An assessment of the lizard fauna on the site of the proposed Vale Nouvelle-Calédonie KO4 Quarry.

Cygnet Surveys & Consultancy

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Prepared by: Cygnet Surveys & Consultancy
2 Acron Road, St Ives 2075 NSW AUSTRALIA
Email: gerryswan@axtsystems.com

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1. INTRODUCTION

Cygnet Surveys and Consultancy (CSC) were contracted by Vale Nouvelle-Calédonie to provide an expert assessment of the lizard fauna likely to occur on areas associated with the proposed development of the KO4 quarry and overflow area of the KO4 sediment storage facility, and identify the potential occurrence of sensitive species or habitat of conservation significance for lizards on these areas.

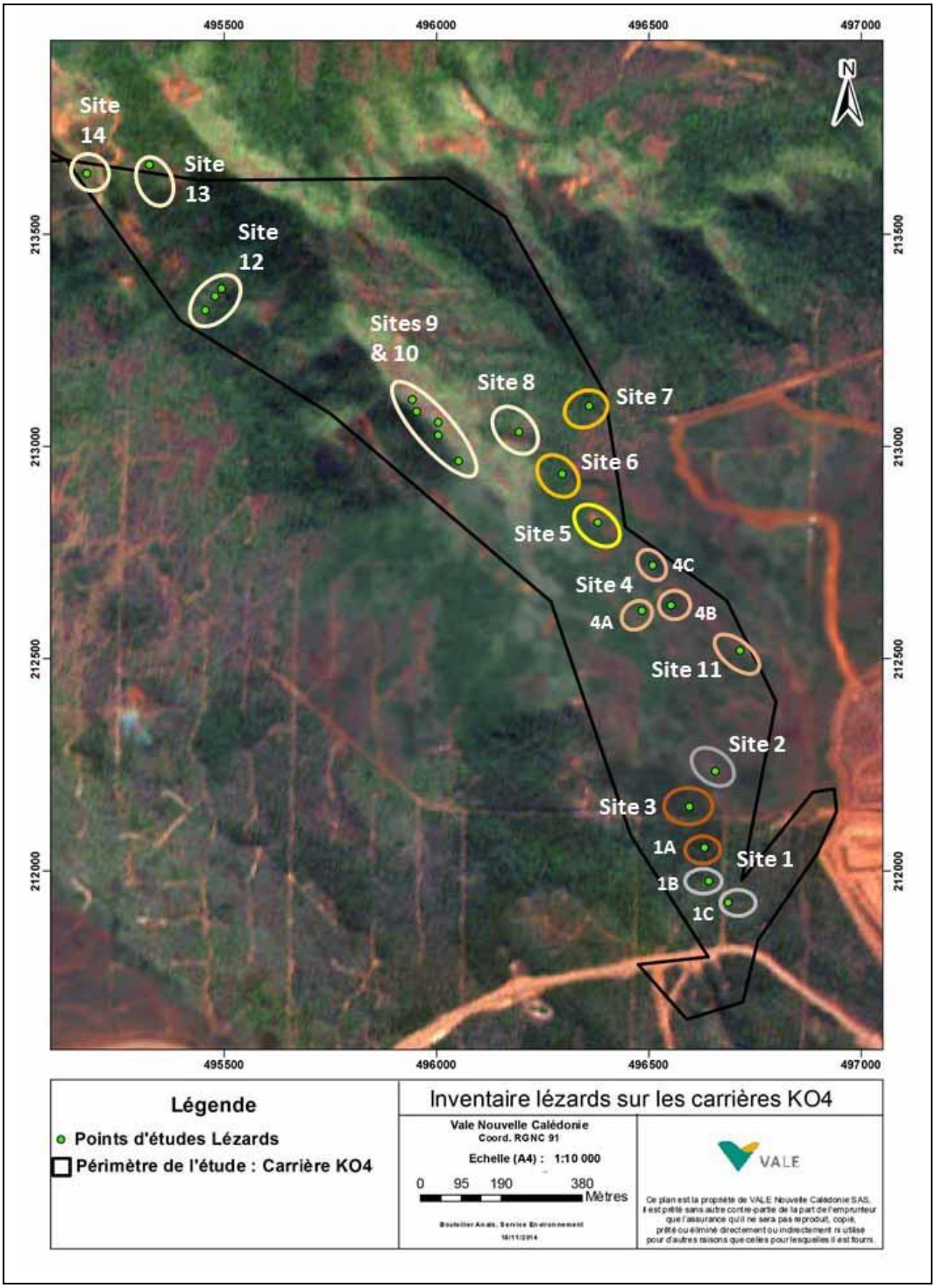
A number of studies have been commissioned by VN-C to investigate the lizard fauna of the Goro Plateau. The nature of these studies has been to establish monitoring sites for lizards (Sadlier & Swan, 2008), to inventory the lizard fauna in the areas of mine development (Sadlier & Swan, 2009a; Sadlier & Swan, 2010a; Sadlier et al., 2011a) including the proposed development of the KO4 sediment storage facility (Sadlier *et al*., 2014d), and to inventory the lizard fauna of proposed areas for preservation (Sadlier & Swan, 2009b and Sadlier *et al*., 2011d). More recently a number of baseline inventory studies have been commissioned to assess the lizard fauna of concessions held by VN-C (Sadlier & Swan, 2010b & 2010c; Sadlier *et al*., 2011b, 2011c, 2012, 2013a, 2013b, 2013c, 2014a, 2014b, & 2014c).

