A REPORT ON POSSIBLE MEASURES TO CONSERVE THE THUKELA AGATE SNAIL [*Cochlitoma simplex* (Smith, 1878)] ON PORTION 1 OF THE FARM MOOIDOORN HOEK No. 3722, MAGDALENA COLLIERY, DUNDEE, KWAZULU-NATAL

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SUMMARY

The offset area proposed in the report prepared by Zunckel Ecological & Environmental Services (2013) for the conservation of the Thukela Agate Snail (Cochlitoma simplex) on Ptn.1 of the Farm Mooidoorn Hoek No. 3722, Magdalena Mine, is based on two indigenous vegetation types that were mapped and described by Mucina & Rutherford (2006) in their publication Vegetation of South Africa, Lesotho and Swaziland.

The recommended size of this offset area is derived from the areas which these two vegetation types occupy within the boundaries of the proposed extension to the discard dump on Magdalena Mine.

On a site visit undertaken by the writer and Dr. D. Herbert on 14 November 2013, a large number of shells of C. simplex in various stages of degradation were found in an extensive mosaic of closed and open thicket which straddles, by a wide margin, the boundary between the two vegetation types mentioned above.

Both categories of thicket on Mooidoorn Hoek No. 3722 are dominated by Acacia karroo. This type of community is not referred to by Mucina & Rutherford as being characteristic of either of the vegetation types identified by Zunckel (2013).

Consequently, given that much of the area on which A. karroo-dominated thicket occurs on the property has been severely eroded in the recent past, and because it is well known that A. karroo is an aggressive invader of many disturbed areas in southern Africa, it can be assumed that the thicket on Mooidoorn Hoek is a secondary community.

Throughout the portion of thicket on Mooidoorn Hoek No. 3722 which was traversed during the site visit, shells were invariably found on soils which contained significant quantities of small (ca. 10mm Ø) concretions of calcium carbonate.

The availability of calcium is known to be a limiting factor for growth and reproduction in snails.

Consequently it is hypothesised that the distribution, and probably also the high density of snails evidenced by the large number of shells seen on Mooidoorn Hoek No. 3722 is determined by the distribution of calcium-rich soils which occur on the property and not by the two vegetation types of Mucina & Rutherford.

Therefore, until such time as the extent of these calcium-rich soils has been determined it is not possible to apply the criteria described by Ezemvelo KZN Wildlife to determine the optimum size of an offset area.

Based on visits made to other areas where C. simplex has been found, Dr Herbert formed the impression that the population density on Mooidoorn Hoek No. 3722 may be unusually high. However, because no density data were collected during the site visit, or exist for any other area where the snail has been found, this impression remains subjective.

It is also possible that, by chance, the route which was walked by the writer and Dr. Herbert, crossed the area on Mooidoorn Hoek where the population density of the snail is exceptionally high. However, because it is probable that the source of calcium enrichment lies within strata which comprise the Vryheid Formation which forms the higher-lying portion of the property on which the thicket occurs, it is reasonable to suspect that the density of C. simplex is high throughout the thicket-covered mid and foot-slopes of the property.

In the light of this assumption, because similar thicket habitat, which appears to occur on the same geological formation, was seen on other properties between Dundee and Magdalena Mine, it seems likely that other populations of C. simplex occur elsewhere in the vicinity of Ptn.1 of the Farm Mooidoorn Hoek No. 3722.
If sufficient evidence is collected to justify the view that the population of this snail on the property is unique, and relevant information is obtained to determine the optimum size of an offset area, the location of such an area on Mooidoorn Hoek No. 3722 remains a matter of concern.

Concern arises from the fact that if an offset area is created on Ptn.1 of the Farm Mooidoorn Hoek No. 3722 the only area in which it could be accommodated is downslope of where it is proposed to establish the extension to the discard dump.

Notwithstanding that the proposed design for the extension of the discard dump includes a line of dams along most of the perimeter of the dump, the fact that water draining out of coal mines, and from discard dumps, is typically acid, is an issue of concern..

If the water which is trapped in these dams and/or water from the base of the discard dump finds its way into the groundwater of an offset area which has been identified because it contains soils which are high in calcium carbonate, the acidity could lead to the reduction of available calcium to the extent where the offset area becomes unsuitable for the snail.

The concern outlined above is exacerbated by the fact that the level of groundwater on the property has been reported as high.

Also of concern is that the nature and extent of the source of the calcium carbonate concretions is unknown. However, it is very likely that at least some of this source will – sooner or later – become buried beneath the proposed extension to the discard dump.

