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GOAL ATTAINMENT SCALING: A PERFORMANCE EVALUATION TOOL FOR ASSESSING THE ACHIEVEMENT OF ENVIRONMENTAL GOALS

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INTRODUCTION

The purpose of this paper is to present a management tool, known as "Goal Attainment Scaling" (G.A.S), which has been adopted by the Department of Mines and Energy of South Australia (MESA) to monitor and assess the environmental performance of the petroleum and mining industries in South Australia. This tool will be presented in the perspective of MESA's proposed new approach to regulating the upstream petroleum industry and will be illustrated by examples of trials conducted by MESA to validate the adoption of G.A.S as an environmental goal assessment tool.

The existing upstream petroleum industry regulatory regime in South Australia is of the traditional prescriptive 'command and control' style which imposes techniques and solutions to industry rather than required outcomes. Considerable criticism of prescriptive regulation has been voiced over the past few years. Such criticism includes the unduly restrictive nature of prescriptive regulations (Cullen, 1990) which by imposing solutions rather than objectives often quickly become out-of-date to technological advances. Other criticism highlights the susceptibility of single industry regulators being captured by the industries being regulated (Braithwaite, 1991). Concern also exists over conflict of interest by regulatory agencies with multiple and conflicting responsibilities (eg a single regulator promoting industry development on the one hand and then regulating that industry's environmental and safety performance on the other). As pointed out by Laws and Aust (1994, p.848), although there are counter arguments, there are many who argue that "the 'one stop shop' regulator concept for an industry risks compromising decision making".

Public pressure for industries to become more accountable for their environmental responsiblities (Gunningham, 1994, pp.122-123) has also put pressure on government regulatory bodies to make their regulatory processes more transparent and to involve the community in the regulatory process.

To address these concerns a new approach to government regulation of the upstream petroleum industry is being developed by MESA. This new approach is termed objective regulation (Laws and Aust, 1994) and in terms of environmental management it involves:

- establishment by government in dialogue with industry and the community of meaningful and measurable environmental objectives; and
- integration with management systems designed to assure achievement of environmental objectives, including operator and regulator audits of outcomes and the effectiveness of the environmental and management systems.

The aims of objective regulation include:

- more effective and efficient regulation;
- achievement of better environmental outcomes;
- provision of greater flexibility to industry in terms of the application of new and improved technology to achieve environmental objectives; and
- giving greater assurance to the community that environmental objectives are being achieved.

One of the implications of objective regulation is the need for a means of identifying and measuring objectives. In early 1994 the Petroleum Division of MESA began an investigation into seeking out such a means. Through this investigation a concept known as "Goal Attainment Scaling" (G.A.S) was introduced to MESA by the Flinders Institute of Public Policy and Management of South Australia (FIPPM). It was immediately recognised by MESA that G.A.S can be used to facilitate consultation with all other stakeholders so as to enable MESA to establish the environmental goals to be achieved and the measurement criteria upon which to assess the achievement of those environmental goals. As a result of this, MESA in conjunction with the FIPPM introduced G.A.S to the South Australian Department of Environment and Natural Resources and a number of South Australian petroleum exploration and production companies (Sharp, 1994). Since this time MESA and the industry has actively pursued the adoption of G.A.S as a management system tool in the assessment of the environmental outcomes of various petroleum and mining activities (Malavazos, 1995; Malavazos & Dobrzinski, 1995).

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GOAL ATTAINMENT SCALING (G.A.S)

Definitions

The following definitions are offered (Table 1) for the terms used extensively in the discussion throughout this paper:

Table 1
Key Definitions

Objectives	Broad statements of desirable conditions, often related to government and company policy statements. For example, an environmental policy objective may be to ensure that: "activities are carried out in a manner that avoids or where that is not reasonably practical, minimises any adverse impact on the environment."
Goals	Statements of desired outcomes for any activity. When all of the goals have been attained the objective is considered to be achieved. For example, a goal may be: "minimisation of visual impact" or "minimisation of vegetation disturbance".
Activitities	These are the things which are done or carried out which may result in some form of environmental impact. eg. the construction of an access track to a mine or well site; oil or gas pipeline construction and operation; disposal of produced formation water; extracting material from a borrow pit, etc.
Outcomes	These are the actual results which are likely to be achieved by the activity and are used to determine whether a goal has been achieved. For example, an environmental outcome of the construction of an access track may be that 75% of the natural vegetation has regrown on the track 2 years after cessation of track use. Outcomes are used to assess the level of goal attainment.

Goal Attainment Scaling Theory

G.A.S originates from the United States of America where it was developed in the late sixties to evaluate the effectiveness of mental health programs (Kiresuk & Sherman 1968) and has been subsequently extended into the evaluation of other human service programs such as education and social work (Kiresuk et al, 1994). The application to environmental performance evaluation as proposed in this paper could be the first time that it has been applied to such a field since no precedents have been found.

