Working towards NNL of Biodiversity and Beyond

Strongman Mine – A Case Study (2014)

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About this Document

Solid Energy became a member of the Business and Biodiversity Offsets Programme (BBOP) and offered the Strongman Mine II as a pilot project in 2007. In 2009, Solid Energy together with BBOP published a case study on the biodiversity management and offset work undertaken at Strongman up to that point (available at http://www.forest-trends.org/documents/files/doc_3124.pdf). The present document serves as an update on the mine's progress since then and following a second-party evaluation (pre-audit) against the BBOP Standard on Biodiversity Offsets (BBOP, 2012). For more detail and a history of the company's work in applying the mitigation hierarchy and biodiversity offsetting, it is useful also to refer back to the 2009 case study.

With the publication of this update, Solid Energy and Forest Trends hope to further the state of knowledge on biodiversity management and offsetting, stimulate discussion, and share information on technical aspects of offset design and implementation, including some of the challenges that may be encountered and solutions that may be available.

It is important to recognize that this is a "work in progress" and that experience on good practice offsetting continues to provide lessons and that the practice, the relevant Standards, and society's expectations in terms of biodiversity management keep evolving.

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Executive Summary

The Strongman Mine, located on the West Coast of the South Island, is one of several coal mines operated by Solid Energy New Zealand. Opencast mining began in 1997, and by 2005 just over 100 ha of vegetation (tall mixed podocarp and beech forest, sub-alpine shrubland) had been removed.

In 2007, Solid Energy put Strongman forward as a Pilot Project for the Business and Biodiversity Offset Programme (BBOP; http://bbop.forest-trends.org/) with the aim of testing and contributing to the development of best international practice in biodiversity offset design and implementation. The commitment, as part of this, to undertake a retrospective no net loss biodiversity offset for the mine is in line with Solid Energy's corporate environmental policy objective to have "a net positive effect on the New Zealand environment."

To develop the biodiversity offset for the mine's residual impacts, Strongman was guided by the tools published by BBOP. This includes the BBOP Standard (2012), against which an evaluation in the form of a "pre-audit" of the project was undertaken in late 2012. Key steps that have formed part of offset design involved:

- Consulting with stakeholders on design and implementation measures for the offset
- Determining key biodiversity components and assessing limits to what can be offset
- Selecting appropriate metrics to quantify residual losses and required gains, focusing on forest and scrub vegetation types, as well as the iconic great spotted kiwi, basing calculations on an "area x condition" currency, and taking into account time discounting
- Identifying offset sites and choosing a suitable site (with like biodiversity) and activities that will allow for adequate, additional gains to be achieved
- Determining arrangements for effective implementation.

The offset design process is almost complete. The Roaring Meg Ecological Area (RMEA), listed amongst the conservation priorities in New Zealand, has been chosen by stakeholders and the company as the preferred location for offset activities, given the significant scope to achieve additional conservation outcomes and a net gain relative to the residual losses caused by Strongman. Conservation measures have been proposed to control exotic and invasive pest species (e.g., possums, stoats, goats, rats), thus improving the reproductive success of kiwi and threatened small bird species, as well as forest condition. The Department of Conservation has been identified as the most appropriate implementing agency for these conservation actions planned over the long-term.

The global economic climate that manifested itself in late 2012, the subsequent reduction in demand for steel and the associated impacts on the price of metallurgical coal have led to the offset design and implementation being put on hold for the time being. In the event that this situation reverses itself and the economic climate supports the decision to plan and implement the biodiversity offset, Solid Energy proposes completing the process.