If this does happen, the extent to which it may continue to contribute calcium to the surrounding soils may be compromised.

In the light of the information presented above, the following recommendations are made:

i. Undertake a survey to determine the nature of and extent of the source of calcium-enrichment of the soils on the midslope and footslope of Ptn.1 of the Farm Mooidoorn Hoek No. 3722.

ii. Map the distribution of the calcium-enriched soils on the property taking note to record the presence (and preferably, at least at a number of relevant places, the density) of snails and/or their shells.

iii. Determine whether the snail is present in a selected number of similar-looking habitats, in the same geological setting as occurs on Ptn.1 of the Farm Mooidoorn Hoek No. 3722, within a radius of not less than 20 km of Magdalena Mine. This exercise should include the similar-looking (i.e. thicket) habitat that occurs on the Dr. Alden Lloyd Nature Conservation Area near Dundee.

iv. Reassess the measures which have been proposed to reduce the risks of acid water diminishing the level of calcium present in the upper horizons of the soils in the area where an offset area could be located on Ptn.1 of the Farm Mooidoorn Hoek No. 3722.

If the snail population on Ptn.1 of the Farm Mooidoorn Hoek No. 3722 is found to be unique in any way (e.g. the snail does not occur in similar habitats in the vicinity of the mine or it is verified that the population is exceptionally high) and suitable measures can be put in place which will minimise the risk of the calcium-rich soils becoming unsuitable for the snail, then the area of calcium-enriched soils should be used to determine the size and location of an offset area on the property.

However, in making this last recommendation it is important to keep in mind that the design life of Magdalena Mine is 22 years. After this, and successful closure, it is considered reasonable to assume that whoever the owners of the mine at that time may be, will want to sell the property. Consequently, the long-term security of an offset area on Ptn.1 of the Farm Mooidoorn Hoek No. 3722 needs to be addressed if such an area is to be established on the property.
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1. Introduction
In their seminal publication *The Mammals of the southern African Subregion* (Skinner & Chimimba 2005) describe 354 species of mammals including marine species such as seals, whales and dolphins.

Taylor (1998) points out that of the 168 species of mammals found in KwaZulu-Natal, 103 are regarded as small mammals (e.g. bats, mice, shrews etc.) and 65 as larger species.

What is perhaps particularly striking is that these 168 species, which represent 47.5% of the species recognised by Skinner & Chimimba (2005), are to be found in the province which occupies only ca. 7.7% of the total area of RSA¹.

Samways (1994) estimated that ca. 250 000 species of insects occur in southern Africa.

There are about 3600 species of spiders and 130 species of scorpions in southern Africa (SANBI 2013).

Land Molluscs are the familiar snails and slugs of which about 650 species occur in southern Africa (SANBI 2013).

Herbert & Kilburn (2004) described and mapped the distributions of 275 terrestrial molluscs which occur in the eastern portion of South Africa (i.e. KwaZulu-Natal, southern Swaziland, SE Mpumalanga, eastern Free State, eastern Lesotho and Eastern Cape).

The numbers of species referred to above (there are many other groups of invertebrates which have not been referred to) support the often-expressed view that the fauna of southern Africa is rich and varied. However, what is not as well known is how exceptionally rich the fauna of KwaZulu-Natal is relative to other parts of southern Africa, especially given it’s comparatively small size.

Because in so many parts of the world it is well known that large numbers of animal and plant species have become extinct over very short periods as a consequence of human activities high levels of species richness alone are often used as the basis for conservation. What ought to also be appreciated is that no matter how high the species richness of an area may be very few, if any, of the species present are entirely independent of one another. They all play some role in the functioning of the environment which humans are part of and depend upon.

Admittedly, the precise nature of the roles which most of these species – especially invertebrates – play is presently unknown or, at best, only partially understood. Nevertheless, that they play roles which, for example, vary from animals such as butterflies and even moths being responsible for pollinating the flowers of crops which are the basic components of the diets of most South Africans to animals such as earthworms and dung-beetles, which play a major role in the decomposition of plant and animal waste and that the one group is in one or more ways dependent on the other, are compelling reasons for conserving species especially when so little is yet known about the roles which so many of them play in maintaining a healthy environment.

Perhaps one of the most compelling reasons which support this line of thought is the extent to which - in only the last decade or so - it has been appreciated how sensitive, and reliable, animals such as dragonflies, butterflies, frogs and chameleons are as indicators of environmental pollution and climate change.