An important feature of G.A.S is that for any goal (whether it be environmental or otherwise) all stakeholders are involved in evaluating and seeking consensus on the most important aspects of the goals to be achieved and the likely range of desirable and undesirable outcomes of activities undertaken. The technique forces participants to document in an unambiguous way the expected outcomes ranging from the more to the less favourable. The various levels of outcomes can take the form of descriptive statements, statements supported by photographs or quantitative data. Each outcome level is rated in respect of the chance it has of occurring, as described in Table 2.

TABLE 2
Likely Outcome Levels for any Goal

Rating Level	Outcome	Description
-2	Very unsatisfactory level for attainment of goal.	Lowest probability of occurring.
-1	Unsatisfactory attainment of goal.	Lower probability of occurring.
0	Minimum desirable level of attainment.	Highest probability of occurring.
+1	More favourable level of attainment.	Lower probability of occurring.
+2	Ideal level of attainment.	Lowest probability of occurring.

The outcomes defined and assigned to the G.A.S scale are intended to emulate of a normal distribution probability curve about the value of 0 with a standard deviation of 1. That is, statistically speaking, the outcomes assigned to the G.A.S score of 0 must be desirable outcomes which have the highest probability of occurring, however, these may not necessarily be the most desirable. The outcomes assigned to -1 and +1 must have equally the next lowest probability and the -2 and +2 outcomes must have equally the lowest probability (Figure 1). With application and further data acquisition it is likely that these outcomes will need further refinement in order to emulate such a distribution. The use of G.A.S recognises that the more desirable outcomes (ie +1 and +2) may not be achievable all of the time, but instead, the achievement of at least a 0 outcome will indicate expected and satisfactory goal attainment.

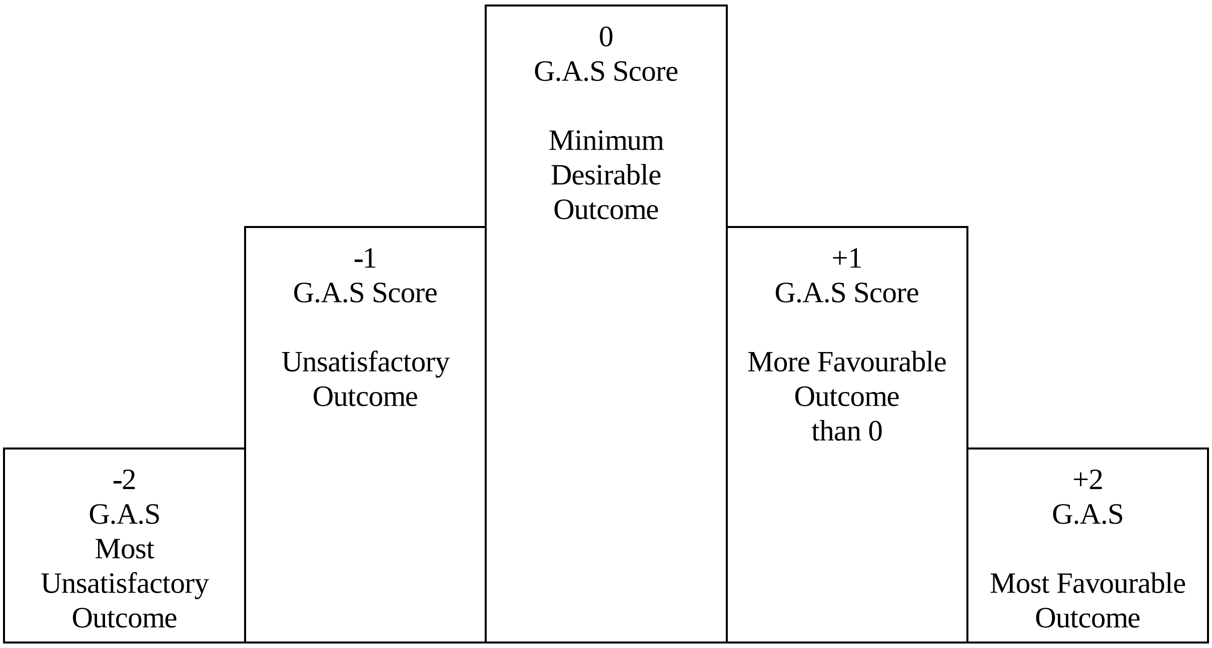


Figure 1: Frequency Distribution of Various Outcomes

Continual Improvement

G.A.S is a dynamic concept, in other words the goals and measurable outcomes defined can be subject to continuous review and assessment by stakeholders so as to ensure that changing circumstances and community perceptions are not overlooked. That is, it recognises that the definition of environmental goals and their respective desirable and undesirable outcomes are based on the best available information at hand at the time these are defined. With new information coming to hand and with improvements in technology these goals and outcomes can be reviewed.

