? If so, what, and how well planned / built with respect to environment?					
Have toilets been provided? Where are they situated?					
Do receptacles for waste have scavenging animal proof lids?					
What litter is there – who is littering?					
Are there facilities for the disposal of oils / etc and how often is it removed to an approved disposal site?					
Is there evidence of oil / diesel spills? Bunding or not?					
What fuel source is being provided for cooking?					
Housekeeping					

Table 4.5: Environmental and other data collection.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
Are records being kept?					
Wildlife activities around the operations area?					
Water monitoring (sampling and testing being conducted)?					
Waste management (Liquid and solid waste records)					
Noise / vibration/ dust levels assessments?					
Cuttings and drilling fluids tests					
Soil tests					
Have archaeological sites been found / disturbed / described?					
List of other key environmental and drilling related data sets recorded?					

Table 4.6: Health and safety.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
COVID-19 and HIV and AIDS Protocols in place?					
Is there First Aid Kit containing anti-histamines etc?					
Are restricted and dangerous areas clearly marked off?					
Do vehicles appear to maintain the recommended speed limits?					
Do vehicles always drive with headlights on?					
Other HSE Incidences					

Table 4.7: Recruitment of labour.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
What labour source is used?					
How has the recruitment practice been done?					

Table 4.8: Management of the natural habitat and surficial materials management.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
Has there been any development done on or very close sensitive areas?					
Has anyone been caught with plants or animals in their possession?					
Has there been wilful or malicious damage to the environment?					
Has topsoil / seed bank layer been removed from demarcated development areas and appropriately stored?					

Table 4.9: Tracks and off-road driving.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
Are existing tracks used and maintained?					
What new tracks have been developed and are they planned?					
What evidence is there of off-road driving? Who appears to be responsible?					
Are corners being cut, what type of turning circle are there? Three point turns vs. U turns?					
Have unnecessary tracks been rehabilitated and how well?					
Comments					
All tracks impacted by the drilling operations rehabilitated by smoothing the 'middle mannetjie' (middle ridge between the tracks) and raking the surface					

Table 4.10: Management of water resources.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
How is potable water supplied and how often?					
Is water being wasted?					
Is there any leakage from pipes or taps?					
Is consumption being records? Provide figures.					

Table 4.11: Community engagements / ESG, public relations and Corporate Social Responsibility (CSR) projects updates.

Mitigation	Compliance	Follow-up Action Required	By Whom	By When	Completed
Have community engagements been undertaken before, during and after the implementation of the activities. Provide details information of on the ESG performances including location, date, time, minutes, and photos as may be applicable					
Have any complaints been made about the project activities by the different I&APs? If so, what, and how was the issue resolved?					
Provide updates on the Corporate Social Responsibility (CSR) projects					

4.6 Hydrocensus Results Around Proposed Well Sites

4.6.1 Status of Rural Water Supply in PEL 73, Kavango West and East Regions

The first hydrocensus survey in PEL 73 was conducted on behalf of REN by Pioneer Minerals and Mining Consultancy from the 14th April-05th May 2021 and this programme continue to be undertaken as an annual event. Ninety water points were visited and include those falling around proposed D1-D6 and G1-G6 exploration and appraisal wells sites. The survey was restricted to a 2.5km buffer zone surrounding the seismic profile lines all falling within the AOI and also covered the area of the proposed D1-D6 and G1-G6 exploration and appraisal wells sites.

Water points are referenced by waypoint number (WPT), assigned to the water point during the survey. Most localities visited were predominantly water points established by the MAWLR, Division Rural Water Supply (RWS), consisting mainly of boreholes. Shall water wells in the area were the main stay of water supply in the past. Boreholes have since, systematically replaced these water wells. Water wells still exist and are used for domestic and stock watering. They often positioned along the major ephemeral rivers or Omurambas and remain a major source of water for rural communities. Water wells provide the most rudimentary access to water and water are abstracted using rope and bucket. Wells are in the minority and are always within a 2km radius of an existing borehole. In some areas, wells have dried up and people consequently abandoned the area.

A typical RWS borehole consists of storage facilities (3x10m^3 plastic tanks), a tap stands and a drinking trough for animals. Mono rotary pumps driven by diesel engines mainly equipped boreholes in the past. Improvements in water supply technologies saw submersible pumps replacing mono pumps. Solar and electrical driven systems are progressively replaced mono pumps, since many villages went without water because of diesel fuel shortages. Diesel is difficult to access, since Rundu is the only centre, which sells diesel and inaccessible for many rural villages.

Many communities prefer installations of solar driven pumps because of the low cost associated with these systems. In places where water has a high demand, higher pumping rates are required, and electricity and diesel are the preferred power sources. RWS for the Kavango Region is not without challenges and improvements in technologies and design can contribute in a positive way. Many boreholes are taken care by a “pump boy” as caretakers. However, many of these “pump boys” lack the technical ability to service and maintain water points. This is the biggest threat ensuring adequate water supply to many villages in both Kavango West and East Regions.

Many communities expect government to provide access to water, which comes at a price, especially in areas where water is not readily available everywhere like in Kavango East and West Regions. Government funds and implements most water supply development projects, which consist of the drilling and construction of water supply infrastructure. Thereafter, the upkeep of water supply points becomes the responsibility of the community. Communities at times cannot afford, nor has expert knowledge or tools to maintain their water points, which leads to infrastructure being dilapidated and abandoned when out of order. Institutions with own water supply visited during the survey were mainly schools, clinics, and police stations.

The Ncaute Police Station is the only police station in the area, visited. In some instances, schools and clinics were mostly reliant upon water supply from community boreholes and in other instances had their own water supply. Water supply to schools, clinics, and police stations is the responsibility of their respective Ministries and Regional government. Problems related to community boreholes leave many schools and clinics without water, since the reinstatement of water supply lies with the water point committees and not with the Ministry of Education or Health.

Maintenance of water supply infrastructure for schools and clinics with their own water supply, are subject to maintenance contracts, issued under their respective Ministries and Regions. Many schools and clinics suffer from water shortages because of the lack of reliable service contracts issued or no maintenance being done at all. Water demand by water point was calculated based on figures of large and small stock and people near a water point. Forty litres/day (40l/day) for large stock, 20l/day for small stock and 50l/day per person were allowed for water demand calculations. Water demand figures were gathered from community members present at a water point.

4.6.2 Water Monitoring

A hydro census was conducted to compile additional data on the groundwater resources and water infrastructure within the project area, PEL 73. The intention was to determine the level of access to water within the immediate area of REN exploration activities, but also to gather which localities might be affected by REN exploration activities. Two aquifer systems have been identified, during the hydrocensus, to occur within the AOI namely a shallow perched aquifer, and a primary sedimentary aquifer.

Perched Aquifers primarily occur along ephemeral rivers (Omurambas) within the Ndonga and Omatako Omurambas, occurring at depths no greater than 5m. The perched aquifers have limited extent both laterally and vertically. These aquifers are still used as sources of water, abstracting from water using a rope and bucket. Wells are equipped with hand pumps to abstract water. Water from wells is used for both domestic and stock watering.

Kalahari Aquifers occur at greater depths comprising saturated Kalahari Group sediments of sands, silts and clays. The Kalahari Aquifers vary in depth and thickness and is basically a function of basin morphology. Kalahari Aquifer yields are varied and ranges between <1m^3/h and up to 14m^3/h for the boreholes surveyed in the AOI in PEL 73.

Depth to groundwater is shallow (<10m) to moderate (10-50m), with shallow groundwater occurring mostly along the Omurambas and deeper groundwater occurring further away. More than 50% of boreholes located had no groundwater information. Over the entire PEL 73, a total of 90 water points, were visited during the survey and consisted of 78 boreholes 11 wells and one pond.

Based on the findings of the hydrocensus that the following groundwater monitoring programme has been implemented and will continue to be undertaken inclusive of all the existing and proposed water boreholes to be drilled around the proposed D1-D6 and G1-G6 exploration and appraisal wells sites:

(i) Boreholes near existing and proposed D1-D6 and G1-G6 exploration and appraisal wells sites should form part of the monitoring programme that includes water quality sampling and testing.

(ii) Water quality sampling should be undertaken quarterly or bi-annually with the results shares with the local communities or land owners for proposed D1-D6 and G1-G6 exploration and appraisal wells sites falling on commercial farms on communal land, and.

(iii) A groundwater monitoring network should include all water points with high water demand and boreholes near the existing and proposed D1-D6 and G1-G6 exploration and appraisal wells sites. The groundwater monitoring will not only assist REN in effectively utilising the local groundwater resources but will also help local communities in avoiding over pumping of boreholes due to high-water demands. The monitoring of community water boreholes with high water demand will help in detecting increases in sodium salts overtime due to over pumping. Without the monitoring the increase in salt resulting in poor water quality may be wrongly attributed to the drilling of the proposed D1-D6 and G1-G6 exploration and appraisal wells sites by REN while the real cause to the deterioration of local groundwater quality is the over pumping.

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusions

Mitigation measures for both positive and negative impacts have been proposed and management strategies are provided in this Environmental Management Plan (EMP) for drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 covering the following stages:

(i) Site preparation and preconstruction.

(ii) Site construction phase.

(iii) Equipment mobilisation.

(iv) Spudding, drilling, logging, casing, and cementing process to Total Depth (TD).

(v) Drilling completion, well plug / seal of porous horizons and abandon hole.

(vi) Rehabilitate all surface disturbances and clear the site of any debris, and.

(vii) Camp removal, site closure plan implementation, restoration / abandonment/ handover.

This EMP Report has been prepared for implementation by the Proponent. The mitigation measures described in this report, are based on the findings and recommendations of the EIA Report and specialist inputs and recommendations. The Proponent shall implement and monitor the developed environmental management best practices in addition to the following principles:

- ❖ The precautionary approach to be adopted in instances where baseline and project specific information, mitigation measures, guidelines or standards are insufficient or unavailable, and.

- ❖ The principles of environmental management and mandatory timeframes as provided for in the EIA Regulations No. 30 of 2012 and the EMA, 2007, (Act No. 7 of 2007) shall be observed at all times.

The Proponent shall incorporate the provisions of this EMP in the Environmental Management System (EMS) in line with the Environmental Policy of the company.

5.2 Recommendations

The following is the summary of the key recommendations with respect to the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73 inclusive of the supporting infrastructures such as the new access roads to each of the proposed new well sites, the use of existing borrow pits and other associated services:

1) All the applicable permits, authorisation, and consents shall be obtained before the start of preconstruction, construction and drilling operations.

2) The Proponent shall adhere to the provisions of all the national legislation, regulations, policies, procedures, and all the required permits / authorisation / consents must be obtained before the start of the operations for each of the proposed well sites and supporting infrastructure areas.

3) Mitigation measures detailed in this EMP Report are based on the findings of the EIA Report, and have been modelled around two main concepts namely: Best industry practices which are based on the Best Practicable Environmental Option (BPEO) and local Namibian requirements unique to the area of exploration.

4) All the provisions of the EMP and mitigation measures shall be implemented, adhered to and monitored and sites inspections by the external project specialist consultants and EMP monitoring teams shall be undertaken before, during and after the start of construction, operational and closure, rehabilitation and restoration activities for each of the proposed well sites and supporting infrastructure areas.

5) Before the implementation of the individual well drilling operations, the Proponent shall consult with the land owners / land rightsholder / local community / owners of the communal fields and villages that may be affected or likely to be disturbed by the proposed project activities including access to the well locations and sources of construction materials covering the existing borrow pits areas. All the consultations and engagements shall be undertaken through the existing regional and local structures covering the Office of the Governors for Kavango West and West Regions, Councillors, Traditional Authorities, Farmers Associations, Village Headpersons, and Village Development Committees (VDCs) and local community levels.

6) Before any form of field-based activities are started in a local area, written consent shall always be obtained from the land owners / local community through the village headperson, traditional authorities, and regional council as may be applicable to avoid misunderstanding and unnecessary surface user rights conflicts.

7) All borrow pits belong to the traditional authorities and construction materials must be purchased from the relevant traditional authority having jurisdiction over a given borrow pit area and a purchase agreement must be signed before construction materials can be obtained from any given borrow pit in Kavango East and West Regions.

8) Appropriate setback distances (exclusion zones) around sensitive structures such protected areas and human settlements shall always be observed. Such exclusion zone shall be for example be in the ranges of between 400m-500m from an exploration well site to a nearest settlement\ village.

9) Before detailed site-specific activities such as the drilling site clearing or track widening or extensions activities, the ESG Coordinator, Wildlife Monitoring Specialist, Project HSE Officer and EMP coordinator with the support of the external specialist consultants as may be required, should consider the sensitivity of the local receiving environment including influence on the local community, flora, fauna, and archaeological sensitivity of the area and if required commission a field-based site assessments in advance of any such site disturbances.

10) All trees shall be permitted by MEFT before they are cleared and no tree shall be cut before the harvesting permit has been granted.

11) The ESG Coordinator, Project HSE Officer, EMP coordinator and Wildlife Monitoring Specialist shall lead, implement, and promote environmental protection culture through awareness raising of the workforce, contractors and sub-contractors.

12) The Proponent shall provide all the necessary support including human and financial resources, for the implementation of the mitigations, effective environmental management, and monitoring covering the lifecycle of the proposed operations.

13) The ESG Coordinator, Project HSE Officer, EMP coordinator and Wildlife Monitoring Specialist with the support of the external specialist consultants shall develop simplified environmental induction and awareness materials for all the workforce, contractors, subcontractors visitors.

14) Where contracted service providers are likely to cause environmental impacts, these will need to be identified and contract agreements need to be developed with costing provisions for environmental liabilities.

15) Implement internal and external monitoring of the actions and management strategies during the drilling of the proposed exploration and appraisal wells sites Nos. D1-D6 and G1-G6 in the AOI in PEL No. 73.

16) Develop and implement a monitoring programme that will fit into the overall company's Environmental Management Systems (EMS) as well as for any future EIA for as may be required, and.

17) Final Environmental Monitoring Closure report shall be prepared by the EMP coordinator with the support of the ESG Coordinator, Project HSE Officer, Wildlife Monitoring Specialist and support of the external specialist consultants as may be required to be submitted to the regulators and to mark the formal closure of the drilling of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 within the AOI in PEL No. 73, and.

18) Precautionary principles / approaches shall always be exercised especially in situations where specific mitigations, regulatory guidelines, standards, or appropriate setback distances (exclusion zones) around sensitive local cultural resources such as community meeting areas, burial or cultural sites have not been provided. Local communities shall always be consulted on matters related to sensitive local cultural resources not provided for in the international guidelines / standards or this EMP Report.

Direct supervision, involvement, and continuous monitoring of the process of clearing of all the drilling sites, access tracks, and borrow pit areas, and actual drilling operations shall always be implemented. All the responsibilities to ensure that the mitigation measures and recommendations contained in this EMP are executed, monitored and reported, rest with the Proponent.

REN as the Proponent and operator of PEL 73 shall provide all appropriate human and financial resources necessary for the effective implementation and monitoring of this EMP. It is the responsibility of the Proponent to make sure that all members of the workforce including contractors, subcontractors and visitors are aware of the provisions of this EMP and its overall aims and objectives.

6. ANNEXES

1. **CV of the EAP / Team Leader**

2. **Detailed Specifications of the Crown 750 Drilling Rig**

3. **Reconnaissance Energy Namibia Best Practices Documentations:**
    - ***Best Practices: Environment, Social & Corporate Governance (ESG)***
    - ***Best Practices: Exploratory Drilling***
    - ***Best Practices: Water-Based Drilling Fluid Systems***
    - ***Best Practices: Water***
    - ***Best Practices: Wildlife, Flora, and Habitats***

4. **Fauna and Flora Specialist Report**

5. **Surface and Groundwater Specialist Report**

6. **Archaeological Field-Based Specialist Report**

7. **Public, Stakeholders and Community Consultations Materials**

Curriculum Vitae

Dr Sindila MWIYA *(PhD, MPhil/PG Cert, BEng (Hons), Pr. Eng)*

SUMMARY OF QUALIFICATION

- **Doctor of Philosophy (PhD) Engineering Geology/Geotechnical / Geoenvironmental / Environmental Engineering and Artificial Intelligence** – Research Thesis: Development of a Knowledge-Based System Methodology (KBSM) for the Design of Solid Waste Disposal Sites in Arid and Semiarid Environments (Namibia), University of Portsmouth, United Kingdom, 2003
- **MPhil/PG Cert Engineering Geology/Geotechnical / Geoenvironmental / Environmental Engineering and Artificial Intelligence**, University of Portsmouth, United Kingdom, 2000
- **BEng (Hons) Engineering Geology and Geotechnics**, University of Portsmouth in the United Kingdom, 1999.

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Professional Profile

Dr Sindila Mwiya has more than twenty (20) years of practical field-based technical industry experience in Environmental Assessment (SEA, EIA, EMP, EMS), Energy (Renewable and Non-renewable energy sources), onshore and offshore resources (minerals, oil, gas and water) exploration / prospecting, operation and utilisation, covering general and specialist technical exploration and recovery support, Health, Safety and Environment (HSE) permitting for Geophysical Surveys such as 2D, 3D and 4D Seismic, Gravity and Electromagnetic Surveys for mining, energy and petroleum (oil and gas) operations support, through to engineering planning, layout, designing, logistical support, recovery, production / operations, compliance monitoring, rehabilitation, closure and aftercare projects lifecycles. He continues to work internationally in the resources (mining and petroleum) and energy sectors, from permitting through to exploration and production. From the frontier regions (high risk hydrocarbons exploration zones) of South Africa and Namibia, to the prolific oil and gas fields of the Middle East, Angola and the West African Gulf of Guinea, Dr Mwiya has been directly involved in field-based aerial, ground and marine geophysical (gravity, magnetics and seismic) surveys, been onboard exploration drilling rigs, onboard production platforms, conducted public and stakeholder consultations and engagements, and worked with highly technical and well organised and committed clients and third-party teams from emerging and well established global resources and energy companies from many countries such as the UK, France, USA, Russia, Canada, Croatia, Norway, the Netherland, Spain, Brazil, China, South Africa, Equatorial Guinea, Angola and Nigeria. He is fully aware of all the competing interests and niche donation-based business environmental advocacy opportunism that exists in the resources sector from the local, regional, and international perspectives.

Through his companies, Risk-Based Solutions (RBS) and Sivieda Group Namibia (SGN) which he founded, he has undertaken more than 200 projects for Local (Namibian), Continental (Africa) and International (Global) based clients. He has worked and continues to work for Global, Continental and Namibian based reputable resources (petroleum and mining / minerals) and energy companies such as Shell Namibia B. V. Limited (Namibia/ the Netherlands), MEL /Monitor Exploration Limited (Namibia/ UK), Reconnaissance Energy Africa Ltd (REN/ReconAfrica) (UK/Canada/Namibia), Debmarine (DBMN) (Namibia), Osino Resource Corporation (Canada/USA/Namibia), MEL (UK, Namibia), Dundee Precious Metals (Namibia / Canada), Headspring Investment (Namibia/ Russia), EMGS (UK/ Norway), Lepidico (Australia / UK), Best Sheer / Bohale (Namibia / China), CGG Services UK Limited (UK/ France/Namibia), BW Offshore (Norway/Singapore /Namibia), Tullow Oil (UK/Namibia), Petrobras Oil and Gas (Brazil) / BP (UK)/ Namibia, REPSOL (Spain/ Namibia), ACREP (Namibia/Angola), Preview Energy Resources (UK), HRT Africa (Brazil / USA/ Namibia), Chariot Oil and Gas Exploration (UK/ Namibia), NABIRM (USA/ Namibia), Serica Energy (UK/ Namibia), Eco (Atlantic) Oil and Gas (Canada / USA/ Namibia), ION GeoVentures (USA), PGS UK Exploration (UK), TGS-Nopec (UK), Maurel & Prom (France/ Namibia), GeoPartners (UK), PetroSA Equatorial Guinea (South Africa / Equatorial Guinea/ Namibia), Preview Energy Resources (Namibia / UK), Sintezneftegaz Namibia Ltd (Russia/ Namibia), INA Namibia (INA INDUSTRIJA NAFTE d.d) (Croatia/ Namibia), Namibia Underwater Technologies (NUTAM) (South Africa/Namibia), InnoSun Holdings (Pty) Ltd and all its subsidiary renewable energy companies and projects in Namibia (Namibia / France), HopSol (Namibia/Switzerland), Momentous Solar One (Pty) Ltd (Namibia / Canada), OLC Northern Sun Energy (Pty) Ltd (Namibia) and more than 100 local companies. Dr Sindila Mwiya is highly qualified with extensive practical field-based experience in petroleum, mining, renewable energy (Solar, Wind, Biomass, Geothermal and Hydropower), Non-Renewable energy (Coal, Petroleum, and Natural Gas), applied environmental assessment, management, and monitoring (Scoping, EIA, EMP, EMP, EMS) and overall industry specific HSE, cleaner production programmes, Geoenvironmental, geological and geotechnical engineering specialist fields.

Dr Sindila Mwiya has undertaken and continues to undertake and manage high value projects on behalf of global and local resources and energy companies. Currently, (2022-2025) Dr Sindila Mwiya is responsible for de-risking permitting, planning through to operational and completion compliance monitoring, HSE and engineering technical support for multiple major upstream onshore and offshore petroleum, minerals, and mining projects, Solar, Wind and Green Hydrogen projects, manufacturing and environmentally sustainable, automated / smart and Climate Change resilient homes developments in different parts of the World including Namibia. He continues to work as a National Technical Permitting Advisor, International Resources Consultant, national Environmental Assessment Practitioner (EAP) / Environmentally Sustainable, automated / smart and Climate Change resilient homes developer, Engineering / Technical Consultant for RBS / Sivieda Group, Project Manager, Programme Advisor for the Department of Natural and Applied Sciences, Namibia University of Science and Technology (NUST) and has worked as a Lecturer, University of Namibia (UNAM), External Examiner/ Moderator, NUST, National (Namibia) Technical Advisor (Directorate of Environmental Affairs, Ministry of Environment, Forestry and Tourism / DANIDA – Cleaner Production Component) and Chief Geologist for Engineering and Environment Division, Geological Survey of Namibia, Ministry of Mines and Energy and a Field-Based Geotechnician (Specialised in Magnetics, Seismic, Gravity and Electromagnetics Exploration and Survey Methods) under the Federal Institute for Geoscience and Natural Resources (BGR) German Mineral Exploration Promotion Project to Namibia, Geophysics Division, Geological Survey of Namibia, Ministry of Mines and Energy.

He has supervised and continues to support several MScs and PhDs research programmes / projects and has been a reviewer on international, national and regional researches, plans, programmes and projects with the objective to ensure substantial local skills development, pivotal to the national socioeconomic development through the promotion of sustainable natural resources coexistence, management, development, recovery, utilisation and for development policies, plans, programmes and projects financed by governments, private investors, and Namibian development partners. Since 2006 until 2017, he has provided extensive technical support to the Department of Environmental Affairs (DEA), Ministry of Environment, Forestry and Tourism (MEFT) through GIZ in the preparation and amendments of the Namibian Environmental Management Act, 2007, (Act No. 7 of 2007), Strategic Environmental Assessment (SEA) Regulations, Environmental Impact Assessment (EIA) Regulations as well as the SEA and EIA Guidelines and Procedures all aimed at promoting effective environmental assessment and management practices in Namibia. Among his academic achievements, Dr Sindila Mwiya is a holder of a PhD within the broader fields of Engineering Geology/Geotechnical / Geoenvironmental / Environmental Engineering and Artificial Intelligence with a research thesis titled Development of a Knowledge-Based System Methodology (KBSM) for the Design of Solid Waste Disposal Sites in Arid and Semiarid Environments, MPhil/PG Cert and BEng (Hons) (Engineering Geology and Geotechnics) qualifications from the University of Portsmouth, School of Earth and Environmental Sciences, United Kingdom. During the 2004 Namibia National Science Awards, organised by the Namibian Ministry of Education, and held in Windhoek, Dr Sindila Mwiya was awarded the Geologist of the Year for 2004, in the professional category. Furthermore, as part of his professional career recognition, Dr Sindila Mwiya is a life member of the Geological Society of Namibia, Consulting member of the Hydrogeological Society of Namibia and a Professional Engineer registered with the Engineering Council of Namibia.

Skills and Experiences with more than 200 Consulting Projects undertaken 2004-2022

Multidisciplinary Experienced PhD Degree-Qualified Professional Registered Engineer with the Engineering Council of Namibia specialised in the following:

- Energy (fossil Fuels and Renewables)
- Mining (Mineral Exploration and Mining)
- Petroleum (Oil and gas Exploration and Production)
- Water Resources Exploration, Recovery and Sustainable Utilisation
- Development of Environmentally Sustainable, Automated / Smart and Climate Change resilient homes, offices, housing schemes, settlements, towns, and cities
- Specialist skills in Environmental policy formulation, development and technical support
- Local, Regional, National, Bilateral and Multilateral Sectoral Projects, from Development to Management, Evaluation and Monitoring
- Pollution Prevention (P2) and Cleaner Production (CP) Programmes, from Development to Management, Evaluation and Monitoring
- Municipal and Mine Waste Streams and Systems Analysis
- Municipal and Mine Landfill / Waste Disposal Sites Development and Management
- Waste Management Minimum Requirements and Management Strategies
- Land Use Planning for Rural and Urban Regional and Local Government Developmental Plans, Projects, Programmes and Strategies
- Geological Technical Support Services to Large and Small Scale, Exploration, Mining and Oil Companies
- Ground Engineering Site Investigation [Geo-Engineering] for various Local, Regional and National Infrastructure Development Projects
- Water and Construction Materials Investigation, Evaluations, Development, Management and Monitoring
- Programmes and Strategies Management and Technical Support Services to Line Ministries, Regional Councils and Local Authorities
- Strategic Environmental Assessments -SEAs
- Environmental Impact Assessments - EIAs

- ❖ Environmental Management Plans EMPs
- ❖ Environmental Management Systems -EMSs
- ❖ Training and industry research in Waste Management, Applied Environment and Geo-Engineering fields

Educational Background

2000 - 2003	University of Portsmouth, UK: Doctor of Philosophy (**PhD**) **in Engineering Geology /Geotechnical / Environmental Engineering (Geoenvironmental Engineering and Artificial Intelligence) - Research Title:** "Development of a Knowledge-Based System Model Methodology (**KBSMM**) for Design of Solid Waste Disposal Sites in Arid and Semiarid Environments" with test sites covering all the Regions of Namibia
1999 - 2000	University of Portsmouth, UK: **MPhil /Postgraduate Certificate in Scientific Research Methods** (PG Cert)
1996 - 1999	University of Portsmouth, UK: **BEng (Hons) Engineering Geology and Geotechnics** (2/1, Upper Class) and **Neil Duncan Special Award** for best final year research project on Design of Kupferberg landfill site investigation (environment, geology, geophysics, and engineering) and design, Windhoek, Namibia
1995 - 1996	University of Portsmouth, UK: Advanced Certificate in Extended **BEng (Hons)/ MEng** Foundation year. Subjects studied are Mathematics (A+), Design (B), Electrical Science (A+), Engineering Science (A), Engineering Material (A+) and Communication Skills (A).
1991	Sesheke Secondary School**: O-Level Certificate -** Subjects studied: English language (B), Mathematics (A) Science (B) Geography (B), Biology (B), Silozi Language (B), Commerce (C) and Religious Education (C).

Employment / Contracts

2004- Present	Risk-Based Solutions (RBS) CC Founder, Technical Permitting & De-Risking Advisor in Natural Resources covering: Minerals Exploration & Mining / Petroleum Exploration & Production / Energy / Water / Environmental Assessments & Management (ESG, SEA, EIA, EMP, EMS) / Automated Property Developer / Programmes and Projects Management / Training / Research
2019-Present	Programme Advisor for the Department of Natural and Applied Sciences a-Namibia University of Science and Technology-NUST.
2000-2014	Part-time Lecturer, Faculty of Science, University of Namibia (UNAM) worked with Prof A. F. Kamona and External Examiner/Moderator-Namibia University of Science and Technology-NUST and worked with Prof Mutjinde Katjiua.
2001- 2004	Chief (4A L1) Professional Deputy Director Level: Division Engineering and Environment, Directorate of Geological Survey, Ministry of Mines and Energy, Namibia.
1999-2001	Senior Engineering and Environmental Geologist, Applied Geosciences, Directorate of Geological Survey, Ministry of Mines and Energy, Namibia.
1992-1995	Geophysics Geotechnician - Field-Based Geotechnician (Specialised in Magnetics, Seismic, Gravity and Electromagnetics Exploration and Survey Methods) under the Federal Institute for Geoscience and Natural Resources (BGR) German Mineral Exploration Promotion Project to Namibia, Geophysics Division, Geological Survey of Namibia, Ministry of Mines and Energy.

Professional membership

- Registered Professional Engineers with the Engineering Council of Namibia (PE24016).
- Member of the Geological Society of Namibia
- Consulting member of the Hydrogeological Society of Namibia

Languages

- English –Excellent (Read, write, and speak)
- Silozi and Subiya – mother tongue (Read, write, and speak)

Selected Publications and Conference Papers

1. Onjefu S, Johannes N, Abah J, Onjefu L, Mwiya S., 2022. Natural radioactivity levels and evaluation of radiological hazards in Usakos marble, Erongo region, Namibia. International Journal of Radiation Research, 20 (2): 403-409.

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References

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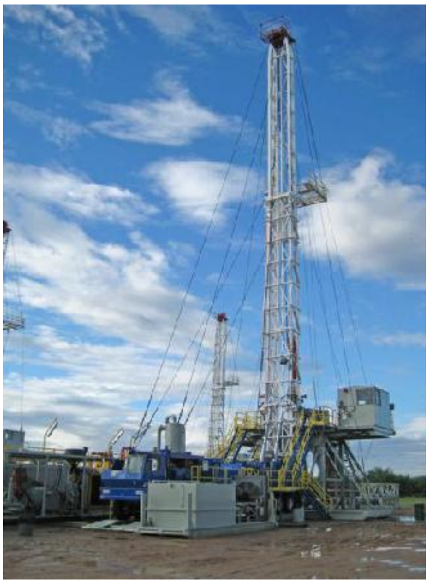
Selected client portfolio 2004-2022 with extensive unpublished Projects Reports over 200 Projects



ReconAfrica's Crown 750 1000 HP Drilling Rig

The Crown 750 was manufactured in the United States and is rated at 1,000 horsepower, equipped with two CAT 540 horsepower diesel engines. Combined with a 440,000 pound hook load, the rig is rated to drill 12,000 vertical feet.