These studies in combination have identified a rich and diverse lizard fauna of ~25 species on the Goro Plateau and adjacent areas of the Grand Sud. Included are a number of **significant species** which have been identified as of particular conservation concern by virtue having one or more aspects of their biology (habitat preferences, diet, home range, etc.) specialized, and which in combination with their extent of occurrence influences the ability of these species to persist into the future. The richest habitat is humid forest from which 20 species have been recorded, including three species of giant gecko formerly in the genus *Rhacodactylus*, one of which is endemic to the Grand Sud. Tall maquis preforest also has a rich lizard fauna, with up to 14 species recorded from this habitat type, whereas open maquis arbustif or herbaceous maquis typically have a low diversity of species and low abundance. As a result of these studies humid forest and maquis forest have been identified as **significant habitats** for lizards in the region.

This study focuses on the main area of the Kwé Range to be developed as a quarry, and the adjacent area to the east on the Kwé River drainage to be affected by the construction of the overflow for the proposed KO4 sediment storage facility.

2. STUDY SITES

Fourteen sites in total were established in the area of the area of the proposed KO4 quarry and spillway for the KO4 sediment storage facility in the period 8th – 16th October 2014. A total of 420 trap stations were operational across the study area over the survey period.



Sites surveyed on the in the area of the area of the proposed KO4 quarry and spillway for the KO4 sediment storage facility in October 2014. – area covered by sites color coded to habitat type.

Site	Co-ordinates		Habitat (type_n1)	(type_n2)
Site 1	Transect A Transect B Transect C	-22.29171S x 166.93774E -22.29241S x 166.93784E -22.29287S x 166.93829E	Paraforest – Gymn. dom. Maquis – hydromorphic Maquis - hydromorphic	L E E
Site 2	Transect A Transect B Transect C	-22.29007S x 166.93797E as for A as for A	Maquis – hydromorphic Maquis – hydromorphic Maquis - hydromorphic	E E E
Site 3	Transect A Transect B Transect C	-22.29084S x 166.93738E as for A as for A	Paraforest – Gymn. dom. Paraforest – Gymn. dom. Paraforest – Gymn. dom.	L L L
Site 4	Transect A Transect B Transect C	-22.28666S x 166.93628E -22.28655S x 166.93694E -22.28570S x 166.93652E	Maquis ligno-herbace on cuirrasse Maquis dense on cuirrasse Maquis dense on cuirrasse	J J J
Site 5	Transect A Transect B Transect C	-22.28480S x 166.93524E as for A as for A	Maquis ligno-herbace de bas des pentes Maquis ligno-herbace de bas des pentes Maquis ligno-herbace de bas des pentes	G G G
Site 6	Transect A Transect B Transect C	-22.28375S x 166.93443E as for A as for A	Maquis ligno-herbace - dense Maquis ligno-herbace - dense Maquis ligno-herbace - dense	U U U
Site 7	Transect A Transect B Transect C	-22.28231S x 166.93504E as for A as for A	Maquis ligno-herbace - dense Maquis ligno-herbace - dense Maquis ligno-herbace - dense	U U U
Site 8	Transect A Transect B Transect C	-22.28287S x 166.93344E as for A as for A	Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes	F F F
Site 9	Transect A Transect B Transect C	-22.28245S x 166.93108E -22.28296S x 166.93158E -22.28349S x 166.93205E	Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes	F F F
Site 10	Transect A Transect B Transect C	-22.28220S x 166.93098E -22.28268S x 166.93159E as for B	Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes	F F F
Site 11	Transect A Transect B Transect C	-22.28750S x 166.93852E as for A as for A	Maquis dense on cuirrasse Maquis dense on cuirrasse Maquis dense on cuirrasse	J J J
Site 12	Transect A Transect B Transect C	-22.27986S x 166.92662E -22.28003S x 166.92647E -22.28032S x 166.92624E	Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes	F F F
Site 13	Transect A Transect B Transect C	-22.27724S x 166.92494E as for A as for A	Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes	F F F
Site 14	Transect A Transect B Transect C	-22.27743S x 166.92352E as for A as for A	Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes Maquis ligno-herbace des pentes erodes	F F F