¹ KwaZulu-Natal = 94 361km² and RSA = 1 219 912km².
What the role of terrestrial molluscs might be as indicators of environmental change has yet to be determined (and is only likely to become known when there are more mollusc specialists to investigate such questions!).

2. Reasons for this report
GCS (2013) state that the owners of the mine are seeking permission to extend the area of the existing discard dump, 3.33ha, to ca.36ha.

In June 2013 Zunckel Ecological & Environmental Services (hereafter referred to as Zunckel 2013) submitted a report to GCS Water & Environmental Consultants titled: Preliminary Ecological Assessment for the Proposed Extension of the Magdalena Colliery Discard Dump (MCDD), Dannhauser Municipality (KZ254).

Surprisingly, because the species was not previously known to occur in the area, one of the important findings in the report was that a number of shells of the “gastropod Cochlitoma simplex were found to be present on the site.”

The authors of the report pointed out that this species is a “KZN endemic found in the Colenso area, Emameni Game Ranch near Brakfontein, and Isandlwana NR, Thukela Basin, Kranskop and Mooi River north towards Ladysmith and the area of Nqutu, South Africa.”

Herbert & Kilburn (2004), who described and mapped the distribution of this snail (then known as Archachatina simplex) stated that the species is “endemic to the Thukela Basin, from Kranskop and Mooi River north to Ladysmith and the Nqutu area …”

Being an endemic species with a very localised distribution in the province, and because its abundance is unknown, C. simplex has been recognised by Ezemvelo KZN Wildlife as a species of conservation concern.

The discovery of the few shells in the area on the mine where it is proposed to extend the discard dump not only raised concerns for the survival of a species of conservation concern but also extended the known range for this species.

Zunckel (2013) states that “Since the footprint of the MCDD extension area will be developed and no natural vegetation will remain, avoidance, mitigation and restoration will not be possible.

It is therefore recommended that a biodiversity offset area will need to be secured according to the Norms and Standards for Biodiversity Offsets: KwaZulu-Natal Province (EKZNW, February 2013) i.e. the site must:
• be as close as possible (east-facing and preferably along the same rocky ridgeline);
• have the same geology, vegetation and rocky habitat types;
• be in a similar or better ecosystem and habitat condition;
• must be 1.5 times bigger (see Table 4) and its area to perimeter ratio must be as high as possible;
• must be connected and porous (see Section 6.4.4); and
• should be protected through EKZNW’s Biodiversity Stewardship Programme.”

3. Terms of Reference.
The Terms of Reference for the present report, as described in an email received from GCS Water & Environmental Consultants on 02 October 2013 were:
“1. Undertake desktop review of potential sites with Dr. D. Herbert, Natal Museum, Pietermaritzburg.
2. Conduct a site visit with Dr. Herbert to ground-truth and confirm potential sites.
3. Produce a short report detailing the site selection process/method and the potential feasible sites identified, including maps.”
4. Location of mine and proposed discard dump extension site
Magdalena Mine is situated in the Amajuba District of the Dannhauser Local Municipality (KZ254) ca. 22km north of Dundee.

The approximate centre-point of the mine-management buildings is 27° 58’ 30.40”S/30° 11’ 53.58E.

A small portion of the area in which it is proposed to extend the discard dump is situated on the northern side of the existing works but most of this proposed area is situated at the south-western end of the existing works on the property described as Portion 1 of the Farm Mooidoorn Hoek No. 3722.

The approximate centre-point of this area, which is ca. 21.894ha in extent, is 27° 59’ 1.23”S/30° 11’ 33.50E.

The locations of the existing works and boundaries of the proposed extension are shown in Figure 1 below.

Figure 1. Locations of the existing works and proposed extension of the discard dump, Magdalena Colliery. (from Zunckel 2013)

5. Geology, Topography, Soils, Climate and Vegetation
Descriptions of the above environmental features are presented in Zunckel (2013).

However, two important items which should be noted are as follows.

5.1 Geology and soils
Zunckel (2013) states that “the site consists of horizontally layered sedimentary units of the Vryheid Formation located within the Ecca Group of the Karoo Supergroup. These sediments comprise sandstones, shales, mudstones, carbonaceous shales and coal seams.”
However, Mucina and Rutherford (2006) describe the geology of Northern KwaZulu-Natal Moist Grassland as comprising: “Predominantly of mudstones, sandstones and shales of the Beaufort and Ecca Groups of the Karoo Supergroup which are intruded by dolerites of Jurassic age.”