READ PRESS RELEASE

GENERAL RIG SPECIFICATIONS

HP Rating: 1,000 HP
Ambient Rating: 50ºC–55ºC
Powered By: 2 x C15 CAT Engines (540 BHP @ 2,100 RPM each); Allison 4700OFS Transmissions
Rig Type: Self-propelled, carrier mounted, 7-Axle (14 x 4), internally guyed

Two Caterpillar model C15 ACERT packaged generator sets on three-point skid rated for 456/365 kVA, 365/292 kWe, 480/400 V, 0.8PF, 3-phase, 60 Hz prime power service
Generator building complete with MCC and generator synchronization
Includes all necessary wiring and electrical rig-up from AC generators to MCC in generator/power control house
Lighting includes fluorescent, flood and Crown lights for mast, carrier substructure, area lighting and S&S furnished building/equipment lighting
Rig intercom system includes 4 hazardous area telephones, one talk-back system and 2 wireless telephones

Lighting designed in accordance with API RP 500/505

DRAWWORKS

Model: S&S 1000-HP, SD
Speeds: 5-forward + Reverse
Brake Type: Band
Assist Brake: Eaton, WCBD-236
Drill Line Size: 1-1/4"
Crown Saver: Included

Single drum new style drawworks with band brakes

One Eaton Model WCBD-324 Assist Brake, water cooled

Main drum Lebus grooving

Water-cooling system manifold for cooling main drum band brakes and auxiliary water brake

Automatic Crown Saver safety shutoff device to limit block travel, installed on drawworks

Hydraulic system, including winch, power tongs circuit, raising, telescoping, leveling and make and brake cylinders

Mechanical drill line spool rack for 3,000 ft of 1-1/4" drill line

MAST (API-4F, PSL-2)

Height: 118', telescopic
Hookload: 440,000 lbs
Mast Raising: Hydraulic
Racking Capacity: 10,800' of 5" R-II DP / adjustable fingers for 2-7/8" to 5" DP
Casing Stabbing Board: Included (Deckard style), adjustable with air winch
Standpipe: 4" x 5,000 psi, single
Hydraulic Catworks: Included

118' x 440,000 lb API guyed telescoping mast with fixed base

Equipped with ladder, safety platform, handrails, fall arrest post, block cradle, two belly lines and two load lines

Automatic erecting racking board for use with 20 ft substructure

Make and break cylinders mounted on back of mast

Adjustable stabbing board with 20' of adjustment above the rig floor in 12" increments

CARRIER

Axles: 7 (14 x 4)
Leveling Jack: 4 hydraulic + 2 manual
Fuel Tank: 100 gallon, on-board
Tool Boxes: 2
Drill Line Spool Rack: Included
Deadline Anchor: Included
Rig Ramp: Included
Rig Hydraulic System: Included

Self-propelled, back-in carrier

Driller's side and off-driller's side folding walkways and handrails

Highway lighting package

Three front non-drive steering axles with rear wheel drive tandem axles, and two non-drive pusher/tag axle

All axles equipped with air braking system

Two Caterpillar C15 540 hp ACERT diesel engines

Two Allison Model 4700 OFS transmissions

One 5,000 lb air winch mounted on rig floor

One 12,000 lb hydraulic winch mounted on carrier deck

Two tool boxes, one mounted on the underside of the carrier frame and one on the deck

SUBSTRUCTURE (Hydraulic Telescopic Lift)

Floor Height: 20'
Setback Cap: 300,000 lbs
Rotary Cap: 440,000 lbs
Clearance: 16'-6"
BOP Handling: 2 x 15 ton manual winches

20' skid mounted hydraulically raised telescoping substructure
30 ton BOP handling system
Chain driven rotary with 2-piece case with adapters for 27-1/2" rotary table
Mud boat, including steel checker plated tire guide rails and heavy-duty lugs for pinning to the load beam
Load beam to match the mast loading requirements

TRAVELING & ROTARY EQUIPMENT

Block with Hook: 250 ton, 5 x 36" sheaves
Rotary Table: 27-1/2" with master bushing
Swivel: 220 ton
Links: 255T x 2-1/4" x 96"

One 1-1/4" OD, 6 x 19, RR, EIPS, IWRC, 3,000 ft drilling line
One 220 ton swivel
One each, minimum 250 ton, traveling block and hook
One set, 250 ton 2-1/4" x 96" API elevator links
One 27-1/2" rotary table, less master bushing
One each SPB (or equivalent) solid body pin drive master bushing assembly, complete with bit breaker plate and sling for 27-1/2" rotary table

INSTRUMENTATION SYSTEM

Driller's Console / Control Panel: Included
Drilling Recorder: Included (7-pen)
Mud watch system: Included (ADMS)

One 2 bay drillers console; Tong torque indicator, weight indicator, rotary torque, rpm meter, SPM meter, mud gauge, drilling recorder, auto-driller assembly, ton mile / km indicator, advanced driller monitoring system (ADMS), DAC box assembly

MUDSYSTEM

Capacity: 1,000 BBL Active
Number of Tanks: 3 + 1 (trip)
Shakers: Dual
De-silter: Included
De-sander: Included
Mix Hoppers: Dual
De-gassers: Vacuum & Poorboy Type
Bell Nipple & Flowline: Included

143 m3 (900 bbl. active) mud tank system; shaker tank skid, suction tank skid, trip tank, mud reserve tank

Mixing skid with provisions for mixing hoppers

Electric driven centrifugal pumps for solids control functions

Equipment includes 4-panel shaker, de-sander, de-silter, vacuum de-gasser, mud agitators & bottom mud guns

Oilfield type skid and required plumbing

MUDPUMPS

Quantity: 2
Input HP Rating: 750/800
Model: EWECO-800
Powered: CAT (C27, 875BHP @ 2,100 RPM)
High Pressure Piping: Included

Two 800 hp triplex mud pump, unitized with single engine independent cross-mounted pump drive for rear mounting Caterpillar C27 875 hp engine and PTO

Remote air control with hose to driller’s panel, includes throttle, clutch control and emergency shutdown

One Caterpillar Model C27 ACERT diesel engine rated 875 bhp @ 1800 rpm Industrial B rating

Two 5-x-6 supercharging pump driven by AC motor

MISCELLANEOUS

Air Compressors: 2 x Sullair rotary (25 HP each) with air dryers and 2 x 120 gallon receivers
Generator House: 2 x CAT C15, with MCC
Rating: 365KVA/50Hz each
Rig Lighting: Included
Brake Cooling System: Included
Intercom System: Included
Rig Manuals: Included (2 sets)
Diesel Tank: 300BBL (w/ Filtration)
Rotary Hose: 3-1/2" x 5000 psi
Catwalk: 5’W-x-42"H-x-60’L
Anti-Slip Matting: Included (Rotary table area)
Winches: (1) 5,000 lbs (air) drill floor (1) 12,000 lbs (hydraulic) deck

Doghouse mounted on rig floor

Brake water cooling system used for cooling main drum brakes and assist brake

Manual catwalk assembly

300 bbl. cylindrical diesel fuel tank

Two rotary screw compressors with dryers and receivers

Best Practices: Water-Based Drilling Fluid Systems

100% Organic Drilling Fluid System

ReconAfrica is using proven, safe, effective technologies and applying rigorous safety and environmental protection standards in all aspects of our operations.

When a well is drilled, drilling fluid is used to cool the drill bit and carry the rock cuttings to the surface. ReconAfrica is using a 100% organic, water-based, biodegradable, chloride-free drilling fluid system that minimizes environmental impacts. This system incorporates the latest technologies for both safe drilling and surface/subsurface environmental protection. It is the most expensive of water-based approaches. We have intentionally avoided older and lower-cost systems, such as lining the fluid reserve pond with plastic, which can present significant challenges – both operationally and environmentally – during the reclamation phase.

System Design

Fluid system:

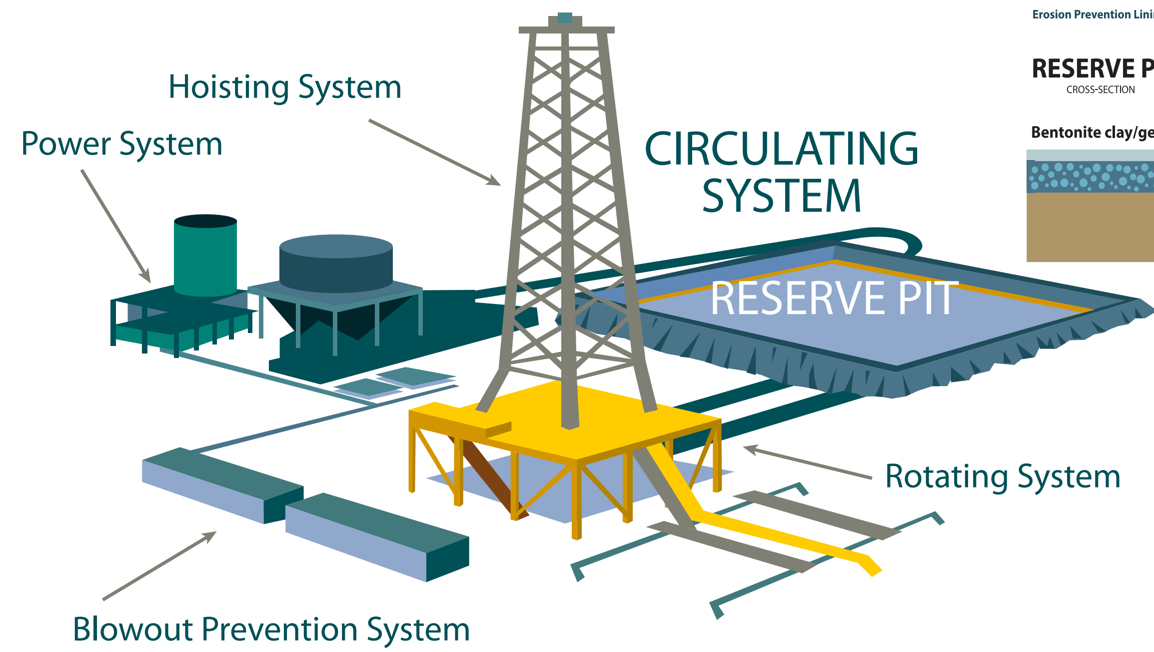
- Water-Based – the best approach to protect the environment
- This Polyamine/ Polymer/PHPA system uses freshwater as the base fluid
- Plant-based products added to base fluid are organic and biodegradable

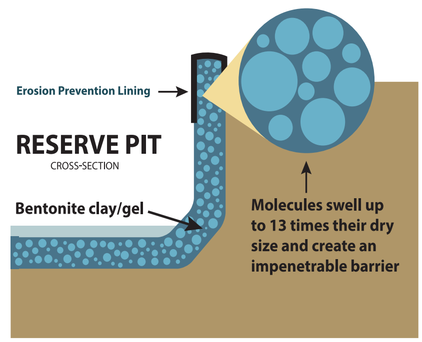
Circulating System

- Part of our Crown 750 drilling rig
- Includes pumps, distribution lines, separators and solids control
- To further enhance safety, third more powerful pump added

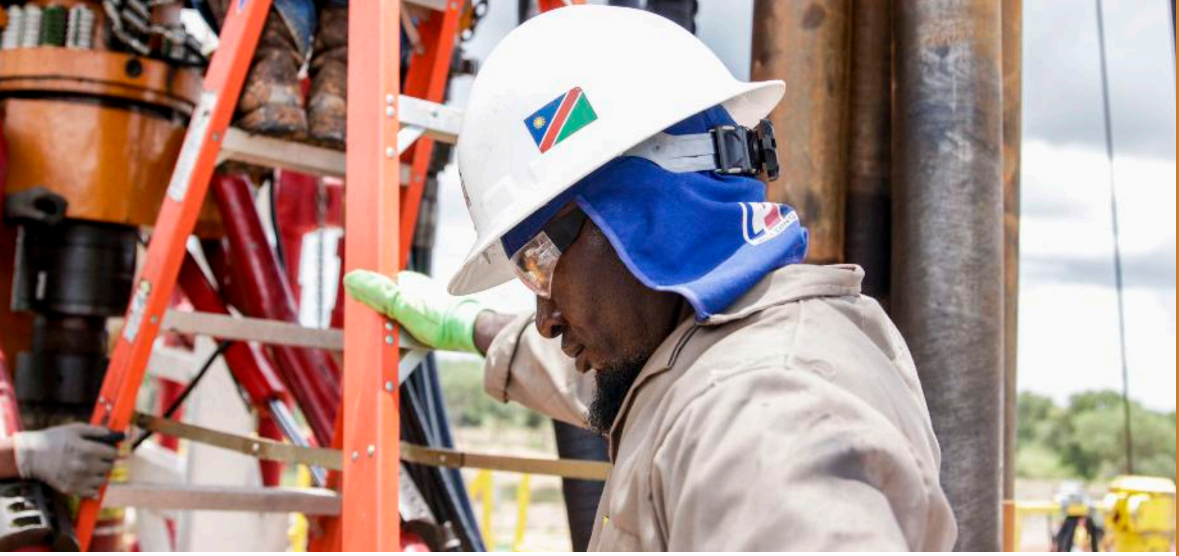
Reserve Pit

- Where excess fluids and cuttings are managed (along with storage tanks)
- Rocks being drilled are benign and any fluids encountered stay in ground
- Cuttings also being captured and bagged for analysis





ReconAfrica's reserve pit contains bentonite clay/gel. When it gets wet, the molecules swell up to 13 times their dry size and create an impenetrable barrier.



Frequently Asked Questions

Why can't I see a black liner on the pond (reserve pit)?

ReconAfrica's reserve pit uses a bentonite clay/gel layer as a safer (and more expensive) alternative to polyurethane pit liners. We are using the same product used widely by farmers and others when their ponds start losing water. What makes bentonite clay/gel such an effective additive for this operation is that once the platelets become saturated with rain or sprayed on water, they swell to 10 to 13 times their dry size, find their way to any cracks or fractures in the pit/ponds, stick together and seal them off to form an impenetrable barrier.

While polyurethane pit linings are generally safe and still used in the industry, they are older technology, can rip during installation and overlaps can leak if not installed correctly. We install a layer of black liner at the top of the reserve pit simply to prevent erosion.

How do you know the reserve pit system is working?

ReconAfrica always has a full-time expert on-site, testing the reserve pit fluid properties on a regular basis. There are also experienced geologists on-site examining the cuttings every 3 metres to understand the formations that are being penetrated, to measure and monitor their properties. As expected, we have not seen any flow or loss of fluid into the ground from the pit.

What will you do with the used drilling fluids once each well is complete?

ReconAfrica will recycle 100% of the drilling fluids and re-use the fluids during drilling operations for the remaining conventional stratigraphic wells.

When drilling is complete, the fluid can be used to fertilize soils. We are currently working with local agricultural authorities to test this process. All our drilling fluid products are organic and biodegradable, promoting nitrogen levels which are an essential nutrient for plant, crop and grass growth. We plan to use this on our own sites and share this excellent topsoil enhancement with nearby farmers.

Our focus is on sustainable development. ReconAfrica will adhere to the most stringent standards and practices to protect the land, the water, the wildlife and Namibia's social well-being. That's our commitment and responsibility.

Where do the cuttings go once captured from the drilling fluid system?

ReconAfrica is having the cuttings analyzed by international and nationally-based environmentally focused laboratories. Half of the cuttings set aside for the Namibian government for future study.

About ReconAfrica

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To date, ReconAfrica has been granted licences by Namibia and Botswana to explore and confirm the presence of their resources; we have no licence to produce oil or to engage in hydraulic fracturing ('fracing').

This project aims to prove a potential reserve that could lead to economic stimulus, funding local and regional jobs and other socio-economic benefits such as increased infrastructure, potable water access and investments in environmental and wildlife conservation.

Should oil and gas be discovered, the traditional authorities and elected governments of Namibia and Botswana will determine how they will manage those resources.

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Best Practices: Environment, Social & Corporate Governance (ESG)

Committed to the Highest Standard

ReconAfrica's Corporate Social Responsibility (CSR) policy is designed to ensure we conduct our business activities responsibly and to align with the expectations of communities, governments and other stakeholders. Our environmental, social and governance (ESG) criteria provide a basis for measuring our performance against the highest global standards.

- With respect to our **environmental** criteria, we strive to collaborate with stakeholders and to be a steward of the environment
- Our **social** criteria help us to assess the fairness, transparency and effectiveness of our interactions with communities, stakeholders and partners, including our suppliers and contractors
- Our **governance** criteria allow us to monitor progress and improve on our goal of equitable decision-making and to determine the effectiveness of our internal controls in meeting our commitments to stakeholders and shareholders and our obligations to regulators

We are committed to doing business in compliance with a stringent Code of Business Conduct and Ethics and associated policies. ReconAfrica also adheres to the Canadian Extractive Sector Transparency Measures Act (ESTMA).

Environmental Protection

ReconAfrica is committed to protecting the environment, avoiding environmentally sensitive areas, minimizing disturbances and implementing best practices according to international standards.

- We are focused on conventional oil and gas reservoirs which flow naturally under their own pressure
- ReconAfrica respects the integrity of all designated protected and environmentally sensitive areas, such as the Tsodilo Hills in Botswana. We have a collaborative agreement with the Government of Botswana that excludes the Tsodilo Hills from the company's licence area and we will respect all exclusionary areas
- Our wells will be drilled with organic and biodegradable water-based drilling fluids and we will use the most effective casing and materials to ensure complete protection of all water sources and aquifers

Our Health and Safety Commitment

ReconAfrica's Environmental, Health & Safety (EHS) goals include the following:

- Zero accidents/incidents
- No harm to people
- No damage to the environment

Local Economic Development

ReconAfrica works with local, regional and national business suppliers and service providers in a broad range of sectors, including: water well drilling; construction; logistics and transport; telecom; camp management; training; medical services and supplies; human resources and contracting; engineering and project management; and environmental services.

We also strive to maximize local and national hiring and provide training in key technical areas associated with our business. In the Kavango area, ReconAfrica is currently supporting the growth of the agriculture, tourism and service industries.

Community Outreach

Our CSR-ESG team has been working with the Ministry of Environment, Forestry and Tourism (MEFT), Ministry of Water, Agriculture and Land Reform (MAWLR), NamWater, Ministry of Mines and Energy (MME), (NAMCOR) Regional Governments, all levels of traditional authorities and communities to implement various environmental and social projects, including: drilling of four community water wells and ongoing permitting for another six water wells in both East and West Kavango. ReconAfrica is also completing on-site technical training; initial development of health and well-being projects encompassing agriculture, animal husbandry and health practices; and a water-management plan (sampling and monitoring).

Consultation and Engagement

Numerous consultation sessions regarding our seismic and stratigraphic programs were completed directly with communities. ReconAfrica continues to engage interested and affected stakeholders on an ongoing basis. ReconAfrica reaches out to traditional authorities, community leaders and community members both in formal consultation community meetings and also in what are locally known as "cluster village interaction" sessions, which are all translated into the local stakeholders' languages. We also work alongside regional, elected and national authorities to keep them updated. *(con't.)*

ReconAFRICA

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ReconAfrica's CSR team was invited by the San (Kwe) leaders to participate in extensive engagement, during which we provided translated project information in their indigenous language. Among the participants in these sessions were the Traditional Chief, Senior Headmen, Traditional Councillors and community members.

Frequently Asked Questions

How is ReconAfrica supporting local communities?

When ReconAfrica arrived in the Kavango Region, we wanted to do something with immediate and lasting benefit for those living in the area. Working with Namibian officials and local leaders, we learned that nearby access to quality drinking water is a critical issue.

ReconAfrica worked with local leaders to initiate a program to drill community water wells for those living at a great distance from existing wells. We have already completed several community wells that are providing potable water for those that need it most.

For more information on how we are improving water access in Kavango visit: https://reconafrica.com/our-sustainable-approach/the-voices-of-kavango/

Many reports say ReconAfrica is fracing. Is this true?

ReconAfrica is conducting a conventional oil exploration program. To date, ReconAfrica has been granted licence by Namibia to explore and confirm the resource. And if this exploratory phase confirms an environmentally and economically viable reserve, the Namibian people and authorities will determine if and how they will extract that reserve.

Are Namibians actually being employed by ReconAfrica?

Yes. We are committed to hiring locally and nationally whenever possible. This includes opportunities for skilled and unskilled labour. To date (December 2021), ReconAfrica has employed more than 500 Namibian residents in such roles as: electricians; rig floor-hands; project managers; material technical specialists (construction, environment, wildlife surveying, water and hydrology); health, safety and environmental experts; administrative assistants; garden site workers; and general laborers. The local and national employment numbers will increase as we move forward with our conventional exploratory well program.

Additionally, ReconAfrica is working with Namibian educational institutions to enhance training programs directly related to the energy industry.

Why is ReconAfrica drilling for oil when the world is calling for the end of fossil fuels to combat climate change?

ReconAfrica recognizes climate change is real and is taking measures to reduce its carbon footprint. ReconAfrica recognizes the acute importance of being results focused, with extensive environmental and social governance approaches in place.

The world is just beginning a multi-decade transition to greener energy sources. ReconAfrica agrees with the Namibian and Botswanan governments that oil will be needed for several decades to come, especially in the developing world. We are here at the invitation of Namibia and Botswana to explore the potential of their energy resources. A stable energy industry can be developed in an environmentally responsible manner to support the development of much-needed economic and social benefits, as well as investments in conservation and wildlife protection. Namibia and Botswana, as importers of oil, natural gas and electricity, have established policy, legislation and regulatory structures to encourage the responsible development of their natural resources.

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ReconAFRICA

Best Practices: Exploratory Drilling

Exploring the Kavango Basin

ReconAfrica is working collaboratively with national governments to explore oil and gas potential in Northeast Namibia and Northwest Botswana – the Kavango Sedimentary Basin. In all aspects of our operations, we are using proven, safe, effective technologies and applying rigorous safety and environmental protection standards.

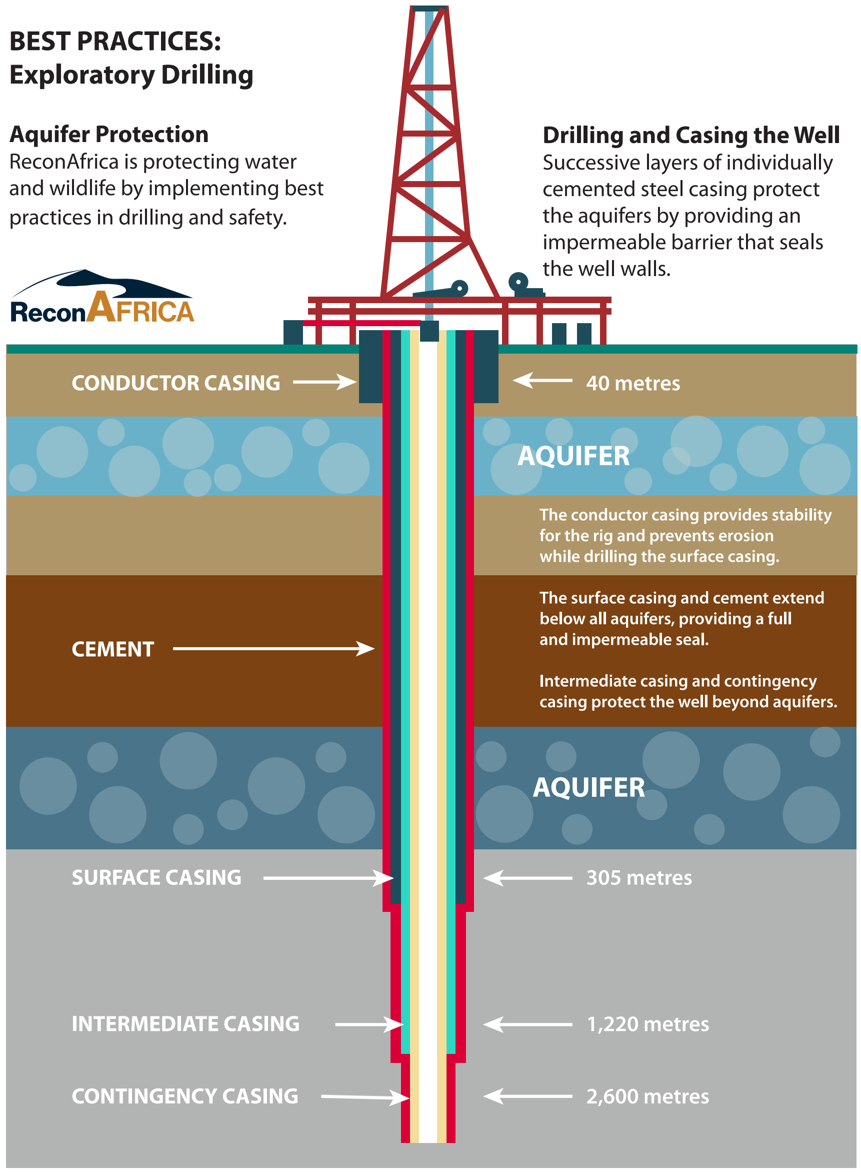
Stratigraphic Drilling Program

To date, ReconAfrica has received permission from the Government of Namibia to drill three conventional stratigraphic wells to provide a more complete picture of the geological formations in the area. This is a conventional drilling program. We have no license to produce oil or to engage in hydraulic fracturing ('fracing'). Data from the initial wells and seismic program will be used to determine future drilling locations that will aim to achieve commercial levels of oil and natural gas production.

Exploratory Drilling Sites

ReconAfrica is not drilling near migratory routes or any other area that would adversely impact wildlife. Our first drilling sites is located approximately 40 km from the boundary of the Khaudum National Park; 55 km south of Rundu; 50 km south of the Okavango River; and about 260 km from the Okavango Delta in Botswana. Our second drilling site is 16 km north of the first site and our third site is expected to be located approximately 60 km southwest of the initial two wells.

National Parks, the Tsodilo Hills and the Okavango Delta are outside of our licence and the project has set no-go buffer zones to protect the environment and wildlife that include a 10-km setback from the Okavango River and 20-km setbacks from the Okavango Delta and Tsodilo Hills in Botswana.



FOR ILLUSTRATION ONLY. Not to scale. Each well will vary depending on geology and technical requirements.

100% Organic Drilling Fluid

ReconAfrica is using a 100% organic, water-based, biodegradable, chloride-free drilling fluid system that minimizes environmental impacts. Water-based systems are the best approach to protect the environment. We install a layer of black liner at the top of the reserve pit simply to prevent erosion.

Drilling fluids keep the drill bit cool and bring rock cuttings to the surface that we study to determine if there is oil and gas in the ground.

ReconAFRICA

Many reports say ReconAfrica is fracing. Is this true?

ReconAfrica is conducting a conventional oil exploration program. To date, ReconAfrica has been granted licence by Namibia to explore and confirm the resource; we have no licence to produce or frac. And if this exploratory phase confirms an environmentally and economically viable reserve, Namibian authorities will determine if and how it will extract that resource.

When do you expect to complete the stratigraphic test well drilling program?

ReconAfrica received approval from the Government of Namibia, in the form of an Environmental Clearance Certificate, for 3 stratigraphic wells. The first well was completed in April 2021 and the second well was completed in July 2021. We anticipate completing the third well by the end of 2021 and may apply for permission to drill a fourth well early in 2022 depending on the analysis of our initial wells and low-impact 2D seismic program.

Drilling of the third well and any additional wells will begin only after we submit updates to the required government documentation.

Do you expect to strike oil when drilling the stratigraphic test wells?

The exploratory stratigraphic wells are not intended to produce flowing oil. We are only analyzing the rocks to determine if there is a working petroleum system in the basin.

How will you know the aquifer is not harmed?

The well casing and drilling techniques we use ensure that there is no impact on aquifers. The wells are fully contained before we introduce our 100% organic water-based drilling fluid system. That system includes measures at the surface to ensure there is no possibility of contamination of water sources above or below the surface.

Additionally, we are drilling water wells at each exploratory well location to identify and analyze aquifers that are present, provide water for our operations and provide adjacent aquifer monitoring during drilling. Following our exploratory drilling program, the potable water wells will belong to the community.

About ReconAfrica

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ReconAfrica Project Overview

Reconnaissance Energy Africa (ReconAfrica)

Reconnaissance Energy Africa (ReconAfrica) is a Canadian-based oil and gas company, currently engaged in energy exploration in Northeastern Namibia and Northwestern Botswana. Working in partnership with and under the ongoing oversight of multiple Namibian government ministries as well as national land, water, and environmental protection agencies, ReconAfrica's license to operate provides for conventional, early-stage exploration, within Northeast Namibia's Kavango region. Our drill sites are situated in a sparsely populated area of the Kalahari Desert and are more than 260 km west of the Okavango Delta area in Botswana.

Our exploration is focused on confirming the presence of a conventional hydrocarbon bearing system (rock formations) under the Kalahari Desert, in the Kavango Basin. An initial stratigraphic well-drilling program was permitted and began in late 2020, and a 2D-seismic program has been designed and is in the permitting phase. These programs will provide preliminary results which will begin indicating the possibility of Namibia becoming an energy independent nation.

ReconAfrica has purchased and is using a Crown 750 drilling rig for exploration. The Crown 750 is a relatively small, truck mounted drill, purpose-built for desert mobility and light impact. Our equipment can drill to a maximum depth of 3,960 metres (13,000 feet) and is designed for use in drilling vertical conventional formations. ReconAfrica does not want or need, nor has the company applied for, been granted, or given, any licences that would permit or support fracing, or any other form of unconventional energy exploration.

In terms of project water use, retention and recycling, ReconAfrica has installed the latest technology while drilling in the Kavango, including using 100% organic drilling-fluid systems that seek to minimize environmental impacts. We have intentionally avoided older and lower-cost systems, such as pit lining, which presents significant challenges – operationally and environmentally – during the reclamation phase. The water-based system ReconAfrica has opted to use has been tested and proven safe and environmentally sound and has been approved for use by the most stringent regulatory regimes around the world.

The Environmental Clearance Certificate (ECC) issued to ReconAfrica for the drilling of the initial exploratory stratigraphic wells is in full compliance with provisions of Environmental Management Act (EMA) No. 7 of 2007. A detailed Environmental Impact Assessment (EIA) study is required for application for an ECC, and this study was provided by ReconAfrica to the Ministry of Environment, Forestry and Tourism through the Office of the Environmental Commissioner. The full EIA study and documentation related to multiple consultations undertaken as part of that study is available from the Office of the Environmental Commissioner.

ReconAfrica is fortunate to work in the region of San (Khwe) Indigenous communities in Namibia. They are among a number of critically important stakeholders within our operating area, which also includes Traditional Authorities, community Headmen and Headwomen, and Communal Land Board members. Local and regional community members have made it clear they see ReconAfrica's project as having a positive overall impact for their people, communities, and region. This includes the creation of employment opportunities through short and long-term contracts and the hiring of local labour as well as semi-skilled and skilled positions that will be sourced both regionally and nationally. A direct benefit also lies in the training of young Namibians through contributions to Namibia's national training fund.

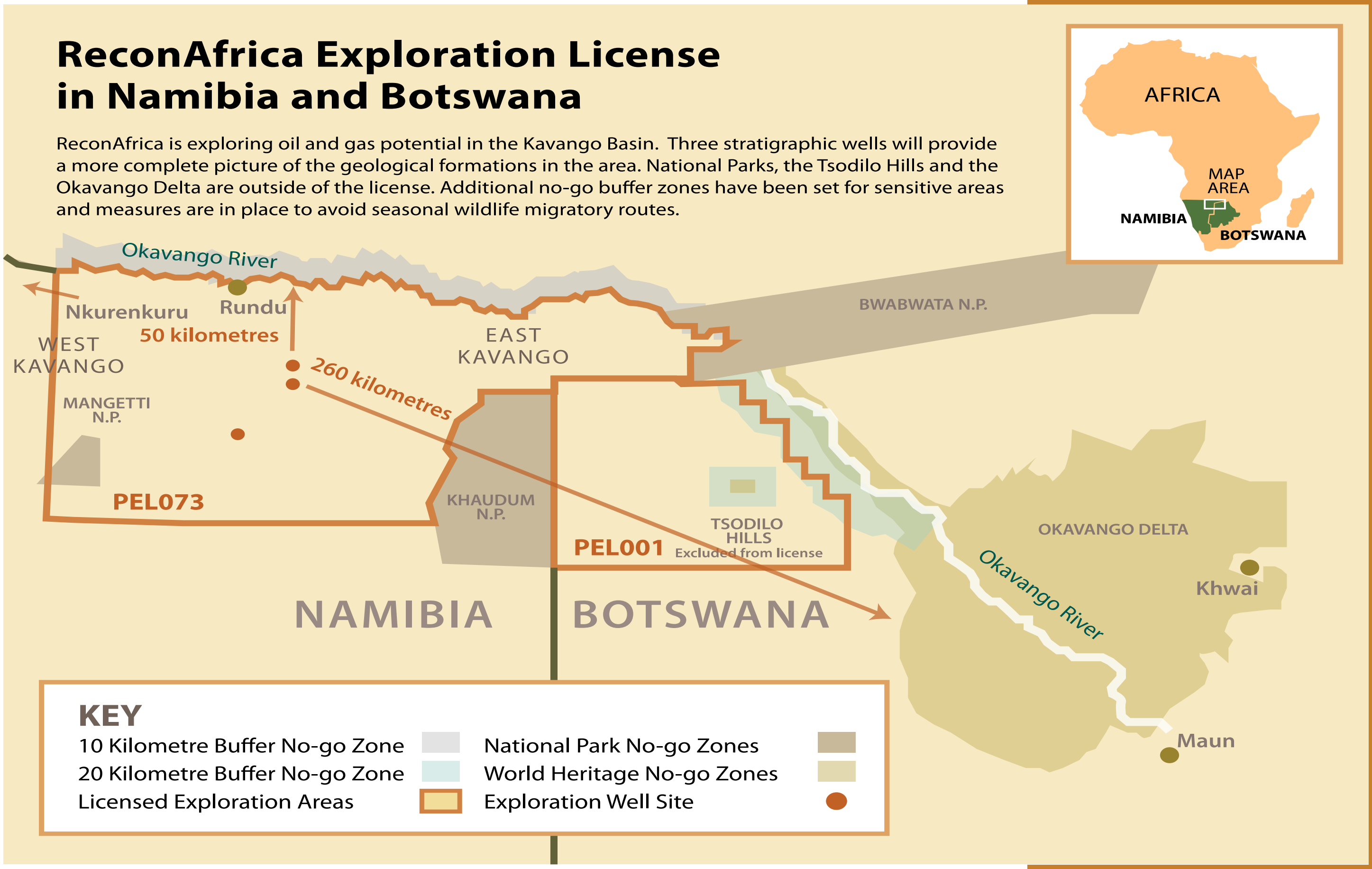
In addition to job creation, ReconAfrica has worked in partnership with Rural Water Management Plan technical specialists and senior officials at the Ministry of Agriculture, Water and Land Reform, to drill new water wells and contribute to Namibia's much-needed national plan. Our teams have completed drilling and construction of four community water wells and are taking steps to receive permitting from the Ministry to support construction of an additional six community wells that will tie into the Rural Water Management Plan.

ReconAfrica understands the importance of water and wildlife, and to this end, has implemented a water-management strategy, as well as employing local team members solely focused on wildlife surveys. Our work extends beyond regulatory and planning sessions with various government ministries and includes ongoing partnerships with Namibian University and other technical personnel. These relationships have helped inform and support our decision-making with representatives within wildlife conservancies, Non-Government Organizations (NGOs) and United Nations organizations, including UNESCO and OKACOM (the Permanent Okavango River Basin Water Commission).

ReconAfrica Project Overview (cont.)

The map below illustrates ReconAfrica's license area, including buffer zones and no-go zones.

As one of more than 30 national and international resource companies investing in Namibia's future, at ReconAfrica we believe our operations in the Kavango area is having and will continue to deliver important benefits to the country and its people, locally, regionally, and nationally. While opinions vary on many different aspects of resource exploration and development, we believe that Namibia alone – its people and its traditional authorities, through its democratically elected governments – should decide and determine how it will manage its abundant natural resources. ReconAfrica will continue to work closely with, and at the direction of, Namibian ministries, regulatory agencies, civil organizations, academics and those living in the Kavango region, to ensure every aspect of resource development unfolds as the country deems fit, responsible, and sustainable.



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ReconAFRICA

Best Practices: Water

Protecting Kavango's Water

ReconAfrica is implementing the most advanced drilling practices available to protect the environment above and below the surface. We are working collaboratively with government, Regional Authorities, Traditional Authorities and other experts and interested stakeholders to protect the Kavango Region's water – and to provide potable water from the area's considerable aquifer systems.

Water-Management Plan

ReconAfrica's water-management plan includes groundwater assessments, hydro census, monitoring, and mitigation. The water-management program has three key objectives: aquifer protection; surface water and drainage management; and sustained protection of project no-go zones.

Technology to Protect Aquifers and Surface Water

ReconAfrica has conducted comprehensive Environmental Impact Assessments (EIAs) to fully understand and protect the integrity of the region's aquifers and surface water. When we drill a well, we implement safe, proven and effective technologies and techniques designed to prevent contamination. When drilling, ReconAfrica protects the well with one of the most important components in the drilling process – casing. The multiple layers of cement and steel casing provide the foundation of the well, sealing it to prevent any fluids from escaping.

A 100% Organic Drilling Fluid

ReconAfrica is using a 100% organic, waterbased, biodegradable, chloride-free drilling fluid system that minimizes environmental impacts. Water-based systems are the best approach to protect the environment. We install a layer of black liner at the top of the reserve pit simply to prevent erosion. Drilling fluids keep the drill bit cool and bring rock cuttings to the surface that we study to determine if there is oil and gas in the ground.