Note: 'Habitat' corresponds to the broad vegetation types (type_n1), and the code for the finer level of vegetation type (type_n2) as determined in field during the course of the surveys.

The representation of vegetation type covered by the 14 sites surveyed was paraforest (9.5%), maquis on hydromorphic soils (12%), dense maquis on cuirrasse (14%), ligno-herbaceous maquis (7%) and dense ligno-herbaceous maquis (14%) at the base of the range, and ligno-herbaceous maquis (36%) on eroded slopes of the range. Low, sparse ligno-herbaceous maquis with outcropping peridotite rocks on the crest of the range (7%) was targeted as suitable habitat for the threatened skink *Lacertoides pardalis*. Forest areas on the KO4 quarry study area were not part of the surveys undertaken in October 2014, as these will be investigated later as a part of study of key forest areas in the KO4 basin.

***Arilastrum* paraforest – site 1A.**

***Gymnostoma* dominated paraforest – site 3A-C.**

Paraforest constituted a small proportion of the habitat surveyed in the study area. The area of *Arilastrum* paraforest investigated at site 1A and the area of *Gymnostoma* dominated paraforest at site 3A-C were located within the area of the proposed KO4 spillway.

Maquis on hydromorphic surfaces constituted a small proportion of the habitat surveyed in the study area. Both areas of hydromorphic maquis investigated, site 1B-C and sites 2A-C, were located within the area of the proposed KO4 spillway.

Left – site 1B. Dense maquis with a dense groundcover of sedges.

Maquis on hydromorphic surfaces.

Right– sites 2A-C. Open maquis with scattered sedges on cuirrasse surface.

Dense maquis on a ferralitique ironcap surface (cuirrasse) was widespread in the south of the study area. Two areas of this habitat type were investigated, sites 4 and 11, both of which were located within, or adjacent to, the area of the proposed KO4 spillway.

Left – site 4C.

Dense maquis on cuirrasse.

Right– sites 11A-C.

Ligno-herbaceous maquis (site 5) and dense ligno-herbaceous maquis (sites 6 & 7) were the dominant vegetation type on the lower slopes of the range, and areas at and adjacent to the base of the range. This vegetation ranged from low (1-2m) to moderately tall (2-4m), with the higher vegetation usually occurring in gullies on the lower slopes and in areas adjacent to drainage lines at the base of the range. The sites located in ligno-herbaceous

maquis and dense ligno-herbaceous maquis had a dense understory of sedges, although the composition of these varied. Ligno-herbaceous maquis had a groundcover of predominately broad-leaved sedges and the dense ligno-herbaceous maquis of the gullies and at the base of the range an understory of predominately narrow-leaved (tubular) sedges.

Right: dense ligno-herbaceous maquis (site 6) on the lower slopes of the range.

Below left: Ligno-herbaceous maquis (site 5) at the base of the range.

Below right: dense ligno-herbaceous maquis (site 7) at the base of the range adjacent to drainage line.

The dense ligno-herbaceous maquis was overall a more enclosed habitat, which in combination with a dense groundcover of sedges provided an overall more humid micro-environment at ground level.

Ligno-herbaceous maquis on eroded surfaces was the dominant vegetation type on the mid to upper slopes of the range of the range. This vegetation type was typically low (1-2m<) and open with a groundcover of dense broad-leafed sedges, becoming lower and sparser with a lower groundcover on the slopes and crest of ridges of the range. Exposed peridotite rock outcrops were scattered on the upper slopes and crest of the range.

Ligno-herbaceous maquis on eroded surfaces – area of sites 12, 13 & 14.