GCS (2013) states that “on Magdalena No. 7574 coal reserves are truncated by dolerite sills to the north and south-east and that these sills have acted as resistant caps …”

The site visit on 14 November 2013 revealed that the plateau area which is situated immediately above the western boundary of the proposed extension to the discard dump is an extensive dolerite sill which corresponds to a resistant cap as described above.

The eastern margin of the sill does not coincide with a distinct vertical cliff i.e. scarp as illustrated by Soil Classification Working Group (1991) but the midslope immediately below the margin, on which it is proposed to develop the extension to the discard dump (PEDD), is strewn with dolerite boulders for a considerable distance.

Fewer boulders, which were also much smaller than those on the midslope, were seen on the footslope.

The presence of this dolerite sill is confirmed by the relevant portion of the 1: 250 000 geological map of the area.

Photo 1. View looking east from the eastern edge of the plateau referred to in the text above showing the abundance of dolerite boulders in this area. The route walked by Dr. Herbert and the writer commenced just to the left of the tree which can be seen on the left margin of the photograph.(14/11/13).

No sedimentary rocks were seen immediately below the edge of the plateau referred to in Photo 1 above. However, lack of time made it impossible to verify that such rock types are present at lower altitudes.

However, that such rock types must indeed be present can be assumed from the fact that Mucina & Rutherford (2006) state that the geology of Income Sandy Grassland (see below) comprises “sandstones and shale of the Madzaringwe Formation (Ecca Group of Karoo Supergroup) supporting poorly drained soils, mostly of the Glenrosa form.”
Johnson et al. (2006) state that “the Madzaringwe formation consists of up to 200m of alternating sandstone, siltstone and shale, the latter containing coal seams.” These authors also state that “brownish calcareous concretions and irregular carbonate bodies are present in both the sandstones and mudrocks.”

Immersing a few of these concretions in dilute (17%) hydrochloric acid resulted in immediate and vigorous effervescence indicating a high level of calcium carbonate.

Photo 2. View looking north-west towards the skyline to illustrate the absence of a scarp. The dotted line indicates the approximate alignment of the route walked by Dr. Herbert and the writer. (14/11/13)

Figure 2. Clipped portion of 27 Map series 1: 250 000 Geological Series, 2730 Vryheid showing the distribution of The buff coloured areas represent Vryheid Series and the magenta areas dolerite. The proposed extension to the discard dump is shown as an irregular black-line polygon and the boundary of the property described as Ptn.1 Mooidoorn Hoek No. 3722 by the yellow line.
No detailed investigation of the soils in the area of the PEDD was undertaken. However, at a number of places on the midslope where erosion has resulted in exposure of the soil profile a distinct melanic topsoil horizon was noted.

On the lower parts of the midslope, but in particular on the footslope below the eastern boundary of the PEDD melanic topsoils which included large quantities of small (ca. 10mm Ø) pale grey concretions were found on the surface. These concretions were particularly conspicuous in the many erosion gullies which have been incised across these slopes.

The presence of calcareous concretions, and the absence of signs of wetness immediately below the A horizon suggests that the profiles seen on the steeper parts of the midslope are representative of the Shingwedzi Family of the Inhoek Form (Soil Classification Working Group 1991).

The high abundance of concretions present on the portions of the footslope where the remains of the snail were found might lead one to suspect that the Steendal (melanic A over soft carbonate horizon) and/or Immerpan (melanic A over hardpan carbonate horizon) Forms dominate on this terrain unit (van der Merwe 2000).

However, given that the mean annual rainfall for the area is between 640mm and 1000mm (GCS 2013) and Fey (2010) states that both these forms “occur at the driest end of the climatic spectrum” and that the “calcic condition may be associated with limestone parent material”; a material which is not typically found in the Vryheid formation, makes it unlikely that these two soil forms are present.

Nevertheless, the fact remains that a very effective source of calcium enrichment is probably situated somewhere on the midslope where it is proposed to create the EDD and only a more thorough investigation, which must include chemical analysis of a number of soil samples, is required to locate it and confirm the identity/ies of the soil profiles.

Photo 3. Photograph illustrating the numerous small concretions of what tested to be calcium carbonate that were encountered on the footslope which occurs below the eastern boundary of the proposed extension to the discard dump. Ruler: 15cm. (14/11/13).
5.2. Vegetation
The Zunckel report (2013) identifies two vegetation types that are described by Mucina & Rutherford (2006) as occurring within the proposed extension to the discard dump.

**Income Sandy Grassland** occupies an area of ca. 5.367ha at the NE end of the proposed extension area while the remainder – ca.16.527ha – is **Northern KwaZulu-Natal Moist Grassland**.