Graphical Indicator

The quantitative representation of qualitative data, makes G.A.S an effective means for simple assimilation of the environmental situation in relation to any goal at any point in time. This is illustrated by the following:

<u>Normal Distribution of G.A.S Scores</u>
The aim over time for any particular goal is to obtain a frequency of G.A.S scores which resemble a normal distribution curve about the 0 score as shown on figure 1. This would reflect that the outcomes originally specified are being achieved as expected.

<u>Right Skewed Normal Distribution</u>
If it is discovered that the distribution is skewed towards the +1 or +2 side then it may be that the original 0 G.A.S outcome was too pessimistic and that the outcomes set as +1 or +2 would be more representative of the 0 outcome. Therefore this skew towards the right could be taken as an indicator to readjust the scales so as to more appropriately reflect the most likely outcome.

<u>Left Skewed Normal Distribution</u>
If the distribution of G.A.S scores skews towards the -1 or -2 side then it could mean any of the following:

- industry is non-complying and needs to reassess its operational activities; or
- the zero outcome set is too optimistic and impractical to achieve.

EFFECTIVE PERFORMANCE MEASUREMENT

In light of the need to be outcome and objective focussed under an objective based regulatory regime, for a management tool such as G.A.S to be effective, it would need to have the following attributes as depicted by the Australian Manufacturing Council principles for best practice environmental regulation (AMC, 1993).

Consultation

All relevant environmental goals and criteria for measuring the achievement of those goals must be developed from a process of consultation encompassing the views and interests (values) of all stakeholders (ie industry, government and community). Consultation is necessary to ensure that regulatory decisions are taken in the public interest.

Transparency

Provision of clear and unambiguous evidence to all stakeholders of the environmental performance allows judgements to be made of the effectiveness of the regulatory regime. This can be achieved via the consultation process in which in addition to determining the appropriate goals, the stakeholders are involved in evaluating and reaching consensus on the most important aspects of the expected desirable and undesirable outcomes for measuring the achievement of each goal.

Flexibility

Recognition that predetermined goals and outcomes may either be too optimistic or too pessimistic when it comes to application. Also under changing circumstances, such as the introduction of new technology, what may not have been achievable in the past may now be possible. Therefore environmental goals and outcomes need to be reviewable on an as-need basis.

Focus on Goals & Outcomes

The focus of an effective performance measuring tool needs to be on the achievement of measurable goals rather than on the procedures and processes adopted to achieve those goals. This ensures goals are being achieved and that time is not unnecessarily wasted on irrelevant detail. This also provides the flexibility and freedom to alter procedures as required to ensure that the goal is being achieved.

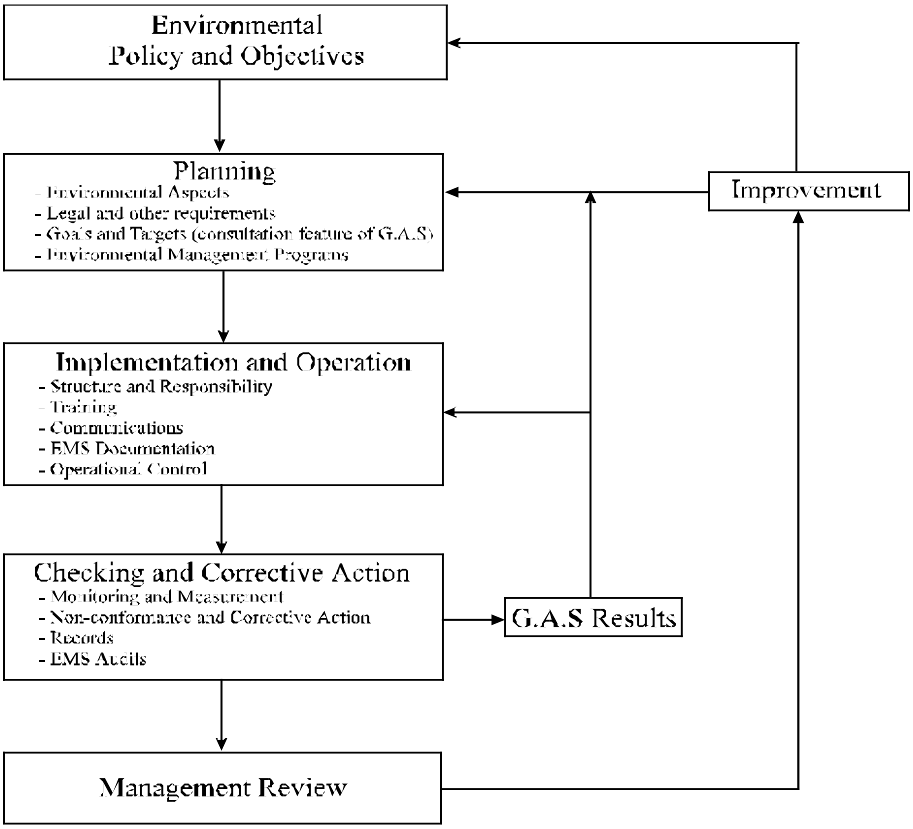
Efficiency

Measured and reported data should be kept to the minimum necessary. This ensures the focus is on the important aspects of operations and also avoids unnecessary wastage of time and money during audits and inspections.