Avoiding Waterbodies and the Okavango Delta

ReconAfrica will not be exploring or active in the Tsodilo Hills World Heritage Site, the Okavango Delta World Heritage Site or any National Parks. The company has set no-go buffer zones that include a 10-km setback from the Okavango River and 20-km setbacks from the Okavango Delta and Tsodilo Hills. The entire project is being designed to protect the environment.

Technology and Expertise Bring Access to Water

The majority of those who live in the Kavango region rely on the Okavango River for their water supply, or well water for those living in rural

areas further from the river. For many women in Kavango, their daily routine involves walking up to 10 km each way to the closest source of potable water.

ReconAfrica is using its drilling expertise to provide new potable water from the region's considerable aquifer systems; to date, we've drilled four solar-powered community water wells, with plans to drill and donate another 24 water wells.

There are many reports that the Okavango Delta is at risk due to ReconAfrica's upstream operations. Is this true?

No. ReconAfrica's operations pose no risk to any sensitive waterbody, including the Okavango Delta. The Okavango Delta is 260 km away from the closest of our three exploratory drill sites and no-go buffer zones have been established to ensure no sensitive waterbody will be impacted.

Will ReconAfrica's operations harm the local water supply?

ReconAfrica is implementing the most advanced technologies and systems available in our exploratory drilling operations to ensure all water, above and below ground, is protected. Our 100% organic, water-based, biodegradable drilling fluid system is the best, most expensive water-based system available and our multiple layers of steel and cement casing eliminates the risk of cross contamination in the well.

ReconAfrica is focused on providing more potable drinking water by using our expertise to drill new community wells that provide much better access to those living in rural areas who previously had to walk up to 10 km to the nearest well. Learn more at https://reconafrica.com/our-sustainable-approach/the-voices-of-kavango/

We keep hearing ReconAfrica is going to frac in Namibia and fracing uses a lot of water. How does this protect our water supply?

ReconAfrica is conducting a conventional oil exploration program. To date, ReconAfrica has been granted licence by Namibia only to explore and confirm the resource; we have no licence to produce or frac. And if this exploratory phase confirms an environmentally and economically viable reserve, Namibian authorities will determine if and how it will extract that reserve.

Is it true that conventional oil production can require a lot of water?

For our exploratory drilling program, we require a very minimal amount of water. If a viable new oil reserve is discovered in Kavango, water requirements for conventional wells would remain minimal during drilling. Water would not be required for conventional oil production, as natural below-ground pressures are typically more than sufficient to maintain production for many years in such an undeveloped deposit.

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ReconAFRICA

Best Practices: Wildlife

Wildlife Conservation

ReconAfrica is committed to sustainable development and employs industry best practices wherever it operates to protect the environment, including policies and protocols to support wildlife conservation efforts in Namibia and Botswana. As part of this commitment, we've conducted comprehensive Environmental Impact Assessments (EIAs) to fully understand and protect the region's wildlife.

Commited to Protecting Kavango's wildlife

ReconAfrica is focused on conventional oil and gas reservoirs which flow naturally under their own pressure – we are not fracing. We are implementing the most advanced drilling practices available. We are avoiding ecologically sensitive areas, migratory routes and national preserve areas. We are implementing the world's lowest-impact 2D seismic testing system. We are working with experts across the region to ensure we collect and integrate local feedback and knowledge from communities, businesses, tourism, government authorities and multi-national African conservation groups into our wildlife conservation plans.

To facilitate our environment and wildlife protection programs, ReconAfrica has a wildlife survey and wildlife environmental monitor as part of our team. We're committed to conservation in the region and will continue to work with stakeholders to support those efforts.

Avoiding Sensitive Areas and Migratory Routes

While ReconAfrica is not drilling near migratory routes, the seismic program will cover broader licenced areas, as permitted by government. ReconAfrica will not be exploring or active in the Tsodilo Hills World Heritage Site, the Okavango Delta World Heritage Site or any National Parks. As an additional layer for protection, the company has set no-go buffer zones that include a 10-km setback from the Okavango River and 20-km setbacks from the Okavango Delta and Tsodilo Hills.

We are also incorporating measures and planning activities to avoid migratory routes during seasonal migration periods. The entire project is being designed to protect the environment and wildlife.

2D Seismic: Low-Impact – Low Frequency

- ReconAfrica's exploration commitment in Kavango includes a 450 km, 2D low-impact seismic survey program – a simple, low-impact ultrasound of the Earth.
- We are implementing the world's lowest-impact 2D seismic testing system, the Explorer 860
- All seismic activities will take place only in government-approved license areas
- 95% of seismic survey will be performed on existing roads/tracks
- ReconAfrica will not operate at night, when elephants typically communicate
- There will be no indication of seismic operations after we leave

One Explorer replaces 4 larger Seismic trucks. It operates at a low frequency that does not affect wildlife.

ReconAFRICA

You say that you are currently not drilling on wildlife migratory routes, what if you discover oil?

To date, ReconAfrica has only been granted licence to explore and confirm a resource in Namibia. If our exploratory program is successful, Namibian authorities will determine if and how a reserve would be extracted. All regulatory processes, including comprehensive Environmental Impact Assessments (EIAs) and wildlife protection practices would be applicable for any future development. ReconAfrica would include comprehensive mitigation plans in any future developments to ensure migration patterns are considered and there are no impacts on wildlife. We want to protect Africa's diverse wildlife as much as anyone. And we will.

What is the difference between 2D and 3D seismic?

In onshore exploration, 2D seismic is the tool used in new basins like the Kavango. Seismic testing is a process that uses sound waves to determine what's under the earth. 2D seismic pushes soundwaves directly down rather than outward as 3D systems do. Additionally, 2D seismic uses longer, individual lines that are processed individually (3D seismic uses shorter, denser spaced seismic lines that are processed together). This greatly reduces the footprint of the seismic waves being emitted, the equipment required and the impacts to the environment and wildlife.

Recognizing the sensitivities for wildlife in Kavango, the Namibian government ensured all seismic testing would use the 2D low-impact seismic process.

Will seismic testing harm the elephants' sensitive hearing?

ReconAfrica is implementing the most environmentally responsible 2D low-impact seismic system ever developed. This system uses a lower and different frequency than elephants use for communications and we will not operate at night when elephants typically communicate. Combined with our efforts to avoid migratory routes and the buffer zones set to avoid ecologically sensitive areas, these measures will ensure elephants are protected.

Are the buffers to ecologically sensitive areas like the Okavango Delta permanent?

To date, ReconAfrica has only been granted licence by Namibia to explore and confirm the resource; we have no licence to produce. We fully expect that these zones will be applied for all future activities should a resource be discovered and the Government of Namibia decides to move forward with development.

How can you be sure you are avoiding wildlife migration routes?

ReconAfrica has conducted Environmental Impact Assessments (EIAs) that detail traditional migration patterns for wildlife in Kavango. Working with local experts, authorities and other stakeholders to include their knowledge in the EIAs, we understand where wildlife lives throughout the year and when to avoid sensitive areas at times such as breeding. The governments of Namibia and Botswana must approve our EIAs before we can conduct any activities. And we have a wildlife survey and wildlife environmental monitor as part of our team who is responsible for ongoing monitoring and mitigation of the associated programs.

Meet our Wildlife Monitor

"In all of our operations, ReconAfrica includes comprehensive mitigation plans to ensure we do not harm wildlife. We want to protect Africa's diverse wildlife as much as anyone."

Francois Jahs
Wildlife Survey & Monitoring

About ReconAfrica

ReconAfrica is a Canadian-based oil and gas company working collaboratively with national governments to explore oil and gas potential in Northeast Namibia and Northwest Botswana – the Kavango Basin.

To date, ReconAfrica has been granted licences by Namibia and Botswana to explore and confirm the presence of their resources; we have no licence to produce oil or to engage in hydraulic fracturing ('fracing').

This project aims to prove a potential reserve that could lead to economic stimulus, funding local and regional jobs and other socio-economic benefits such as increased infrastructure, potable water access and investments in environmental and wildlife conservation.

Should oil and gas be discovered, the traditional authorities and elected governments of Namibia and Botswana will determine how they will manage those resources.

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For more information visit : www.reconafrica.com

GROUNDWATER ASSESSMENT – PEL 73 RECONNAISSANCE ENERGY AFRICA

GROUNDWATER REPORT – DRILLING OF MULTIPLE EXPLORATION AND APPRAISAL WELLS

DECEMBER 2022

Compiled by AMV Julius

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LIST OF ABBREVIATIONS

a	annum
cm	centimetres
°C	degrees Celsius
Ha	hectares
km	kilometres
L (l)	litres
mamsl	metres above mean sea level
m	metres
m^2	square metres
mg/l	milligrams per litre
mm	millimetres
Mm^3	Million cubic metres
ppm	parts per million
NE	northeast
NW	northwest
SW	southwest
SE	southeast
SSE	south-south east

LIST OF ACRONYMS

CGW	Central Graben West
ECC	Environmental Clearance Certificate
ESG	Environmental and Social Governance
GMMP	Groundwater Monitoring and Management Plan
GROWAS	Groundwater Database
HH	Households
MAWLR	Ministry of Agriculture Water and Land Reform
MAWRD	Ministry of Agriculture and Rural Development
MET	Ministry of Environment and Tourism
Namwater	Namibian Water Corporation Ltd
OKACOM	Okavango River Basin Commission

PEL	Petroleum Exploration License
Recon Africa	Reconnaissance Energy Africa
RWS	Rural Water Supply
TDS	Total Dissolved Solids

1 BACKGROUND

Reconnaissance Energy Africa (Recon Africa) is junior Oil and Gas Company engaged in exploration and development of petroleum commodities. Thus far Recon Africa has completed the drilling of 3 stratigraphic wells and acquired 2D seismic surveys across PEL 73 for continued exploration drilling.

Reconnaissance Energy Africa is the operator of Petroleum Exploration License (PEL) 73 located in north-eastern Namibia, and covers blocks 1719, 1720, 1721, 1819, 1820 and 1821 which lies between latitudes 17°S and 19°S and longitudes 19°E and 21°E. PEL 73 covers most part of the Kavango East Region and partially the Kavango West Region, covering 25 462km^2. Figure 1 below depicts the location of PEL 73, north-eastern Namibia, with the location of planned and existing wells drilled.

Reconnaissance Energy Africa intends to spud and drill 12 additional oil and gas wells. The interpretations of seismic surveys have led to the identification of graben structures within the PEL 73, and hence the positioning of the 12 well locations.

This report is an assessment of groundwater resources within and around the proposed well locations in support of the scoping and environmental impact assessment of the drilling and related activities.

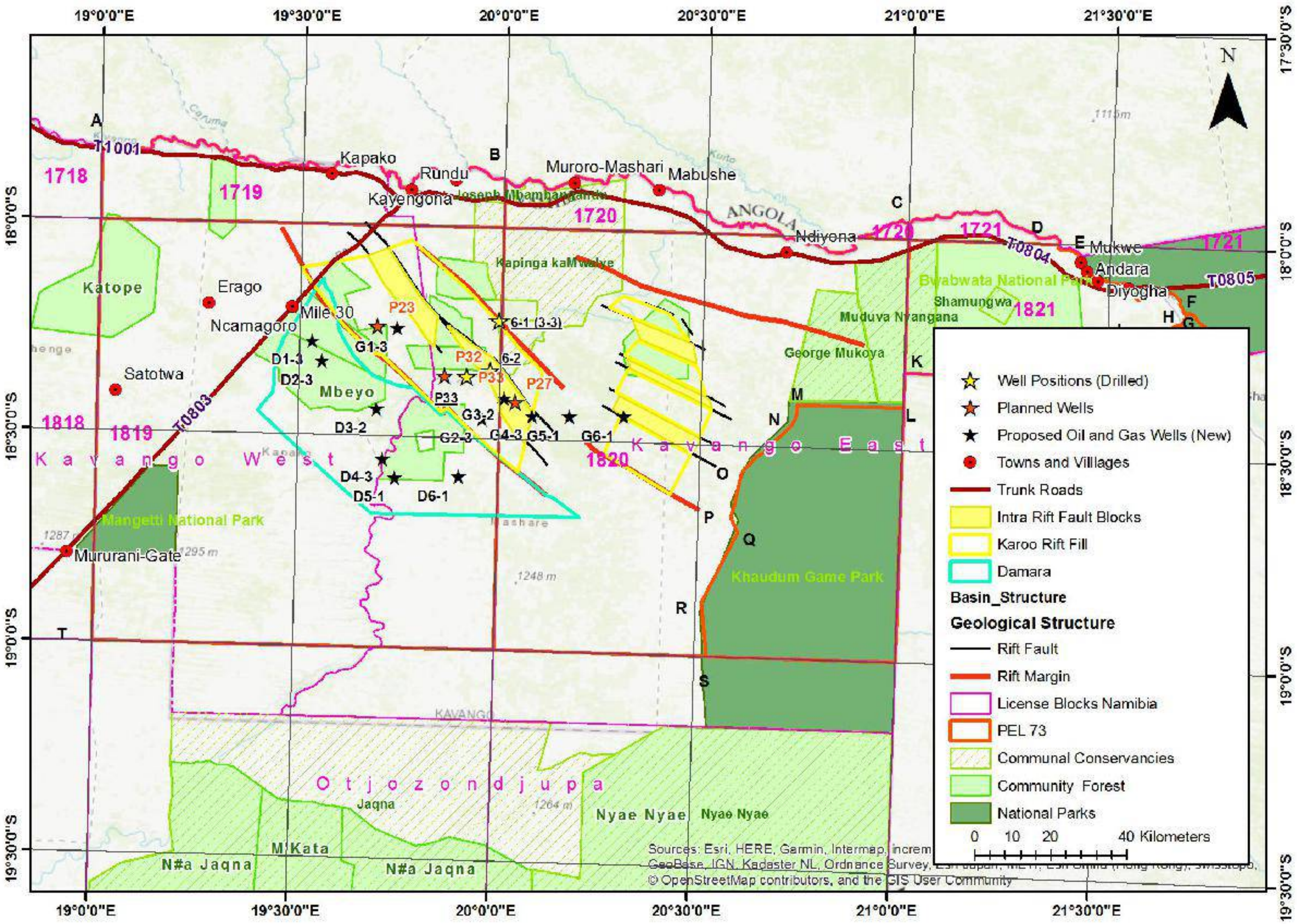

Figure 1. Location of proposed (new), planned and drilled oil and gas wells – PEL 73, Northern Namibia

2 INTRODUCTION

Recon Africa to date regarding groundwater management and monitoring has:

i. Conducted a desk study on groundwater resources across PEL 73 - February 2021.
ii. Conducted a hydro census of boreholes, within a 2.5km buffer zone of seismic lines of the 1st , 2nd and 2nd phase extension – April 2021 and July – October 2022.
iii. Provided aid for the development of water supply to various rural communities and drilled and installed 19 boreholes, thus far.
iv. Monitored surrounding community boreholes and production boreholes within the operational areas of exploration (January2021- Decmber 2022).

Various reports have been compiled and completed by Pioneer Minerals and Mining Consultancy and reports of completed works are available as separate documents, which can be made available to interested and affected parties, should it be required.

Reports include:

- *Desk Study – Assessment of Groundwater Resource PEL 73, February 2021.*
- *Hydro Census – Assessment of Groundwater Resources PEL 73, May 2021*
- *Drilling Reports – WW205848 and WW205849*
- *Monitoring of Production Boreholes – June 2022*

Sources of water for the Kavango Regions (East and West) and PEL 73, is mainly from the Okavango River and from groundwater. Groundwater resources mainly consist of:

a) Shallow perched aquifers (<5m – 10m deep) along the Ndonga and Omatako Omurambas;
b) Primary Kalahari Aquifers at depths greater than 20m;
c) Artesian aquifers adjacent to the Okavango River below a perched aquifer of poorer quality water in the vicinity of Rundu and surrounds and;
d) Secondary aquifer along bedrock features and dykes underlying Kalahari sediments.
e) Primary Aquifer – Karoo Basalts and Karoo Fill Sediments below the Kalahari Aquifers.

Despite the wide spread occurrence of water groundwater, access to water is still limited for the people of the Kavango region. A high percentage of people living in and around the Okavango River have to travel long distances to gain access to water, with the looming threat of crocodiles and hippopotamus found in areas along the river. The hinterland where the distribution of people and density of boreholes are far less concentrated, limited access to water is also experienced. Access to water is further exacerbated by poor water quality, dry boreholes in areas of limited Kalahari sediments thickness and groundwater at greater depths in excess of a100m, which occurs mostly further west.

2.1 The Kavango Region an Overview

The Kavango River is a highly environmentally sensitive area and of national importance as it borders the Okavango River with Angola, one of the few perennial water flows, which Namibia shares with its neighbouring countries. The Okavango River is one of Africa's greatest rivers which drain the Kalahari Desert, the largest expansions of sand. Namibia has no permanent rivers within its borders, except for the rivers they share with neighbouring countries, and is one of the driest countries in Sub-Saharan Africa. The Zambezi, Linyanti/Chobe Rivers share borders with Zambia to the north, Botswana to the South and Zimbabwe in the east. In the south Namibia shares the Orange River with South Africa. Namibia therefore, relies heavily on groundwater for its survival. The Okavango River is the only source of surface water for the Kavango Region, which has its origin in the Angolan highlands and traverse across the Kavango Region for 415km and finally drains inland into the Kalahari Desert, forming a unique wetland and oasis, the Okavango Delta in Botswana. The Okavango Delta is a world heritage site.

Historically the Kavango area was sparsely populated affected by tribal conflicts, slavery and diseases such as malaria and sleeping sickness. Population only started expanding during the last 100 years. Before and during the civil war in Angola, large numbers of people moved from Angola settling in Namibia. Namibia over the last decades invested substantially in rural development, constructing schools, health facilities, roads, transport infrastructure and small scale agriculture. Higher densities of people developed along the Okavango River and major transport corridors. The hinterland to the south however, is less densely populated, which in many cases is the result of the scarcity of surface water in these areas. Areas, such as the Omatako Omurambas and interstitial dune valleys, where surface water is likely to accumulate, has higher concentrations of people compared to higher dune areas. Dune areas are highly porous and soft under foot, which hampers access. Approximately 70% of the Kavango population lives in a strip in and around the Kavango River and creates a highly uneven distribution of people. This reiterates the importance of having access to water. People living outside this strip away from the Kavango River are greatly dependent on groundwater for their survival.

Rundu is the 2nd highest populated urban area in Namibia after Windhoek, the capital of Namibia. Rundu together with other centres in close proximity carries 30%

of the Kavango's regional population. Despite being an urban area many people are still having rural livelihoods. However, rapid growth and developments are seeing Rundu's population changing from a rural character to an urban population.

Settlements away from the river developed because of the population pressures on arable land and grazing. People moved into other areas away and south of the river, into territories they could farm. Wealthier farmers with large herds of cattle created cattle posts, which developed into smaller villages over time. Many water points away from the river were established by government, donor agencies and nongovernmental organisations to stimulate the drive of development for the people. Also the improvement of access roads meant new territories were available to explore.

The establishment of large scale development projects on commercial farms along the river were initiated to foster commercial farming. Kavango largely is still communal land, despite the drive to develop commercial farming areas, owned largely by government and private individuals. The majority of private commercial farms had been demarcated by the Ministry of Land and Resettlement with leaseholds of 25-99 years being issued.

In communal land areas, inhabitants have the right to customary rights to use land allocated to them. People only have rights to settle/reside and rights to cropland. Areas occupied by people gets mapped and certified by Land Boards to demarcate such areas. Inhabitants therefore do not own the land and cannot be used as an asset or collateral.

Communal land is owned by the state, but is controlled by Traditional Authorities, who decides who may settle, farm or develop land in the area. Applicable laws have been enacted, such as the Traditional Authorities Act of 2000 and the Communal Land Reform Act of 2002, which informs and guides the decision making process.

However, little or no control is exercised on how land is used, once allocated. This leads to excessive land clearing, logging and overgrazing of pasture lands which ultimately results in land deforestation and degradation.

Farming is the major economic activity and obviously the major source of income for people of the Kavango Region. Livestock farming is largely practiced, with crop farming to a lesser extent. The majority of people practice subsistence farming. Livestock consist of small herds of goat and cattle, while pearl millet (mahango) is the dominant crop, since it grows well on poor sandy soils with low erratic rainfall. Other crops include maize, sorghum and vegetables. Dry-land farming is practised where crops are not irrigated. Crop yields are low and fails to contributes to people's food needs and food security because of low soil fertility. People, therefore relies on cash incomes to supplement their livelihoods and is eager to earn cash, since other employment opportunities are found to be scarce in the region.

Economic development are largely dependent on the sustainable development and protection of water resources, especially groundwater resources away from the river, where it supports, schools, clinics and farming to a large extent.

Rural water points inland from the Kavango River are a focus point of traditional pastureland, which is considered communal. The establishment of water supply indiscriminately is a matter of concern as it leads to land degradation. It is known that the sustainable utilisation of rangeland is under threat in the vicinity of a new water point. The development of rural water supply points therefore should follow a consultation process with Water Point Committees and the Division Rural Water Supply, in line with Community Based Management practices, which is supported by Government. Other threats to the availability of communal pastureland are illegal fencing, land clearing for crop cultivation and human settlement.

No water management is practised within the Kavango Region for communal boreholes. Private boreholes are being drilled indiscriminately and lack proper capture of groundwater data. Community based utilisation and management of water points, has not always been ideal, which in many instances are due to a lack of knowledge and resources and the understanding of the groundwater regime. It is essential that stakeholders in the water supply sectors take cognisance of the steps and processes involved in developing water supply for rural communities which is a first step in the right direction, which overall will add value to the management of groundwater resources as a whole.

Many government projects attempted were mainly in support of the production of cereal, oil seeds (peanuts and sunflower), cotton vegetable and fish. These projects were not without obstacles as the local people found it difficult to manage soil fertility, pests, harvesting and marketing. In addition incentives for community participation were weak or absent. Irrigation schemes are costly with regards to capital and running costs, especially electricity, fertilizers and of course transport. Despite these shortcomings, the scope for agriculture remains, which through efficient use of water from the river. Irrigation should target high yielding crops and should investigate fish, beef from feedlots, avocados, mangos, and paprika. Water consumption from the Okavango River remains small in comparison to annual flows into the Okavango Delta. Despite this the Okavango River remains under threat from processes such as:

- Increased abstraction
- Changes in water and sediment flow

- Pollution and change in nutrient levels
- Loss of vegetation and soil erosion and veld fires

Pressure on the Okavango River is much more for Namibia than for Angola and Botswana and should be managed as an integrated ecological unit.

The Kavango Region is abundant in natural resources with a variety of wild life and natural vegetation occurring along the river and inland to the south. Woodlands are dominant to the south, in areas of soft sandy soils. Woodlands have of a variety of tree species of which are Pterocarpus Angolensis, Burkea Africana (wild syringa), Baikiaea plurijuga (Zambian Teak) and Guibourtia Coleosperma (African Rosewood and False Mopanie. Pterocarpus Angolensis is well-known hard wood species for furniture and decking, because of its grain, colour and stability. The craft industry of the region is highly dependent on these wood species. At present a moratorium has been placed on the harvesting of protected wood species. Despite the moratorium, illegal harvesting is still continuing unhindered, earmarked for the Chinese export market.

Other vegetative resources are the mangetti tree (producing kashipembe – a nutritious but potent drink), thatching grass and many other plant species which have commercial value potential. For example blue sour plum, bird plum and baobab has potential for oils for cosmetics, and jackal berry and monkey oranges for liquor.

Wildlife along the Kavango River has long gone disappeared because of the removal of natural vegetation by people settling along the river. As a consequence most of the wild life is concentrated within National Parks such as Bwabwata and the Khaudom National Park. The Mahango Nature Reserve within the Bwabwata Park has the highest concentration of big wild animals in Namibia and the highest variety of bird species too. Wildlife is tourist attractions which generate income opportunities for local people through the use of lodging and camping facilities.

3 THE OKAVANGO RIVER

The Okavango River is a major source of water for domestic use and livestock, irrigation and bulk water supply schemes, including town water supply. The Okavango River originates from the Bie Plateau highlands, in Angola and is fed by the Cubango and Cuito rivers draining south. These rivers enter the borders of Namibia and become the Okavango River. The Okavango River drains south and then east, into a dry arid region, the Okavango Delta in Botswana. The Okavango Delta/Swamp is more of an oasis and is one the largest fresh water wetlands of the World. Approximately 9.4km^3 of water drains into the Okavango Delta each year.

Water consumption from the river remains low in comparison to annual average runoff. Very few people within the Kavango Region has access to safe drinking water (treated river water), in comparison to urban areas, such as Rundu. Boreholes in close proximity to the river is considered a source of safe drinking water and supplies groundwater to many bulk water supply schemes such as schools, health facilities, village water supply and other public facilities. These boreholes tap shallow aquifers formed by paleo-channels of the Okavango River. Shallow aquifers are most likely recharged by groundwater flowing from the south, which imply the Okavango River is gaining water from these shallow aquifers. Recharge happens either directly through rainfall or from seepage from deeper aquifers flowing towards the Okavango River. Groundwater quality is generally of good quality, with most boreholes recording total dissolved solids of less than 1000mg/litre. However there are instances of water quality not being of suitable quality, with poor and good quality water found in close proximity of each other. The probability of contamination from animal waste remains high and should be safe guarded against by placing kraals further away from water points.

Water from the Okavango River is generally of good quality for the entire course of the river. Water is clear, low in nutrients and sediments and low in turbidity. There is concern that pollution is most likely to occur from effluent of town water supply and fertilizers from irrigation projects, mostly in Namibia.

Figure 2. Okavango River Drainage Basin.

The gradient for the Okavango River remains shallow and becomes shallower until its mouth at the Okavango Delta. The Okavango River floodplains are quite extensive and have widths of 2-6km. Floodplains below the Cuito confluence are permanently flooded, similarly to areas downstream of the Okavango Delta.

Peak flows for the Okavango River occurs mainly in April, with the Cuito peaking in April or May. Water flow within the Okavango River is much more varied compared to Cuito. The highest flow recorded for the Okavango River was 962m^3/s, with the lowest at 11m^3/s, whereas Cuito recorded high and low flows of 550-600m^3/s and 64m^3/s respectively. The Okavango River contributes more water than the Cuito with an average flow of 405m^3/s for the Okavango and 175m^3/s for Cuito. Much of the Okavango River flow is between January to May, whereas the Cuito contributes more water for the rest of the months. Runoff measured at Rundu on average is approximately 5,000Mm^3/a, with runoff at Mukwe after the Cuito confluence, approximately 10,000Mm^3/a. Important is that peak flow/run-off within the Okavango River is highly variable, dependant on rainfall within its catchment; with its base flow remaining fairly constant, when the river subsides.

4 GROUNDWATER RESOURCES

4.1 Introduction

The assessment of groundwater resources is derived from various works completed as described above. The objective of this report is to highlight the basic elements of groundwater which will contribute to water being utilised in a sustainable manner and not cause pollution through planned exploration activities. A monitoring and management plan will be proposed that will mitigate and address concerns that might arise from drilling activities of oil and gas exploration wells.

Reconnaissance Energy Namibia (Pty) Ltd is the operator of PEL 73, which covers most of the Kavango East Region and part of the Kavango West Region. Groundwater is a source of water providing much of the water requirements for exploration activities, including the drilling of oil and gas wells and performing geophysical exploration activities, such as seismic surveys. Groundwater consumption includes water for domestic use for personnel/crew, for road and drill pad construction and any other activities related hereto.

Water requirements for exploration activities are comparatively low in comparison to the development and production of oil and gas wells.

The water supply requirements are only concerned with exploration activities and do not include the development and production of oil and gas resources. Water demand for the drilling of exploration wells is roughly estimated as 1m^3 water per meter.

Aquifer's extent and occurrence for the Kavango Region, is still not well understood, despite a substantial number of boreholes sunk in the area. The majority of drilling done has been mostly for water supply for rural communities.

The latest research conducted for the Kavango Regions, date as far back as 1990. Groundwater development has been neglected over the past 2 decades, as most boreholes drilled are mostly concerned with rural water supply points, which is a cheaper option than piped water.

Historic works conducted commissioned by the Ministry of Agriculture, Fisheries, Water and Rural Development in 1990 comprised:

- Phase 1 - Desk study and Hydro Census

- Phase 2 – Drilling and Test Pumping of Exploration Boreholes

No other geohydrological studies have been conducted since. Other work conducted was the formulation of a water supply development plan to expand and improve water supply for the Kavango region's rural population, with the focus on the rehabilitation and equipping of existing water points, and the drilling and installation of new water points. The objective of Kavango's Regional Rural Water Supply Development Plan was to provide water supply infrastructure to 90% of people in the Kavango Region by 2010.

The management of groundwater resources is vital in securing long term water supply and requires industry, role players and stakeholders to subscribe to best practices, so needed. This requires Government to enact legislation and policies to ensure the proper management of Namibia's water resources. Namibia's legislation is outdated and does not comply with other latest legislations concerning water resources. New legislation is necessary which should be the overarching document regarding all water in Namibia. However this process is quite complicated and will require inputs from all role players, stakeholders, engineers, scientists, technicians, drillers and the supply industry. The management of water resources will be lacking without appropriate legislation and standard operating procedures within the water supply industry.

The assessment of groundwater resources are further complicated by the lack of groundwater management practices. The management of groundwater resources is not prioritised given such an arid region. The establishment of a regional groundwater monitoring network is a good start for the long term monitoring of groundwater for the Kavango Region.

4.2 Project Location – PEL 73

PEL 73 is located in north-eastern Namibia, covering 25 462km^2, covering mostly the Kavango East Region and part of the Kavango West Region. Rundu is the only urban centre of the region and is situated 400km north east of Windhoek and 716km by road. PEL 73 covers blocks 1719, 1720, 1721, 1819, 1820 and 1821 and lies between latitudes 17°S and 19°S and longitudes 19°E and 21°E.

Recon Africa intends to drill 12 additional oil and gas wells as depicted in Figure 1 and 3. Thus far 3 stratigraphic wells (6-2, 6-1 and P33) have been completed, since January 2021, with the latest well drilled during July-August 2022. Figure 3 illustrates the location of the completed stratigraphic oil and gas wells, planned wells and the newly proposed wells in the order of target and priority, with one being the highest priority.

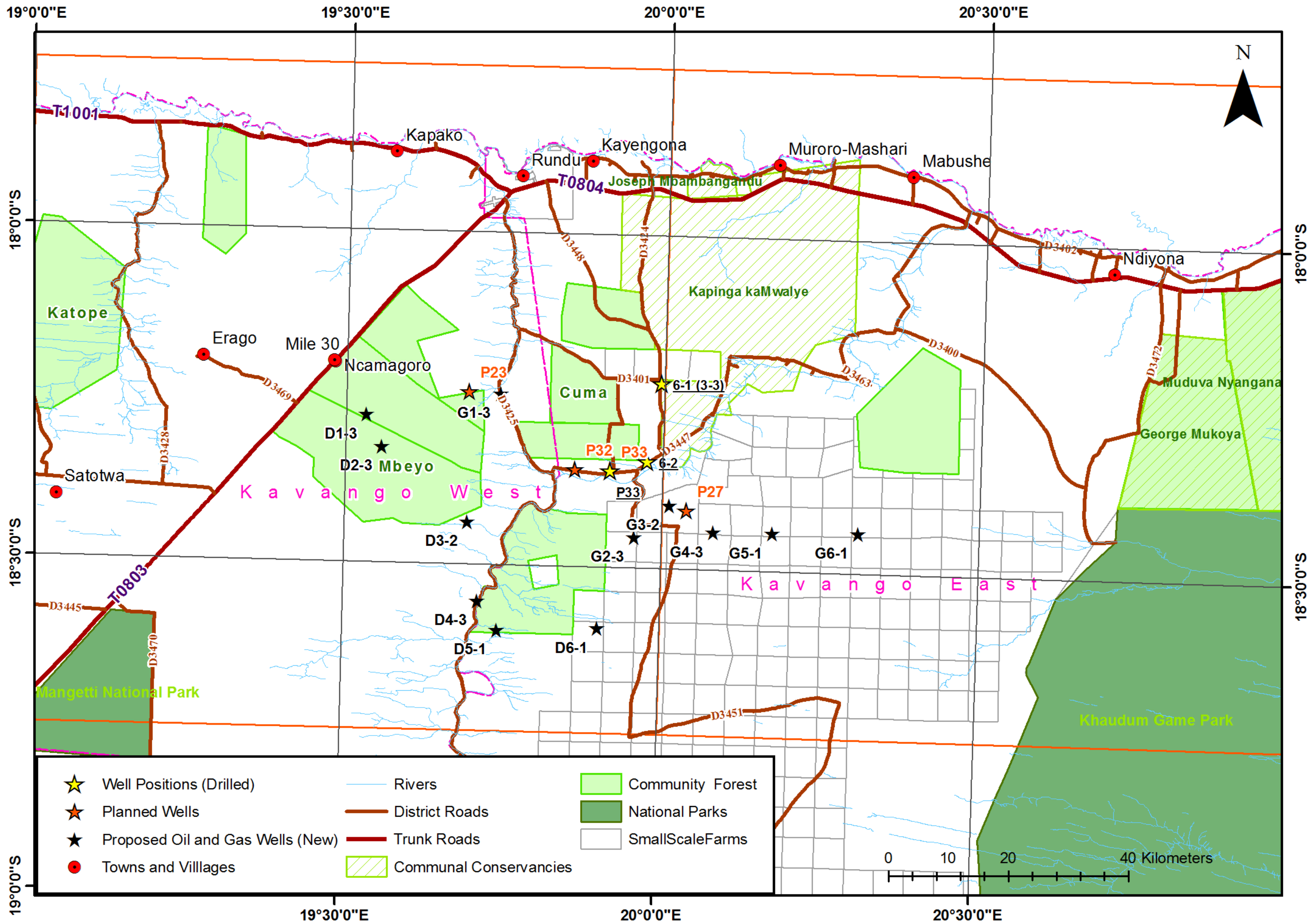

Figure 3. Location of existing, planned and newly proposed oil and gas wells – PEL 73

4.3 Geology

4.3.1 The Kalahari-Karoo Basin Structural Framework

The structural framework has been derived and summarised from a paper by CR Jones published by the Ministry of Mineral Resources and Water of the Republic of Botswana – Botswana Notes and records, Volume 12 Issue 1, 1980.