The conservation status of both vegetation types is categorised by the South African National Biodiversity Institute (SANBI) as **Vulnerable**.

In a subsequent refinement of Mucina & Rutherford’s mapping EKZNW refer to **Northern KwaZulu-Natal Moist Grassland** as **Glencoe Moist Grassland**.

This does not change the conservation status of this vegetation type.

Aside from the fact that the proposed extension of the discard dump will result in some losses of two vegetation types of conservation importance it is also important to note that although most of the area which has been mapped as **Glencoe Moist Grassland** is not in fact grassland but is instead a low (trees 2-5m, shrubs 1-5m), dense (canopy cover >20%) thicket in which *Acacia karroo* is the dominant canopy species with *Diospyros lycioides*, *Acacia robusta* and *Tarenna junodii* being the sub-dominant tree species (Zunckel 2013).

Below the SE boundary of the PEDD this same type of thicket extends at lower altitude beyond the eastern boundary of what is shown in Figure 3 of Zunckel (2013) as **Glencoe Moist Grassland** into what is shown in the same figure as **Income Sandy Grassland**.

During the site visit which was undertaken on 14 November 2013 the only conspicuous change in this thicket community was that the canopy trees were shorter and more widely spaced than higher up the slope. Consequently, in this area this woody community probably qualifies to be termed low open (canopy cover 19-11%) thicket.

At the scale at which the above-mentioned vegetation types have been mapped it is considered unrealistic to suggest that the change in the structure of this thicket coincides with a change in vegetation type.

Indeed, it is considered more likely that it coincides with co-occurring changes in slope gradient, soil depth, severity of soil erosion in that the woody canopy became less dense as the slope gradient declined and the soil depth increased. Recent land-use, especially browsing by goats and cattle, cutting of trees on this flatter lower-lying area has probably also played a significant role in modifying the structure of this community.

That the entire area of this thicket community is accessible to domestic livestock which are owned by neighbouring subsistence farmers, was evidenced by the numerous stock-paths which traverse the area on which it is proposed to extend the discard dump and the slopes below it, the closely-cropped grass understory and the abundant patches of dung.

The severity of this grazing and browsing pressure, along with people collecting dead trees and branches, are probably the primary factors responsible for the thin and patchy distribution of plant litter.

In the light of Herbert & Kilburn’s (2004) description that “*C. simplex* “inhabits riverine thicket bushveld and more grassy savanna; during the dry season hides in the base of grass clumps and under fallen aloes; patchily distributed, but not uncommon where conditions are favourable.” it was surprising that such a large number of shells of *Cochlitoma simplex* were found throughout this thicket community, including the more sparsely wooded footslope area, during the site visit.
Photo 4. View looking south-west in an open area of the low dense *Acacia karroo*-dominated thicket which occurs throughout the area on which it is proposed to extend the discard dump. Note the abundance of dolerite boulders which it is assumed are derived from the dolerite sill at the top of the slope in the foreground. (14/11/13).

Photo 5. View looking north-west towards the dolerite ridge on the skyline which illustrated in Photo 1. The vegetation in the foreground is typical of the low open thicket referred to in the text above which occurs on much of the footslope area. Almost all the dense thicket which can be seen on the steep slope immediately below the skyline occurs within the area which will become occupied by the proposed extension to the discard dump (14/11/13).
6. Description of the site
Approximately 19.84 ha of the proposed extension to the discard dump is situated on the property described as Ptn.1 of Mooidoorn Hoek No. 3722 while the remaining 19.13 ha is situated on the adjacent property described as Rem. of Farm Magdalena No. 7574.

Very little natural vegetation remains on Magdalena No. 7574.

Aerial photo 1. Aerial view showing the boundary of the proposed extension to the discard dump (red polygon) and the property described as Ptn.1 Mooidoorn Hoek No. 3722 (yellow polygon). The dotted green line indicates the approximate route walked by the writer and Dr. Herbert.
7. Methods
As has been stated above, the field assessment was undertaken on 14 November 2013.

After the area in which the snail had been found previously (Zunckel 2013) was pointed out to us by the mine manager, the writer and Dr. Herbert walked through the area indicated by the dotted green line shown on Aerial photo 1 in the direction shown by the arrow.

After descending only a few meters below the ridgeline the first of many shells of the snail were found.

Attempts to locate live individuals we made using a small trowel to scrape way litter at the bases of a considerable number of trees and shrubs. However, no live individuals were encountered although the state of many of the shells indicated that the animals had died relatively recently. This was concluded from the fact that the periostracum on these shells was still fully intact.