ENVIRONMENTAL MANAGEMENT SYSTEMS (EMSs)

One of the requirements of objective regulation is for industry to develop management systems designed to achieve goals and objectives. It would be necessary for such management systems to be integrated into the regulatory regime with regard to goal setting, reporting and auditing.

An environmental management system includes both internal and external audits to check compliance with procedures and achievement of goals and objectives as well as reporting to the regulator and community on the issue of compliance, for example annual performance reports. Reporting to the community of audits by the regulator will also need to be considered. In relation to auditing and reporting the achievement of environmental goals, G.A.S can be integrated into the environmental management system (EMS) to support these processes.



A management tool such as G.A.S fits into the goal and target setting and the checking and corrective action elements of an EMS to ensure that desirable environmental outcomes are achieved (Figure 2).

Figure 2. A model showing the core elements of an environmental management system integrating the concept of G.A.S
(as adapted from ISO/CD 14001.1 Revision and ISO 9001:1994)

The elements of an EMS and the way G.A.S can be integrated into some of these are described below:

Environmental Policy

This element of the system ensures that an organisation's top management declares its environmental policy and objectives.

Planning

A feature of this element is that it defines the organisation's environmental goals and targets needed to be achieved so as to satisfy its declared environmental policy. This element also establishes and maintains the programmes necessary to achieve those goals and targets. It is in this element that the views and interests of all stakeholders must be accommodated when establishing the environmental goals and targets. G.A.S facilitates consultation with all stakeholders so as to seek consensus on the most important aspects of the goals to be achieved and the likely range of desirable and undesirable outcomes that could result from the activities undertaken. G.A.S also forces the stakeholders to define the expected outcomes from the most to the least desirable which will then enable an assessment of the achievement of the goals by all parties.

Implementation and Operation

This element of the EMS ensures that the roles, responsibilities and authorities are clearly defined, documented and communicated and that all operations are adequately controlled in order to facilitate an effective EMS.

Checking and Corrective Action

A feature of this element is to ensure that the organisation establishes and maintains procedures to monitor and measure on a regular basis the key characteristics of its operations and activities that can have significant impact on the environment. This includes measuring for the expected environmental outcomes for each goal as defined by all stakeholders under the Planning element of the EMS. This would require visiting the operation sites and measuring the actual environmental outcomes so as to assess the level of achievement for each environmental goal.

A means for doing this is through the adoption of G.A.S where the operational feature of this concept involves measuring the actual environmental outcomes and scoring them against those defined by the stakeholders. These scores can then be used as a basis upon which corrective action to the appropriate elements of the EMS can be taken (Figure 2).

The role of G.A.S in terms of this element is for auditing the environmental outcomes of the operations and not for auditing the effectiveness of the overall management system. In other words, G.A.S can be used to audit the effectiveness of operations in achieving desired environmental outcomes whereas auditing the EMS for conformance to the prescribed standard can only be dealt with through a specific management system audit.

Management Review

This element ensures that the organisation's top management shall review the EMS to ensure its continual suitability, adequacy and effectiveness. This element of the EMS ensures that the management review of the system shall address the possible need for changes to policy, objectives and other elements of the EMS in the light of system and outcome audit results, changing circumstances both internal and external to the organisation and the commitment to continual improvement.

EXAMPLES

The use of G.A.S was tested by assessing the achievement of environmental goals of rehabilitation activities at petroleum well sites and mineral exploration drill sites in South Australia. To illustrate the preceding discussion, the results of these tests are presented. The regions in which the sites are located are predominately desert with mainly sand dune and floodplain landsystems.

PETROLEUM WELL SITES

Activity: Abandonment of Well Sites

Vegetation clearing and earthworks over an area of about one hectare are essential safety practices in the construction of petroleum well sites. When well sites are abandoned, the industry is required to ensure that these sites rehabilitate back to a state compatible, as far as is possible, with the surrounding landscape. Two of the environmental goals of such an activity are, upon abandonment of the wellsite:

- to facilitate natural revegetation on the well site; and
- to stabilise the well site as much as possible against the effects of erosion.

Goal: Facilitate Natural Revegetation

For the purposes of this illustration we will look at the goal to facilitate natural revegetation on abandoned well sites. For this goal, MESA and the operator defined a series of likely environmental outcomes which could be used to assess the extent to which the goal is being achieved. However, it must be stressed that these are only preliminary at this stage until further consultation is carried out with all other stakeholders. Nevertheless, they have enabled MESA to carry out initial trials on the use of G.A.S as an environmental assessment tool in evaluating the environmental performance of the petroleum industry in this region of South Australia (Malavazos, 1995).