The Kalahari Basin's foundation of structural elements dates as far back to the Damara Orogeny. The Kalahari Basin is a vast inland basin with basement floors formed by Archean Craton rocks of the Kasai Craton in the far north and the Kaapvaal and Rhodesian Craton to the south east. The Limpopo Mobile belt separates the Kaapvaal and Rhodesion Cratons in the east. Elsewhere the basement floor consists of Precambrain rocks. The north eastern striking Damara-Katanga Orogeny forms much of the basal rocks of the Upper Kalahari Basin and Cuvelai Etosha Basin. At the edge of the Kaapvaal Craton to the south, the Cape Fold Belt formed a narrow strip which underlies the Kalahari sediments in this region. A graben feature defined by aeromagnetic data, striking northeast separating Archean cratons to the south from Damara-Katangan in the northwest is observed. Magnetic observation indicates that Precambrian rocks have been down-faulted to great depths. The infill sediments of the graben are not known and it is likely inferred to be of Precambrian rocks, capped by Karoo strata. Prospecting for coal at the north-eastern edge of the basin in Botswana suggests Karoo sandstone and shale to thicknesses of at least a 1000m. At the south western end of the basin the graben appears to align with the flat lying Nama Basin in Namibia filled mostly by sediments of late Precambrian origin.

Uplift of the Damara approximately 465 Ma, was the last orogenic event and was followed by regional up-warp or epeirogenic development of the Kalahari-Karoo Basin associated with continual rifting. The Karoo deposition commenced with the earlier Palaeozoic marine sediments and late Carboniferous Dwyka tillites followed by deltaic and Aeolian sediments during Ecca, Beaufort and Stormberg times. The Karoo cycle was terminated by wide spread volcanism between 200-160Ma. The Kalahari-Karoo Basin was affected by other episodes of faulting, apart from the epeirogenic development and rifting, of which the dyke swarms, striking northwest in north central Botswana and eastern Namibia, is an example. These dyke swarms are associated with the breakup of Gondwana. The pre-Kalahari land surface was one of considerable relief with active erosion during Mesozoic and late Tertiary times. The Kalahari Basin became the locus of terrestrial deposits during the uplift of the great Escarpment of Southern Africa. It is speculated that deposition of the Kalahari sediments started in late Cretaceous indicative of Barotseland and Bushmanland. Tertiary times saw the formation of peneplanation, with positive relief areas being levelled by erosion and the infill of lower lying areas. During Quaternary the climate changed to wetter climate episodes with pediplanation and lacustrine conditions prevailing at the time for parts of the Kalahari Basin. Depositions in grabens of the Okavango Delta and central Kalahari were influenced by recent tectonics or Neo-tectonism.

The general geology of the area can be broadly divided into sequences as listed in Table 1 below. The geology of the study area comprises rocks of the following sequences listed from young to old:

- Kalahari
- Karoo
- Damara
- Pre-Damara Basement (Grootfontein Mafic Complex)

Table 2 is an overview of the stratigraphy typical of the Upper Kalahari Basin, Kavango.

Age	Group/ Sequence	Rock Type	Environments
Recent 64Ma	Kalahari	Recent unconsolidated sands, aeolian sands, gravels, silts, clays, and calcretes	Fluvial - Lacustrine
UNCONFORMITY			
125Ma 305Ma	Karoo	Flood Basalts, Dolerite Dykes, Glacial Tillites, Conglomerates, Sandstones, mudstone, siltstones and shale	Volcanic, Fluvial-Deltaic, Fluvial –Lacustrine Glacial
500Ma 900Ma	Damara	Conglomerates, Tillite; Meta-sediments phyllites, schists, quartzites, marble); Limestone-Dolomites; Granites	Rift Basins Glacial Volcanics
>1000Ma	Pre-Damara	Grootfontein Mafic Complex	Basal Rocks

The geology mentioned refers to geology which outcrops or sub-outcrop within the study area, or was intersected within boreholes. The Pre-Damara is not within the study area, and crops out further south in the vicinity of Grootfontein. The Grootfontein Mafic Complex is one of the older basal rocks of Namibian Geology and forms the ultimate base of the various basins which formed during Namibia's geological history. Basal rocks for the Kalahari Basin in the vicinity of the Kavango Region are either Karoo basalt or Damara rocks (Nosib quartzites east of Rundu).

4.3.2 The Kalahari Group Sediments

The Kalahari Group Sediments cover most of northern and eastern Namibia and is the fill of a huge inland sedimentary basin covering the central parts of southern and central Africa. The Basin covers mostly Angola, Zambia, Namibia, Botswana, and South Africa and is referred to as the Kalahari Basin, with the Cuvelai-Etosha, Upper Kalahari, and the Lower Kalahari as sub-basins. The upper Kalahari Basin and a portion of the Etosha-Cuvelai Basin cover mostly the Kavango Region. PEL 73 lies mostly within the Upper Kalahari Basin or Kavango Basin, referring to local nomenclature. In Namibia the sub-basins have been given local names, such as the Ovambo and Omaheke Basins for the Etosha-Cuvelai and Upper Kalahari basins respectively. The Aranos Basin which is the equivalent of the Lower Kalahari Basin is located further south which is outside the study area and will not be considered.

The Kalahari Group sediments consist mostly of gravels, sands, silts and clays or as a combination of the different layers. These layers are variable and lateral correlation is difficult due to a variable basin floor topography and facies changes over short distances.

The Kalahari Group sediments are a known source of groundwater, but the yield and quality is highly variable.

4.3.3 Karoo Group

The Karoo Sequence is found beneath the Kalahari Group sediments. The Karoo Super Group as it is known stretches over continents and has equivalent rocks in South America, Antarctica and Australia. Various sub-basins defined as half-graben structures, during stages of deformation of the foreland basin formed. The Dwyka Group consists of glacial moraines and is found at the base of the Karoo Super Group. This is overlain by lacustrine sediments of the Ecca Group, consisting of shales, mudstone, limestones, sandstones and carbonaceous shale. The upper most unit of the Karoo Super Group is basalts inter-fingering aeolian sands forming the Kalkrand Formation.

Associated with the Kalkrand Formation is extensive dolerite dykes and sills intruding sediments of the Karoo and Kalahari sediments. Evidence of these dyke swarms are found in aeromagnetic data striking northwest in the eastern part of the Kavango Basin.

It has to be said that boreholes within the Kavango Basin rarely penetrated the Karoo rocks beyond the basalts or aeolian Etjo Formation. Boreholes drilled within the Kavango Basin are rarely drilled deeper than 200m.

4.3.4 Basement Geology of the Kavango Basin

Very little is known about the basement geology of the Kavango Region beyond the upper Karoo Formations as the boreholes drilled in the region rarely went beyond 200m depth. A review of aeromagnetic data of the Kavango Basin gave some idea of basement geology expected and perhaps depth to basement. Separation filtering has been applied to aeromagnetic data to enhance and filter prominent features within the data set. The extent of the magnetic basement and dolerite sills and dyke swarms, underlain by Damara, which is known to outcrop in the area, is clearly visible from the resultant image. Figure 4 maps the anticipated basement geology which has been divided into categories namely, Deep Karoo Basement, Karoo Flood Basalts, Karoo Basalt outcrop/sub-outcrop and Damara basement. The Karoo Flood Basalts underlie mostly the Kavango West and the north western parts of Kavango East. The eastern section of the Kavango East is found to be underlain by Damara Rocks, intruded by Karoo sills and dyke swarms. Further east in the vicinity of Mukwe and Popa Falls the area is underlain by Karoo Basalt in outcrop/sub-outcrop.

The extent of the Karoo flood Basalts are controlled by a northeast fault which is a separation between moderate and deeper basalts in the northwest, whereas the dolerite dykes and sills in the east are mostly controlled by vertical northwest striking features of faults and dykes. A northwest feature which is considered a vertical fault plane, displaces basalts deeper to the south, which is interpreted from drilling completed in the area to the south where bedrock was not intersected. Flood Basalts occurred along fault planes as depicted in Figure 4, which are considered conduits to lava flow.

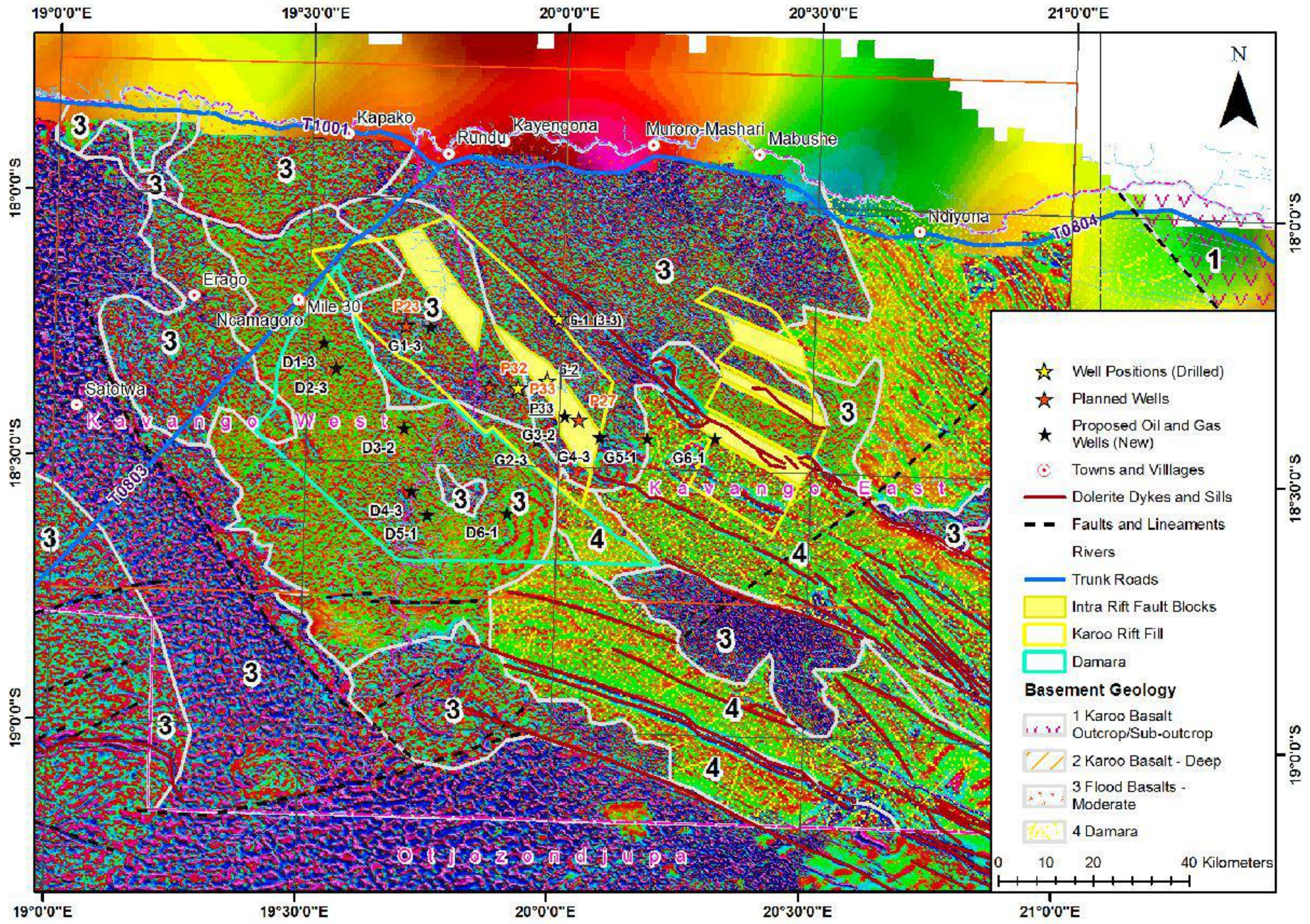

Figure 4. Interpreted Basement Geology overlain with targeted oil and gas plays, Kavango Basin – PEL 73

4.4 Geohydrology

4.4.1 Groundwater Occurrence

The occurrence of groundwater within the Kavango Basin can be divided into:

1. Primary Aquifers – Saturated Kalahari Sediments of the Kalahari Group
   – Karoo Flood Basalts and Karoo Fill Sediments
2. Secondary Aquifers – Fractured/Faulted and Weathered bedrock geology
   Deep seated (Rift) Faults that cuts across Kalahari Group Sediments and Basement Geology
   Recent Faulting defined by surface linears and tree lines

The groundwater potential for the Kavango Region can be described as moderate to low, despite the chance of finding water is more often than not. Water Quality for most places is considered good quality water, especially in the western territories with greater Kalahari thickness. However there are areas where groundwater is of bad/poor quality, and has been the cause of suffering to many communities having no access to drinking water. Poor quality groundwater is mostly located to the east where the Kalahari sediments are thin and has limited saturated thickness. These boreholes penetrate secondary aquifers within bedrock features with poorer water quality. Poor quality water is associated with stagnant waters.

Attempts have been made to correlate Kalahari stratigraphy with groundwater regimes. Upper, lower and middle Kalahari aquifers have been suggested to correlate with Tsumkwe, Eiseb and Omatako Formations (Hegenberger 1982). However, very little is known about their geohydrology in terms of lateral extent, its yield and expected water quality. To fully understand the aquifers found within the Kavango Region, greater research is still required to investigate the prevalent groundwater regimes of the Kavango Basin. Research will separate favourable areas of good yield and quality from areas where groundwater are of an inferior quality. Dumushe (in Otjozondjupa) is one area where shallow good quality water overlies water of a poorer quality. The community uses water from shallow wells for drinking and water from deeper penetrating boreholes for livestock.

Boreholes drilled next to and along the Okavango River, intersect paleo-channels of the Okavango River, with often high yielding boreholes, mostly used for Bulk Water Supply Schemes. It has been found with deeper drilling along the river, that a confined (artesian) saline aquifer underlies the paleo-channel (alluvium) aquifers on top.

4.4.2 Groundwater Data

Hand dug wells and boreholes are the main sources of water for the Kavango Region. Groundwater information was sourced from The Division Geohydrology, which is the entity responsible for Groundwater Management in Namibia under the Ministry of Agriculture, Water and Land Reform (MAWLR). The data is kept in a database called the Groundwater Information System (GROWAS II). Various hydro census of water points have been commissioned over the years, by many private stakeholders and through other studies commissioned by government. It is expected this database to hold the most significant data concerning groundwater for the study area. However, you will find that the current situation on the ground might differ significantly, which is the result of ongoing drilling, without the knowledge or notification of the relevant authorities. This is a considerable loss of pertinent knowledge, since the establishment and development of water resources come at a considerable cost.

The GROWAS database is not a complete base of groundwater in Namibia. A lot of information is still kept in hardcopy and sometimes only the location of a borehole is known without any other information. Information lacking, is lithologies intersected, depth to and type of bedrock, and aquifer/saturated thickness.

Greater effort is necessary to expand the GROWAS database to at least classify aquifers encountered to have a better understanding of groundwater regimes from rudimentary geo-hydrological information. A database with 1052 records has been extracted from GROWAS with the latest records having boreholes drilled in 2020.

A hydro census was conducted in April 2021 to gather information surrounding the Phase 1 seismic survey extent and again in July-August 2022 and from September-October 2022, to locate water points along the 2nd phase seismic surveys lines and the extension thereof. The findings of the April 2022 Hydro Census, can be found as a separate report, as part of the Groundwater Assessment of the Kavango Region, in particular PEL 73. Hydro Census reports for the hydro census of phase 2 and 3 will follow shortly.

4.4.3 Historic Groundwater Investigations

The most significant work conducted for the area was a study commissioned in 1990 by the Ministry of Agriculture, Fisheries, Water and Rural Development. The study concluded:

- The sediments of the Kalahari Group are a reliable source of relatively good quality water. The Kalahari Group sediments are the primary aquifer of the area.
- Water from Secondary Aquifers associated with pre-Kalahari bedrock features were found to be varying in reliability and water quality. The exploration was also more cumbersome.
- The water supply for the area can be divided into areas where water is found at greater depths and requires motorisation to abstract water;
- and into areas of shallow groundwater, where water is abstracted by hand/hand pump.
- Artesian water exists and was found in two places.
- Groundwater flows north towards the Okavango River.
- Two distinct aquifers are present in the Dumushe area with saline water underlying fresh water.

Another regional study conducted was the Regional Rural Water Supply (RWS) Development Plan during 1999-2003, by Lund Consulting Engineers. This study in particular was to develop a water supply development plan to cater for 15 years. No drilling was conducted of any scientific research. The objective of the Kavango Regional Rural Water Supply Development Plan was to provide water supply infrastructure to 90% of people in the Kavango Region by 2010.

These documents give a good account of the groundwater situation in the Kavango Region. The Okavango River Basin Groundwater overview, conducted during 1999, for the Okavango River Basin Commission (Okacom), by Interconsult Namibia, is another study conducted concerning the Kavango Region. This study basically is a desk study (Specialist Report) on the available data resources for the project and its shortcomings. However the document proved useful.

4.4.4 Depth to Groundwater

The investigation of depth to groundwater was mostly derived from data extracted from the GROWAS database. Approximately 35% of boreholes extracted from the database did not contain any rest water level data. Surface heights were allocated to borehole data for 1047 boreholes. Boreholes with inadequate data were omitted from the database for creating a piezometric surface. 682 boreholes had rest water levels which were used to generate a surface and contour plot of the piezometric surface.

A noticeable increase in the number of borehole with relevant geo-hydrological information has been observed, which is a testament of ongoing work in expanding the knowledge base of GROWAS.

A contour map of rest water level (Figure 5) was produced, which is an indication of the depth to groundwater.

Noticeable, is that there is a separation in the depth to groundwater which coincides with a northwest fault line, a prominent geological feature. It is understood that this feature represents weak zone/fault which acted as conduit for magmatic basaltic lava flows. This fault line separates groundwater to the south, with depths between 80-120m, from shallower groundwater to the east, with water levels less than 60m.

Figure 5 further indicates a shallow water table, which occur along the Ndonga and Omatako Omiramba (Rivers). Water depths within Ephemeral River valleys are less than 10m, derived from data compiled during the hydro census, and tap a shallow perched aquifer. This zone seems to follow the valleys of ephemeral rivers/omiramba in that vicinity and terminates against the northwest boundary fault which causes a steep gradient of water level rise further to the south.

Apart from zones of shallow water along the river, the Kavango West Region has groundwater located deeper than 80m. Groundwater for the most part of the Kavango East Region is shallow and is not deeper than 40m. Close to the river water levels are less than 20m. However there seems to be a steep gradient where water levels drop from 40m below ground level to levels of 15m over a short distance, next and close to the river. The depth to groundwater in actual effect provides an over view of the pump inlet depth to abstract water from. The deeper the groundwater, the greater the depth in abstracting water from, for a particular area. The depth to groundwater also highlights areas of shallow groundwater prone to possible contamination.

The newly planned 12 wells target oil and gas plays of Karoo Rift Sediments and carbonates of the Otavi Group, Damara Orogeny.

Five wells to the east, labelled (G2-6), is expected to intersect groundwater at depths greater than 20m, becoming progressively deeper from the west to east. Well G1-3, located further to the north and west along the Ndonga Omuramba is expected to intersect shallow groundwater of less than 10m.

Oil and Gas wells targeting the Damara carbonates (numbered D3-6), especially located along the Omatako Omuramba is expected to intersect shallow groundwater in less than 10m. Wells (D1&2) located further north and to the west, as depicted in Figure 5, suggests groundwater is expected at depths greater than 30m.

Water supply boreholes, drilled to supply water to rig operations, in general should emplace a sanitary (bentonite) seal at the top of the borehole to prevent any contamination of the shallow aquifers, especially in areas along the Ndonga and Omatako Omiramba.

4.4.5 Groundwater Flow

A map of the piezometric surface of groundwater has been constructed from 682 boreholes with rest water level information. This map is an indication of the flow of groundwater for the Kavango Region. It is widely accepted that groundwater flow mimics the topography, which means water will flow from the south, north towards the Okavango River, and to the east towards the Okavango Delta in Botswana. This perhaps is true, on a broad scale but local change in flow can be expected. Figure 6, is a piezometric surface created to determine the flow of groundwater in the region. Three groundwater highs are depicted in Figure 6, from where groundwater flows away to lower/depressions.

One significant depressed zone, lies south of the northwest fault zone, which is the boundary between deep and shallow waters and act as a graben where water is draining into. North of the Omatako Omuramba, groundwater flows north, whereas south of the Omatako Omuramba water drains south.

In the north in the vicinity of Nkurenkuru, there is a northwest high from where groundwater drains south towards the ephemeral rivers, and then towards the Okavango River. A general NW-SE area of elevated groundwater, running parallel to the river, has groundwater draining first inland towards ephemeral rivers, then north-eastwards towards the main river flow.

Groundwater in the south east in the vicinity of the northern dyke swarms, water drains south-south-east (SSE) in the direction of the Okavango Delta. The lowest groundwater is located in the east in the vicinity of Andara and Popa Falls, where water follows in the direction of the river.

At the western edge of the Kavango Region, groundwater is connected to the Ovambo Basin, flowing in a south-westerly direction. In the Ngoma-Baramasoni area groundwater seems to accumulate in this depression. This area is plagued with water of poorer water quality, believed to be stagnant water.

The piezometric surface plot suggests groundwater flow is quite complex and the groundwater flow is not the sample case of following the general topography, which is south to north and west to east. The significance is that recharge of the Kalahari Aquifers is from different areas, which is mainly to the south but also from areas in the central areas of the Kavango region, which is from rainfall in that area. Groundwater flow to some extent is the manifestation of faulting found in the area. The overall groundwater gradient for the Kavango can be described as low-gentle.

There seems to be a correlation between the graben rift margins and the piezometric surface depicted in Figure 6. Groundwater of proposed oil and gas wells north of the southern graben boundary will drain north-easterly, into a sink, bound by the most northern graben rift boundary. Groundwater northeast of the northern rift boundary drains towards the Okavango River, whereas groundwater south of the northern rift boundary drains south-westerly towards the sink.

Groundwater south of the southern rift boundary drains first towards the Omatako Omuramba and then north-easterly into the sink bound by rift boundaries.

The northwest fault line trace can be interpreted as a rift fault, with groundwater flowing towards the fault line trace.

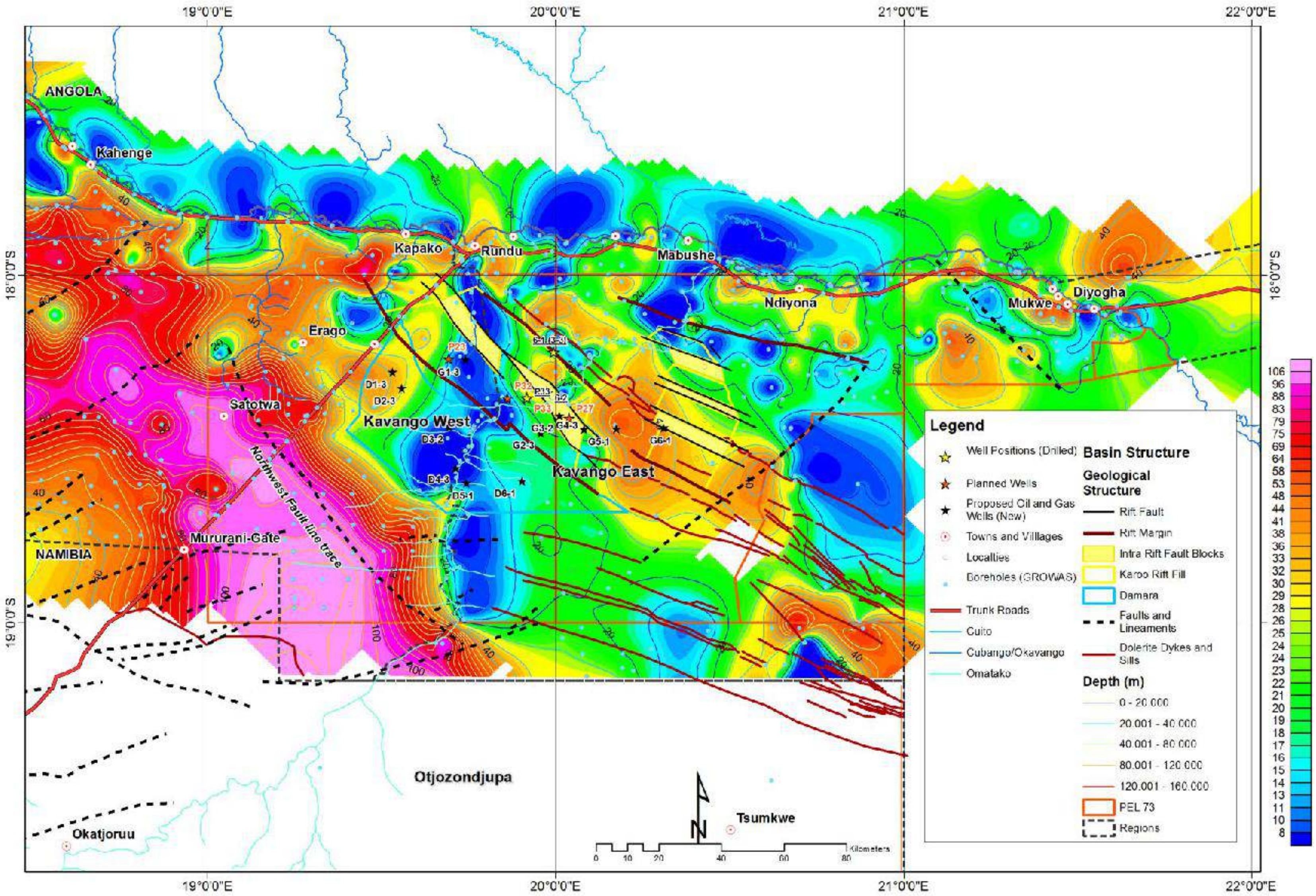

Figure 5. Depth to Groundwater (rest water level), Kavango Region – PEL 73

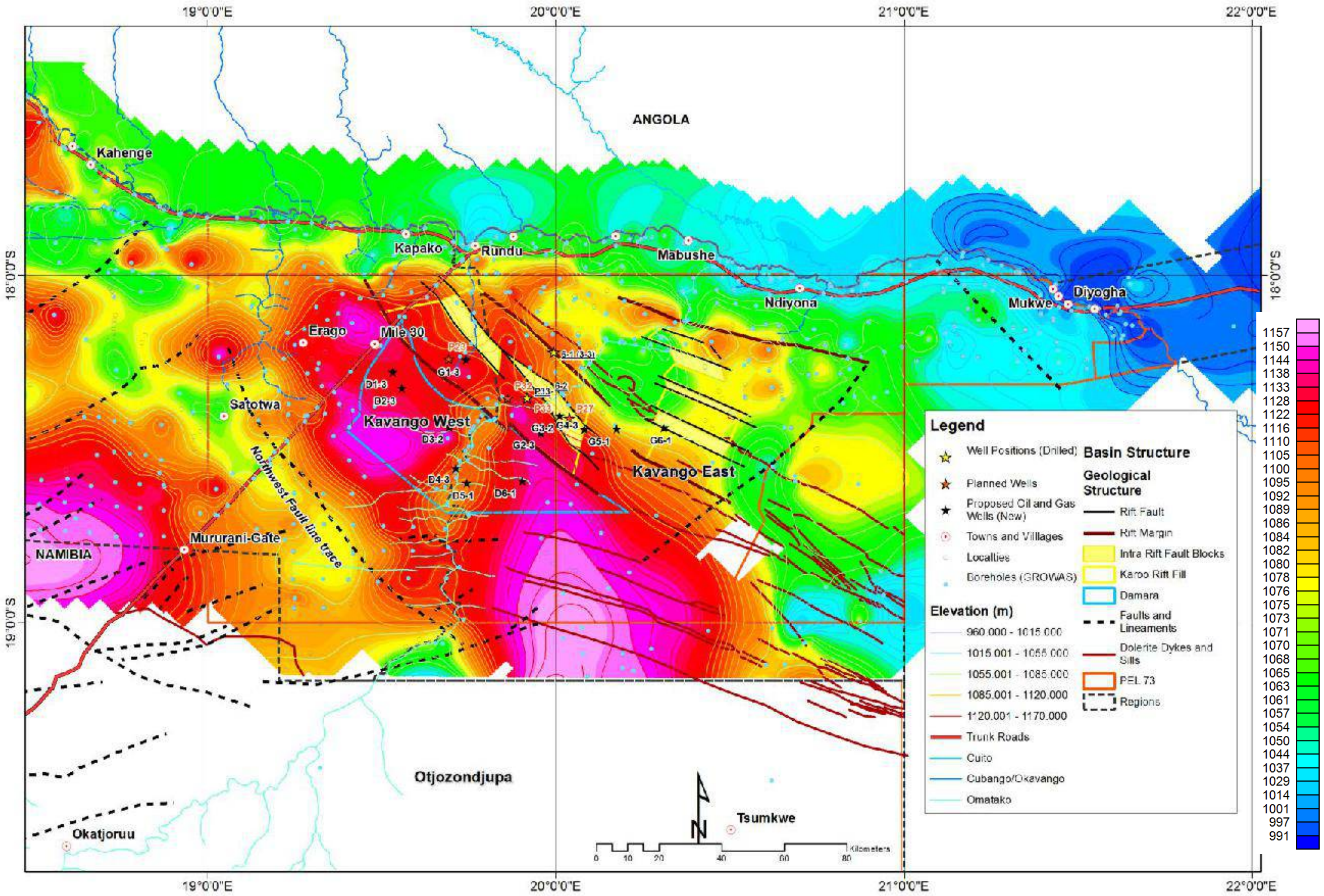

Figure 6. Piezometric Surface, Kavango Region – PEL 73

4.4.6 Borehole Yield

A plot of borehole yield was produced to determine the distribution of borehole yield for the Kavango Region. Approximately 30% of the dataset had no yield information or was not recorded. The remainder of the data (726 records) was used to generate the plots of borehole yield. The lowest yield of $0.08m^3/h$ was recorded for the dataset with the highest yield of $98m^3/h$, with an average of $10m^3/h$ and a median of $7.8\ m^3/h$.

Figure 7 below is a Histogram plot of borehole yield for the particular dataset.

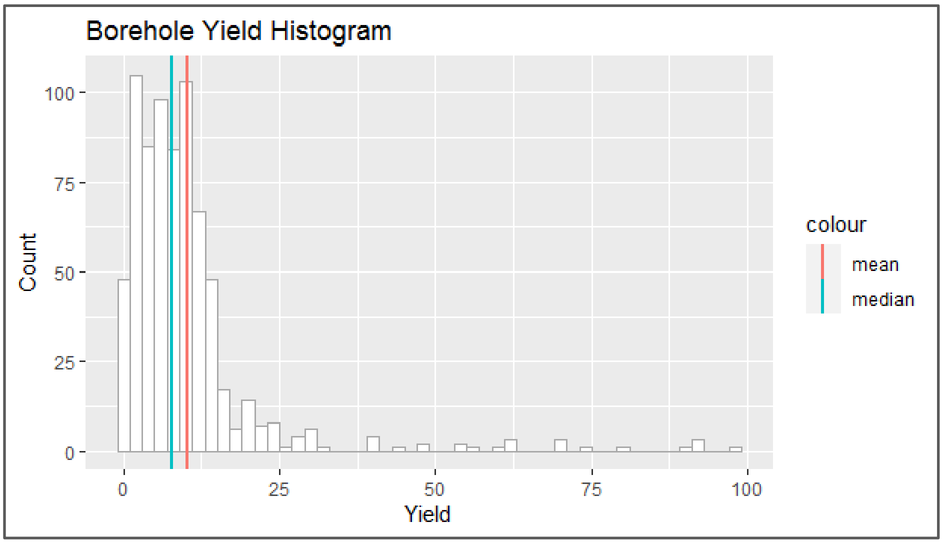

Figure 7. Borehole Yield Histogram, Kavango Boreholes

The statistics reveal that the majority of boreholes have yields between 2-4 m^3/h, followed by boreholes with yields between 8-10m^3/h, with a median of approximately 8m^3/h. This suggests that boreholes on average have moderate yields of 8m^3/h. These yields are significant in relation to other parts of Namibia, where rural water supply borehole yields are perhaps less than 4m^3/h in general.

Exceptional yields of 50-98 m^3/h have been recorded for certain boreholes, which is mostly in close proximity to the river. Higher yielding boreholes further away from the river are an exception to the rule and data from GROWAS in these instances should be reviewed. Overall boreholes tapping the Kalahari Aquifer have above average yields compared to other parts in Namibia, which suggest that groundwater potential is good for exploiting groundwater in the Kavango Regions. The concentration of boreholes is denser in the vicinities closer to the river, whereas areas of lower density are found furthest east (Khaudom) and further west, north of the commercial farms, where access to these areas are cumbersome. To some extent borehole yield is influenced by the design of a borehole, where a poor design can result in a loss of yield capacity due to poor well performance. This makes the correlation of yield with other geohydrological parameters or lithologies and stratigraphy cumbersome.

There is a remarkable difference in yield from boreholes east and west of Mururani, the veterinary checkpoint at the southern border of the Kavango Region. Higher yielding boreholes to the west are influenced by basement faults striking northeast, which originate in the vicinity of Tsumeb, where Otavi Dolomite is cropping out. In the east, boreholes are deeper and intersect water at greater depths, with lower saturated thickness and yields. This is a classic example of where bedrock features contributes to greater yield capacity despite both sets of boreholes intersecting Kalahari sediments.