Ligno-herbaceous maquis – site 12

Ligno-herbaceous maquis – site 14

Left: ligno-herbaceous maquis (site 9). Above and below: exposed peridotite rock outcrops on the crest of the range (site 10).

3. METHODS

Survey sites at each area were selected according to the following criteria:

- to encompass the full range of habitats so as to assess the species diversity for each area as completely as possible.
- to target specific habitats in which lizard species of particular conservation concern might occur.
- to obtain an estimate of the number of individuals of each species likely to be affected by the proposed development activities.

Previous studies to assess the diversity and abundance of lizard species in forest and maquis habitats in the Grand Sud have shown that strategically placed glue traps are highly effective in detecting the presence of the majority of day active skink species, and particularly effective in detecting the presence of secretive species. It is also the only effective method for detecting the presence of skink species in areas with a dense understory and groundcover. For these reasons this was the primary method used to detect diurnal and secretive skinks in all habitats across the areas surveyed.

The number of sites surveyed reflected the extent and diversity of habitats present, and the logistics with regard to accessibility. Each survey site had two to three transects, each transect representing a site replicate. At each transect one glue-trap was laid at each of 10 stations (each station 5-8 m. apart) along a transect line. Glue traps were strategically placed under or next to sheltering sites (crevices and cracks created where outcropping cuirasse boulders contact the ground, under and next to logs), in areas of litter or amongst surface debris, and under vegetation. Records are also kept of lizards encountered opportunistically on transects during the course of checking glue traps.

Geckos are usually the less diverse of the two lizard groups present. Geckos are active at night foraging in low shrubs, small trees, or the forest canopy. By day they shelter in retreat sites in standing vegetation or under cover on the ground. Timed nocturnal searches were undertaken in the first two hours after sunset. These night searches generally consisted of walking along tracks through maquis and forest habitats in the general vicinity of survey sites, or through the forest following transect markers. The method used to search for geckos is by detecting the reflection from the eye when a beam of light is directed towards the lizard, or by scanning vegetation with a powerful light at closer range to observe geckos on twigs or branches. Binoculars modified to carry a torch and emit a light beam from below the eyepieces of the binocular are used to detect eye reflection. This method readily detects both the larger and smaller geckos, but to be effective it generally requires a minimum search distance of 10-15m., and a co-worker is often required to collect the gecko for positive identification while the first observer keeps the animal in sight from a distance. During this

period timed nocturnal searches were undertaken in the major habitat types present as follows: 1.5 person hours in dense maquis ligno-herbaceous shrubland on cuirrasse as transect running from site 11 to site 4; 1.0 person hour in dense maquis ligno-herbaceous shrubland on cuirrasse as transect running from site 4 to site 5; 1.0 person hour in *Gymnostoma* dominated paraforest at site 3.

The assessments of diversity of individual areas are based on extensive field and research experience on the New Caledonian lizard fauna by the CSC Principal Investigator and also draw support from the results of previous studies by CSC in the Grand Sud.

Typical placement of glue traps under vegetation in herbaceous maquis.

Typical placement of glue traps in the open (above left) and under a log (above right) in forest habitat.

4. RESULTS

***Species Recorded*:** eleven species of lizard (nine skinks and two geckos) were recorded across the 14 sites surveyed within the KO4 quarry area in October 2014.

Species	Sites														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No.
Caledoniscincus austrocaledonicus	-	1	-	1*	1	-	-	1	7	-	13	-	3	4	31
Caledoniscincus notialis	-	-	-	-	5	6	2	11	1	-	3	4	11	-	43
Lacertoides pardalis	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3
Lioscincus nigrofasciolatus	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Lioscincus tillieri	-	1*	-	1*	-	-	-	1	-	-	-	1	-	-	4
Marmorosphax tricolor	7	6	13	1	-	2	3	-	-	-	-	-	-	-	32
Phoboscincus garnieri	-	-	-	-	-	1*	-	-	-			-	-	-	1
Sigaloseps deplanchei	-	-	5	-	2	-	-	-	-	-	1	-	-	-	8
Tropidoscincus variabilis	1	-	1	1	3	1	1	5	3	2	1	2	5	2	28
Bavayia septuiclavis	-	-	5	2	-	1	-	-	-	-	-	-	-	-	8
Rhacodactylus auriculatus	-	-	-	1	1	-	-	1	-	-	-	-	-	-	3
Total	8	8	24	7	12	12	6	19	11	5	18	7	19	6	162

Note: an asterisk [*] denotes recorded from observation only. Sites are color coded to major habitat type.