The outcome of this goal is dependent on the type of soil and the amount of rainfall from the time of abandonment. The low frequency of rainfall and flooding events in this arid environment is not conducive to rapid revegetation and this has to be recognised when establishing outcomes to assess this goal. Historical data from the sand dune and floodplain landsystems in this region indicates that the re-establishment of perennial grasses and shrubs requires 3 or 4 major rainfall events or 1 or 2 flood events. This tends to correspond to 5 or 6 year periods. Therefore for well sites abandoned for at least 5 years, the outcomes defined to assess the achievement of the revegetation goal are presented in Table 3.

TABLE 3
Likely Outcomes for Environmental Goal to Facilitate Revegetation on Abandoned Well Sites in Sand Dune Landsystem

-2 Much less favourable outcome	-1 Somewhat less favourable than minimum desirable outcome	0 Minimum desirable outcome	+1 Somewhat more favourable than minimum desirable outcome	+2 Much more favourable outcome
No revegetation evident.	Very little perennial revegetation, site mostly bare when compared to surrounding landscape.	Perennial grasses & shrubs revegetated, type consistent with surroundings. Some bare patches still present.	Vegetation type and density the same as that on surrounding landscape. No bare patches, lower maturity of vegetation than that on surrounding landscape is evident.	Vegetation type, density & maturity indistinguishable from surrounding landscape.

Note: The descriptions of the outcomes in Table 3 are illustrated with photographs of typical examples.

Audit Results

To illustrate the use of these defined likely outcomes to assess the revegetation goal, the following frequency chart (Figure 3) is included as derived from a recent audit carried out by MESA on a number of abandoned well sites (Malavazos, 1995).

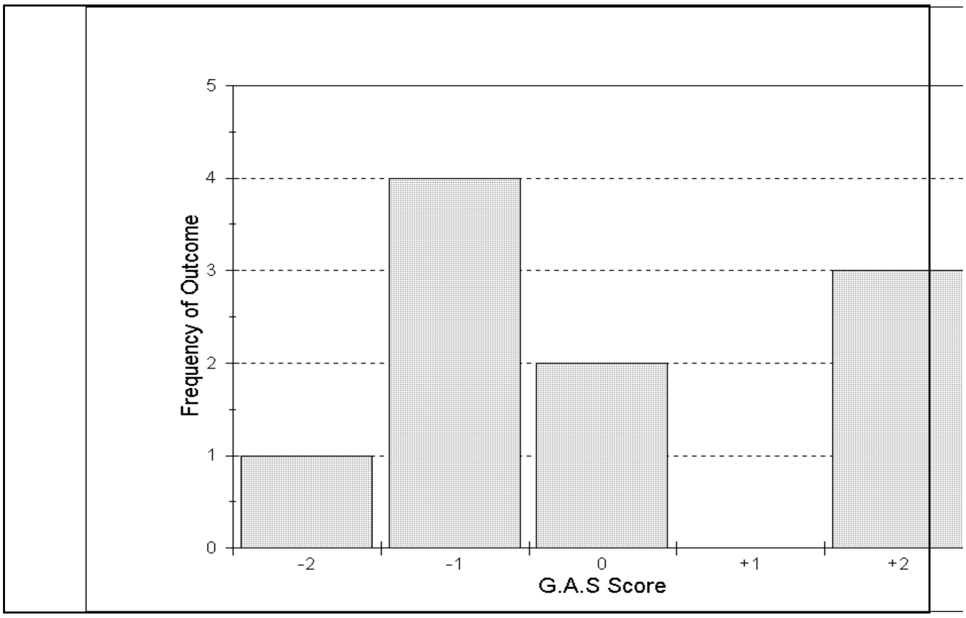


Figure 3. Frequency chart for revegetation outcomes measured on dune field abandoned well sites.

Firstly, it must be pointed out that these results are based on a single inspection trip visiting a sample of only 10 well sites which is too small for reliable statistical analysis. A more representative view of the actual achievement of this goal will be when the results of the inspections of more well sites are viewed cumulatively. However, for the purpose of this discussion, the results in Figure 3 revealed that 50% of the sites visited have achieved undesirable outcomes for this goal. With the exception of the 3 sites which showed the most desirable revegetation (ie +2 outcome), the other 70% of the sites visited are skewed to the left about the -1 G.A.S score. As discussed earlier, this skew could be an indication that the procedures and activities carried out to facilitate the achievement of this goal are failing or that inadequate rainfall/flood events have ocurred over these sites.

As a result of this information, the operator responsible for these well sites was requested by MESA to review the operational aspects of its environmental management system for the rehabilitation of abandoned well sites to address this apparent non-compliance. In such a situation, where the inspection is carried out on the basis of G.A.S, the regulator (ie MESA) is only interested in the operational aspects used to achieve the goal in assisting in evaluating the operator assurance that the non-compliance has been addressed in response to the measured outcomes.