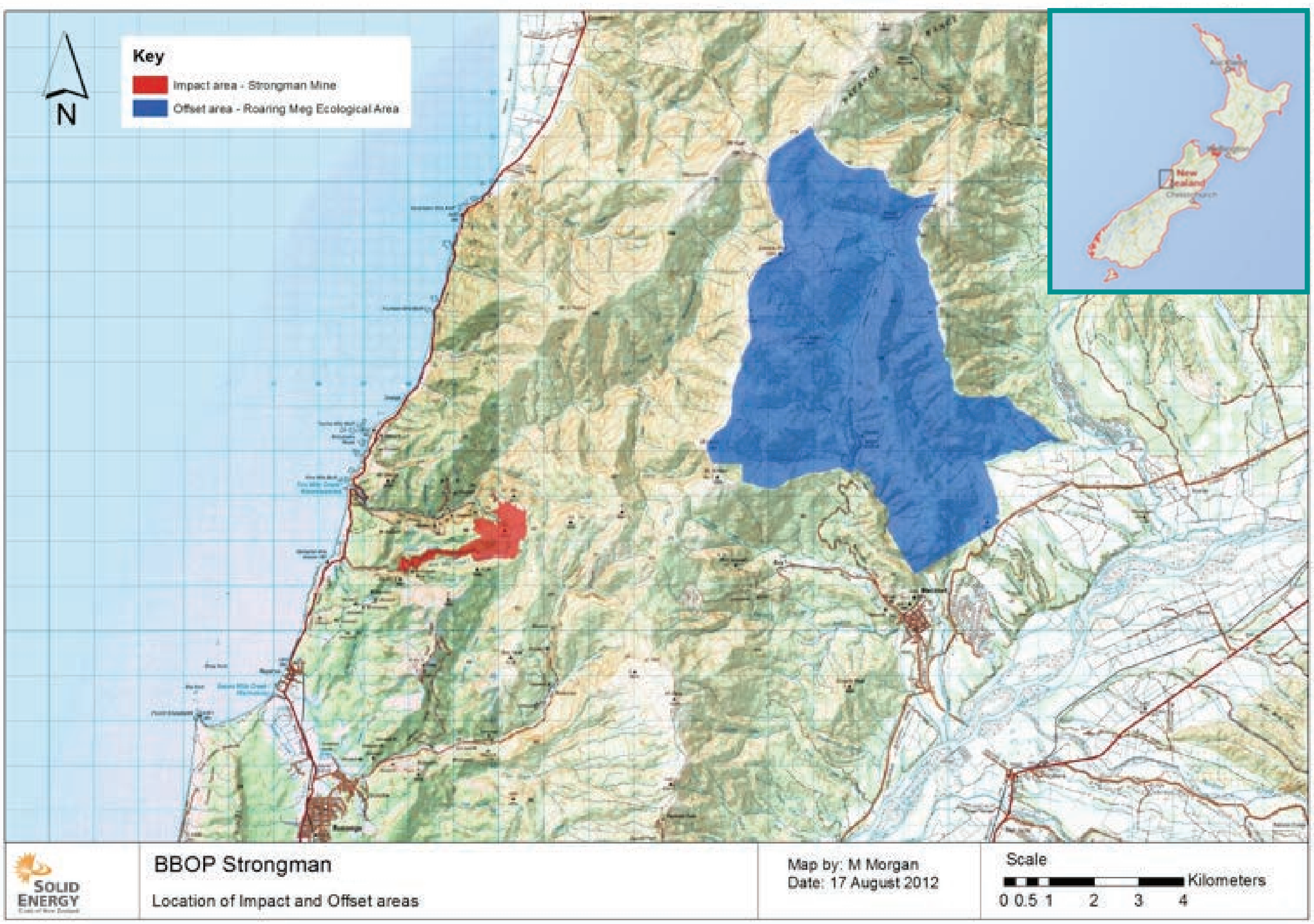
1

Project Information and Context

1. Project Information and Context

The Strongman Mine is one of several coal mines operated by Solid Energy New Zealand Limited (Solid Energy, SENZ). The mine is located near the coastal town of Greymouth on the South Island (Figure 1) and falls on government-owned land administered by the Ministry of Business, Innovation and Employment (formerly the Ministry of Economic Development, MED). The area immediately around the mine is a designated Coal Reserve, and this in turn is surrounded by Conservation Estate land that the Department of Conservation (DoC) administers. The landscape around the mine area falls within the Blackball Ecological District of North Westland and is characterised by quite steep terrain, with hills covered in native forests and incised by numerous watercourses, such as Nine Mile creek, draining towards the narrow coastal plain in the west.

Figure 1. Location of the Strongman mine and of the proposed biodiversity offset area (Roaring Meg Ecological Area, RMEA)



Source: Solid Energy New Zealand

Underground mining began in 1939 at Strongman 1 and continued until 1994 when production at the Strongman 2 Underground Mine commenced further up the Nine Mile Valley. Opencast mining began in 1997 at Strongman 2 (Strongman North) to recover the balance of the shallower coal resources. Strongman 2 Underground Mine closed in 2004 and mining was completed in early 2005 when just over 100 ha of vegetation (tall mixed podocarp and beech forest, sub-alpine shrubland) had been removed. Since then, significant rehabilitation and restoration work has been undertaken at the site (Solid Energy, 2009; Mitchell Partnerships, 2012).

Strongman coal is particularly prone to spontaneous combustion, and a fire in the underground mine was first noted in 1998 (Solid Energy, 2009). SENZ has managed partially to control but not to extinguish the fire, which is expected to continue burning in some areas for the foreseeable future and will require ongoing management. While most of the underground mine and adjoining opencast mine areas are not affected, heat damage has affected surface vegetation in some parts of the site. In early 2012, small-scale opencast mining operations restarted to recover additional coal reserves, and further works commenced to contain the fire and prevent it from spreading southward (M. Morgan, pers. comm., 2012).

In 2007, Solid Energy put Strongman forward as a Pilot Project for the Business and Biodiversity Offset Programme (BBOP; http://bbop.forest-trends.org/) with the aim of testing and contributing to the development of best international practice in biodiversity offset design and implementation.The commitment to undertake a retrospective no net loss biodiversity offset was intended to complement existing commitments made by Solid Energy in 2003 to address the mine's environmental impacts beyond on-site rehabilitation (Solid Energy, 2009). This is in line with the corporate environmental policy stating the "overall environmental objective is that the cumulative result of all the activities we undertake will have a net positive effect on the New Zealand environment" (Solid Energy Environmental Policy, 2003).[1] In the Strongman case, this has been interpreted to mean no net loss or a net gain in biodiversity relative to impacts caused by the mine, and the stated intention is to design a biodiversity offset in line with the BBOP Principles (Solid Energy, 2009).

Biodiversity offset design for Strongman commenced in 2008. This included identifying the mine's impacts and site boundaries in space and over time, reviewing existing biodiversity information, identifying affected key biodiversity components, undertaking complementary field work (e.g., to characterise reference sites), and quantifying biodiversity losses – by means of an "area x condition" metric for vegetation (habitat hectares) and separately for an iconic bird species, the great spotted kiwi (Solid Energy, 2009). The key biodiversity components include different ecosystem types affected, namely 43.3 ha of scrub-type ecosystems and 111.6 ha of forest-type ecosystems, as well as threatened and iconic species.

In 2010, an investigation into potential biodiversity offset sites and activities was undertaken. This followed an earlier, preliminary identification of options (as outlined in Solid Energy, 2009). Three "pre-screened" potential offset sites were evaluated using a multi-criteria analysis of social, environmental, and economic factors (Golder Associates, 2011). The results were discussed with key stakeholders, and the preferred option – Mount Watson/Roaring Meg Ecological Area (RMEA) – was selected as part of this process. The RMEA lies to the North East of the Strongman mine and is a large area (3618.6 ha) situated on Crown land administered by the Department of Conservation. More detailed desktop and field surveys of the RMEA were undertaken in

[1] Please see http://www.solidenergy.co.nz/index.cfm/1,447,0,0/Environmental-Performance.html. The "net-positive effect" policy statement is also noted in several other public documents (e.g,. the Annual reports and 2009 BBOP Strongman case study).

late 2011 and early 2012. The aim of this work was to gather and compile information on the area's ecological condition, its equivalence to biodiversity affected by Strongman, the potential for generating additional conservation gains, and the available implementation options for a biodiversity offset (Mitchell Partnerships, 2012).

In late 2012, Solid Energy commissioned an evaluation of the Strongman project's biodiversity management and offset work against the BBOP Biodiversity Offset Standard that was published in early 2012. This "pre audit" was to assess Strongman's performance against internationally recognised best practice in biodiversity offsetting and to provide Solid Energy with a set of recommendations for moving towards compliance with the voluntary Standard.[2] At the time of the evaluation against the BBOP Standard, Solid Energy, and the Department of Conservation, the key implementing agency for the offset, were in the process of planning, with the input of other key stakeholders, the precise offset activities to be undertaken in the RMEA. These activities for the following year and beyond were outlined in a preliminary ten-year work programme. Other relevant arrangements and agreements were concurrently being put in place (e.g., an appropriate agreement between Solid Energy and DoC to implement the offset work). A sudden, significant downturn in the coal market in late 2012 affected the timing of the implementation programme, with work on the offset being delayed until further notice. The conclusions and recommendations of the completed evaluation remain relevant for the project when work on the offset recommendations.