The diversity of species recorded was modest (6 or fewer taxa) across each of the habitat types surveyed. Four taxa were recorded from the few paraforest sites surveyed, which included the primarily 'forest' inhabiting skinks, *Marmorosphax tricolor* and *Sigaloseps deplanchei*, and night survey work in this habitat recorded the gecko *Bavayia septuiclavis*. The areas of paraforest examined at site 3 had extensive broken cuirrasse at the surface of the forest floor, which has been identified as suitable habitat for several fossorial species of skink. The paraforest is also suitable habitat for the skink *Caledoniscincus notialis*, which was not recorded but would be expected to occur there.

Four species of skink were recorded from maquis habitat on hydromorphic surfaces. The sites surveyed were adjacent to paraforest, and their proximity to this 'forest' habitat could account for the presence of the primarily 'forest' inhabiting skink *Marmorosphax tricolor* at site 2.

A similar diversity of skinks (~4 taxa) was recorded from the two sites (sites 4 & 11) in dense maquis on cuirrasse, and night survey work in this habitat recorded the gecko *Bavayia septuiclavis*. The species recorded from this habitat type included the generalist species *Caledoniscincus austrocaledonicus* and maquis specialist *Lioscincus tillieri*, and the 'forest' inhabiting species *Marmorosphax tricolor* and *Sigaloseps deplanchei*. The skink *Tropidoscincus variabilis*, typically regarded as a 'forest' inhabiting species, was recorded in low numbers from the maquis habitat at sites 4 and 11.

Ligno-herbaceous maquis (site 5) and dense ligno-herbaceous maquis (sites 6 & 7) at the base of the range also had a modest diversity of species, with four taxa recorded from the low maquis at site 5 and six from the taller and denser maquis at sites 6 and 7 collectively. The most common species recorded from these maquis habitats was the primarily 'forest' inhabiting skink *Caledoniscincus notialis*, which was present at all three sites, as was the primarily 'forest' inhabiting skink *Tropidoscincus variabilis*. Two of the skink species, *Lioscincus nigrofasciolatus* and *Phoboscincus garnieri,* were each recorded from a single individual, both are generalist species and widespread across the region, and would be expected to occur in other maquis and forest habitats. The presence of *Caledoniscincus notialis* across all sites was unexpected, and is attributed to density of the groundcover of sedges at these sites, which provides a suitably moist microhabitat for this 'forest' species. The gecko *Bavayia septuiclavis* was recorded from a capture on glue traps, but would be expected to be widely distributed, albeit sparsely, across ligno-herbaceous maquis and dense ligno-herbaceous maquis habitat elsewhere in the study area.

Ligno-herbaceous maquis on eroded mid and upper slopes of the range constituted a very large part of the habitat within the study area, and as a consequence the majority of sites surveyed. Regardless of the higher survey effort (compared to other sites examined) undertaken, only four species of skink were recorded to be moderately widespread in this habitat type. Two of these, *Caledoniscincus notialis* and *Tropidoscincus variabilis*, generally regarded as 'forest' inhabiting species, were recorded from most ligno-herbaceous maquis sites on the mid and upper slopes of the range, and were reasonably abundant at two mid slope sites (sites 8 and 13). The widespread occurrence of these two species across ligno-herbaceous maquis habitat on the slopes of the range is similarly attributed to the density of the groundcover of sedges on the slopes which provides a suitably moist microhabitat for this species. Conversely, the apparent absence or low abundance of *Caledoniscincus notialis* from the crest of the range at sites 9, 10 and 14 is likely due to the low and scattered occurrence of sedges at these sites. Another skink, the generalist species specialist *Caledoniscincus austrocaledonicus* was also recorded from the majority of sites surveyed on the mid to upper slopes of the range, as was expected, and the maquis specialist species *Lioscincus tillieri* was

recorded from two sites but would be expected to occur throughout open maquis habitat on the range.

Outcropping peridotite rocks in low ligno-herbaceous maquis on the crest of the range was targeted as suitable habitat for the threatened skink *Lacertoides pardalis*, and the species was recorded from glue taps laid primarily in crevices in the rock outcrops. Three individuals, an adult, subadult and juvenile (pictured left) were caught and released on site. The return of 3 individuals from 30 traps indicates the population on the crest of the ridge is likely to be robust. The traps set for *Lacertoides pardalis* were run over two days. The first day of the trap run was not optimal, with only moderate temperatures and overcast conditions, whereas the second day was warm and with little cloud, and it was at the end of this was that day all three individuals were recorded.