Borehole yield in the vicinity of the newly proposed oil and gas wells, exhibits yields of $5m^3/h$ and greater. In some instances boreholes have yields greater than $10m^3/h$. Figure 8 depicts borehole yield for PEL 73 and includes borehole surveyed during the hydro census conducted during April 2021. Yield in general is not an absolute but provides a glimpse of expectation for certain areas and yields of above $5m^3/h$ is expected for the areas of the newly proposed oil and gas wells.

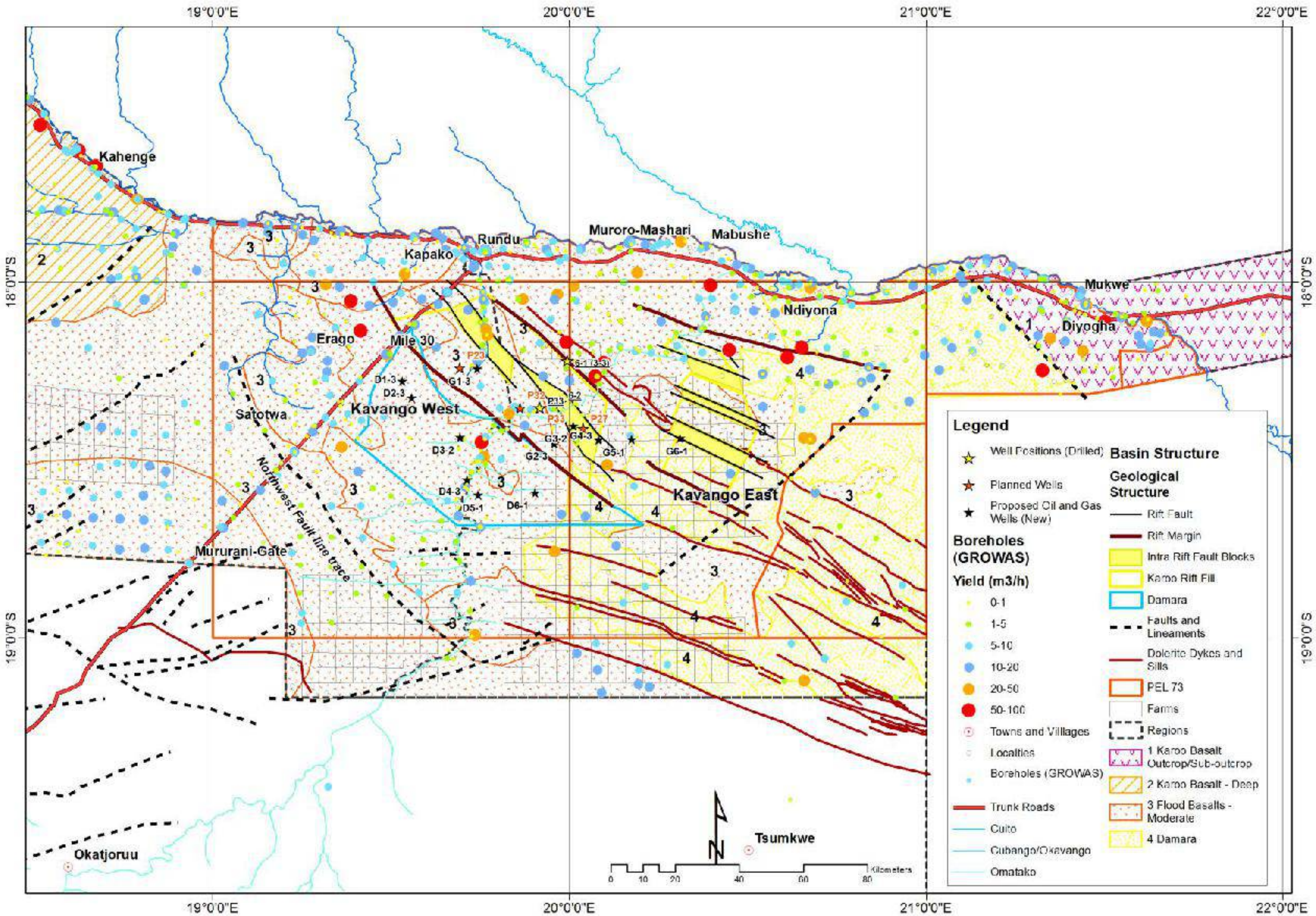

Figure 8. Borehole Yield, Kavango Region – PEL 73

4.4.7 Water Quality

Water Quality is essential to ensure water does not pose a potential risk to the health of people, the environment, animals and aquatic ecosystems. Water quality analyses determine whether water has no adverse effect on the fitness of water for a specific use. Water quality is being described by its physical, chemical, biological and aesthetic properties to determine its fitness for a variety of uses. Water quality properties are determined by constituents/determinants dissolved or suspended in water.

Water Quality Guidelines are a set of information provided by constituents with a water quality range for each constituent and the norms used to assess its effects, and how effects might be mitigated and possibly remedied/treated.

According to the Namibian Guidelines for the evaluation of drinking water for human consumption with regard to chemical, physical and bacteriological quality water is classified as A, B, C or D. Table 3 below describes the classes of water quality.

Table 1. Water Quality Classification

Class	Water Quality
A	Excellent
B	Good
C	Poor (low risk)
D	Unsuitable for human consumption

Good quality water falls within Class **A** or **B**. Class **C** water is of poor quality but can still be used to some extent. Class **D** is unfit for human consumption, but can be used for stock watering or not.

Water Quality data has been deduced from an extract from the GROWAS II Database. The latest water quality analyses were selected as a representation of water quality of a particular water point, since more than one analysis was exported from the GROWAS database. Total Dissolved Solids (TDS) is a good indicator of the overall water quality and is the determinant used to evaluate the water quality at a regional level. Class A and B are accepted ranges of water quality with class C and D, not acceptable for human consumption.

A total of 717 records have been extracted from the reduced GROWAS database.

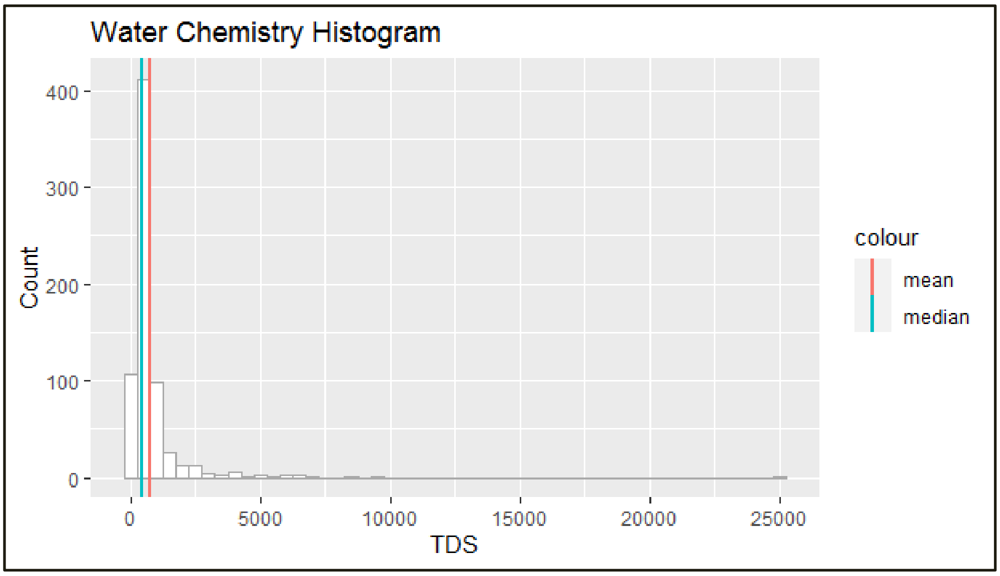

Figure 9. Total Dissolved Solids (TDS) Histogram, Kavango Region

A histogram plot of TDS (Figure 9) was constructed from water chemistry data from GROWAS. 90% of the data had a TDS between 500-1000mg/l (ppm), which is considered water of good quality and of Class B at least. The average TDS for this dataset was 745ppm which is water of Class A, according to the Namibian Guidelines of Water Quality. About 75% of the data falls within the category of good quality water. The highest TDS recorded for boreholes of the Kavango Region is 24,799ppm. Water Quality exceeding a TDS of 2,000ppm is considered Class C and is not fit for human consumption. About 86 (12%) samples exceeded this value. Despite the occurrence of poor quality groundwater, groundwater of good quality does exist in the vicinity close by, normally not further than 5km. It is inferred that poor quality water occurs in the same vicinity of high yielding boreholes, which is associated with bedrock aquifers and stagnant water. Poorer water quality might also be associated with the saline aquifer water below a fresh water aquifer. Care should be exercised in areas of shallow bedrock, to ensure drilling does not intersect layers of poorer water quality. It is in the opinion of the author that poorer water quality is associated with stagnant water in areas underlain by basalt bedrock, where the Kalahari aquifer is fairly thin.

However, no correlation could be established between poorer water quality and any lithology or stratigraphy. Boreholes with poorer water quality is high in sodium salts ($NaCl_2$ and Na_2SO_4), which is indicative of stagnant water with high resident times.

33 Water samples were collected during the hydro census of 90 boreholes. The results of the water quality analysis can be found within the hydro census report as

per Namibian Water Quality Guidelines. A summary of results is given in paragraph below. Results from the latest hydro census conducted from July to September 2022 are still outstanding.

Twenty three (23) samples had water of an acceptable quality, of which 11 were of class A and 12 of class B. Close to a 3rd (10) of the water samples had water of poor quality, which were either class **C** or **D**. Water with class **C** water quality (5 samples) were mostly attributed to water with high turbidity caused by discolouration of Fe and Mn. Only one sample had **C** quality water due to elevated nitrates which was for the well at Baramasoni. Water with class **D** water quality were because of contamination by nitrate, high concentrations of sodium salts (sulphate and chloride), and water with poor turbidity because of high Fe and Mn concentrations. Water quality with high turbidity of class **D** is mostly aesthetic and of low risk, other than affecting the taste of water. Water of class **D** quality with high sodium salts has a salty taste and pose a low to moderate risk, but is acceptable for stock watering. Boreholes with high nitrate concentrations pose a health risk and can cause Methaemoglobinaemia in infants and the irritation of mucous membranes in adults. Water of class **D** can still be used for stock watering, in this instance.

The monitoring of production boreholes and boreholes in close proximity to proposed oil and gas wells revealed that 2 types of water could be identified based on their major ionic composition. Water types identified are:

- Calcium Bicarbonate Waters – typical of shallow fresh groundwater
- Sodium Bicarbonate Waters – typical of deeper groundwater influenced by ion exchange

Figure 10 is a piper plot of major ionic composition clearly indicating the two types of water on the diamond of major cations and anions they occupy.

It is believed that shallow fresher groundwater correlates to Kalahari Aquifer, whereas sodium bicarbonate waters are related to the deeper Karoo Aquifer.

Good water quality of either Class A or B is expected in the vicinity of newly proposed wells and is dependent on the aquifers they penetrate. Kalahari Aquifers are expected to have water quality of Class A, with the deeper Karoo Aquifers, water quality of Class B.

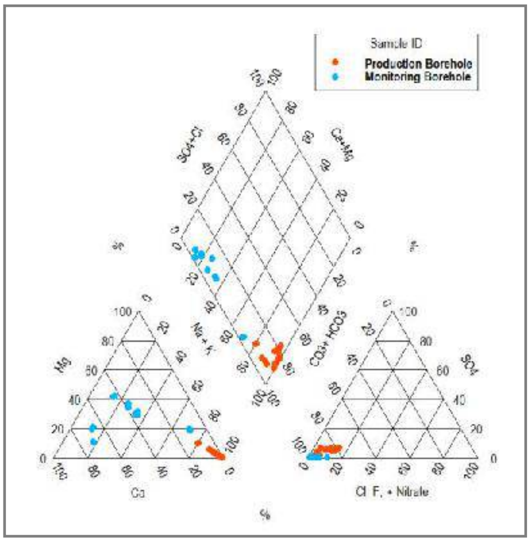

Figure 10. Piper Plot - Production and Monitoring Boreholes

4.4.8 Recharge

The quantification of recharge is complicated and is not supported by the monitoring of wells, which is lacking for the majority of the area. Recharge is calculated as a function/fraction of rainfall. Attempts have been made to estimate the recharge of the Kavango Basin, with results suggesting values of as little as 1mm/annum of mean annual precipitation or 1 litre per square meter (l/m^2). In the absence of good scientific data, recharge, as a rule of thumb, is taken as 1% of the precipitation of Namibia, which estimates recharge to be 120l/m^2, with an annual average rainfall of 500mm.

Various attempts on determining recharge indicate a significant variation in results, which require proper research to make sense of actual recharge. This will require a proper monitoring network, equipped with weather stations at water points for this purpose. However in the absence of proper data a fraction of annual precipitation is a crude method of estimating annual recharge.

Areas of recharge for boreholes in the west are from northeast conduits/fault zones originating in the vicinity of Tsumeb, which results in shallower groundwater and greater borehole yields. Recharge for boreholes on the eastern side of Mururani, and parts inland from the river, gets recharged from local rainfall. It is believed that the deeper aquifers below the flow of the Okavango river is fed by recharge from the Kalahari aquifers, elsewhere, where aquifers are shallow, recharge is from the Okavango river. Water quality is known to deteriorate over time. Recharge (Rainfall) plays a vital role in maintaining water quality with each episode of recharge. Since no monitoring is done including Kalahari aquifers, the changes in water quality over time is not quantified.

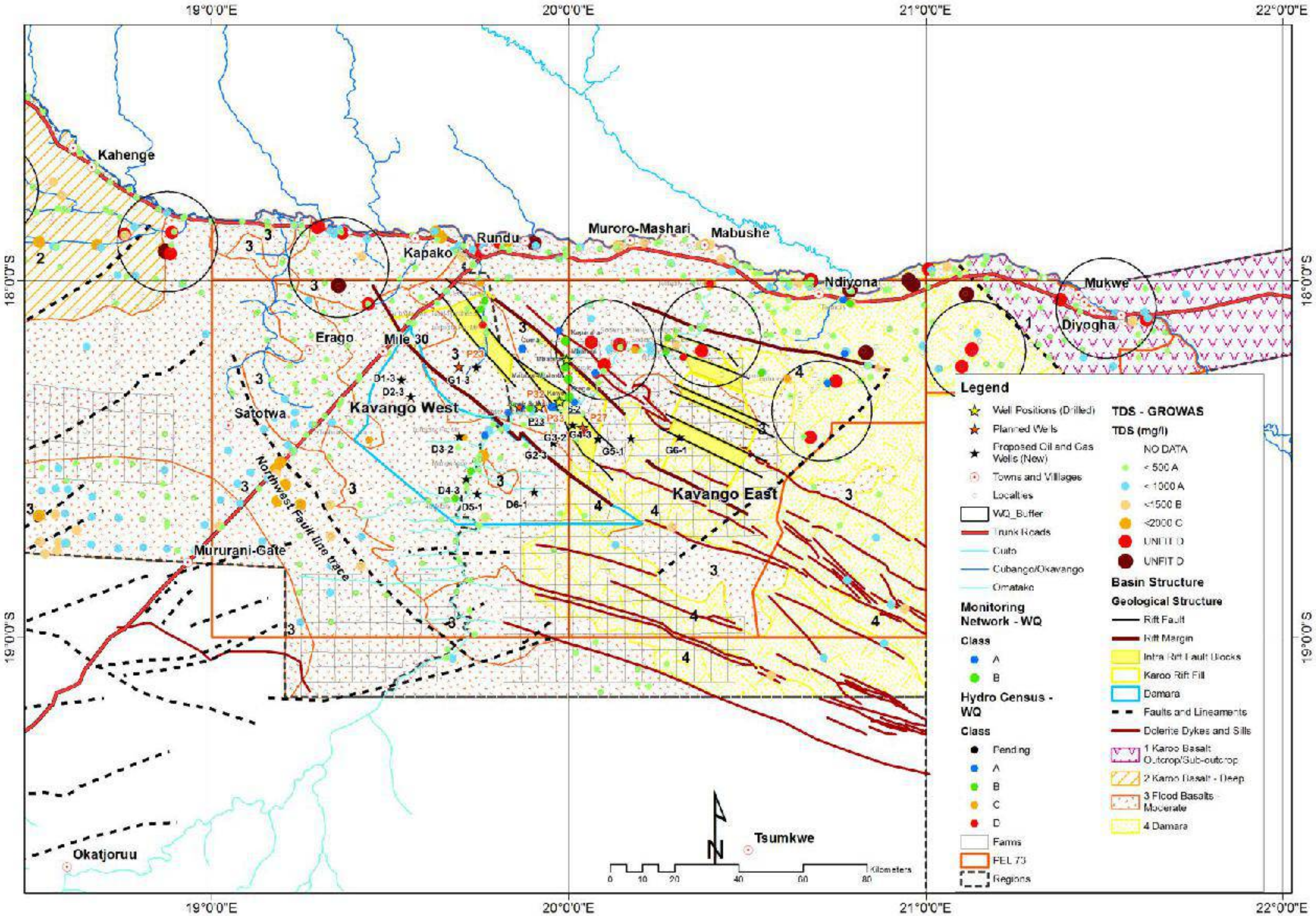

Figure 11. Water Quality, Kavango Region – PEL 73

4.4.9 Aquifer Thickness

The data within in GROWAS does not contain information on the lithologies intersected for most boreholes in the area. Only a few boreholes have data regarding the lithologies intersected. This makes the determination of aquifer thickness difficult. However the saturated thickness can be estimated and defined as the thickness between the first water strike and the final depth of the borehole which gives you an idea of arbitrary aquifer thickness.

The data reduction exercise revealed a few shortcomings, within the database. Some boreholes had water strike data, but not a final depth. Some boreholes had no water strike and final depth data, but had 2nd water strikes recorded. Erroneous data was removed from the dataset before the calculation of saturated thickness.

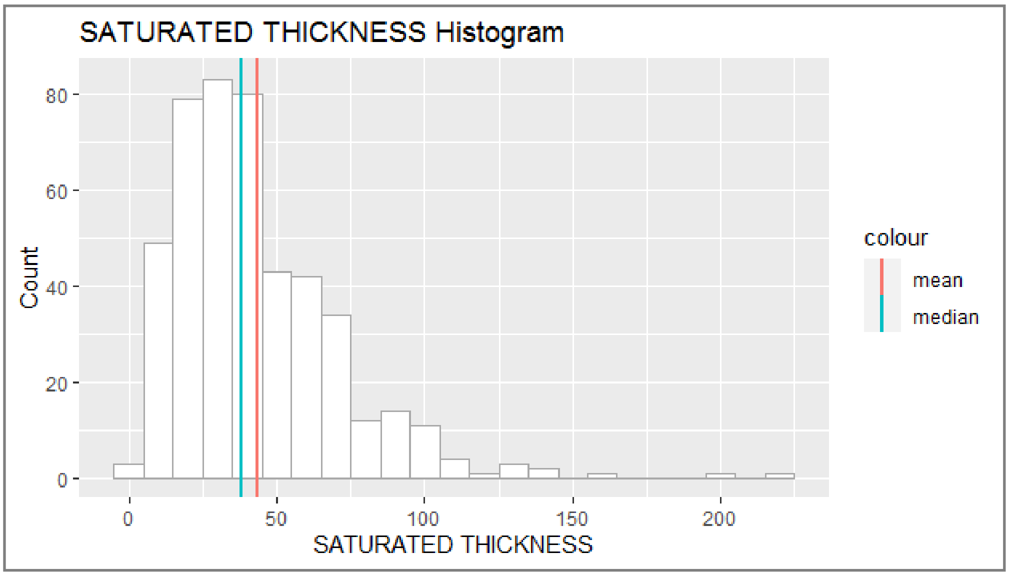

Figure 12. Saturated Thickness, Histogram

From the analysis the following main points have been indentified:

- The average depth of boreholes is 94m, with a minimum of 15m and a maximum of 317m.
- The average water strike is 51m, with a minimum of 4m and a maximum 150m.
- The average saturated thickness for the region is 43.4m, with a minimum of 3m and a maximum of 225m.

Kalahari thickness could not be determined from existing borehole data from GROWAS. Very few boreholes had depth to bedrock or Kalahari thickness recorded. Kalahari thickness is inferred from previous work conducted and is shown in Figure 13. The Kalahari isopachs plotted infers that the Kalahari sediments increase in depth from east to west to southwest and increase in thickness of up to 350m. A depth of over 300m seems like an over estimation, as this depth is possibly derived from boreholes intersecting the Etosha-Cuvelai Basin.

Maps of depth to water strike and saturation thickness with borehole depth have been compiled, which is another indication of depth to groundwater and the yield capacity of a borehole. Saturated thickness gives you an idea of the groundwater potential of the area. The greater the column of saturation the greater the yield capacity anticipated.

There is a marked difference in groundwater intersected by boreholes below or south of the northwest fault, where groundwater was struck at depths greater than a 100m. West of Mururani, along the southern border water strikes were less than 50m, becoming shallower progressing southwest towards Tsumeb. It is believed that the two northeast faults south and west of Tsumeb are conduits giving rise to this elevated water table. Elsewhere south of the Kavango River, water strikes are found to be between 50m and a 100m. Water strikes close to the river are less than 25m. In the vicinity of the proposed oil and gas wells, water is expected to be shallow and will be struck (intersected) within the first 50m of drilling.

Figure 14 maps saturated thickness in relation to borehole depth. Very few boreholes have saturated thicknesses greater than a 100m. The majority of boreholes have a saturated thickness between 40-60m. Deeper boreholes south of the prominent northwest fault have saturated thickness of less than 25m, despite increased drilling depths of greater than 140m. This suggests boreholes will have lower yields in comparison to boreholes with greater saturated thickness. This rationale however is only applicable to boreholes tapping Kalahari sediments.

Borehole saturation thickness in the vicinity of proposed oil and gas wells implies boreholes can have saturation thicknesses of between 50-100m, with depths rarely exceeding a 150m.

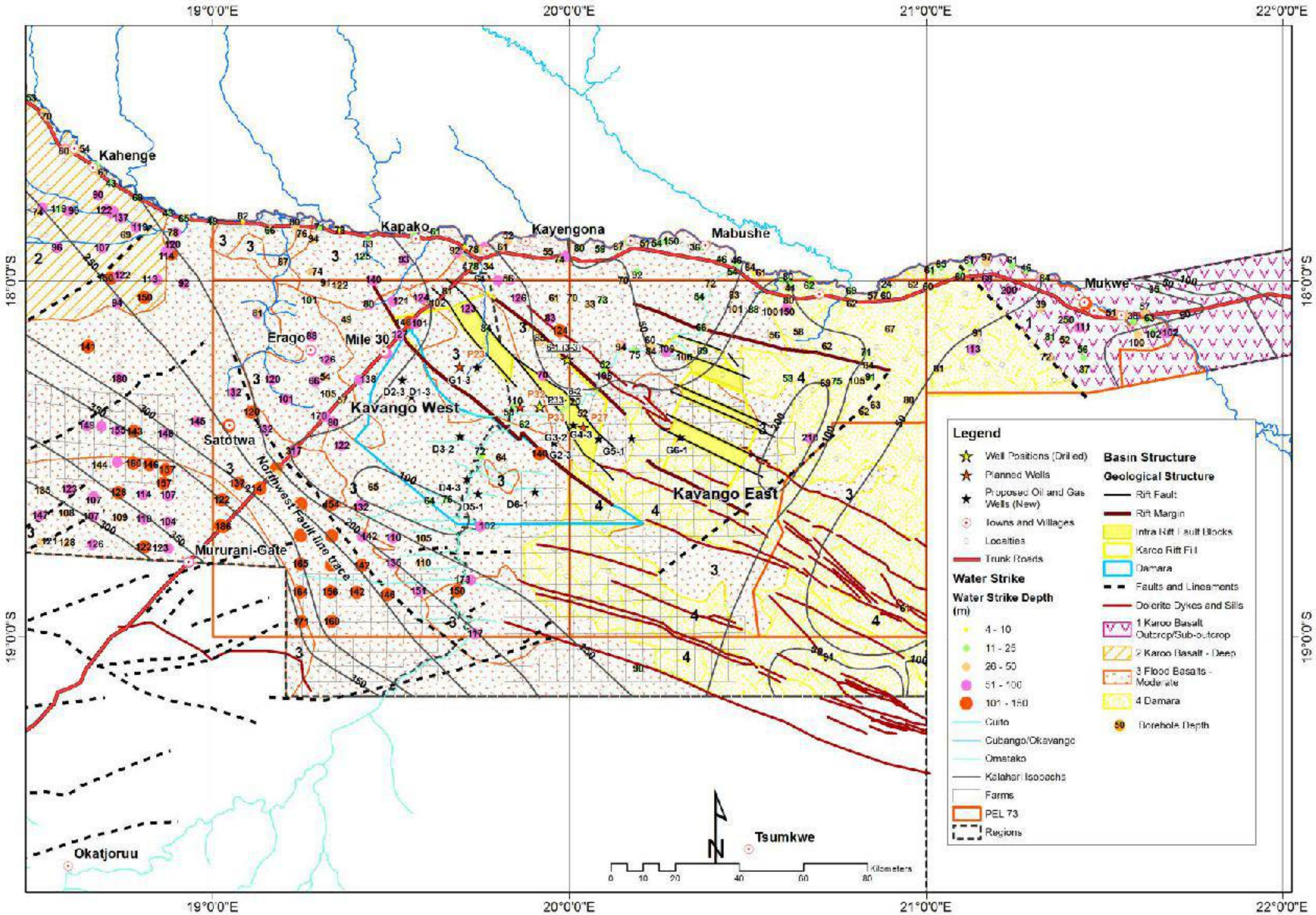

Figure 13. Water Strike Depth, with Borehole Depth, Kavango Region

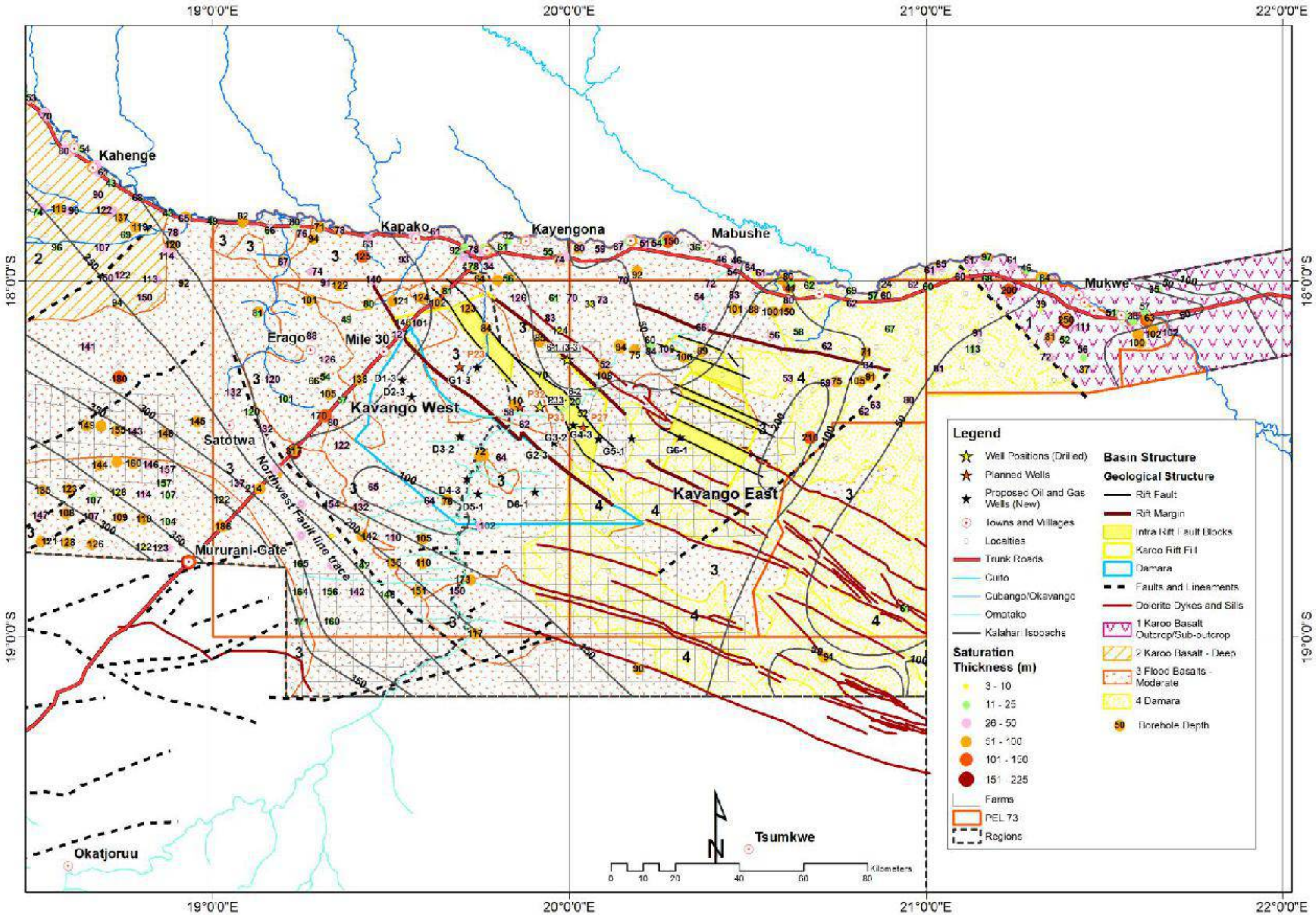

Figure 14. Saturation Thickness with Borehole Depth, Kavango Region

4.5 Groundwater Use and Abstraction

The major consumers of groundwater are communal farmers, who are widely spread across the Kavango Region and use water mainly for livestock and domestic use. No formal abstraction records are kept by farmers, which makes the calculation of water abstraction by farmers problematic.

How much water consumed by community water points is not metered and is therefore not known. The impact of water abstraction by communities is difficult to determine. Various attempts have been made to determine the water demand per water point, but the figures produced are unreliable, especially the livestock numbers per household (HH) per water point. Relying on census population data is also cumbersome, since the number of people served by the number of water points in an enumerator is also elusive.

However given the data available, an attempt was made through the use of spatial analysis and assumptions on the number of livestock per hectare, to determine an average water demand figure per enumerator per borehole.

The water demand per enumerator has been calculated based on the number of livestock it can support per hectare (10LSU) and the population size per enumerator. Approximately 80 litres per day (L/day) have been allowed for water consumption for both livestock and people. A spatial join was done on census data which assigns the number of boreholes to its enumerator which it contains. Results of the analysis were as follows:

The least water required is 0.005m^3/h or 0.14m^3/day and the highest of 5.9 m^3/h or a 141m^3/day, with an average of 0.9 m^3/h or 22 m^3/day. Borehole Yield, on average, can supply approximately between 8-10 m^3/h or 192-240 m^3/day.

The results of the analysis determine that the average borehole yield satisfies the required water demand per water point. The required water demand for the drilling of an oil and gas well has been given as approximately 7m^3/h, which is close to the average borehole yield for the region. Normal operational or safe yield is normally taken as 70-80% of sustainable yield. This indicates that a borehole must yield at least 9m^3/h to fulfil the water requirements of the drilling of the stratigraphic well.

Only farms under irrigation of more than 1ha, require an abstraction permit, or if water is for other use other than for domestic/farming use. An application for a water abstraction permit is recommended despite the area not being in a water controlled area. Water belongs to the state, and has been entrusted to the communal traditional authorities to control the allocation and right of use of water resources over its territory. However since the Traditional Authorities, do not have the capacity, the authority rests with the Division Geohydrology to assess and approve a water permit, for the water supply of the drilling and exploration of PEL 73.

Other users of groundwater are schools, clinics and police stations and other amenities. Schools and clinics have water points exclusively assigned to it; however these installations get shared with the communities. The maintenance of rural water points is assigned to RWS, but the functions of RWS since, had been transferred to the jurisdiction of Regional Councils.

The Namibian Water Corporation (Namwater) is the official bulk water supplier of settlements and villages. Namwater has a few schemes in the Region, which is mostly located along the river. Table 2 lists the operational schemes operated by Namwater. All these schemes draw water from aquifers close to the river and do not draw water from the river. Water from boreholes has the advantage that it does not require purification or treatment.

Table 2. Namwater Bulk water Supply Schemes, Kavango Region

Scheme Name	Aquifer Type	Area
Andara	Unconfined primary	Kavango
Bagani	Semi-confined primary	Kavango
Buinja	Semi-confined primary	Kavango
Kahenge	Unconfined primary	Kavango
Kayengona	Semi-confined primary	Kavango
Mpunguvlei	Semi-confined primary	Kavango
Mupini	Semi-confined primary	Kavango
Nkurenkuru	Semi-confined primary	Kavango
Nyangana	Semi-confined primary	Kavango
Omega	Semi-confined primary	Kavango
Rupara	Semi-confined primary	Kavango
Sambiu	Semi-confined primary	Kavango
Tondoro	Semi-confined primaty	Kavango

4.6 Conclusions

i. The Kalahari Basin formed during the uplift of the Great Escarpment and deposition occurred in grabens formed through recent tectonics.
ii. The Kalahari Group Sediments is underlain by basement rocks of Karoo Basalts, Damara Quartzites and Dolomites and Pre-Damara Basement.
iii. The Kalahari Basin is a vast inland basin which stretches over Angola, Zambia, Namibia, Zambia, Botswana, and South Africa.
iv. The Kalahari Sediments is a major primary aquifer of the Kavango Basin, with variable yield and water quality.
v. The Karoo flood Basalts, dyke swarms and sills underlies much of the Kavango Basin.
vi. A northwest fault is considered to be a major conduit of flood basalt and caused displacement of basalts to the south.
vii. Aquifers prevalent in the Kavango Region are primary aquifers of saturated Kalahari Group sediments; secondary aquifers are fractured/weathered bedrock, fault zones cutting across basement geology, and Kalahari sediments and recent faults visible at surface.
viii. Groundwater potential of the Kavango Region is moderate to low.
ix. Aquifers present along the rivers are saline artesian aquifers overlain by alluvium aquifers of paleo-channels of the Okavango River.
x. The main sources of groundwater are abstracted from hand dug wells and boreholes.
xi. The depth to groundwater is deeper in the west than in the east.
xii. Groundwater flow of the Kavango Region is the manifestation of recent faulting found in the area, with a low-gentle gradient.
xiii. The majority of boreholes yield between 2-4m^3/h, with yields of 8m^3/h on average.
xiv. Most boreholes have good quality water with TDS levels between 500-1000mg/l.
xv. Boreholes with poor quality water are high in sodium salts and are associated with stagnant waters.
xvi. Groundwater quality is maintained with each recharge episode.
xvii. Average borehole depth for the Kavango Region is slightly above 90m, with average water strikes of 51m and saturated thickness of 43m.
xviii. Borehole yields are sufficient to fulfil the water requirements of the exploration phase of PEL73.
xix. A Groundwater Monitoring and Management Plan are tools of effective groundwater management and is for the:

- protection of available groundwater

- detection of pollution at an early stage
- Establishment of effective management practices of groundwater use.