MINERAL EXPLORATION DRILL SITES

Activity: Rehabilitation of Drill Site Access Tracks

As far as vegetation clearing and soil disturbance is concerned mineral drill sites are less imposing than petroleum well sites. The major impact results from the construction of tracks to access these sites. This mostly entails the clearance of vegetation which results in the formation of tyre tracks on the landscape from the drilling rig and other associated vehicles. The environmental objectives of the rehabilitation of such tracks are:

- Minimise third party use along these tracks after abandonment;
- Minimise impact on vegetation; and
- Minimise impact on soil.

The goals to be achieved in order to accomplish these objectives are given in Table 4.

TABLE 4
Access Track Rehabilitation
Environmental Goals under each Environmental Objective

OBJECTIVES	Minimise Third Party Use	Minimise Impact on Vegetation		Minimise Impact on Soil
GOALS	Minimal visibility of access track.	Short Term Goal: Minimal vegetation clearing.	Long Term Goal: Good revegetation.	Minimal Erosion.

As in the case for petroleum well sites, the revegetation goal is strongly dependent on rainfall events and time. Therefore in the case of the objective to minimise the impact on vegetation, both a short term and long term goal were defined. The short term goal would be used for any recent abandonment of tracks and the much older tracks would be assessed on the achievement of the long term revegetation goal.

The outcomes defined to assess the achievement of these environmental goals are given in Table 5. As for the petroleum well sites, these outcomes are only preliminary until further trials and consultation is carried with all other stakeholders, including the industry.

Audit Results

An audit conducted in July 1995 by MESA on a small number of drill site access tracks utilised the assessment outcomes described in Table 5. The results of this audit are summarised in Figures 4 and 5. In Figure 4 the combined frequency of all the G.A.S scores shows that for more than 70% of the sites visited the overall environmental impact of these tracks is acceptable. However, on an individual environmental goal basis, Figure 5 shows that more than 70% of the drill sites visited demonstrated unacceptable third party use. The response by industry to this finding will be to review its procedures used to disguise abandoned access tracks from passing traffic so as to more effectively prevent third party use of these tracks.

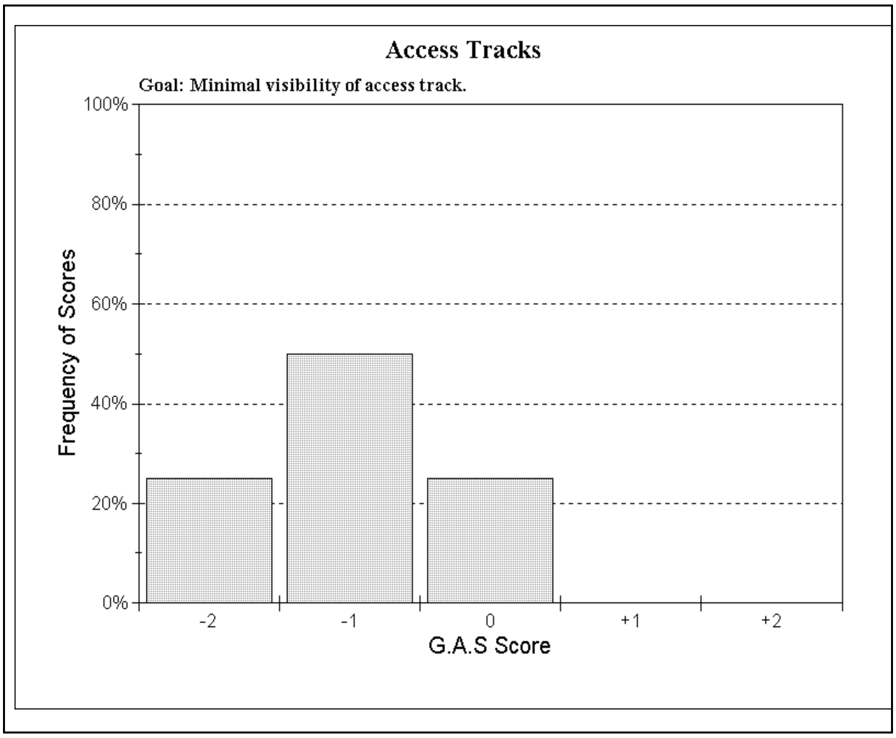


Figure 4. Combined frequency chart of G.A.S scores for all access track environmental goals.