[2] Strongman, as one of the early BBOP Pilot Projects, is a "work in progress:" The offset work started before the BBOP Principles and Handbooks were finalised in 2009 and before the Biodiversity Offset Standard was finalised (BBOP, 2012). Strongman nevertheless aims to comply with the Standard, but this sequence of events is acknowledged. Thus the project was planned in line with the ten Principles for best practice biodiversity offsets, but it was not specifically designed to comply with all the Criteria and Indicators comprising the Standard.

2

Impacts on Biodiversity and Mitigation Measures

2. Impacts on Biodiversity and Mitigation Measures

2.1 Impacts on Biodiversity (including Residual Impacts)

The construction and start of operations at the Strongman 2 Mine (henceforth referred to as Strongman or Strongman Mine) pre-dated the practice of undertaking full Environmental and Social Impact Assessments (ESIAs), which is now common internationally and a legal requirement in New Zealand. Thus the pre-mining baseline biodiversity data, and assessment of the mine's impacts needed for the design of measures to achieve "no net loss," were reconstructed using a variety of methods and best available data sources.[3] These included aerial photography (e.g., from 1985), historical data for the region (e.g., plot data from the National Vegetation Survey Database), selected specialist studies (e.g., of birds, snails, endemic plants) conducted at and around the mine at various time periods (2006, 2007, 2008), and field surveys undertaken in 2008 at "proxy sites" around the mine footprint to reconstruct biodiversity patterns (e.g., vegetation types) that are likely to have been present prior to the mining activities.

On this basis, significant residual impacts on biodiversity (up to 2005 when operations first ceased)[4] were determined to include:

- Loss and/or degradation of indigenous forest (111.6 ha) and scrub vegetation (43.3 ha), sub-divided into Scrub; Yellow-silver pine/Pink pine/Manuka; Rimu/Mountain beech/Hall's totara forest; Rimu/beech forest, Lowland forest (see Solid Energy, 2009 for detailed data on these).
- Loss of forest bird habitat relating to 15-20 indigenous bird species surveyed in the area, including nine species listed as threatened in New Zealand (see Buckingham, 2008; in Solid Energy, 2009), and specifically, as part of this, a reduction in the home ranges of the iconic great spotted kiwi, *Apteryx haastii*, estimated to occur at densities of up to 7.1 individuals/100 ha in the area.

This set of residual impacts formed the focus for designing the Strongman mine's offset (see below).

Potential impacts on other biodiversity components, including endemic plant species, and the Nine and Ten Mile Creek water courses and associated aquatic biodiversity, were also assessed. However, based on the available data[5] these were determined as not significant given the application of prior mitigation measures (i.e., avoiding and minimising of impacts) before and during the mine's operational phase.

[3] The pilot project was conceived as a retrospective offset, with impacts having occurred prior to offset design being initiated.
[4] The residual impacts anticipated from newly initiated mining have not yet been assessed or documented by Solid Energy.
[5] This was based on best available existing datasets (e.g., in the case of the flora) and data from the Strongman biological monitoring programme, which included sampling of periphyton, aquatic invertebrates and fish between 2003 and 2007, as verified by independent surveys (e.g., Olsen, 2007, Harding, and Niyogi, 2008: See SENZ, 2009).

2.2 Mitigation Measures to Limit Impacts on Biodiversity

Most of the measures implemented at Strongman Mine to avoid and minimise biodiversity loss were not explicitly defined, documented, or monitored from the start of construction and mining activities, as they would be today. Information on these mitigation measures, most of which were applied in the past, is therefore only outlined in a general way, with the exception of measures aimed specifically at limiting impacts on water courses (Solid Energy, 2009). While Solid Energy "operated in compliance with the New Zealand statutes (including its Coal Mining Licence and resource consent conditions)," the 2003 commitment to go beyond traditional rehabilitation measures and to aim for no net loss of biodiversity was an "acknowledgement that the efforts to avoid and remedy the impacts at Strongman 2 had fallen short of appropriate standards. This in turn triggered the initiative to develop a series of 'offsetting activities' including the BBOP project"' (Solid Energy, 2009).

By contrast, the mine's active measures since 2002 to rehabilitate/restore areas affected by Strongman are set out in a detailed mine closure plan (Golder Associates, 2007) and in the BBOP case study (Solid Energy, 2009). The outcomes of this rehabilitation work are also being tracked annually by the Strongman environmental team using permanent photo-points and transect surveys. By 2011 virtually all disturbed areas had been planted, and the regenerating vegetation was dominated by *koromiko* (Hebe salicifolia, 22.1% of all plants) and manuka (Leptospermum scoparium, 19.9% of all plants). Approximately 20% of native plants found during monitoring had established without being planted and must have colonised from natural vegetation nearby. Self-established plants were dominated by a variety of fern species (comprising 13.3% of all plants) and kamahi (Weinmannia racemosa, comprising 4.4% of all plants). Closure criteria had not yet been met and planting and weed control were continuing (R. Harrison, Solid Energy, pers. comm.; Mitchell Partnerships, 2012).

Note: Impacts due to new mining (since 2012) have affected some of the rehabilitation sites to date. This is being tracked as part of the regular rehabilitation/restoration monitoring.

2.3 Limits to What Can be Offset

As part of reconstructing the biodiversity baseline for the Strongman mine, specialist ecologists thoroughly reviewed the level of irreplaceability and/or vulnerability of all potentially affected terrestrial and aquatic biodiversity components (Solid Energy, 2009). This is a crucial step to check whether a set of residual impacts could feasibly be offset and whether the goal of no net loss is likely to be achievable or whether there is a significant risk of non-offsetable impacts.