At a number of places along the route shown on Aerial photo 1 both Dr. Herbert and the writer searched areas several meters on both sides of the route.

Invariably these ‘diversions’ were determined by seeing whole or portions of shells which no longer retained a periostracum and were consequently weathered and bleached white.

A considerable number of shells were collected, especially around the bases of trees and shrubs, but, after considering the feasibility of undertaking a localised count soon after entering the thicket, it was decided to abandon this in favour of using the time available to determine how wide-spread the snails were on the slope.

Consequently no attempt was made to count the number of shells seen.

However, in excess of 50 shells, of varying maturity and condition, were collected by Dr. Herbert for museum record purposes.

8. Findings
As has been indicated several times above, a considerable number of shells of Cochlitoma simplex were found on both sides of the route shown on Aerial photo 1.

Although, no attempt was made to count all the shells seen, it is considered reasonable to guess that this was in excess of 100 individuals over a distance of ca.300m.

At this time, no definitive explanation can be given for the large number of shells which were observed.

However, investigation of the following hypothesis may provide an explanation.

Like other members of the family Achatinidae, C. simplex is a herbivore. However, “because calcium carbonate is needed in relative abundance for shell construction” and sufficient amounts are not always available from vegetable matter “valuable additional supplies can be obtained by eating soil, or by rasping soft calcareous rocks and the empty shells of dead snails. In addition, the sole of the foot may produce an acidic secretion that can dissolve calcareous materials…..” (Herbert & Kilburn 2004).

The need for high levels of calcium carbonate and the presence of numerous concretions of what has been assumed is calcium carbonate on and below the surface of the soil which was crossed by the route shown on Aerial photo 1 would therefore seem to be the probable explanation for the high density of C. simplex which occurs on and below the slopes where it is proposed to extend the discard dump.
9. Discussion

9.1 Estimates of the minimum size for an offset area

9.1.1 Vegetation types as a basis

Table 4 in Zunckel (2013) reveals that the total size (35.77ha) of the area which is recommended be set aside as an offset area for conservation of *C. simplex* but possibly also the millipede *Doratogonus minor* and the butterfly *Durbania amakosa* subsp. *natalensis* is derived from the sizes of the areas of the two vegetation types which will be occupied by the proposed extension of the discard dump i.e. **Northern KwaZulu-Natal Moist Grassland /Glencoe Moist Grassland** (27.719ha) and **Income Sandy Grassland** (8.051ha).

Neither the millipede nor the butterfly were seen during the field visit of 14/11/13 and, it is not known whether one or both of these animals do occur on the property and, if either one or both do, to what extent they are dependent on **Income Sandy Grassland** and **Northern KwaZulu-Natal Moist Grassland/ Glencoe Moist Grassland** for their survival.

Secondly, as has been stated above, large numbers of the remains of *C. simplex* were found throughout the thicket which was crossed by the route walked by the writer and Dr. Herbert.
Superimposing the boundaries of **Sandy Grassland** and **Northern KwaZulu-Natal Moist Grassland/ Glencoe Moist Grassland** on the areas of thicket revealed that both dense and open thicket do not show any degree of coincidence with the boundaries of these two vegetation types of Mucina & Rutherford (2006).

This may be due to the scale (1:1 million) used by Mucina & Rutherford (2006) being too ‘coarse’ to identify areas of thicket as small as those which occur on Pttn.1 Mooihoek Hoek No. 3722 and adjacent properties.

Alternatively, because *Acacia karroo* is very widespread throughout southern Africa and is an aggressive invader of disturbed areas, it may be that Mucina & Rutherford did not consider it’s presence significant enough to include it as a species which is characteristic of either of these vegetation types.

In the light of the above, it can be argued that using the areas of **Sandy Grassland** and **Northern KwaZulu-Natal Moist Grassland/ Glencoe Moist Grassland** that fall within the PEDD to estimate the minimum size of an offset area is misleading.

### 9.1.2 Geology as a basis

Because, as was also stated above, the literature consulted indicates that calcium carbonate concretions are likely to occur in rocks of the Vryheid Formation but not in dolerite the relevant portion of the 1:250 000 geological map was overlain on the two aerial photos which cover the properties which form Magdalena Colliery.

Here too, no coincidence could be seen between the boundaries of dolerite and Vryheid Formation as shown on the geological map and the areas of thicket.

As in the case of Mucina & Rutherford’s vegetation map, it may be that this lack of coincidence is a reflection of the comparatively ‘coarse’ scale of the geological map.