***Significant species*:** one species of significance, the threatened skink *Lacertoides pardalis*, was recorded from the KO4 quarry area during the October 2014 survey period.

***Significant sites*:** the area outcropping peridotite rocks on the upper slope and crest of the range is habitat for the threatened skink *Lacertoides pardalis*.

Areas of maquis paraforest in the region are known to contain a number of significant skink and gecko species, particularly when situated on a broken cuirrasse surface. The area maquis paraforest investigated at site 1A is part of a larger block of maquis paraforestier a *Arilastrum* that lies within and adjacent to the study area, and is similar to sites investigated from which a suite of threatened lizard species have been recorded. Similarly, the area of *Gymnostoma* dominated maquis paraforest investigated at site 3 which is partially on a broken cuirrasse surface is similar to sites investigated from which a suite of threatened lizard species have been recorded.

Otherwise, much of the KO4 quarry area consists of open and dense maquis habitat that typically has a low diversity of lizard species and no species of particular conservation concern reliant upon it.

5. SUMMARY

Significant species

Significant species are those of particular conservation concern by virtue of having one or more aspects of their biology (habitat preferences, diet, home range, etc.) specialized, and which in combination with their extent of occurrence can determine the ability of the species to persist into the future.

One significant species of lizard, the threatened skink *Lacertoides pardalis*, occurs among the outcropping peridotite rocks on the upper slope and crest of the range that is included in the proposed KO4 quarry.

Several other lizard species of conservation significance have been recorded from and paraforest habitat similar to that surveyed on the KO4 quarry area. The skinks *Graciliscincus shonae*, *Nannoscincus mariei* and *Simiscincus aurantiacus* have been recorded from paraforest habitat on the 20-30 year mine plan, and the geckos *Eurydactylodes symmetricus* and *Bavayia goroensis* have been recorded from paraforest habitat on the Kwé Range. All are listed as threatened on the IUCN Red list.

Significant sites

Previous studies have recorded a total ~15 species of lizard from maquis paraforestier and preforestier habitat type on the Goro Plateau (Sadlier *et al*., 2011a). This is a level of diversity approaching that recorded for humid forest, and far greater than maquis arbustif or ligno-herbaceous maquis. A high proportion of species recorded from maquis paraforestier and maquis preforestier habitat (10 of 15) are regional endemics (species restricted to the southern ultramafic region), and a number of these are listed as of conservation significance under IUCN Red List criteria.

Two areas of paraforest habitat occur in the very southern end of the area included in the spillway adjacent to the proposed KO4 quarry, one of which is situated on a broken cuirrasse surface. Several threatened species, the skinks *Simiscincus aurantiacus*, *Nannoscincus mariei* and *Graciliscincus shonae*, and the geckos *Eurydactylodes symmetricus* and *Bavayia goroensis*, have been recorded from patches of paraforest in areas adjacent to the KO4 quarry and spillway study area. The occurrence of the skink species in paraforest habitat is usually associated with the presence of a broken ferralitique cuirrasse iron cap, which provides the suitable microhabitat for some species.

Areas of outcropping peridotite on the upper slopes and crests of the ranges in the Grand Sud is habitat for the threatened skink *Lacertoides pardalis*. Due to the topography of the ranges and the sporadic occurrence of outcropping peridotite across the Grand Sud, the species has a largely disjunct and dendritic distribution in the region (Sadlier et al., 2014). The

population of *Lacertoides pardalis* on the range in the area of the proposed KO4 quarry represents the second known population of the species south of Grand Lac and Lac en Huit, the other being on the Kwa Neie range at Forét Nord and Mine A1.

6. KEY POINTS

The survey of the KO4 quarry area in October 2014 identified the presence of two significant areas for species of particular conservation significance:

- the area of outcropping peridotite on the upper slopes and crest of the range which is habitat for the threatened skink *Lacertoides pardalis*.
- areas of tall *Gymnostoma* paraforest on a broken ferralitique cuirrasse iron cap and *Arilastrum* paraforest in the south of the study area for the proposed spillway, which are expected to contain a diversity of lizard species, including several of conservation significance.

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