To inform this assessment of limits, the specialists used the latest national threat status information (Hitchmough, 2007), regionally relevant data (Boffa Miskell, 1997, DoC, undated) and best available local survey information. The conclusion was that the mine's residual impacts on all terrestrial and aquatic biodiversity could be considered "offsetable" (i.e., capable of being offset), bearing in mind that the retrospective nature of the review, amongst other factors, involves a degree of uncertainty (Solid Energy, 2009). Also worth noting is the issue of scale: Nationally mapped ecosystems were used as a proxy for the affected vegetation types. This is because threat status classifications are available for these "Land Environments of New Zealand" (LENZ), thus providing important contextual information necessary for irreplaceability and vulnerability determination.

However, when looking in more detail at some of the constituent biodiversity components of the affected forest types, particularly at emergent trees, it is important to acknowledge the difficulty of achieving NNL for residual impacts on these components within moderate timeframes, given the long time that it takes to accrue gains in terms of mature emergent trees[6] (whether by restoration or through averted-risk offsetting). Amongst other things, this highlights the importance of explicitly considering the timeframe within which it may be possible to achieve no net loss (NNL) when assessing risks and designing offsets. The situation with respect to emergent trees is interesting in this case. While they are not themselves regarded as highly irreplaceable biodiversity components, it is important to ensure: a) that they are not providing irreplaceable resources to highly threatened biodiversity (e.g., birds) that may suffer an irreversible decline as a result of a delay between impacts and offset provision, and b) that adequate measures to replace the slow-growing components are available, planned for, and put in place. In the Strongman case the view of specialists is that the emergent trees affected by the mine are in fact restorable over time (Bramley, Bartlett, and Harrison, pers. comm., 2012).

[6] With respect to achieving NNL even for slow-growing components it would be necessary to assume that NNL is not temporally constrained (or that a very long "payback" timeframe is acceptable) and that ecological, technical, and practical factors would allow for successful replacement.

3

Biodiversity Offset Design

3. Biodiversity Offset Design

Solid Energy used the BBOP-published materials as the main source of best practice guidance in developing a biodiversity offset with the aim of achieving no net loss (NNL) for the Strongman mine (see http://bbop.forest-trends.org/pages/guidelines). The 2009 BBOP Strongman Case Study (Solid Energy, 2009) details key offset design steps that were taken, such as reviewing the mining project's scope and activities, and the policy context for biodiversity offsets, initiating a stakeholder participation process, and determining the need for and feasibility of developing an offset based on residual adverse effects on biodiversity (see above).

A Key Biodiversity Components Matrix was constructed to summarise key species, habitats, ecosystem processes and services affected by the Strongman mine along with the values that stakeholders cared most about (see Solid Energy, 2009). The listed components were selected due to their status of special conservation concern and because they were particularly valued by stakeholders (e.g., threatened, rare, iconic, charismatic species, such as kiwi or other native birds) or because they are representative of biodiversity type and state overall and can serve as good "proxies" of overall biodiversity (e.g., vegetation – forest and scrub).

Building on previous biodiversity and offset-related work at Strongman, the following steps were taken:

- Methods to calculate the biodiversity loss/gain balance were chosen (see above and Solid Energy, 2009)
- Potential offset locations and activities, and the gains that could be achieved in each case were assessed;
- The most appropriate offset locations and activities were selected; and
- The offset design was recorded and the offset implementation process begun.

3.1 Choice of Methods to Account for Biodiversity Losses and Gains

The approach to accounting for biodiversity losses and gains has focused on vegetation or habitat types (forest and shrubland) and also on the iconic great spotted kiwi. These components were chosen as good biodiversity indicators that can be considered as representing affected biodiversity overall. The use of good indicators is important since it is not possible to measure and account for each and every component of biodiversity affected by the project, and readily measurable and quantifiable indicators can be monitored over time to assess the no net loss balance for Strongman.

In line with current best practice, the approach to accounting for biodiversity losses and gains considered two main factors, namely a) the equivalence and b) the amount of biodiversity exchanged (i.e., lost and gained). Equivalence (i.e. similarity between the type of biodiversity affected by the project and the biodiversity conserved through the offset) was considered by reviewing/comparing impact and offset sites according to a range of criteria that indicate similarity (in type, time, and space of affected biodiversity) to establish the "like-for-like" basis of the exchange. The amount of biodiversity was quantified by means of a "habitat hectares" type of metric (e.g., see Parkes et al., 2003). This combines the area or extent and the condition of affected biodiversity relative to reference conditions (see Solid Energy, 2009). In the case of Strongman, the condition of vegetation, divided into forest habitat and shrubland, was expressed by means of the attributes listed in Table 1.

To establish the loss/gain balance for achieving a no net loss biodiversity outcome for Strongman, the calculations then involved working out the difference (i.e., the loss) between the "pre-mining" baseline situation[7] and the 2005 "post-operations" situation at Strongman (i.e., the loss measured in habitat hectares) relative to the difference (i.e., gains in habitat ha) between the "without-offset" situation[8] and a predicted "with-offset-activities" situation at potential biodiversity offset sites (see Solid Energy, 2009, Mitchell Partnerships, 2012). Losses and gains were expressed relative to benchmark or reference conditions for the measured attributes (see Table 1), with benchmark levels representing "best attainable" condition for those attributes (e.g., as would be the case in a well-managed protected area).

To account for the time lag between impacts occurring and gains being generated, a discount rate of 1% was applied.[9] The lag period was taken to be 30 years, from 1993, when losses occurred, to 2023 (expected delivery of gains). To calculate the loss/gain balance the basic formula used was

Biodiversity gain (in habitat hectares (hh), relative to the "baseline" situation)/(1+ discount rate)^{n}
where n is the time over which replacement of biodiversity occurs.
The gains need to equal or exceed biodiversity losses (in hh, relative to baseline situation) at time = 0.