This lack of coincidence between geological and thicket boundaries may also be as a result of ‘over-generalization’ when the map was compiled largely from aerial photographs.

The implications of the above are, that even along the upper margin of the midslope, most of the area which is strewn with dolerite boulders is in fact Vryheid Formation.

Therefore, unless a more accurate investigation is undertaken to map the eastern boundary of the dolerite which forms the plateau and the underlying Vryheid Formation it is not possible to verify whether the upper i.e. north-western margin of the thicket is determined by rock type or soil depth or some other factor.

For such an exercise to provide information that could be used to estimate the minimum size for an offset area using the criteria applied by Zunckel (2013) the presence (or absence) of the snail within say 5m to 10m of the revised geological boundary would also be required.

That the snail – possibly in considerable numbers – may be found very close to a more precise boundary between the dolerite and Vryheid Formation i.e. well within the area shown as dolerite on the 1:250 000 geological map, is suggested by the fact that on 14 November 2013 the first shell of *C. simplex* was found only a few meters below the edge of the plateau just within the margin of the thicket.

While establishing a more precise boundary between the dolerite and Vryheid Formation would provide a more accurate basis for determining the minimum size of an offset area it would be far more important to try to establish the source of calcium enrichment to the soils which occur below the eastern boundary of the PEDD.
9.1.3 Soil erosion
GCS (2013) identifies overgrazing as one of the activities which have occurred in the past on Magdalena No. 7574.

The extent and severity of the soil erosion which can also be seen on the aerial photographs on Ptn.1 Mooidoorn Hoek No. 3722, and other adjacent properties suggest that severe disturbance of the soil has occurred in the recent past. Therefore, it is postulated that it is this and the ability of A. karroo to rapidly invade such areas and form dense persistent thickets and open woodlands rather than geology which is the factor which is most likely responsible for the presence and distribution of the areas of thicket on the property.

Fey (2010) states that “natural veld on melanic soils provides sweet grazing” which would suggest that the erosion was caused by persistent overgrazing by domestic livestock.

In the light of the three factors considered above it is proposed that it is highly probable that a distinct pattern exists between the distribution of C. simplex on the property and soils which contain high levels of calcium carbonate. Consequently, until the distribution of these soils has been mapped, there is no objective data which can be used to estimate a suitable size for an offset area more accurately than is stated in Zunckel (2013).

9.2 Other considerations
9.2.1 Runoff from the base of the PEDD
Figure 2 shows that the lower i.e. eastern perimeter of the proposed extension to the discard dump is fringed with a series of ponds which are intended to trap and retain runoff from the discard dump.

However, this retained runoff will, as is typical of runoff from coal mines, be distinctly acid (Manders 2009)

A further aspect of concern is that GCS (2013) state that the ground water table on Ptn.1 Mooidoorn Hoek No. 3722 is high.

Therefore, it is of concern that, if this acidified runoff finds its way into the underlying and adjacent soil which is rich in calcium carbonate, it will reduce the quantity of the calcium carbonate thereby leading to a decline, or possibly even the disappearance, in the longer term, of the snail on the property.

Estimating the rate at which ‘normal’ leaking of acidified water may reduce the level of calcium carbonate is beyond the scope of this report. However, even if the necessary data are provided for such an estimate, the danger nevertheless remains that because the fringe of ponds is upslope of the area in which there is sufficient space to establish a large enough offset area, the possibility of an extreme rainfall event, which would lead to over-topping of the ponds, is a factor which cannot be ignored.

In other words, locating an offset area in the area shown on Aerial photo 2 would still leave a threat hanging over the chances of survival for any snails occurring in an offset area located immediately downslope of the fringe of ponds.
9.2.2 Uniqueness of the population of *Cochlitoma simplex* in the area for the PEDD

There are two aspects to this item namely:

a. Is the population which occurs on the slopes on which it is proposed to extend the discard dump exceptionally large i.e. unique?

b. Given that similar looking habitat was seen on the same terrain morphological units i.e. midslopes and footslopes in the landscape which was seen between the mine and Dundee, is it not possible that other populations of *C. simplex* occur in the area?

Because no population density data have been collected at any other localities where the snail has been found, it is difficult to justify a population census study on Magdalena Mine because there are no other data against which to compare.
Aerial photo 2. Aerial view of Ptn.1 of Mooi doorn Hoek No. 3722 showing: (a) approximate boundaries of the areas of **closed thicket**, (b) **open thicket**, (c) **dolerite** as indicated in the 1:25 000 geological map, (d) the proposed extension to the discard dump (e) **boundary of Ptn. 1 of Mooi doorn Hoek** and (f) the area in which an offset area with suitable vegetation and probably also dominated by calcium-enriched soils could be established.
Establishing whether or not the snail is present in similar-looking habitats in the landscape surrounding the mine would have at least the following benefits:

- possibly broaden the known distribution of the snail;
- provide more certain information as to whether the population on Magdalena Mine is a remote outlier population;
- address more precisely the issues of linkage corridors, porosity etc. which are addressed in Zunckel (2013).