5 EXPLORATION ACTIVITIES

5.1 Water Legislation

The applicable legislation related to Water is the Water Act 54 of 1956, which is concerned with the control, use and the conservation of water for domestic, agricultural, urban, and industrial use. Act 54 of 1956 was repealed and replaced by the Water Resources Management Act 24 of 2004. The Water Resources Management Act 11 of 2013, then repealed the Water Resources Management Act 24 of 2004. However, the Water Resources Management Act 11 of 2013 has not being enacted and shall be brought into force on a date set by the Minister by a Government Gazetted Notice.

The Water Act 54 of 1956 in this instance is still in force with only certain provisions applicable to Namibia.

Applicable to groundwater is Section 30A, which states water abstracted from subterranean water is considered public water. Further water for industrial purposes must furnish the Department Water Affairs in writing with those particulars regarding the use and disposal of purified or treated water as maybe prescribed by regulation (Section 21(1)(c). In short groundwater belongs to the state, with provisions made for domestic, agriculture and urban use. It is expected of institutions dealing with water supply to exercise a duty of care, to prevent any pollution that can endanger the health of people and any water supply used for drinking and domestic purposes.

5.2 Exploration Activities – PEL 73

Exploration activities currently are mainly referred as “Upstream Activities”, which are activities concerned prior to making a discovery. The main activities typically are the drilling of deep exploration vertical boreholes, geophysical (seismic) surveys, preparation of well pads and other site preparation activities. Production and development activities can only follow when a discovery is made and continues with the establishment of a well field through continued drilling. The activities under scrutiny will only involve activities of the Exploration Phase, which involves:

- Drilling of multiple stratigraphic or appraisal wells for the collection of core samples for analysis; Exploration wells might intersect potential oil and gas bearing horizons.

The *Exploration Phase* is followed by an appraisal phase to evaluate the resource potential of the discovery, which intensifies operations and in general will involve additional activities and equipment.

This study will only assess the activities related to exploration activities, with regards to drilling of oil and gas wells and water supply boreholes, water demand, the disposal of waste water and the management of water sources surrounding these exploration wells, to detect and prevent any pollution that might take place.

The Exploration Phase assumes no production and the rehabilitation of sites, which involves wells to be plug and the monitoring of wells to be implemented.

The water requirements for exploration activities can readily be met by groundwater resources in the vicinity of the of the exploration activities. The water requirements for geophysical surveys and oil and gas well drilling are relatively low.

Impact: Water is mainly required for domestic use (drinking, cooking and ablutions) and for exploration drilling. An estimate of 26m^3/day or just over 1m^3/h is estimated water demand for stratigraphic drilling and exploration activities. This water demand includes a crew of a 100 people with a water requirement of a 150L/day.

Groundwater resources within the area of operations are vulnerable to pollution, since the depth to groundwater is relatively shallow and the surface cover is un- to semi-consolidated and highly porous, with low water retention capabilities and very little run-off. Waste water can reach the aquifer and cause pollution if disposed of in the immediate area of the drill site.

Structural damage to borehole infrastructure due to activities of the seismic survey is hardly unlikely. The technique deployed is vibrosis seismic with a weight drop. Boreholes in the area are cased/lined to prevent collapse of the geological formation and should withstand shockwaves being generated by thumper trucks.

Mitigation: The impact of groundwater use is usually mitigated by carrying out a hydro census, in an area surrounding the water supply boreholes, within a radius sufficient to determine the area of influence, which is mostly determined by the lateral extent of aquifers prevalent in the area. The hydro census will include the areas of investigation along the paths of the seismic lines to ensure that if damage is claimed that there is a record on the status of the water point prior to the survey.

Groundwater occurrence for the Kavango Region is widely spread and a 10km radius surrounding the oil and gas well is a wide enough area to establish the impact of surrounding wells and communities. A groundwater monitoring programme will be implemented to ensure that exploration activities have no adverse effect on the existing surrounding water supply. The drilling of oil and gas wells for the 1st 1000m will be sealed and cased off, to prevent any leakages or contamination into the surrounding upper formations.

The monitoring programme will include assessing yield capacity, groundwater consumption, rest water level monitoring and water quality and the status of pumping infrastructure. A groundwater monitoring network will be established covering the 12 exploration well positions and along the lines of geophysical surveys.

Waste water will be disposed of in a safe manner, by piping it into impermeable sceptic tanks/reservoirs on site, which will be emptied and disposed of by a third party contractor.

5.2.1 Risk Assessment

The impact of exploration activities are based on the likelihood of these activities having an impact on the surrounding communities water resources. Risk assessment categories range from Very Low, Low, Moderate, High, Very High.

Table 3 below is a risk assessment associated with Exploration Activities and its impact on groundwater/water.

Table 3. Risk Assessment of Exploration Activities, PEL 73

		Mitigation		
Impact	**Area of Influence**	**Consequence**	**Likelihood**	**Risk**
Contamination of Groundwater Resources	Local	Moderate	Slight	Low
Increase in water demand	Local	Moderate	Unlikely	Low
Increase in sewage treatment requirements	Local	Low	Unlikely	Low

Overall the impact of the exploration activities with respect to groundwater resources is very low. Despite the low risk, adequate measures require that activities will have no adverse effect on the people and its groundwater resources. A groundwater monitoring and management plan will therefore be implemented in areas where immediate activities of seismic surveys and drilling will take place.

5.3 Groundwater Monitoring and Management Plan

A Groundwater Monitoring and Management plan (GMMP) are part and parcel of effective management of groundwater resources. The aim of the GMMP is to ensure groundwater quality and the availability of groundwater resources are not adversely affected by the exploration activities of Recon Africa of PEL 73. The GMMP's purpose is for the:

- protection of available groundwater
- detection of pollution at an early stage
- establishment of effective management practices of groundwater use.

5.3.1 Groundwater Monitoring

A hydro-census will be conducted and expanded into areas of the immediate vicinity of the 12 exploration wells. The hydro census will be incorporated with the completed census data and will form the baseline of groundwater data for the study area. Typical groundwater information will be collected and includes rest water levels, pumping regimes, water demand, rate of abstraction and of course water quality.

An expansion of the monitoring network will be contemplated and will include a number of strategically located boreholes from both census areas for monitoring water quality, water levels and rate of abstraction where possible. The monitoring will determine the impact of operations surrounding the exploration activities of the operator.

5.3.2 Rest Water Level Measurements

Rest water levels will be measured over time, at the time of active exploration. Any change in rest water levels is an indication of change in available water resources, which could be a localised or an area wide occurrence. Rest water level fluctuations might be, because of seasonal variation or as a result of recharge or due to over exploitation. The extent to how much water levels fluctuate might result in intervention measures to be introduced to mitigate changes experienced. Measuring of rest water levels also determine the groundwater movement/flow of the area. Thus far results from 2 production boreholes at stratigraphic oil and gas wells drilled, have indicated minimal fluctuations from initial water levels.

Rest water level measurements will be taken at all locations part of the monitoring network on a two-three monthly basis. Rest water level measurement will be done intermittently and not on a continual basis.

5.3.3 Rate of Abstraction

The rate of abstraction will be measured at water points, where possible, during the hydro census. This requires wells to be pumped for a while, to have an idea of the pumping rate. Interviews will be conducted with community members to have an idea of their pumping regimes as to how much water is abstracted on a daily basis per water point. This will provide an overview of water points with greater demand, which will have a greater impact on people should this water point be adversely affected. The rate of abstraction from production boreholes at well sites will be metered to remain within the allowable abstraction volumes of abstraction permits.

5.3.4 Water Quality

Samples of water quality will be collected and submitted to recognised laboratories for analysis. Analysis will be done according to the Namibian Guidelines of Water Quality for Drinking Water. Other reference frameworks of water quality will also be consulted to ensure water quality remains within the range of no adverse effects for standard drinking water. The intention of water quality monitoring is used as an early warning of detecting pollution. Contamination can be localised or an area wide occurrence. Should pollution occur, remedies will be proposed to soften or reverse pollution. Operations will be immediately halted if pollution is found to be life threatening or irreversible.

5.3.5 Monitoring Time Frame

Monitoring will be conducted over a 12 month period or for as long as exploration is ongoing in the area. Boreholes used for the supply of water for drilling will be sampled on a monthly basis. This will include the rest water level measurement and water sampling for water quality analysis. Water quality sampling will include bacterial, chemical, physical and organic determinants of water.

Boreholes defined as part of a monitoring network will be visited bi-monthly/quarterly, and the same parameters recorded as for water supply production boreholes. The sampling interval for collecting monitoring data will provide good background information as to the changes over 4 seasons and might highlight seasonal or periodic fluctuations in the data.

The sampling frequency might change over time, taking the latest results into account. The sampling frequency might increase or decrease accordingly. Should exploration continue for a longer period of time, and depending on results, the monitoring frequency might be reduced to be bi-annually/annually.

5.3.6 Quality Assurance and Quality Control

Quality Assurance and Quality Control (QA/QC) will be implemented to ensure results are sound and can be trusted, and that results are within an acceptable limit of variation. Duplicate and blank samples will be introduced to control the analysis received from the laboratories.

5.3.7 Data Management

The data collected during this project will be compiled into a database, with a facility to export data to other formats, where it will be imported into statistical software programmes to do the necessary analysis, to determine whether interventions are need or not.

5.3.8 Reporting

Reports will be compiled at frequency intervals determined by the monitoring time frame. Monthly reports will be generated for production wells and bi-monthly reports for monitoring wells. A Final Report will be compiled at the end of the project which will mark the end of the exploration phase.

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https://sites.google.com/view/rcheritage-services/home

20 January2023

UPDATED ARCHAEOLOGICAL REPORT

PROPOSED OIL DRILLING PROJECT IN PEL 73, KAVANGO EAST AND WEST REGIONS, NAMIBIA

PREPARED FOR:

Risk-Based Solutions (RBS) CC

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QUALIFICATIONS AND EXPERTISE OF THE CONSULTANT

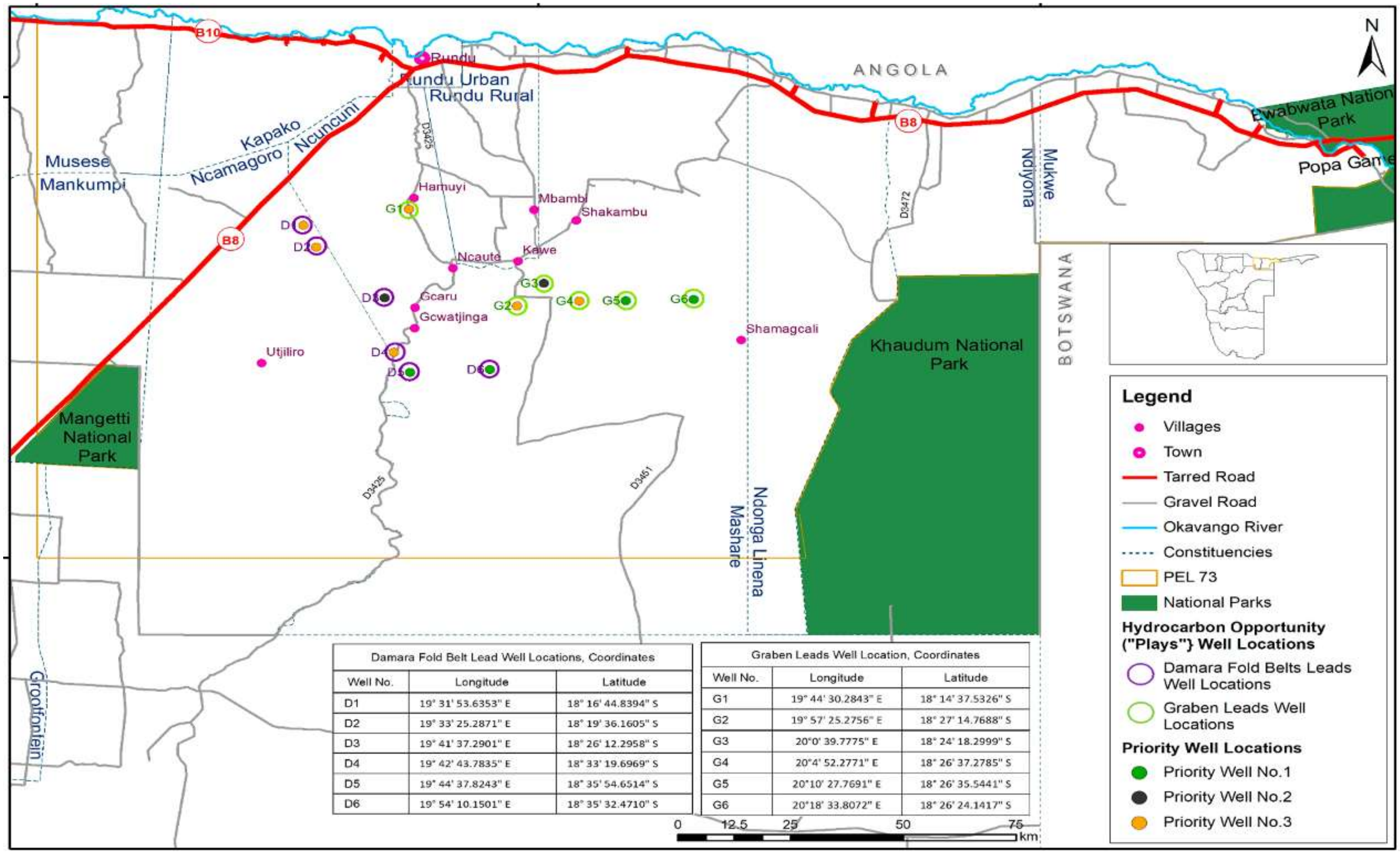
NAME	**Dr Alma Mekondjo Nankela**
RESPONSIBILITY ON THE PROJECT	Updated detailed archaeological report for the proposed oil drilling project in PEL 73, Kavango East and West regions, Namibia.
QUALIFICATIONS	PhDs & Masters' degrees in Quaternary and Prehistory and Bachelor degree in History and Geography.
PROFESSIONAL REGISTRATION	Association of Southern African Professional Archaeologists (ASAPA); Namibia Scientific Society (NSS); The Society of Africanist Archaeologists (SafA) and the International Council on Monuments and Sites (ICOMOS).
EXPERIENCE IN YEARS	15+
EXPERIENCE	Dr Nankela has conducted extensive archaeological research across Namibia; developed archaeological and cultural heritage policies and operational guidelines; carried out heritage management and conservation works at various local and UNESCO heritage sites in Namibia.
HERITAGE PERMIT NO.	02/2022
REPORTING REQUIREMENT	National Guidelines for Heritage Impacts Assessment in Namibia, National Heritage Council of Namibia (2021) and National Heritage Act, (No. 27 of 2004).

EXECUTIVE SUMMARY

RESEARCH CULTURE HERITAGE SERVICES (RCHS) CC has been appointed by Risk-Based Solutions (RBS) CC, a Consulting Arm of Foresight Group Namibia (FGN) (PTY) LTD on behalf of the Reconnaissance Energy Namibia (REN) (PTY) Ltd (the Proponent) which hold PEL No. 73 covering Degree Square Block No. 1819 and parts of Blocks 1719, 1720, 1721, 1820 and 1821 over the Kavango Sedimentary Basin (KSB) in Kavango West and East Regions in northern Namibia to update an existing archaeology and heritage report through site visits to assess and verify the existence of the pre-identified heritage resources within the footprint of the project (See Nankela, 2019 & 2021) desktop reports; identify new potential sensitive heritage resources; establish their heritage significances and devise mitigation and management measures towards their preservation to satisfy provisions of the National Heritage Act, (No. 27 of 2004) and its Regulations (2005) as well as requirements of the Environmental Management Act (No.7 of 2007) and its Regulations (Govt Notice No. 30 of 2012). The assessment report therefore aimed to assisting the client in obtaining a consent from the National Heritage Council (NHC), (the Competent Authority) under the provisions of the National Heritage Act, (No.27 of 2004) to allow the project to proceed with the proposed oil explorations development and its associated infrastructure developments.

The site's visit and detailed field archaeological heritage assessment was carried out on the proposed current project area between the 7th- 14th December 2022 mainly concentrating on the proposed prioritized exploration and appraisal wells Nos. D1-D6 and G1-G6 (**Figure 1**). Although not vulnerable, the verification of pre-identified key sites from Iron Age archaeological occupations located about 12 to 28k km from proposed drilling sites along the Omatako River basin between Ncaute and Taratara villages were physically examined and adequately assessed, and this assessment confirm that such resources are no longer of heritage significances as the area has been extensively disturbed by advanced recent expansions of agricultural farming activities and related local development and such surface scatter were likely reburied in the ground as they could not be found. However, extensive engagements with the local communities (traditional authorities & Councillors) in proximity (within 10km radius) of the proposed prioritized exploration and appraisal wells such as Hamuyi, Gcaru, Ncaute, Kawe, Mbabi, Shakambu, and Gcwatjinga has yielded a number of significant sensitive heritage resources in form of graves and sacred sites relevant to the National Heritage Act, (No 27 of 2004) but such sites are still not vulnerable to this development as most of the wells are located either on State land (communal land) and or communal conservancies where communities do not necessary live with some site traversing on large leasehold farms-commercial farms on communal land (**Figure 2**).

As a result, data presented here are considered to be sufficient as a basis for the assessment consequently, locations of the proposed prioritized exploration and appraisal wells Nos. D1-D6 and G1-G6 pose no threats to the heritage resources. Subsequently, it is recommended that a consent is issued to the proponent to enable the project to proceed. However, the proponent is cautioned of possible hidden, or buried archaeological, palaeontological, or ethnographic remains that might be exposed as the project proceeds therefore, mitigation and management actions devised by means of Chance Find Procedure must be adopted.



Damara Fold Belt Lead Well Locations, Coordinates		
Well No.	Longitude	Latitude
D1	19° 31' 53.6353" E	18° 16' 44.8394" S
D2	19° 33' 25.2871" E	18° 19' 36.1605" S
D3	19° 41' 37.2901" E	18° 26' 12.2958" S
D4	19° 42' 43.7835" E	18° 33' 19.6969" S
D5	19° 44' 37.8243" E	18° 35' 54.6514" S
D6	19° 54' 10.1501" E	18° 35' 32.4710" S

Graben Leads Well Location, Coordinates		
Well No.	Longitude	Latitude
G1	19° 44' 30.2843" E	18° 14' 37.5326" S
G2	19° 57' 25.2756" E	18° 27' 14.7688" S
G3	20°0' 39.7775" E	18° 24' 18.2999" S
G4	20°4' 52.2771" E	18° 26' 37.2785" S
G5	20°10' 27.7691" E	18° 26' 35.5441" S
G6	20°18' 33.8072" E	18° 26' 24.1417" S

Figure 1: Regional location of PEL 73 in relation to the proposed prioritized exploration and appraisal wells of the project. Source: (Risk Based Solutions, 2022:4)

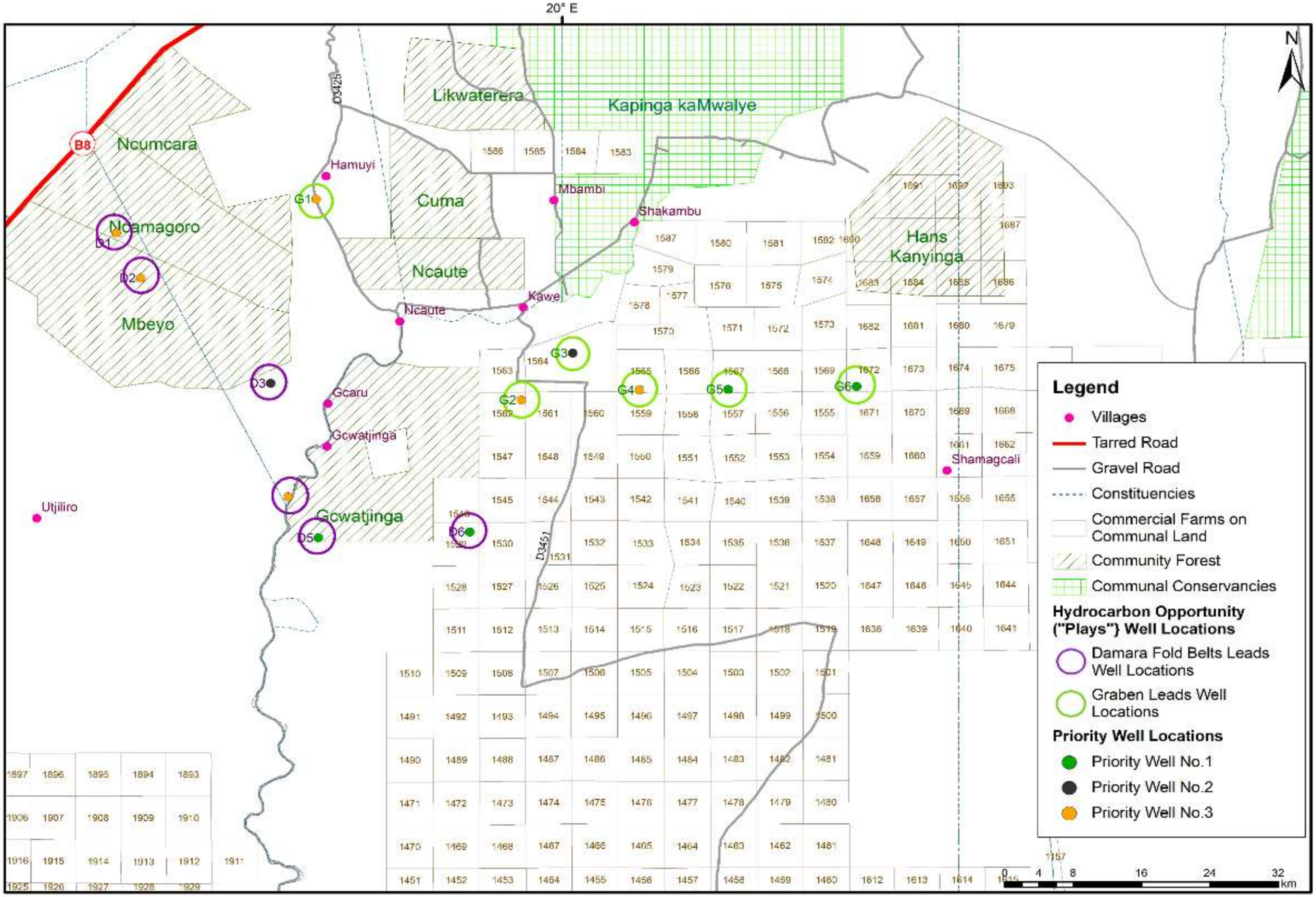


Figure 2: Detailed locations of the proposed prioritized exploration and appraisal wells in the project. Source: (Risk Based Solutions, 2022:8).

1. INTRODUCTION

Reconnaissance Energy Namibia (REN) (PTY) Ltd Petroleum Exploration License (PEL) No. 73 covers square block No. 1819 and parts of Blocks 1719, 1720, 1721, 1820 and 1821 over the Kavango Sedimentary Basin (KSB) in Kavango West and East Regions in northern Namibia (**Figure 3**). From 2021 through 2022, the Proponent commenced with the drilling programme for PEL No. 73 in a number of stratigraphic test wells in the petroleum provinces at Mbambi 6-1, Kawe 6-2 in 2021 and Makandina 8-2 in 2022 respectively (**Figure 2 & 4).** Available project information revealed that the drilling activities at the stratigraphic wells are meant to confirm and map the Kavango Sedimentary Basin (KSB, associated sub basins and petroleum systems with well targets, prospects and leads as part of a de-risking process based on regional data sets including airborne geophysics, initial 2D seismic and regional geological mapping results. As a result, the current proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 are designed to confirm the existence of economic oil and/or gas resources with the delineated targets/prospects and leads process based on additional 2D seismic survey data acquisition and interpretation, airborne geophysical surveys and the stratigraphic well data sets (**Figure 5**).

In the nutshell, the drilling of the current proposed exploration and appraisal wells drilling programme is to continue with the search for oil and gas in Kavango Sedimentary Basin and the associated subbasins and to identify potentially commercial petroleum systems based on the previously granted permits. Risk-Based Solutions (RBS) CC has been engaged on behalf of the Proponent to carry out/ improve the Environmental Impact Assessment (EIA) of the proposed exploration and appraisal wells Nos. D1-D6 and G1-G6 of the project in terms of the Environmental Management Act (2007) and its Regulations (2012) to support the renewal application for Environmental Clearance Certificate (ECC).

Accordingly, the undersigned, A. Nankela from Research Culture Heritage Services (RCHS) CC was subcontracted to carry out this assessment. In Namibia, heritage resources are protected under the National Heritage Act (No. 27 of 2004), which makes provision for archaeological assessment of projects such as the proposed oil explorations in order to strategically consider how potentially negative impacts can be avoided within the footprints of the proposed area that the proponents intend to explore as projects of this magnitude are also subjected to archaeological assessment.

As a "Listed Activity", the heritage component forms part of the required specialist studies to be considered in the overall EIA as the National Heritage Council (**the Competent Authority**) is listed as an "Interest and Affected Party". Therefore, heritage assessment intended to satisfy requirements of the National Heritage Act No, (27 of 2004); its Regulations (Government Notice 106 of 2005) as well as National Guidelines for Heritage Impact Assessment in Namibia (2021), in which the process of review, verification and consent will be required to clear the project. This is because, in Namibia, archaeological/heritage resources are protected under the National Heritage Act, (27 of 2004) which makes provision for archaeological/heritage assessment such as these. Accordingly, it was imperative that a after a desktop assessment, a field archaeological heritage assessment is carried out to critically verify if pre-identified key sites from Iron Age archaeological occupations located about 12 to 28k km from proposed drilling sites along the Omatako River basin between Ncaute and Taratara villages are still relevant/ significant in terms of National Heritage Act, (27 of 2004) and to identify further potential sensitive heritage resources and localities within the footprint of the in advance. This approach allows sufficient time for mitigation of impacts before site preparation and construction commence. Risk Based Solutions cc has accordingly adopted the recommendation that allowed the undersigned to carry out this field assessment. The report therefore complements the baseline archaeological assessment carried out in 2021 (see Nankela, 2021). This report should therefore be read along with the desktop report for contexts.

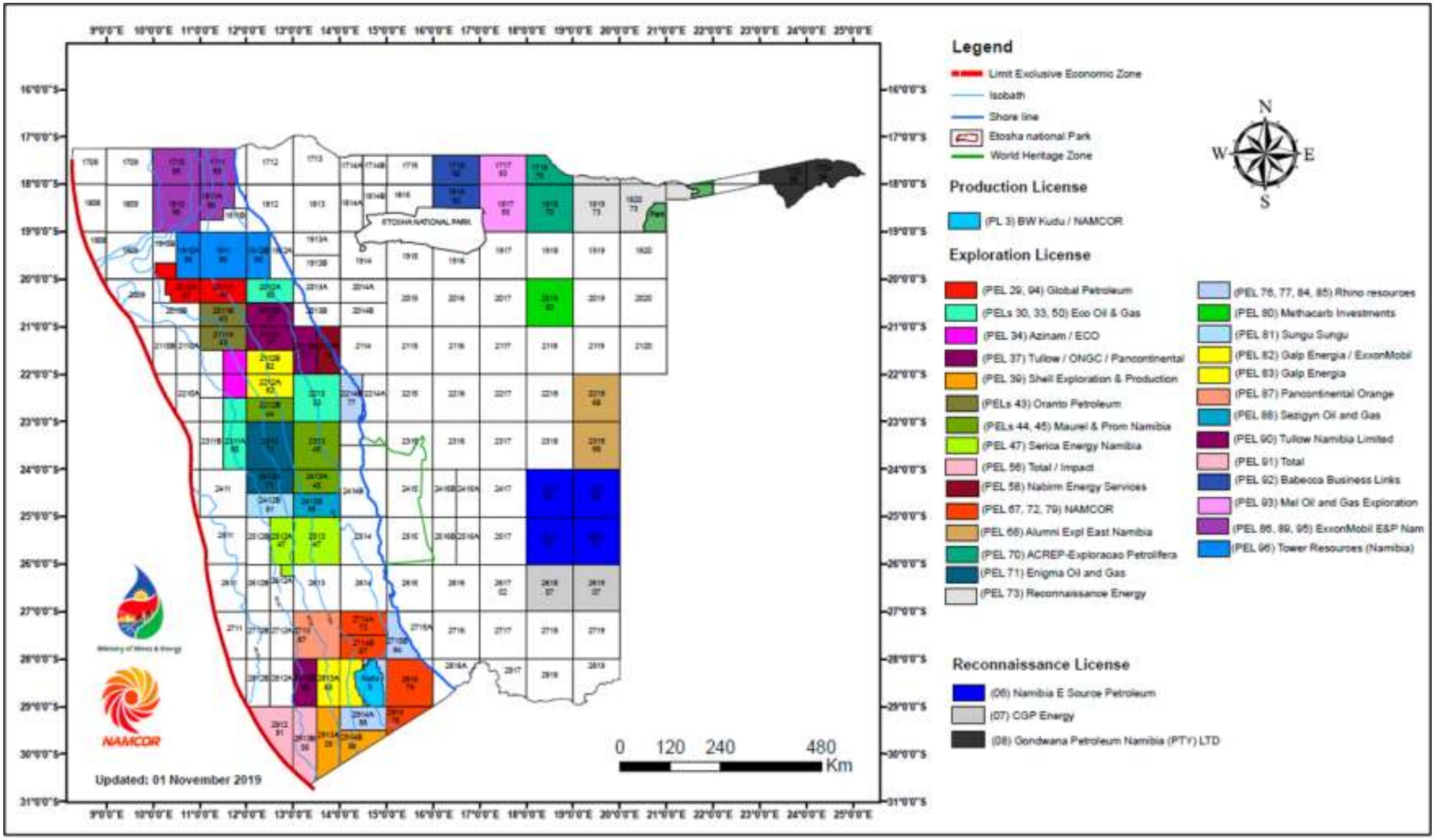


Figure 3: Hydrocarbon Map of Namibia indicating the locations of Petroleum Licenses (PELs). Source: www.namcor.com rfc. (RBS, p4)

Figure 4: Above and below images show the drilled wells at Makandina (in 2022) and Mbambi (in 2021) locations. Images Credit: (RCHS, December 2022).

2. TERMS OF REFERENCE

This heritage impacts assessment study aimed for the specialist to:

1. Verify and assess the existence of pre-identified archaeological sites near the proposed exploration and appraisal wells and generally the entire project.
2. Identify and assess new potential heritage resources within the project that might be negatively affected by the project.
3. Establish the nature and degree of significance, sensitivity, and vulnerability of the heritage resources.
4. Demarcate sensitive heritage sites requiring special mitigation measures to eliminate, avoid, or compensate for possible destructive impacts of heritage resources.
5. Devise management recommendations to manage the "Chance Find" heritage resources.

3. LEGAL REQUIREMENT

The National Heritage Act, (No. 27 of 2004) is the regulatory authority for the identification, protection, preservation, management, and promotion of Namibia's heritage resources. Part 1 of the Heritage Act defines 'heritage resources' as both *places* and *objects* of archaeological, palaeontological, and rare geological objects including meteorites, cultural, historical, ethnographical, scientific, and technological and social significance. The significant places also include "the natural or existing condition or topography of land", as well as the "trees, vegetation or topsoil or the body of water" that maintain the ecological functioning and integrity of the specific area. In these aspects, the Act provides legal protection for both tangible and intangible heritage resources. The newly developed "Guidelines for Heritage Impact Assessment in Namibia of 2021" have been formulated for the implementation of the National Heritage Act, especially Section 51 (3) which outlines requirements for heritage impact assessment in Namibia. Here, the aspect of intangible heritage may as well include sacred sites "places to which oral traditions are attached to or which are associated with living heritage, graves and burials, historic settlements and military sites by means of a building, garden or a tree" are considered to be of heritage significances in Namibia. The significance of the heritage resources (sites, structures and artifacts) is determined by means of their typological classifications defined in Part 1 of the Act in relation to their uniqueness, condition of preservation and research potential. Therefore, these aspects are not mutually exclusive, and the evaluation of each resource is achieved following the significance criterion ratio entrenched in the 'Guidelines for Heritage Impact Assessment (HIA) in Namibia of 2021".

The National Heritage Council (NHC) maintains a heritage register in accordance with Part IV of the Heritage Act. The register lists 'significant heritage' places and objects of national importance. The register allows new approved entries to be added based on an assessment of their heritage significance and thereafter publication of the sites in the Government Gazette. As a result, Part V applies immediate legal protection to heritage sites added on the register to prevent unnecessary disturbances or damages to heritage resources as an inevitable result of infrastructures development unless permitted in terms of Section 48 of the Act. Moreover, the aspects concerning the conservation, management, and impact assessment studies of cultural heritage resources for projects such the oil and/or gas resources exploitations are also addressed in the Environmental Management Act, 2007 (No. 7 of 2007) which includes man-made features in its definition of the environment as "anthropogenic factors" such as archaeological remains or any other evidence of human activity. The need for Environmental Impact Assessment forms part of the Act, and this requires that "Namibia's cultural heritage must be protected and respected for the benefit of present and future generations".