Table 1: Attributes Used to Characterise Biodiversity (Vegetation) Condition for Strongman's Loss/Gain Calculations

Forest attribute	Benchmark condition	Pre-project (1985)	Post-project (2008)
Canopy cover	90%	90%	8%
Emergent cover	20%	5%	1%
Shrub understory (1-4 m) cover	50%	40%	15%
Palatable species / Unpalatable species	100%	40%	1%
Intactness of flora: native / non-native plants	100%	90%	24%
Ranges with juvenile kiwi	30%	20%	0%
Small bird species occupancy	100%	50%	5%

Note: See Solid Energy, 2009. The reference (benchmark) condition for each attribute is shown as is the pre-mining and post-mining condition for Strongman.[10]

[7] As noted previously, this was done retrospectively by reconstructing the pre-mining extent and condition of affected vegetation types based on a variety of methods and tools (including aerial photography, fieldwork in proxy sites around the current mine, historical databases and literature, studies done in the region).
[8] The "without-offset" baseline was equated with the measured "before-offset" condition of the offset area, i.e., it was assumed not to vary over time, so that gains were assessed relative to a fixed starting point or a "static" baseline.
[9] This is to address the issue of people's time preference, i.e., their preference to derive benefits now rather than in the future.
[10] The reference or benchmark condition is the condition attainable under intensive conservation management on mainland islands. The pre-project condition is reconstructed based on reference plots and 1985 aerial photography. Post-project condition is based on fieldwork carried out in 2008 in which disturbance was characterised.

Based on these figures, Solid Energy (2009) calculated residual habitat losses to comprise 41.3 habitat hectares of forest and 24.8 habitat hectares of shrubland, which need to be offset by commensurate gains. Note that at the time when residual losses were calculated, the attributes were aggregated to reflect these habitat hectare values (Solid Energy, 2009).[11]

The overall value of 66.1 habitat hectares of vegetation was then adjusted to account for the time lag involved since the losses were incurred in 1993 and up to 2013 (Mitchell Partnerships, 2012). Assuming that all habitat was removed at once, and using a discount rate of 1%, the present value of the loss overall (i.e., combining forest and shrubland) was determined to be 80.65 habitat hectares.

3.2 Site Selection for Equivalence and Calculating Potential Gains

The suitability of three potential offset sites and associated conservation activities was evaluated based on their relative ecological appropriateness and benefits,[12] social acceptance (stakeholder preference), and economic implications (Golder Associates, 2011). The evaluation involved a desktop analysis of spatial and non-spatial data, information from relevant field studies, and stakeholder views and was combined with expert judgment. It identified RMEA at the southern end of the Paparoa Mountain range as the most suitable of the three sites. The initial assessment was followed by field surveys undertaken in 2011. This was done firstly to verify the similarity ("like for like nature") of Strongman and RMEA in terms of species and habitat composition (fauna and flora), topography, and altitudinal range of the habitats. Secondly, detailed data[13] were collected to characterise the "pre-offset" and "without offset" baseline condition of the biodiversity attributes chosen for the quantitative biodiversity accounting process (Mitchell Partnerships, 2012).

The baseline condition for attributes at RMEA was relatively high for most of the vegetation-related attributes: as a percentage of benchmark conditions (Table 1 above), the average result for canopy cover measurements was 80%, for understorey 75%, palatable species 79%, intactness of the flora 79%, with only emergent cover scoring a low 10% of reference conditions. The bird-related attributes were 66% (ranges with juvenile kiwi) and 48% (small bird occupancy). This indicates that the greatest opportunity for improving biodiversity at the RMEA site is in terms of small bird occupancy, the reproductive success of kiwi, and emergent tree cover, although improving the condition (and limiting further decline) of the other attributes should also contribute – more modestly – to biodiversity gains at the site. An important implication of the relatively high baseline values for individual attributes is that a relatively large area will be needed to achieve enough gains in "habitat hectares" (condition x area) to balance the losses due to Strongman. Furthermore, it means that a relatively high loss in condition (but smaller area) at Strongman is proposed to be balanced out by a more limited gain in condition (but over a larger area) at RMEA. This is a trade that stakeholders, based on their stated preference for RMEA, appear to have found acceptable.

[11] In the case of gains, data were separately reported (disaggregated attributes) and only later aggregated to allow for a broad estimate of gains relative to the losses.

[12] E.g., factors relating to ecological equivalence (in type, space, time), landscape context, and the probability of conservation success and risk of failure were broadly assessed as part of this multi-criteria analysis.

[13] The field surveys to collate these data were conducted in late 2011. The biodiversity attributes (see above) were measured at 19 field sites across the altitudinal range. Data for birds, including great spotted kiwi, were collected by traversing the area in transects, with five-minute bird counts undertaken every 200 m (Mitchell Partnerships, 2012).

The principal conservation measure proposed for achieving biodiversity gains was the integrated control of invasive, exotic pest animals to reduce the decline in native biodiversity condition (both of vegetation and avifauna). The reason is that predation by introduced mammals including mustelids (stoats, ferrets, weasels), possums, and rats is now recognised as the main agent of decline for many New Zealand forest birds and removal of these animals as effective at restoring populations (Innes et al. 2010). The same invasive animals have also been shown to affect plant communities adversely either directly by consuming leaves, seeds and fruit or by reducing pollinators and seed dispersers (Wilson et al., 2003; Kelly et al., 2010). Control particularly of possums and rats is also thought to benefit *Powelliphanta* snail populations (Walker, 2003). Goats and deer are also known to affect vegetation adversely by preferentially browsing particular species, even when these animals are at low densities (Norton, 1995, Tanantzap et al., 2009).

Based on this, broad predictions of gains that could be achieved at RMEA have been made and related to the Strongman losses. The predictions were made assuming the following (Mitchell Partnership, 2012):

- Successful predator control leads to the full recovery of all attributes from their present status to reference conditions (Table 1) within a ten-year timeframe. This means an overall 25% improvement in condition of the attributes from present levels. In fact, even more rapid gains are predicted from effective pest control especially for the kiwi population.
- Offset implemented starts in 2012, with first improvements measurable in 2013.[14]
- A 1% discount rate is applied to adjust the amount of gain that is achievable, given the time lag involved in generating gains.
- Measurement is against a static baseline (both for losses and gains), i.e., no change in conditions (e.g., deterioration) in the "business-as-usual" situation is included in the calculations (i.e., there is no contribution to gains due to a declining baseline situation). This is thus a conservative gains estimate, as some decline would be expected without pest management.
- Attributes can be aggregated for the time being to predict overall condition improvement (gain). This was in line with the way losses have been reported and is acceptable for a broad gains estimate. However, this may need to be reviewed and loss/gain calculations refined, based on individual attributes being reported in a disaggregated format, which is more transparent (in terms of which attributes are traded against each other in achieving gains) and enables more accurate tracking of specific ecological changes due to management actions.