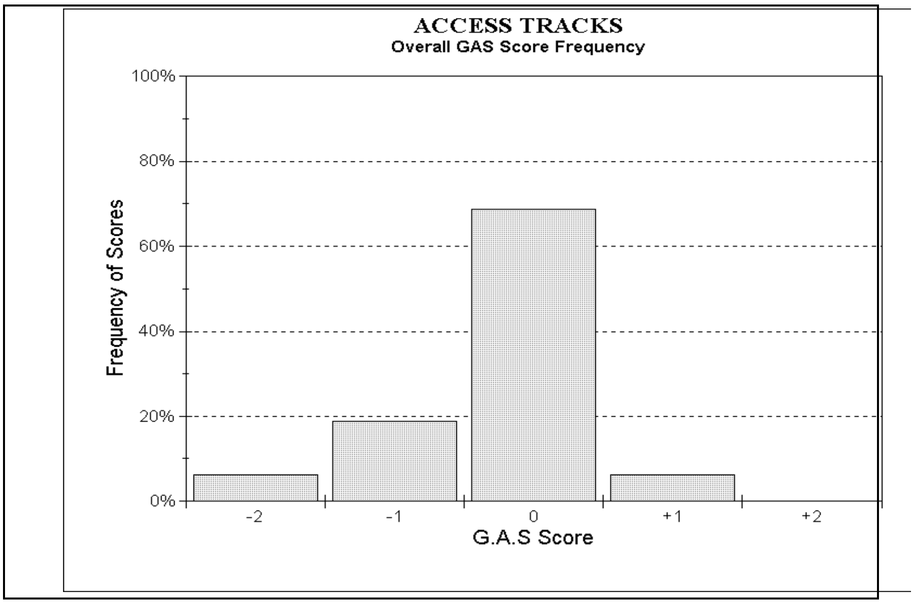


Figure 5. Frequency chart of G.A.S scores for minimal access track visibility environmental goal.

OTHER ENVIRONMENTAL GOALS

Other preliminary environmental goals and the likely environmental outcomes being considered for adoption for assessing the abandonment of petroleum well sites and mineral exploration drill sites in sand dune land systems are included in Tables 6 and 7 respectively. Early experience has shown that assessment of these goals by a number of independent observers has given closely comparable results.

CONCLUSIONS

G.A.S is simply an environmental performance measurement tool which facilitates the process for determining environmental goals and defining unambiguously the outcomes and criteria upon which those goals will be assessed. G.A.S doesn't offer solutions to manage the impact but instead acts as a feedback tool integrated into an environmental management system. The EMS then responds appropriately to the G.A.S measurements. G.A.S does not audit the EMS, this is the role of the system audit, but instead it provides data to the stakeholders on the extent to which environmental outcomes are being achieved. The integration of G.A.S into the EMS ensures that effective action is taken on noncompliance events.

G.A.S can be viewed as part of a cultural shift in government environmental regulation from one which has been traditionally based on prescribing and reviewing how industry carries out operations to one which focuses on what industry actually achieves. This moves government away from offering solutions and into ensuring industry achieves goals and that industry is accountable for those achievements.

The adoption of objective regulation by MESA compliments the adoption of EMSs by industry to ensure the effective management of operations in relation to environmental impact and a focus on industry being responsible and accountable for the achievment of environmental goals. The derivation of these goals includes the expectations of the community who are becoming increasingly active on issues pertaining to the environment. Consequently the means of assessing the impacts of industry on the environment also must change to more effectively accommodate the need to ensure that environmental goals are being achieved and that there is community confidence in both the industry and the regulator in relation to the minimisation of environmental impact.

G.A.S is consistent with an objective regulatory regime in that it:

- facilitates consultation between all stakeholders for government to establish environmental goals and the criteria to assess the achievement of those goals. If community consultation is properly undertaken, then environmental goals and outcomes to be achieved by industry will represent the views of stakeholders.

- allows industry greater flexibility in implementing the most cost-effective and advanced technology to achieve those goals.

- involves the stakeholders in determining the assessment criteria and can involve them in the assessment process of the actual environmental outcomes achieved. This ensures transparency in the environmental performance of industry and the effectiveness of the regulator, reducing the possibility of 'regulator capture'.

The attributes of G.A.S can be argued to be consistent with those of an effective performance measurement tool as follows.

Consultation & Transparency

These performance measurement attributes are encompassed by G.A.S via the need for effective consultation with all stakeholders (ie industry, government and community groups) for the regulator to determine the goals and measurable outcomes. Through this consultation, a better understanding can be obtained of:

a. the attainable environmental goals of the activity being undertaken;
b. the resources available to carry out the activities and rehabilitation programs;
c. the community acceptable outcomes; and
d. the criteria by which the achievement of the goals will be assessed.

Flexibility

G.A.S promotes continual improvement of environmental goals and outcomes as new information and technology come to hand.

Goal & Outcome Focussed

The focus of G.A.S is on setting and measuring the achievement of goals. This is of primary importance for the successful implementation of G.A.S and ensures that procedural and process aspects are dealt with outside the G.A.S framework and within the management system.

Efficiency

Due to its focus on operational outcomes rather than operational details and on the quantitative representation of qualitative data, an inspectoral system based on G.A.S is inherently more efficient than the existing prescriptive inspectoral practices.