Other applicable laws and policies relevant to the protection of heritage resources globally are the international standards and protocols expected to be followed to ensure best practice during development activities. For instance, the Performance Standard 8 of the International Finance Corporation's (IFC) Performance Standards on Environmental and Social Sustainability (2012) addresses both national and World Cultural and Natural Heritage. Therefore, the requirement 7 states "Where the risk and identification process determine that there is a chance of impacts to cultural heritage, the client will retain competent professionals to assist in the identification and protection of cultural heritage." The standards apply whether or not the heritage material is protected, and irrespective of whether it may have been previously disturbed. To comply with these standards, a baseline survey and assessment is required. The European Investment Bank's Environmental and Social Handbook (2013) also includes cultural heritage impact assessment amongst its list of requirements.

Relevant standards for impact assessment in relation to fieldwork and data dissemination, standard methodologies are recommended to follow the Standards and Guidance set within the Chartered Institute for Archaeologists (CIfA) where both field survey and desk-based assessments are universally recognized. The African Development Bank (AfDB) Guidelines to the environmental and social assessment procedures (ESAP) of 2001 further guides heritage assessment. Its guidance is integrated in addressing all crosscutting themes promoting sustainable development.

Furthermore, Namibia being a States Party to the World Heritage Convention, the country strictly follows and adopts the operational guidelines for the implementation of the World Heritage Convention that aim at facilitating the implementation of the convention concerning the protection of the inscribed world cultural and natural heritage properties on the World Heritage List against any deterioration or disappearance of these most prized assets because of their exceptional qualities, that has been considered to be of "Outstanding Universal Value". It is for this reasons that to ensure the proper identification, protection, conservation and presentation of the world's heritage, Namibia has ratified vital UNESCO conventions including the 1972 Convention in 2000 - concerning the protection of the World Cultural and Natural Heritage, the 2001 Convention on the protection of the Underwater Cultural Heritage in 2011, the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage in 2007, the 2005 Convention on the Protection and Promotion of the Diversity of Cultural Expressions in 2006 and the 1995 Convention on Wetlands of International Importance especially as Waterfowl Habitat in 1995 to which Okavango Delta in Namibia is applicable given the fact that PEL 73 include this highly sensitive ecological system. However, it's important to stress that the Okavango River is approximately 260 km from the Area of Influence (AOI) or the impact areas.

4. ASSUMPTIONS & LIMITATIONS

This archaeological heritage study assumes that all background information and layout plans provided by the applicant are correct and up to date. The assessment therefore focussed mainly on the impact areas that have been determined during the project scoping phase and its amended seismic studies, hence does not apply to, and may not be used for any other future developments and expansions on the remainder of the affected PEL 73 properties outside the assessed areas. The available heritage records from desk studies were harvested by inferences from the results of archaeological, ethnographical, and historic research and surveys carried out in the Kavango regions as well as from previous assessment works in the same general area as the proposed project. It is these records that were augmented by recent comprehensive field assessment carried out between the 7th- 14th December 2022 in both Kavango East and West regions. Such studies are critical in understanding the archaeological and heritage background of the project area and its immediate surroundings to establish the nature and type of heritage resources. Based on these data, it was possible to predict the likely occurrence of further heritage sites with some degree of accuracy, and to present a general statement of the local heritage distribution and its sensitivity. However, the field assessment was only restricted to verifications of pre-identified sites based on the value of surface finds recorded in the course of previous field surveys as well as interviews with affected local communities in vicinity of the project as part of the community consultations to record possible unknown heritage resources in particular, historic graves or burial grounds and other intangible/sacred sites of community values. Due to the fact that much of the archaeological record, and that with potentially the best context, is covered by vegetation and surface sediments, the proponent is caution that other potential hidden or buried heritage remains may be exposed during the construction phase of the development activity as the project proceeds. Overall, there were no major constraints and limitations associated with the study such as access to the PEL 73 project site and or community consultations.

5. APPROACHES AND METHODOLOGY

This assessment was conducted according to best practice principles following the "Guidelines for Heritage Impact Assessment (HIA) of 2021" which includes the evaluation of heritage resources significance and vulnerability in Namibia. The basic process of evaluations – the desk study (phase i) where scoping/ baseline reports were produced was followed by current field-based assessment (phase ii) including management plans (phase iii) in fulfillment of the conditions in the Heritage Research Permit 02/2022 issued to the author.

5.1. Desktop & Literature Review

Although the Kavango region is archaeologically poorly investigated, previous heritage and archaeological studies in the immediate surroundings have already provided detailed descriptions of the history, heritage, and archaeological record of the area (see for example and references in Huffman 1980; J Gibbons 1981; Jacobson 1987; Kinahan 2000, 2003; Sandelowsky 1974; 1979, 2004; Richter 2002/2003, 2007 and Kose 2004, 2008 and 2009). The broad overview of the archaeological record presented in the above-named reports have been summarized in the scoping and desktop assessment reports (Nankela 2018 and 2021). Here about seventeen (n=17) sensitive archaeological sites dating from the Late Stone Age (LSA) about (MNI=12); Iron Age (IA) sites (MNI=5) and historic structures (MNI=1) were identified. Such sites are both isolated and a group of archaeological sites found along the Okavango River and Omatako River (a major tributary of Okavango River basin) between Ncaute and Taratara villages. Fortunately, these sites are not vulnerable as the surface artefacts were collected during the survey (Richter's (2002/2003), nor will they be affected by the oil exploration activities as they are located between 12 and 28k km away from proposed oil drilling wells. However, there were key heritage concerns identified in earlier assessment and how they relate to the assessment being conducted here. This is a case of five (5) LSA archaeological sites in Kavango East region within the 2D seismic survey lines that will likely be affected (**Figure 5**).

Of the concerns were possible direct disturbance of sites and possible clearing of land/vegetation to make way for the road's networks and other related infrastructure development. The proponent was therefore advised to avoid possible encroachment into these sites until field assessment is carried out to verify their existence and significance. Thereafter, detailed inspection of aerial imagery available through Google Earth were also used to examine aerial imagery to determine which development activities encroached upon these potentially 5 sensitive areas, and to locate man-made structures or ruins for potential future investigation in the event that they were threatened by proposed development activities. Existing natural disturbances i.e. erosion and developments such as subsistence farming were noted via aerial imagery and were then inspected on foot during this field survey.

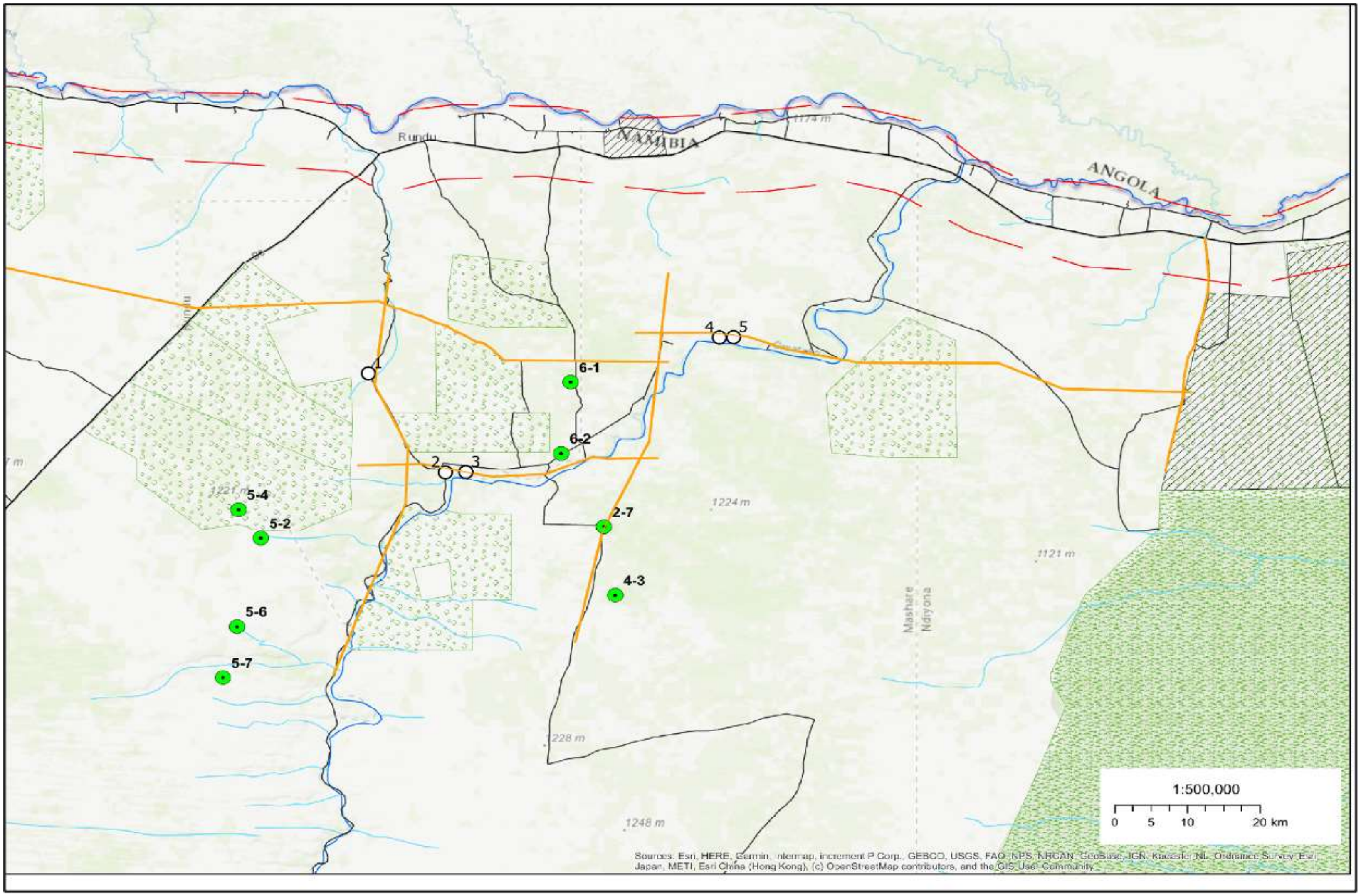


Figure 5: The 2D Seismic survey line within PEL 73 in relation to five archaeological sites (white circles). Source: (Nankela, 2021:18).

5.2. Community Consultations

The public participation process is a critical integral part of the EIA process, and it was deemed necessary that various affected local communities- in Kapako and Mashare Constituencies of the Kavango West and East Regions which falls within the boundaries of the Mbunza and Shambyu Traditional Authorities (**Figure 6)** as well as other interested groups - regional leadership (Rundu Rural East and Rundu Rural West) within the project are engaged on heritage matters with respect to the proposed drilling of the D1- D6 and G1-G6 exploration and appraisal wells, and results of the Heritage Impact Assessment (HIA) to be integrated in the Final EIA and EMP of the project. Therefore, this HIA intend to supplement existing secondary data as the largest gap in heritage knowledge of this area was the absence of current ethnographic and historic contexts of the present-day communities living near the proposed exploration and appraisal wells due to the fact that the large part of Kavango region is still unexplored in terms of research. Consequently, it cannot be ruled out that heritage resources do not exist. In addition, heritage interest groups may then provide feedback to the questionnaire as part of the official community consultation. Therefore, this field assessment is based on the latest available information, and will be amended should new information be made available.

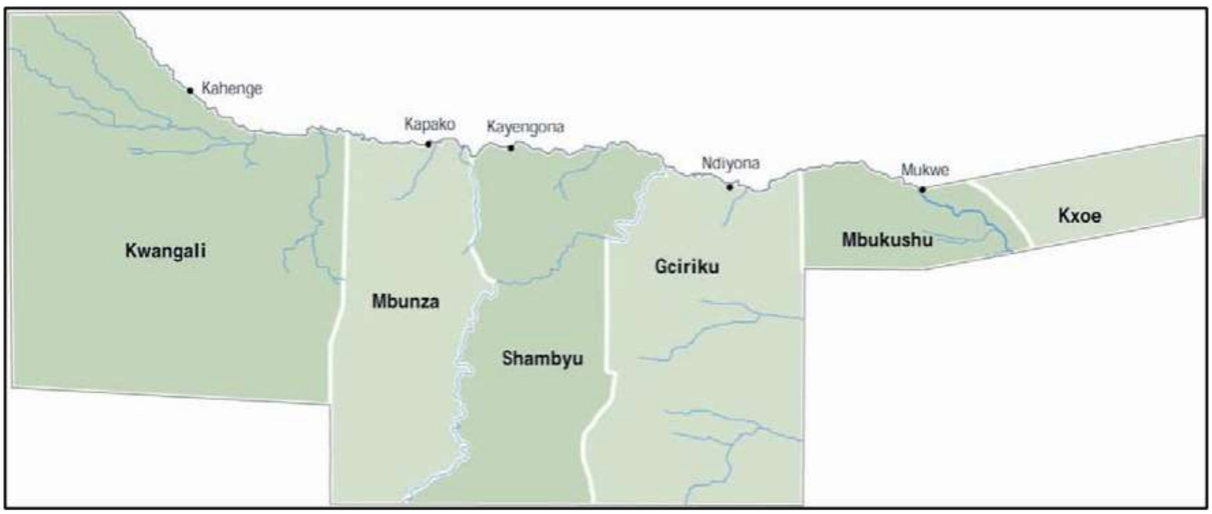


Figure 6: The two affected Traditional Authorities in PEL 73 in Kavango East and West. Source: (Mendelsohn 1999:8).

6. BRIEF PROJECT DESCRIPTION

ReconAfrica owns 90% interest in Petroleum Exploration Licence 73 while Namibian State oil company NAMCOR holds the remaining 10% interest in the Licence making it a wholly-owned Namibian subsidiary. However, the licenses cover 2.2 million acres in Botswana and 6.3 million acres in Namibia, for total licensed land of 8.5 million acres in the Kavango Basin (**Figure 7**), granted under the Energy regulation, Section 29-38 of the Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991). The Licence has an exploration period comprising a number of phases, ending 29 January 2025, or if extensions are requested and granted, ending 29 January 2029 therefore with a production license having a 25 year term following declaration of a commercial discovery. ReconAfrica's drilling operations in Kavango basin reportedly started in 2021 and targeted mainly three to six wells in the coming year.

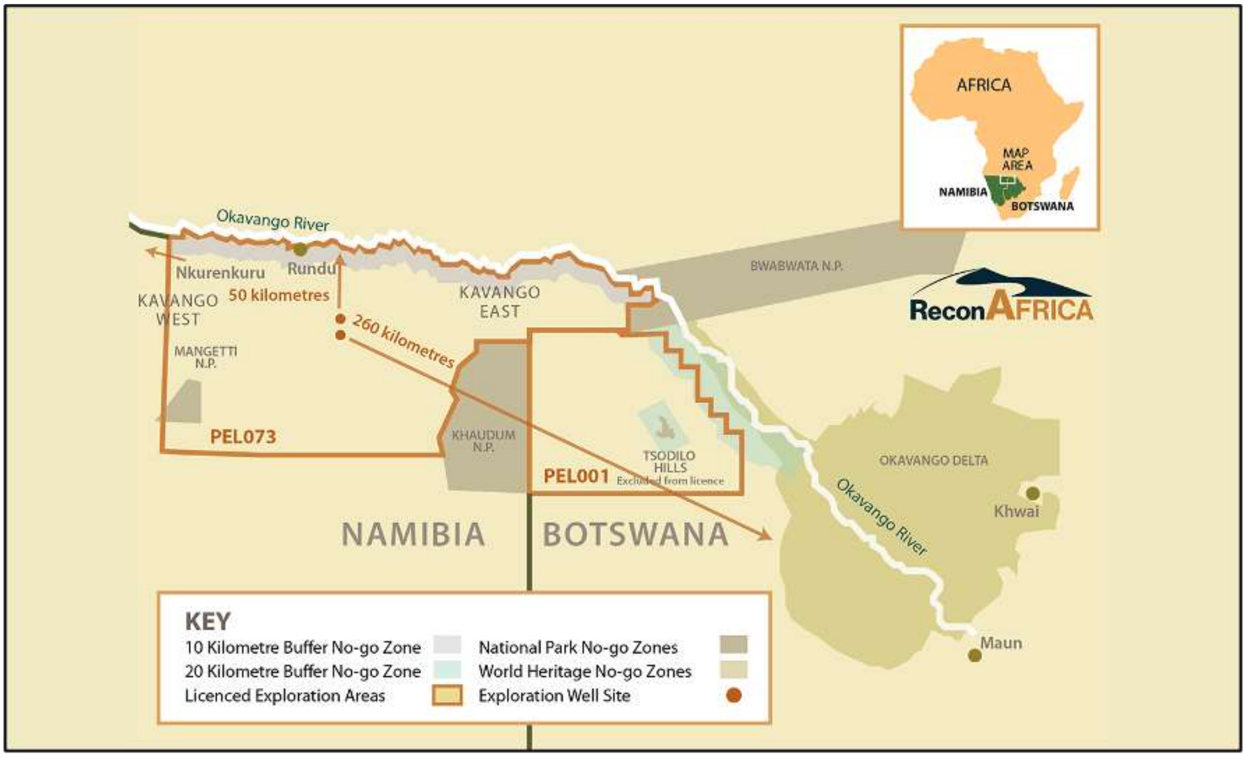


Figure 7: The Kavango Basin in relation to PEL 73. Source: ReconAfrica. Accessed from: https://reconafrica.com/operations/kavango-basin/

The main goal is to confirm organic rich source rocks and conventional opportunities in Namibia and Botswana. During the 2021, ReconAfrica has completed the evaluation of the first well (6-2) drilled in the Kavango Basin, evaluation of the second well (6-1) and has acquired and processed 450km of 2D Seismic survey (according to information for the website). Furthermore, the preliminary results of the 6-1 Mbambi, and 6-2 Kawe, 8-2 Makandina stratigraphic test wells drilled by in 2021 and 2022 and the subsequent 2D seismic survey data acquired in the Kavango Sedimentary Basin (KSB) has reportedly established a significant rift basin similar to other major petroleum provinces / rift basins in other parts of the World (see Risk Based Solutions, 2022:6). Accordingly, the integrated interpretation has established the following three (3) groups of hydrocarbon opportunities ("Plays"), Primary: Karoo Rift Fill (Light Oil), Secondary: Intra-Rift Fault Blocks (Light Oil), and Secondary: Damara Fold Belt (New Play, Gas/Gas Condensate as illustrated in (Figure 1). The results of the seismic data obtained in 2021 has established an unexpected new petroleum system (play) for KSB called the Damara Fold Belt which was surprisingly unanticipated in the original studies of the KSB (refer to Figure 1) also in (Risk Based Solutions, 2022). The objectives of the current proposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 is to continue with the search for oil and gas in Kavango Sedimentary Basin and the associated sub-basins and to identify potentially commercial petroleum systems (Risk Based Solutions, 2022).

The drilling of the proposed exploration and appraisal wells will be undertaken using the Crown 750 truck mounted drill rig currently being used by REN to drill the stratigraphic wells and will apply the same drilling technology with the addition of well testing in an event of a discovery (Plates 1 and 2). REN will then continue with the drilling of the stratigraphic wells based on the current granted permits until all the required permits, consents, and authorisations to drill the proposed prioritized exploration and appraisal wells Nos. D1-D6 and G1-G6 have been granted by the Government (Risk Based Solutions, 2022). However, the drilling of the proposed prioritized exploration and appraisal wells, cannot be undertaken without an Environmental Clearance Certificate (ECC) and other permits and consents thus additional EIA with different specialists' studies.

7. THE RECEIVING ENVIRONMENT

7.1. Physiography

The Petroleum Exploration License (PEL) 73 is located in north-east of Namibia known as the Kavango regions. The region is known for its complex ecological mosaic supporting extensive growth of woodlands hence broadly defined as Namibia's "key forest savanna and woodland" according to (Giess 1998; Burke 2002). The land uses in Kavango is said to be largely driven by local environmental and economic conditions with the Okavango River having most effect on the use of land. Today, four divisions classification order of the vegetation defines the region: the broad-leaved deciduous woodland; shrubland; grasslands and riverine, also see (Botta-Dukát et al. 2005). Much of its wildlife that used to occur along the Okavango River has now disappeared primarily due to anthropogenic impacts including deforestation of natural vegetation and intense livestock grazing which led to the intensive transformation of the floodplain and riverbank; the old flood plain (terrace) and terrace slopes. As a result, most remaining wildlife is now concentrated in the Bwabwata and Khaudum National Parks (see **Figure 1).** Topographically, the region is relatively flat but has an average setting of 1115 m above sea level with a difference of 200 m across the vast region (Burke 2002). However, the topography descends northwards towards the Okavango River and where dry rivers (*omiramba)* have incised into the Kalahari sands (Simmonds 2000 *crf.* Burke 2002). The Kavango is a semi-arid environment with an average annual rainfall of 400 - 600 mm, which is one of the highest in Namibia as observed by (Burke 2002). However, most of the rainwater is still underutilized as it rapidly drains through the Kalahari sands (aerosols) that dominate the regions (**Figure 8**). As a result, the porous soils are often very poor for crop production.

The Omatako River (**Figure 8**) is one of the key drainage channels of Okavango River where *Acacia erioloba* trees, and shrubby forms of Acacia erioloba and *Acacia fleckii* are the most prominent woody components of the vegetation, often forming dense stands at the margin of the channel floor is said to grow further inland. This is in addition to Cynodon dactylon, Enneapogon desvauxii, Aristida stipitata and Stipagrostis hirtigluma and some important grasses (Mendelsohn 2009). However, the majority of the Omatako main channel and associated slopes has been greatly altered by agricultural activities where and it is the reason why the pre-identified five LSA archaeological sites could no longer be found. Human occupation here might have been traced from before 2,000 years ago with the expansions of Hunter Gatherers communities in Southern Africa after the pastoral and agricultural communities of Kwangali, Mbunza, Shambyu and Gciriku tribes migrated from central and eastern Africa settled in this area from about 1,500 to 1,000 years ago (Mendelsohn & el Obeid 2004). Today, in addition to to subsistence agriculture and animal husbandry, hunting, fishing, and gathering, handicrafts such as basketry, pottery, woodworking, leatherworking and metalworking in iron, copper and brass also made an important contribution to the economy of the Kavango people (Haingura 1993).

The proposed prioritized exploration and appraisal wells Nos. D1-D6 and G1-G6 therefore are either located in community forests (D1, D2 and D5) others on State land (D6, G2, G3, G4, G5, and G6) while only three (D3, D4 and G1) are located near Gcaru, Naingopo and Hamuyi villages respectively (see **Figure 1**) along D3425 road network. The status and priority rating of the wells are well defined in the (Risk Based Solutions, 2022) of the project.

Figure 8: Omatako Ephemeral River Channel along the D3425 route in Kavango East. Image Credits: (RCHS, December 2022).

7.2. Geology

The Kavango region lies entirely within the Kalahari Basin (**Figure 9**) which covers and extensive parts of northern Namibia and formed during the Cretaceous period (145 to 66) million years ago according to (Burke 2002; Lund 2002*)*. Since its existence, it has been the main catchment of erosion products, today bearing the most extensive sheet of aeolian sand in the world (Partridge 1997 Burke 2002). The oldest aeolian sand sediments are the Tertiary Kalahari sands deposited on the margins of the Kalahari Basin which underlie younger red sands deposited from the Late Holocene period (Partridge 1997; Burke 2002). Further, the oldest rocks in the region are reportedly the Damaran meta-sediments composed of dolomites, quartzites, shale and schist. Overlying the Damaran are the Etjo Sandstone (Lebung) and the Kalkrand Plateau formed during the Late Holocene period and resulted in the formation of calcrete deposits (Simmonds 2000; Burke 2002). As a result, the current land surfaces of the Kavango Region are characterized by extensive areas of aeolian sand-drift and dune formations deposited on calcrete erosion surfaces. The Kalahari Group (**Figure 10**) comprised of unconsolidated to semi-consolidated aeolian and fluvial deposits and has been divided into three main units mainly the: upper – comprising aeolian sands and fluvial sands; the middle - comprising fluvial sands with minor aeolian sands and lower – comprising of conglomerate, red clay with a carbonate cement.

The basin shows a main southeast-northwest trending axis (see Figure 2.1) with two subsidiary basin axes trending southwest-northeast. These trends are the same as the dominant basement trends of the Damaran Orogeny and the dolerite dyke trends which stretch across northern Namibia into Botswana. The effects of the dolerite dyke intrusions on the groundwater flow regime of the regional Kalahari aquifer system is unknown. However, it is unlikely they act as barriers unless they come close to the surface. The geological settings that characterize the proposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 are the Damara Fold Belt Leads (covers the D1 and D6 well locations) and Graben Leads (covers the G1 and G6 well locations) as summarized in (Risk Based Solutions, 2022).

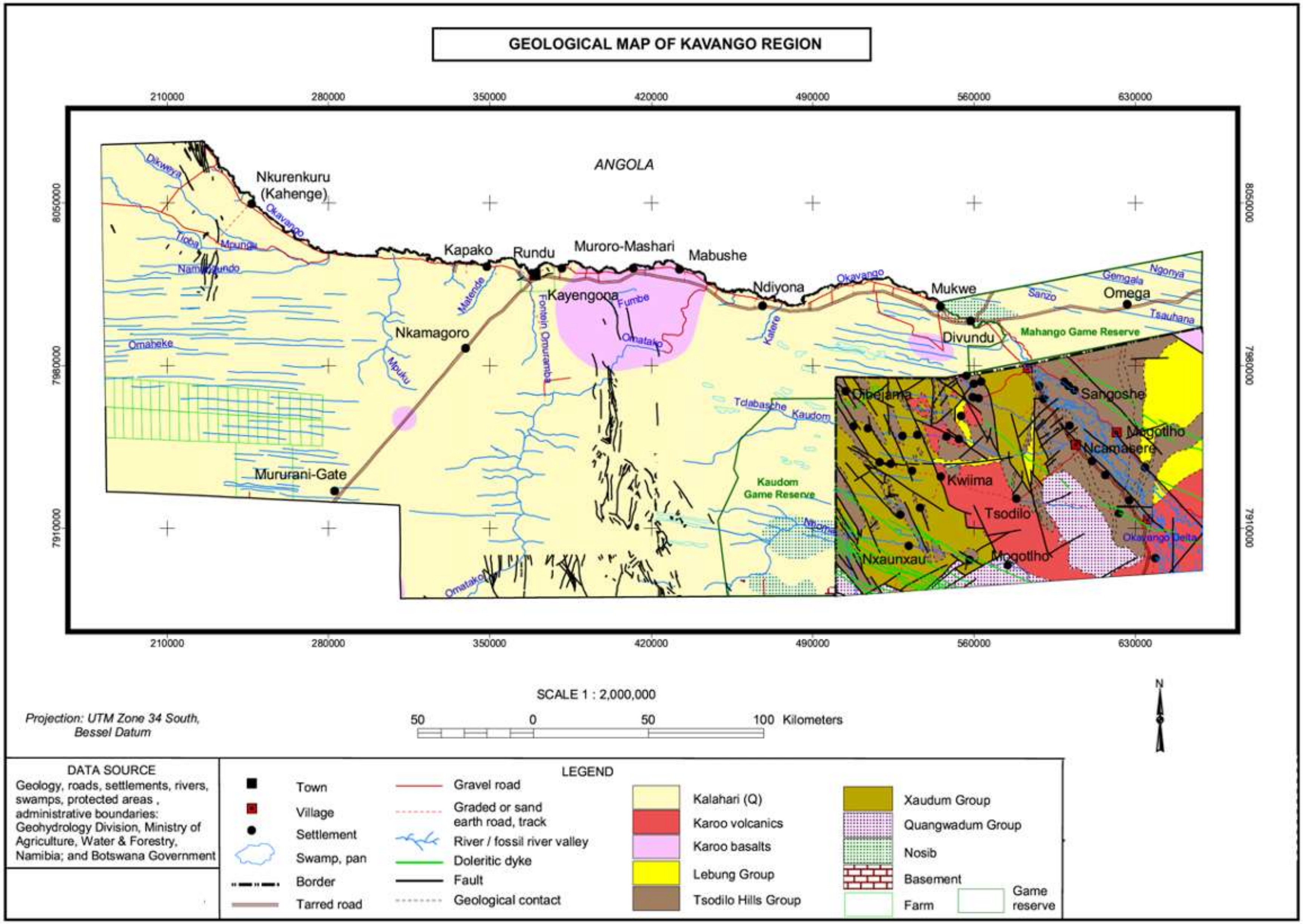


Figure 9: An edited map of Kavango region indicating the main geological units. Source: (WS report (2011).

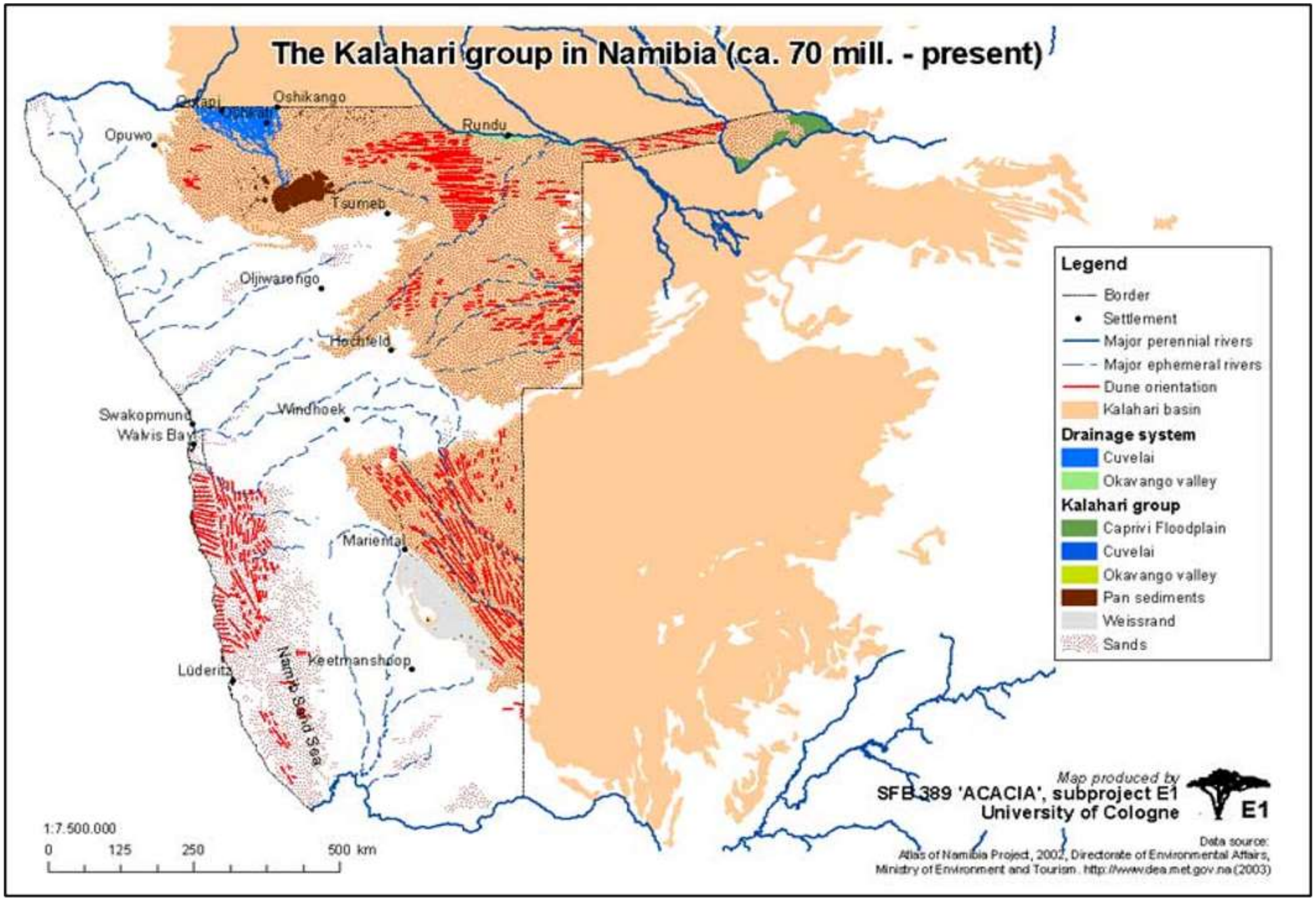


Figure 10: The extension of Kalahari Group in Namibia and borderlines territories. Source: University of Cologne, accessed on: https://www.uni-koeln.de/sfb389/e/e1/download/atlas_namibia/pics/physical/kalahari-group.jpg

8. ASSESSMENT FINDINGS

8.1. Pre-identified Archaeological Sites

Although about 73 archaeological sites are known in the Kavango regions, most of the sites are not vulnerable to the proposed exploration and appraisal of Wells Nos. D1-D6 and G1-G6 within PEL 73 as they are mostly located along the Okavango River. This Kalahari area is broadly covered by a low-density scatter of tools including very old Acheulean hand axes, flakes, cores chunks as well as blades and cleavers assigned to the Early Stone Age roughly c.500 000-130 000 years ago attributed to the archaic humans (Richter (2003). They are therefore the earliest evidence for the tool-making human ancestors occupying these areas. Such artefacts are usually found among alluvial gravels. Such sites are chronologically followed by the microlith industries with its bifacially worked leaf -shaped point dating around BC 10 000 to marking the Pleistocene/Holocene periods (Richter (2002/2003). This period is characterized by substantial technological improvements over the MSA industries. Advancements on previous technologies and new technologies as well as cultural developments include the widespread occurrence of decorative objects (beads and ceramics possible human burials with grave goods including painted stones, an expanded stone tool kit, microlithic stone tool industries (often associated with composite tools such as bow and arrow hunting), bone tools, tortoise carapace bowls, ostrich egg shell containers, fire making sticks and so on.

The LSA stone artefacts are present in the landscape, they occur in low densities - often in isolation, are sometimes mixed with MSA specimens and lack organic and cultural remains. As a result, these materials are generally of low scientific value.Until fairly recently, no archaeological work had been done in Kavango and the small surrounding settlements along the Okavango and Omatako Rivers and Omiramba channels. The existing EIA studies in Kavango barely also incorporated HIA as part of the EIA process. However, few historic studies (Haingura 1993, Maho 1998; Fleisch and Mohlig, 2002; Museum Association of Namibia 2010; Akuupa 2006; Fisch, 2005; Likuwa 2020; Likuwa and Shiweda 2018 etc.) studies and Museum database have confirmed the earlier observations of historical sites and sacred sites including graves linked to the present-day settlers in Kavango.