Based on these parameters, and using the formula described above for determining biodiversity gain, an area of around 400 ha within the larger RMEA should be intensively managed with the aim of attaining reference levels within ten years time (by 2022/23). This would achieve a gain of around 89.87 habitat hectares, and thus translate into a net gain of around 9 habitat hectares relative to the Strongman losses by 2023.

In these broad calculations, which are only indicative at this stage, losses and gains are expressed in habitat hectares of vegetation. Underlying this are predictions of changes in the individual attributes over time in

[14] As noted above, the start of implementation has been delayed, so this timeframe would shift accordingly in a set of revised calculations. However, there is presently no reason to believe that a delay in starting implementation could jeopardize achieving the NNL outcome.

response to management actions. The specifics of predicted changes should undergo detailed review by peers (e.g., through an expert workshop), and monitoring will need to ensure verification of the predictions over time. The information should be used for adaptive management, and refining the loss/gain calculations will be essential in due course. At this stage, the results of predicted changes in individual attributes remain aggregated into an overall improvement value and habitat hectare value, which is a generalization at this stage. In the case of RMEA, most of the anticipated gains are due to predicted improvements in small bird abundance, kiwi populations (i.e., ranges with juvenile kiwi)[15], shrub understorey cover, and the cover of palatable species in the shrub layer.

The "emergent trees" attribute poses a particular challenge in the Strongman case for various reasons. First, while there would seem to be substantial opportunity for improving the condition of emergent tree cover at RMEA (as present condition for this attribute has been found to be very low relative to benchmark levels),[16] predator control is not expected to have a significant effect on emergent tree survival. This is because most of the emergents in RMEA are rimu trees on which possums do not generally feed. This means that no net loss of emergent trees cannot be achieved through the main offset activities planned for RMEA. Second, the timeframes associated with the lifecycle of emergent trees are very long, certainly longer than the timeframe used for the calculations even when these are extended to 50 years. Thus, even though restoration at Strongman is intended to focus particularly on the regeneration of emergent trees to address their loss, replacing adult emergent tree cover, if successful, will also take a very long time to come about and is not expected to occur within the 50-year timeframe.

At present, the gains predictions are associated with significant uncertainty and currently offer first estimates of potential condition gains and the no net loss balance. The estimates will need to be refined and verified in practice through rigorous measurement and monitoring over time, as part of offset implementation.

[15] Anticipated gains in the kiwi population due to predator control are estimated to accrue very rapidly – within a few years - from the pre-offset 66% condition of benchmark to benchmark levels (Mitchell Partnerships, 2012).

16 Also note that ecologists have raise the complication that the benchmark level for this particular attribute is not necessarily appropriate for emergent tree cover at RMEA (Mitchell Partnerships, 2012).

4

Biodiversity Offset Implementation

4. Biodiversity Offset Implementation

4.1 The Proposed RMEA Offset site

The Roaring Meg Ecological Area (RMEA) is a large area covering more than 3600 ha inland of the Strongman site (Figure 1). In terms of its significance with respect to regional and national conservation goals, the following applies: The area was designated (legally gazetted) as an important ecological area in 1980. This designation is used for areas regarded as representative of the natural features within the ecological districts in which they are located. That means RMEA was established for one or more of the following reasons (Norton and Overmars, 2012, in Mitchell Partnerships, 2012):

- To protect representative portions of natural ecosystems;
- To protect rare or unique features including native plants and animals;
- As areas available for study aimed at understanding and explaining natural processes;
- As benchmarks for assessing changes associated with various forms of development in the region;
- As genetic pools for native plants and animals.

In addition, RMEA has been ranked as relatively high on the national list of conservation priorities (J. Lyall, pers. comm., 2012) though the ranking is not high enough to ensure that the area qualifies for conservation funding. This has important implications with respect to "additionality" of conservation management in the area, as outlined here:

The RMEA is located on Department of Conservation (DoC) land and falls within the Māwhera District, a part of the West Coast Region. While RMEA is therefore already legally protected as conservation land, the DoC acknowledges that only a small proportion of priority sites can be actively managed for conservation.[17] Those priorities are identified in the West Coast Region Conservation Management Strategy (DoC, 2010) and do not include RMEA. Thus, while areas such as RMEA remain legally protected as conservation areas, they receive no funding and are not managed to retain their biodiversity value – a situation of "benign neglect."[18] In fact, at present only 17% of DoC-administered land on the West Coast is actively managed for predators (DoC, pers comm., 2014). Yet, as described above, without active management of exotic mammalian predator and pest species, the biodiversity status of the remaining land is on a downward trajectory.

[17] Important to note is that a third (33.4%) of New Zealand and over 40% of the South Island is legally recognized as conservation land and that the figure is particularly high for the West Coast (84.3% of the region; Ministry for Environment, 2010).
[18] This is widely recognised in New Zealand as posing a significant threat to the country's biodiversity.

Thus there is significant opportunity to improve conservation outcomes through better management in the area, given the threats to biodiversity posed by a range of pest animals in the area: Large numbers of possums, stoats, goats, and rats are affecting vegetation condition and recruitment as well as breeding success and survival of bird species, including great spotted kiwi (Golder, 2011; Mitchell Partnerships, 2012)[19]. The issue of predator control is a national issue, not one that is specific to the West Coast area in which this case study is located.

4.2 Planned Offset Activities

While implementation of the RMEA biodiversity offset is still pending, the following activities are intended to form part of the planned integrated pest control programme:

- Targeting possums through the aerial application of pesticide "1080" across an area of around 2600 ha. The implementation of this would follow all the required procedures (e.g., obtaining Ministry of Health approval) and stakeholder consultation and would be undertaken every 5 years. The application would be timed to coincide with and complement similar initiatives in adjacent lands (e.g., the Animal Health Board operates across an adjacent 997 ha).
- While stoats can be partially controlled through the use of "1080," a dedicated stoat trapping programme is also proposed to ensure stoat numbers are maintained at low levels. Two hundred A24 automatic traps will be located along 43 km of trap around and within the control area. Initial trap spacing will be approximately every 200 m but this will be reduced to every 100 m in Year 2 of the programme.
- In the short-term, rats would be controlled as a result of possum and stoat control. However, as rat populations recover more quickly than possums from aerial "1080" applications (within six months, rather than years as for possums) additional rat control through traps may be required to protect small forest birds following beech mast seeding if numbers are shown to rise significantly.
- Ground-based hunting with some helicopter support is proposed to manage goat numbers. Around 100 hunter days will be needed to reduce goat numbers at first. The hunting intensity is expected to reduce in subsequent years.
- Woody weeds are not thought to be a significant issue within the Roaring Meg Ecological Area at the current time. Control is based on periodic assessment of weeds at the site combined with manual herbicide application of known weed incursions.