9.2.3 Artificial enlargement of the existing area of thicket occupied by C. simplex

Consideration was given to the possible benefits that deliberate extension of the area of thicket in which the snail has been found.

That this could indeed be done; probably at low cost by sowing treated seed harvested from locally-occurring trees and shrubs, is not in doubt.

However, what is less certain is the rate at which artificially established trees and shrubs will grow to form habitat into which the snail population will expand.

Having this information is important because the aim of deliberately increasing the area of thicket which is ‘acceptable’ to the snail must be done at a rate which at least equals, but preferably exceeds, the rate at which the existing thicket is lost as the PEDD is created.

A further important consideration is that any deliberate expansion of thicket must be done on areas where the chemical composition – especially the level of calcium – is similar or better (for the snail) than the soils on which the existing thick is growing.

This last point requires that a soil survey be undertaken which would include the existing areas on the mine where the snail is present as well as areas on he mine where it would be feasible to deliberately establish thicket.

9.2.4 Benefits of establishing an offset area on Ptn.1 Mooidoorn Hoek No. 3722

The following benefits are seen if a secure offset area is established on property owned by Forbes Coal (Pty) Ltd.

a. Because the snails appear to favour the areas of litter which accumulate around the bases of trees and shrubs mine management is in a position to stop, or at least regulate, felling and removal of indigenous trees and shrubs on its property.

b. Because grazing and browsing by domestic livestock may be removing potential litter which would secure the presence of the snail (over and above the high levels of soil calcium) mine management is in a position to stop, or at least regulate grazing and browsing.

c. Taking steps to secure the survival of the snail could be used by the company to promote its ‘green image’.

In considering these and any other benefits, it is important to appreciate that the expected design life of the mine is 22 years (GCS 2013).

Consequently, if the owners of the mine sell the area after satisfying the requirements of a closure certificate, it cannot be assumed that the new owner(s) would have an interest in maintaining an offset area.

While the onus to maintain an offset area could be ‘imposed’ on future owners by amending the title deeds of the property this might result in reducing the variety of potential buyers in the future and the value which the property could command.
10. Recommendations
In the light of the above the following steps are recommended:

a. Identify the possible source of calcium enrichment of the soils throughout the area in which *Cochlitoma simplex* occurs on Ptn.1 of Mooi-doorn Hoek No. 3722.
b. Map the areas of calcium-enriched soils which occur on Ptn.1 Mooi-doorn Hoek No. 3722.
c. Establish whether populations of *C. simplex* occur in other similar-looking habitats in the vicinity of Ptn.1 of Mooi-doorn Hoek No. 3722.
d. Re-assess how ‘leak-proof’ the base of the PEDD can be made.
e. Re-assess the effectiveness of the fringe of ponds in preventing acidified water leaking into the soils which underlie the ponds and occur downslope of the ponds.
f. Consider the feasibility of establishing woodlots that could be used by local people in ‘exchange’ for the current pressure which is being imposed on the areas of thicket where the snail is present by people harvesting the indigenous trees and shrubs.

With regard to item 10c above in particular, the writer and Dr. Herbert feel that until such time as it has been said, with reasonable certainty, based on field investigation, that *C. simplex* does not occur on other properties in the vicinity of the mine in similar-looking habitats (i.e. patches of thicket) on landscape elements which are more or less equivalent to the midslope and footslope on which we found it on Ptn.1 of Mooi-doorn Hoek No. 3722, it would be unreasonable to insist that the mine set aside and manage an offset area on its property specifically for this snail.

The basis for our opinion is that until such additional checking is done there is no sound basis for concluding that the population on Mooi-doorn Hoek is unique in terms of either its location or size.

Consideration was given to suggesting that areas be developed on which grazing and browse could be grown in order to persuade livestock owners to reduce the dependence of their animals on the thicket area where the snail is presently known to occur.

However, given that the owners of these livestock are probably highly dependent on their animals it is considered that such a step would be more likely to result in an increase in grazing and browsing pressure rather than reduce it.

11. References


SANBI 2013 www.ispot.org.za/ispot_southern_africa

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