The five pre-identified isolated Middle Stone Age (MSA), Late Stone Age (LSA) and Iron Age (IA) archaeological sites (see Richter, 2003) and (**Figure 11)** were situated on the tributary of the Omatako River Fountain and Omiramba about 12 and 28k km from the proposed wells could not be located during the foot survey due to the fact that areas have been extensively disturbed by natural erosion channels and transformed into small scale agricultural activities as shown in the Google Maps (**Figure 12 A , B & C**).

According to Mendelsohn (2009) about 65 years ago, a large influx of people permanently settled along the Riverbanks and along fossil drainage lines (Omirambas) and inter-dune valleys (fluvisols and calcisols) where small patches of somewhat better soils is fertile for agricultural production (**Figure 13 & 14)**. Although none of these sites have been archaeologically excavated the prospections in the area (**Figure 14)** i.e., close to Hamuyi village near the Forestry Nursery Hamuyi (Site 1) presented at least "remnants of iron smelting site or furnace" attributed to Late Iron Age (LIA) period, has been disturbed and disappeared. Equally, all archaeological sites pre-identified (site 2, 3 and 5) along the Omatako River between Ncaute and Taratara villages (**Figure 11**) where the stone artefacts dating from MSA, LSA and pottery fragments from IA and LIA periods no longer exist. Fortunately, the objects were collected- surface finds during the surveys (see Richter, 2003). While a group of archaeological sites near the Ndonga village near Katere were recovered from a test excavation which yielded recent evidence of human occupation in the form of decorated and undecorated potteries, Levallois flakes, bones, and charcoal.

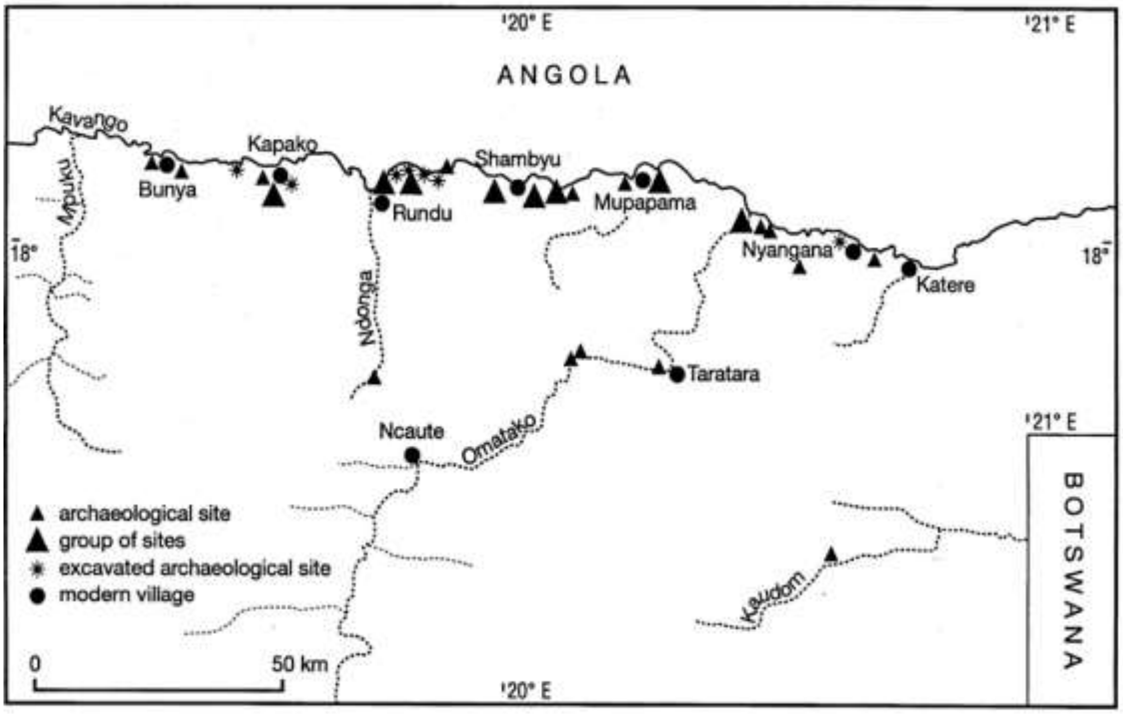


Figure 11: The distribution of archaeological sites in Kavango in relation to those within 20km from the proposed exploration project. Source: (Richter, 2003: 79).

However, it's important to stress that these individual objects were likely a result of post-depositional factors, whose significance is medium since they were likely not in primary settings and in no way vulnerable to the proposed project. The entire biophysical elements surrounding these environments were physically examined, to identify potential sites but none were found.

Figure 12: Google Images (Above, Middle and Below) indicating the transformed areas where the perceived pre-identified were located. (Source: Google Earth, December 2022).

Figure 13: The present day locations of pre-identified sites whose areas have been altered and disturbed. Photos Credit: (RCHS, December 2022).

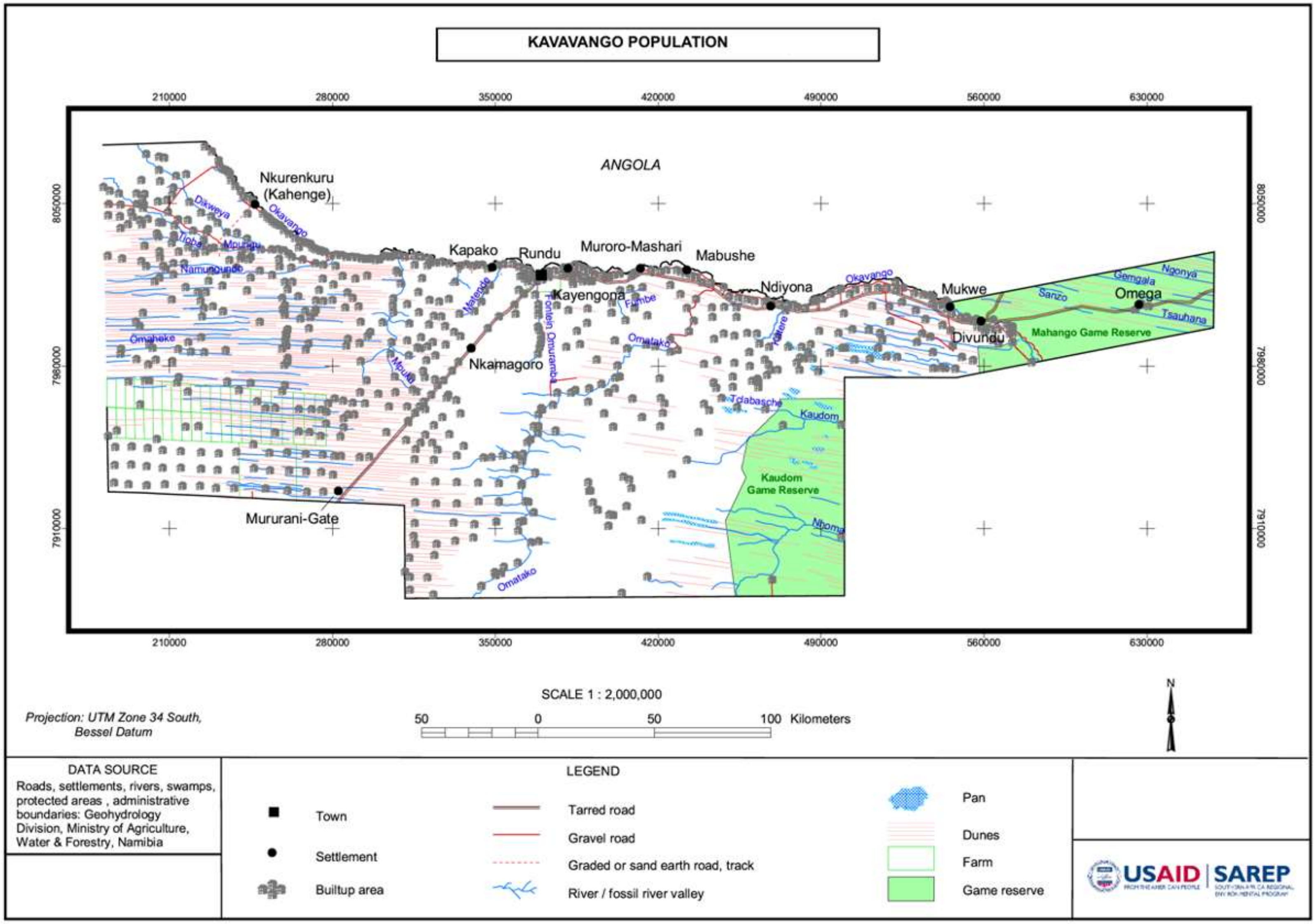


Figure 14: Population settlement along the Omatako River, Omurambas and fossil river valleys in Kavango regions. Source: WS report (2011).

With great collaborations and assistance of staffs at the Rundu Museum, and in particular, Mr. Herbert Munango (the interpreter who arranged meetings with source communities) several ethnographic interviews (oral) and consultative meetings with traditional authorities and local communities (**Appendix 1**)comprising of several people including the local tribal council living within 10km radius of the proposed drilling of the D1-D6 and G1-G6 exploration and appraisal wells were conducted between the 9th to the 13th of December 2022 (see **Figures 15**). This in effort to identify possible heritage resources (tangible and intangible) within the proposed development area; evaluate the potential impacts of explorations and operations of the proposed development on heritage resources to fulfill the objectives for the assessment and build a strong database of primary information on PEL 73 to supplement exist song data of significance of heritage resources. The locations of proposed drilling of the D1- D6 and G1-G6 exploration and appraisal wells were discussed with the groups.

The elders indicated their appreciation that heritage issues were being taken into consideration in the overall EIA. They are not aware any known cultural heritage resources in direct proximity to the proposed drill sites however, they have revealed several cultural sites of importance including traditional homestead of chiefs, ancestral graves, a number of historic cemeteries, royal graves and graves of traditional leaders, unmarked burial grounds, sacred sites and built-up elements such as missionaries' churches. Such sites are 10km away from the proposed Wells' locations hence their vulnerabilities and degree of threat is very low as a result. One can confidently assert that there is no direct impact or imminent threat due to the proposed exploration activities. As a result, several significant heritage resources were identified.

Figure 15: Interviews and consultation meetings and site visits with the source communities and traditional authorities in Kavango East and West regions. Images credits: (RCHS, December 2022).

8.2. Historical and Built Environment

As attested by the archaeological records, the project area forms part of the general Kavango historic landscape with traces of MSA, LSA and IA heritages, contemporary sites of recent Kavango population settlements dating to the last hundred years as well as historic sites associated with white settler migration in particular, the missionaries - Germans and Finnish who played leading roles in the development of Christianity in Kavango from 1910 (Lategan, 1980) resulting in the number built heritage monuments. Although there is no listed built heritage sites in the Heritage Register of the National Heritage Council, one particular significant Evangelical Lutheran Missionary Church (believed to be the oldest in Kavango according to the locals), located at these geographical locations 18°30'23.96"S / 19°43'48.33"E along the banks of the Omatako River (**Figure 16**) believed to have been built and established by a Finnish missionary translator Pentti Toivanen, who worked in the Okavango area and helped translate the Bible into Kwangali (Ngondji, 2010) at eventually died in Rundu and buried at his Church in 2004 at Qcquatjinga village in Ncucuni Constituency approximately 20 km from the proposed drilling site D5. The site is therefore not vulnerable due to its distance, but caution must be applied by the proponent in relation to exploration infrastructure related activities such as roads networks that pass near the village.

Figure 16: The oldest Evangelical Lutheran Church in Kavango, at Qcquatjinga Village, Kavango East. Images credits: (RCHS, December 2022).

8.3. Graves and Burials Sites

In total twelve (12) burial sites comprising between 1 to 150 graves were identified, however there might be several more unidentified graves. These are presented in (**Table 1 and Figure 17, 18 and 19**) below. All grave sites are not vulnerable to the proposed exploration activities because they are located between 5-45 km aways from the proposed drilling of the D1- D6 and G1-G6.

Table 1: Lists various burial grounds recorded in Kavango East and West in relation to the location of proposed Wells.

GPS Coordinates	Area	Description	Typology	Quantity	Distance from D1- D6 and G1-G6.	Vulnerability	Recommendation
18°30'24.62"S 19°43'49.43"E	Gcwatjinga Community Forest	Missionary Grave	Historic	1	20km from G1	None	No Go Zone
18°30'13.08"S 19°43'55.00"E	Gcwatjinga Community Forest	Burial Ground with marked and unmarked graves	Unfenced Traditional Graves in a Small Forest behind a crop field.	8	20km from G1	None	No Go Zone
18°30'26.88"S 19°44'11.00"E	Gcwatjinga Community Forest	Burial Ground with unmarked very old graves	Unfenced ancestral graves in a State Forest behind Omatako River.	7	20km from G1	None	No Go Zone
18°30'22.97"S 19°44'17.00"E	Gcwatjinga Community Forest	Family Grave	Unfenced Recent Grave	1	20km from G1	None	No Go Zone
18°29'50.96"S 19°44'51.99"E	Gcwatjinga Village	Family Graves	Fenced Recent Graveyard	4	20km from D5	None	No Go Zone
18°14'27.91"S 19°44'14.02"E	Hamuyi Village	Burial Ground with unmarked very old graves	Unfenced ancestral graves in a State Forest behind Omatako River and D3425.	+-310	5km from G1 Well site	None	No Go Zone
18°13'20.06"S 19°44'38.83"E	Hamuyi Village	Historic Cemeteries	Unfenced Historic Cemetery near D3425.	+-30	5.8km from the G1 site	None	No Go Zone
18°11'46.78"S 19°45'19.73"E	Hamuyi Village	Community Cemeteries	Unfenced Community Cemetery near D3425.	+- 60	9km from the G1 site	None	No Go Zone
18°12'12.50"S 19°45'14.66"E	Hamuyi Village	Historic Cemeteries	Unmarked and unfenced historic graves	+-13	7km from the G1 site	None	No Go Zone
18° 0' 32.97"S 20°41'29.538"E	Ndiyona Village	Royal and graves of traditional leaders	Marked and fenced historic graves	+-80	7km from the G1 site	None	No Go Zone
17° 52' 31.458"S 19°32'17.898" E	Sigone Village in Kapako	Community Cemetery	Fenced Recent Graves near Okavango River	+-150	45km from the G1 site	None	No Go Zone
17° 52' 56.22"S 19° 33' 5.148"E	Sigone Village in Kapako	Burial Ground with unmarked very old graves	Unfenced graves of traditional leaders	+-10	45km from the G1 site	None	No Go Zone

Figure 17: The above images show mostly ancestral and historic graves that are viewed older while bottom images are some of the graves of Hompas, traditional leaders, families burial plots and recent cemeteries respectively. Interviews and consultation meetings and site visits with the source communities and traditional authorities in Kavango East and West regions. Images credits: (RCHS, December 2022).

Figure 18: A local guide from Hamuyi Village standing at the unmarked graves and very old ancestral graves belonging to San people in the area. Image credits: (RCHS, December 2022).

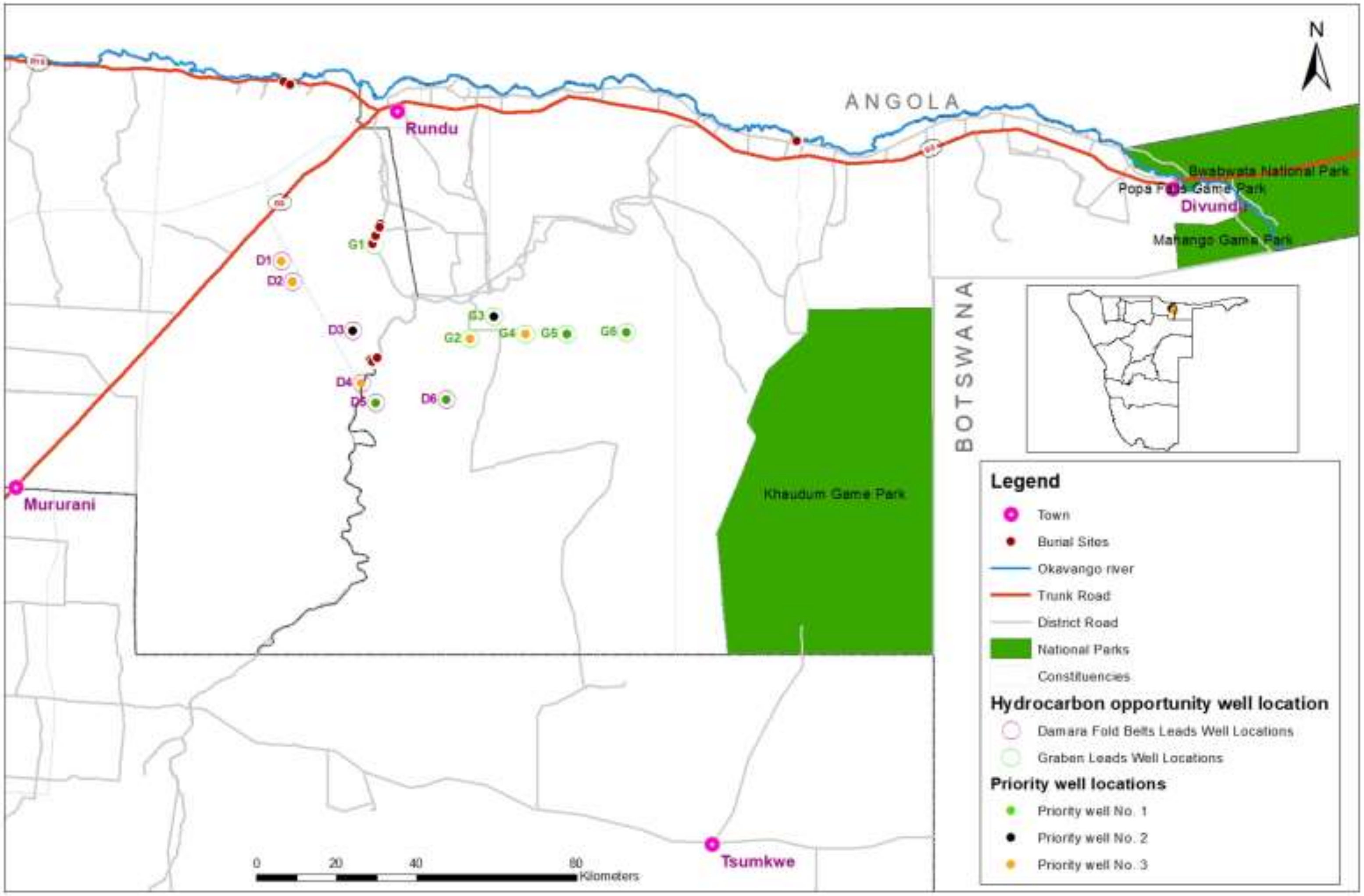


Figure 19: The distribution of Various burial grounds recorded in Kavango East and West in relation to the location of proposed Wells. Image credits: (RCHS, December 2022).

8.4. Sacred Sites

The anthropological interviews with the local communities have also stressed the importance of recognizing places. Accordingly, it has been proposed that traditional homesteads/dwellings including sacred lands of indigenous and traditional leaders are viewed to be significance as places for dialogues and discussions about socio-economic issues, social-cultural survival, biodiversity and environment, community cohesion, discussions about agricultural practices and animal management, ecological, religion and spirituality among many other issues. As a result, the following nine (9) areas have been identified to be culturally and spiritually significant to these communities as summarized in (**Table 2, Figure 20 and 21**).

GPS Coordinates	Area	Description	Typology	Distance from D1- D6 and G1-G6.	Vulnerability	Recommendation
17° 52'46.56"S 19° 33'2.28"E	Kapako Village	Mbunza Traditional Authority	Palace of Hompa Mika Alfons Koundu	40 km from D1 Well site	None	No Go Zone
17° 52'54.288" S 19° 32' 31.518"E	Sigone Village in Kapako	Headwoman Martha Haimbili of Mbunza	Homestead and Crop field	40 km from D5 Well site	None	No Go Zone
18°2'41.14"S 20°42'29.50"E	Ndiyona, Kavango West	Chief Paulus Lipayi Linyando, Gciriku	Chief Homestead and Crop field	20 km from D1 Well site	None	No Go Zone
18°24' 36.21" S 19°47' 0.252" E	Gcaru Village	Assembly point for community gatherings on D3425	Sacred Tree	9 km from D2 Well site	None	No Go Zone
18°29'54.882" S 19°45'9.66"E	Gcwatjinga	Headwoman Engeldrauth Mahongo of Mcuncuni village in Shambyu	Homestead and Crop field	20 km from D5 Well site	None	No Go Zone
18°12'54.12" S 19°44'48.558"E	Hamuyi Village	Headman Reinhard Magundu of Sambyu Traditional Authority	Homestead and Crop field	4.7km from G1 Well site	None	No Go Zone
18°22'2.21"S 19°55'8.67"E	Makandina Village	Headman Damian Hausiku of Sambyu Traditional Authority	Homestead and Crop field	1.3km from Makandina Well site	None	No Go Zone
17°53'23.78"S 19°52'45.51"E	Rundu Rural	Shambyu Traditional Authority	Palace of Hompa Sophia Mundjembwe	38 km from Mbambi Well site	None	No Go Zone
18°16'28.458" S 20°0'4.79"E	Mbambi	Heawoman Rosita Mbabi	Homestead and Crop field	5.9km from Mbambi Well site	None	No Go Zone

Figure 20 Above two images are the palaces of Shambyu and Mbuza (palaces intentionally concealed) Traditional Authorities. These are followed by the sacred gathering tree for local communities. All bottom images are the homesteads and sacred gathering trees of local headmen and head women. Image credits: (RCHS, December 2022).

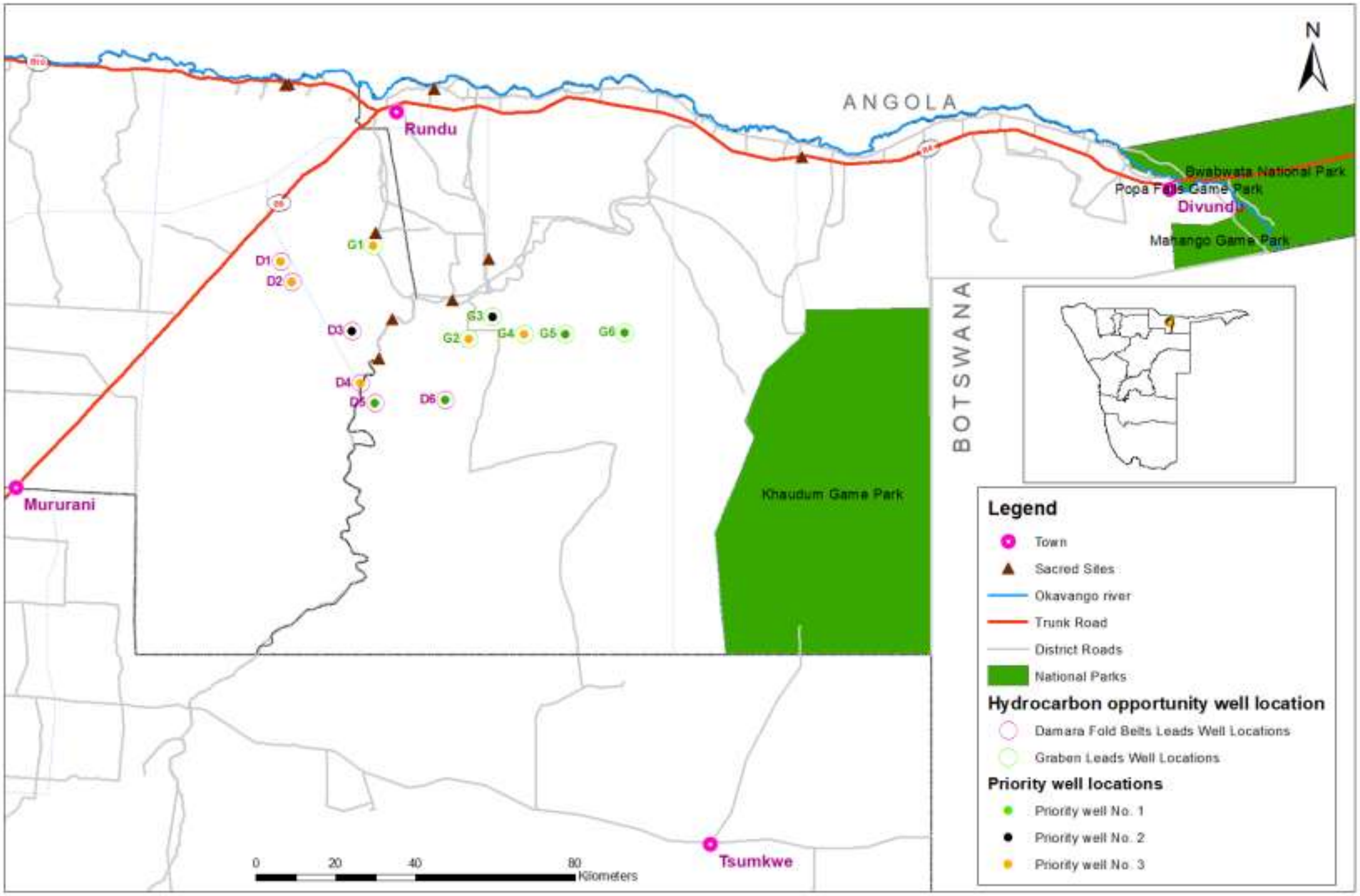


Figure 21: The location of sacred sites in relation to the proposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 Image credits: (RCHS, December 2022).

9. Impact assessment

All the pre-identified heritage localities that were identified within the baseline assessments have been visited, evaluated, and assessed. Although the sites have been altered, disturbed, and damaged, the objects were already collected by the researchers and currently housed in the National Museum of Namibia. However, their sites have lost scientific value and they are longer eligible for further scientific research, in the form of excavations to further understand all archaeological contexts associated with them. Such damage therefore transformed a cultural landscape into a normal landscape without heritage significance. However, the anthropological data harvested from interviews with local communities has yielded several significant but not sensitive and nor vulnerable heritage resources in terms of National Heritage Act, (No. 27 of 2004) within the proposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 within PEL 73. The sites are located from 5km to 45 km away from the Wells locations.

The study is therefore considered to be sufficient as a basis for the two assessments. However, in the unlikely event that archaeological and any other cultural heritage resources are exposed during site works, the expected nature of impact would be in the form of direct physical disturbance or destruction. The expected magnitude of this impact would be considered low due to the fact that impacts on archaeological and heritage resources in general are irreversible, these would be high, with a localized spatial scale. The consequence of the impact would be localized, and its significance would be LOW. The interpretation of this assessment would indicate a low significance, indicating that the risk of archaeological other heritage resources is so low as to have no influence on the project decision. In the case of the "no-go" alternative identified in the baselines and current report, no disturbance to these sites would occur, and it is for this reason that the "no go" alternative has not been devised as a mitigation procedure. From the cumulative impact perspective and given the fact that some areas are disturbed there is zero sensitivity and vulnerability to heritage sites. It is expected that the project will have no negligible cumulative impact on Namibia's archaeology resource base.

10. Management recommendations

It has been established that the porposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 within PEL 73 will likely not impact the identified heritage resourves. In relation to the management of the "No Go Zones"

a) All the identified heritage resources within the baseline reports and current report should be avoided.
b) The heritage resources should not be disturbed and permission would be required from the National Heritage Council for any enchroachment.
c) A Heritage Consent will be required from the Competent Authority in accordance with the provisions of National Heritage Act (27 of 2004) to allow the project to proceed.

In the unlikely event that archaeological and or paleontological traces are exposed during site works, contractors working on the site should be made aware that under the National Heritage Act, (Act No. 27 of 2004) and that any items protected under the definition of heritage found in the course of development should be reported to the National Heritage Council. Subsequently, areas proposed for the exploration and appraisal of Wells Nos. D1-D6 and G1-G6 within PEL 73 and its infrastructure related development have been subject to a site visit and assessment at this stage. Information obtained from the site's visit supplemented the secondary data from reports, publications, and museum databases reflected in the desktop reports. Therefore, primary data obtained from site visit was based on surface indications alone, as well as inferences from the source communities. It is therefore possible that sites or items of heritage significance will be found in the course of development work. It is important that personnel and contractors are sensitized about heritage awareness so that the proposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 within PEL 73 and its infrastructure related development do not encroach intentionally in the identified heritage resources area and so that they may recognize heritage "chance finds' ' in the course of their work. The procedure set out here has been devised by renowned Namibian Archaeologist, Dr. John Kinahan (see Kinahan 2012) and covers critical but practical reporting and management of such finds. The "chance finds" procedure covers actions to be taken in the event of heritage discovery of a site or object to its investigation and assessment by a trained archaeologist or other appropriately qualified person. The "chance finds" procedure is intended to ensure compliance with the relevant provisions of the National Heritage Act (27 of 2004), especially Section 55 (4): "a person who discovers any archaeological object must as soon as practicable report the discovery to the Council". The procedures are replicated below:

Responsibilities:

Operator:	To exercise due caution if archaeological remains are found.
Foreman:	To secure the site and advise management timeously.
Superintendent:	To determine safe working boundary and request inspection; and
Archaeologist:	To inspect, identify, advise management, and recover remains.

Action by person (operator) identifying archaeological or heritage material

1. If operating machinery or equipment: stop work.
2. Identify the site with flag tape.
3. Determine GPS position if possible; and
4. Report findings to Foreman

Action by Foreman

1. Report findings, site location and actions taken to the superintendent.
2. Cease any works in immediate vicinity

Action by superintendent

1. Visit the site and determine whether work can proceed without damage to findings.
2. Determine and mark exclusion boundaries.
3. Site location and details to be added to Archaeological Heritage Geographical Information System (GIS) for field confirmation by archaeologist

Action by Archaeologist

1. Inspect site and confirm addition to GIS.
2. Advise National Heritage Council (NHC) and request written permission to remove findings from the work area.
3. Recovery, packaging and labeling of findings for transfer to National Museum In the event of discovering human remains (i) actions as above, (ii) Field inspection by archaeologist to confirm that remains are human (iii) Advise and liaise with NHC and Police, (iv)) Recovery of remains and removal to National Museum or National Forensic Laboratory, as directed.

11. Conclusions and acknowledgement

In conclusion, the site visit has confirmed as expected that indeed there are significant heritage resources within 10km radius of the proposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 within PEL 73. Such information therefore augmented the existing secondary data in Kavango regions. Of the challenging resources to identify were the fragile, hidden, and unmarked burial grounds found within various community forests, which if not adequately located, could easily be disturbed by any infrastructure's development activity in the region. The situation is much more complex in cases where there are no descendants linked to these burials and if the local communities are not informed about them since the majority of these burials are of San people. In general, it has been observed that large scale developments (roads, water and electricity utilities etc.,) and expansions of agricultural activities are accelerating at an alarming pace in Kavango, and this may have adverse effects on the local archaeology especially where such information is not shared with local and regional leadership. This is the case where the pre-identified archaeological sites could no longer be found as a result of direct disturbances associated with the local economy. Surprisingly, although the internal database of the heritage sites at NHC has extensive heritage sites from Kavango regions, none, not even a single site has been nationally declared as a registered national heritage site. A situation that requires urgent intervention both from NHC, Museum, local leadership, and Regional Council. The heritage resources presented here, although not in detail, have multiple values including but not limited to social, scientific, historic, religious, and cultural and it's worth preserving.

The anthropological Profile of PEL 73 in relation to the proposed exploration and appraisal Wells Nos. D1-D6 and G1-G6 within PEL 73 and its infrastructure related development in Kavango Regions would have not been possible without the support of the staffs at the Rundu Museum in particular Joseph Mbabo, Helvi Nghimbwasha, Herbert Munango who provided information about the affected traditional authorities, arranged meetings with the communities and translated our discussions and overall objectives of the project to the communities as the author cannot speak any Kavango language. We also acknowledge the guidance of Hon. Leopoldine Nseu and her staff at the Regional Council of Ncucuni Constituency in providing the names of local headmen and head women in the respective villages. Finally, we appreciate the support of the Traditional Authorities leadership, in particular Edward Mangundu, Ndjamba Makaka and Rosita Mbabi, Paulinus Lipayi Linyando, Martha Haimbili, Engeldrauth Mahongo, Reinhard Mangundu and Damian Hausiku for agreeing to our interviews, for providing field assistants, for stimulating discussions and constructive comments which helped shape this report and in general the assessment process.

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APPENDIX 1

CULTURAL HERITAGE STAKEHOLDERS IN PEL 73, KAVANGO REGIONS

Name & Surname	Designation	Institution	Village/Town	Postal Address	Email	Contact Number
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Hon. Leopoldine Nseu	Constituency Councillor	Ncucuni, Kavango East	Ncucuni			0816375481
Edward Mangundu Reihard Mangundu	Secretary (VDC) Headman	Traditional Authority	Hamuyi/Hamweyi	Po Box: 1482, Rundu	mangunduedward@gmail.com	0813298110 0815858944
Ndjamba Makaka / Rosita Mbabi	Headman/ Headwoman	Traditional Authority	Mbambi			0812900552/ 0817997686
Paulinius Lipayiya Linyando	Headman	Traditional Authority	Ndiyona			0813761210
Martha Haimbili	Headwoman	Traditional Authority	Sigone, Kapako	-	-	0817156488
Engeldrauth Mahongo	Headwoman	Traditional Authority	Gcwatjinga			0817231654
Siwombe Dolla	VDC	Constituency Council	Gcaru			0813348043
Paulinus Kangoro	VDC	Constituency Council	Ncaute			081 71 37141
Damian Hausiku	Headman	Traditional Authority	Makandina			0812234826
Hannes Balzar	Farm Owner	Wisdom Farm				0815779122