Several different management strategies (outlined below) could be adopted to implement these actions and achieve the gains required for a no net loss or net gain outcome relative to the losses due to Strongman. While no decision has yet been made as to the preferred strategy, the following are options:

[19] There is some existing management in parts of the RMEA, including possum control by the Animal Health Board operating in the NE and protection of great spotted kiwi through Operation Nest Egg and low intensity stoat management (Mitchell Partnerships, 2012). In the offset accounting, the biodiversity benefits due to these activities were deducted from predicted outcomes due to offset activities (Mitchell Partnerships, 2012).

1. Integrated pest management of a core area of 400-450 ha that is intensively managed for all pest species (goats, possums, stoats, rats, woody weeds). Pest control would be continuously maintained and ecosystem gains would be relatively large per unit area;
2. Integrated pest management of the entire RMEA. This would lead to the best ecological outcome and would result in the largest gains beyond those required to achieve no net loss for the Strongman mine. This strategy could provide the opportunity for establishing a conservation banking model.
3. Low-intensity management across the entire RMEA for the key pests affecting vegetation (goats and possums) with less frequent or less intensive control of stoats and rats and concomitantly lower ecosystem gains per unit area than Strategy 1 or 2. By applying low-intensity management to a large area to achieve small habitat improvements sufficient gains could be accrued to ensure no net loss of biodiversity for the Strongman mine.
4. A mixed model with a core area surrounded by a larger area of lower intensity management to act as a buffer to the core area. Habitat hectare gains would be achieved from both types of management, but gains would accumulate more quickly in the core area.

Once the most appropriate strategy has been chosen in consultation with experts and other stakeholders, this will be detailed in a Biodiversity Offset Management Plan, which will further set out all the relevant implementation arrangements (see below).

4.3 Proposed Arrangements for Offset Implementation

The Department of Conservation, represented by local and regional offices and staff, is best placed to act as the primary implementing agency for the RMEA offset. This is based on the staff's excellent knowledge of the region and its ecology as well as the significant experience and expertise that DoC has built up in terms of implementing the proposed conservation measures as part of the offset. A Stakeholder Group meeting convened in August 2012 brought together many of the relevant experts with the requisite technical knowledge to undertake high-quality pest control as well as those with the necessary management capacity to draw up appropriate management and monitoring plans and Memoranda of Understanding (MoUs) and to implement the offset successfully given adequate funding.

Recent changes in the structure of the DoC have resulted in a "Partnership Programme" being established. The purpose of this initiative is to work with business to establish how conservation gain can be realised through partnership arrangements between the two entities. An agreement established under the Partnership Programme and the RMEA Biodiversity Offset Management Plan will also reflect legal and especially financial assurances to sustain the offset in the long term, including in the case of a sale or change in ownership of the Strongman mines by Solid Energy. These assurances will need to be clearly defined in addition to the legal protection status already afforded to the land.[20] Currently, however, the legal and financial arrangements to assure the short-term implementation as well as the long-term viability of the offset activities at RMEA have not yet been finalised. Putting in place appropriate financial arrangements (i.e., both in terms of mechanisms and actual funding) is a priority for immediate as well as long-term implementation of the offset as part of the Solid Energy commitment to strive for a no net loss outcome for the Strongman mine.

[20] RMEA has legal protected status under the Conservation Act, 1987. While the current status does not altogether rule out the possibility of mining being authorised in the area the existing legal protection is regarded as high (Stakeholder Group, 2012).

In late 2012, when a review of the Strongman mine and its offset plans was undertaken against the BBOP Standard, Solid Energy and the Department of Conservation – as the key implementing agency for the offset - were in the process of planning (with the input of other key stakeholders) the precise offset activities to be undertaken in the RMEA over the next year (2013) and beyond as part of a ten-year work programme. Other relevant arrangements and agreements were concurrently being put in place (e.g., a Memorandum of Understanding between Solid Energy and DoC). However, this process coincided with the beginning of a significant downturn in the coal market, affecting the timing of the implementation programme and delaying further work on the offset.

5

Lessons Learned

5. Lessons Learned

The following lessons emerge to date, based on the experiences with the Strongman mine and offset, including the application of the BBOP Standard.

First, with respect to the project and offset itself the following can be noted:

- The most significant lesson to date relates to financing. Late 2012 proved to be difficult timing for Solid Energy: the drop in coal prices, just as offset implementation was due to start, meant that the offset was put on hold. The financing challenge was the result of plans to fund offset activities from the operational budget (rather than from an established fund). The recognition thus is that it is crucial to resolve financing early on and provide assurances so that unforeseen events can be catered for.
- Stakeholder consultation (including with experts, e.g., through dedicated workshops) is essential for credibility, transparency, risk management, and ultimately for good outcomes.
- Good and best practice evolves, and while it is challenging to keep up with this process, key changes need to be integrated in how business is done and in striving to apply best practices,
- It is still too early to determine, with greater confidence, the feasibility of achieving no net loss for Strongman. However, in this regard the concept of offsetting emergent trees (in a reasonable timeframe) presents a challenge and reliance is placed by the project on restoration outcomes. However, even those will not be achieved in a reasonable timeframe.
- Being a "first mover" in the New Zealand context created issues with the stakeholders who had little understanding of the concept. Consequently, in addition to the field and design work required to support the offset, there was a significant investment in developing awareness of the concept of offsetting and its wider implications to the community.
- Mechanisms to protect and assure the financial viability of the offset should be put in place prior to offset implementation and – ideally – before the impacts occur. This project was retrospective in its development and offset implementation has suffered from significantly changed circumstances within the business. A financial mechanism to protect the investment required for the work in the offset should be established at the earliest opportunity.