TABLE 5

GOALS & INSPECTION ASSESSMENT CRITERIA FOR THE REHABILITATION OF DRILL SITE ACCESS TRACKS IN SAND DUNE LANDSYSTEMS

Objectives	**Minimise Third Party Use**	**Minimise Impact on Vegetation**		**Minimise Impact on Soil**
Goals	**Minimal visibility of access track - short term**	**Vegetation Clearing minimised - short term goal**	**Good Revegetation after major rainfall event - long term goal**	**Minimal Erosion**
-2	Track visible, no ripping, obvious 3rd party use.	Deep cuts, root stock removed.	No vegetation on access track.	Severe active erosion with extensive gullying, removal of soil surface, scalds etc.
-1	Attempt made to block track, however evidence of 3rd party use.	No weaving to avoid unnecessary vegetation removal.	Minor vegetation, rootstock returning, scattered annual plants, no perennials.	Moderate, active erosion, small rill gullies thin sheeting, slight scalding.
0	Track ripped to the end of the line of sight, disguising it from view and very little evidence of 3rd party use.	Weaving to avoid vegetation evident, rootstock left on track.	Moderate vegetation, rootstock returning, some signs of annual and perennial plants regenerating consistent with surrounding area.	Minor erosion - mainly around tyre tracks.
+1	Track barely evident, no 3rd party use.	No physical clearance of vegetation, only trampling of vegetation.	Good cover, approaching that of surrounding vegetation with a fair amount of perennials.	Very little evidence of soil movement.
+2	Track invisible and no 3rd party use.	No evidence of track.	Visually complete - undetectable.	No evidence of erosion.

TABLE 6

GOALS & INSPECTION ASSESSMENT CRITERIA FOR REHABILITATION PROGRAMS OF ABANDONED WELLSITES IN SAND DUNE LANDSYSTEMS

Objectives	**Minimise Visual Impact**	**Minimise Impact on Soil**		**Minimise Impact on Vegetation**
Goals	**Well site effectively earthworked**	**Site Stabilised against Erosion**	**For well sites less than 5 years after abandonment. Soil is stabilised and made conducive to revegetation**	**Facilitate revegetation. For well sites abandoned for at least 5 years.**
-2	Wellsite not earthworked at all, original pad untouched.	Severe erosion evident. eg scalding covering more than 40% of well site and/or deep erosion gullies >30cm deep running down edge of well site.	Pad & access tracks not ripped, soil quite consolidated.	No revegetation evident. Compared to surrounding landscape.
-1	Wellsite earthworked, however mound(s) of dirt from inadequate backfilling of mud pits on site remain which make the site distinguishable from surroundings.	Moderate erosion evident. Gullies up to 30cm deep running down edge of site and/or frequent scalding covering between 10% to 40% of lease area.	Pad & access tracks deep ripped, however, moderate erosion evident down edge of site.	Very little perennial or annual revegetation, site mostly bare when compared to surrounding landscape.
0	Original well site contours barely evident from road or from base of dune, only when on actual site, for example, pad edge distinguishable from surroundings.	Minor erosion evident. eg fairly even surface, scalded areas sparse and less than 10% of total lease area and/or small gullies or rills running down edge of site.	Pad & access tracks deep ripped with minor erosion evident down edge of lease.	Even spread of annual, biannual and/or perennial revegetation over the site. Some bare patches evident over the site.
+1	Original well site contours not evident from distance, only after very close scrutiny.	No erosion evident on the site.	Pad & access tracks deep ripped and no erosion evident.	Dense vegetation coverage over the site, mostly annuals or biannuals. Very few bare patches.
+2	Wellsite contours indistinguishable from surrounding landscape, even from close range.	Only natural erosion evident such as regular scalding or erosion gullies, consistent with the adjacent country side.	Pad & access tracks deep ripped with only natural erosion evident.	Vegetation type and density indistinguishable from surrounding landscape.

TABLE 7

GOALS & INSPECTION ASSESSMENT CRITERIA FOR THE REHABILITATION ABANDONED MINERAL DRILL SITES IN SAND DUNE LANDSYSTEMS

Objectives	**Minimise Visual Impact**	**Minimise Impact on Soil**	**Minimise Impact on Vegetation**
Goals	**Drill site effectively restored**	**Minimal Erosion**	**Good Revegetation after major rainfall event.**
-2	Piles of cuttings remain on drill site, tracks/ruts from vehicle tyres still present.	Erosion very evident, particularly along the tyre tracks.	Existing vegetation trampled and cleared with no sign of regrowth.
-1	Piles of cuttings remain on the site.	Evidence of some soil movement.	Little vegetation recovery evident.
0	Cuttings buried or raked over the site.	Very little evidence of soil movement.	Trampled vegetation evident but having strong signs of recovery.
+1	Drill site barely distinguishable from surrounding landscape, only signs of raking evident.	Tyre tracks visible but no evidence of erosion.	Only slight trampling of vegetation evident.
+2	Site consistent with surrounding landscape, no sign of drilling activity evident.	Soil shows no sign of activity.	No sign of disturbance to vegetation.

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