Second, the following points are noted with respect to the Biodiversity Offset Standard (BBOP, 2012):

- The Principles, Criteria, and Indicators (PCI) comprising the Standard offer a comprehensive set of requirements for high-quality biodiversity offsets and usefully cover design and implementation.
- The importance of the Biodiversity Offset Management Plan must be emphasised, especially to enable auditing and verification of numerous requirements. Without this in place, conformance with several of the indicators is difficult to assess in full.

- There are a number of key gaps relating to the verification of achieving NNL. For example, with respect to Principle 4, the criteria and indicators are predominantly process-related and do not ask specifically for the verification of meeting NNL. Furthermore, no timeframe is indicated within which NNL must be achieved. As part of a revision of the Standard, these gaps should be addressed to provide greater clarity and certainty.
- A thorough check should be done to review the sufficiency of all Indicators in terms of meeting the relevant Criteria and Principles.
- Where indicators cover a range of requirements (e.g., an action needs to be "designed, implemented and monitored"); these are complex to assess and should rather be disaggregated into separate indicators to facilitate auditing.
- Specialist understanding and close attention to the PCI is essential to enable the sound evaluation of a mitigation measures, including an offset, against the Standard.
- Overall, using the Standard with its explicit requirements greatly facilitates firstly, understanding what constitutes good practice in applying the mitigation hierarchy and designing and implementing an offset and secondly, putting this into practice.

6

Next Steps

6. Next Steps

The following points summarise important actions that Solid Energy intends to take and that are in line with recommendations emerging from the 2012 evaluation of Strongman against the BBOP Standard:

- Address any new impacts from mining at Strongman with the BBOP Standard in mind, including documenting how the Mitigation Hierarchy has been followed, assessing risks and implementing any required measures to prevent potential non-offsetable impacts due to new mining, and integrating additional residual impacts in loss/gain accounting;
- Refining the loss/gain calculations to take into account new information and changes (e.g., delay in implementation of the offset, which was to begin in 2013) as well as recommendations following expert consultation and review (e.g., of predicted changes in condition of individual attributes, aggregation, disaggregation of attributes, etc.);
- Building on existing processes to expand stakeholder engagement on the offset side (in particular with respect to potentially sensitive issues relating to the control of pest animals);
- Drafting a comprehensive Biodiversity Offset Management Plan for RMEA;
- Ensuring that legal and in particular financial assurances relating to the RMEA offset are finalised and the offset activities are implemented as rapidly as possibly according to plan; and
- Publishing regular updates on the activities, challenges, and successes in implementing the offset.

7

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8

Appendices

Appendices

Appendix 1

The Key Biodiversity Components Matrix for Strongman is reproduced below (see Solid Energy, 2009).

Table 2: Key biodiversity components

Biodiversity	Intrinsic Values	Use values	Cultural values
Animal species Avifauna, which includes threatened* (and iconic) species such as kiwi, New Zealand pigeon, kahariki, long tailed cuckoo, rifleman, New Zealand falcon, western weka, South Island Kaka, South Island fembird (and others)	Presence of threatened species	No direct commercial value; all indigenous bird species listed are absolutely protected under the Wildlife Act.	Special dispensation can allow Maori to collect some culturally important species (e.g., New Zealand pigeon) for ceremonial purposes that are protected by the Wildlife Act; some bird species are considered *taonga* (treasured)
Plant species Threatened species *Peraxilla tetrapetala*; five species at southern limit and five species ENDEMIC to or localised distribution known to be present to the east of the site	Presence of threatened species in the general area	No commercial or other use	Some plant species have medical value but no known current use by Maori
Habitats Tall forest of rimu and beech Upland forest of rimu, beech, Hall's totara Podocarp forest (yellow-silver and pink pine dominated); characteristic of coal measures Podocarp-manuka shrubland characteristic of coal measures but some fire induced	Known habitat for listed threatened animal species, potential habitat for other listed threatened plant species found outside of the site	Recreational hunting (all cultures); possum trapping. The area is "State Coal Reserve" and thus has national economic value	Habitat for plants and species of cultural importance (food fibre and medicinal) considered *taonga*
Ecosystem services Sediment control, stability maintenance, protection of water quality of Nine Mile and Ten Mile catchments	Landscape and ecosystem valued for AMENITY	Functions include: water catchment sediment control, assists stability of steep land, carbon sequestration	Natural water quality is valued by Maori and pakeha for cultural, recreational and amenity qualities

Appendix 2

This appendix sets out some further detail on the attributes selected for measuring condition of forest and shrub habitats at Strongman and RMEA (see also Table 1 in the main report.

- Emergent cover (%). Forests with a podocarp component are characterised by the presence of emergent trees, reflecting age (full maturity) of vegetation. Tree girth, epiphytes, and tree cavities (nest sites for some bats and birds) are also important characteristics of emergent trees.
- Canopy cover (%). In undisturbed forest and scrub nearly all surfaces are vegetated unless large boulders or recent wind-thrown trees are present. The attribute is a surrogate for land stability, strongly linked to erosion, and at full closure weed invasion is reduced.
- Shrub understorey (1 to 4 m height) cover (%). An understorey of shrubs develops only after the canopy has thinned and reached a “mature” height, so this attribute is a measure of the maturity and complexity of a site. It also indicates the abundance of deer and goats. Shrubland (scrub) does not support an understorey, as light levels are too low.
- Ratio browsed: unbrowsed plants/palatable species. This is a measure of the impact of exotic browsing animals, since it has been established through research in the West Coast forests using exclosure plots that both deer and possums have a preference for certain species. This criterion may be replaced by “the density of large-leafed (palatable) species in 0.5 to 2 m layer,” reflecting the impact of deer on understorey and future canopy species.
- Ratio of native to non-native vascular plant species (as a measure of the intactness of native flora). Degraded sites generally have a high number of exotic species and intact native ecosystems have no exotic plant species.
- Proportion of kiwi home ranges with juvenile kiwi. The presence of juveniles indicates a healthy population, as these long-lived birds are highly vulnerable when small, but when >800 g (approximately) are relatively resilient to stoats (their key predator). The use of kiwi home ranges incorporates a measure of population density.
- Small native bird species occupancy. Occupancy of small birds is heavily influenced by the impact of rats, a key predator of small birds, invertebrates and seeds. This indicator is included to counterbalance the impact of a criterion on kiwi, because an exclusive focus on kiwi predators (stoats) can increase abundance of rats.[21]

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