Fauna Management in Gas Pipeline Construction

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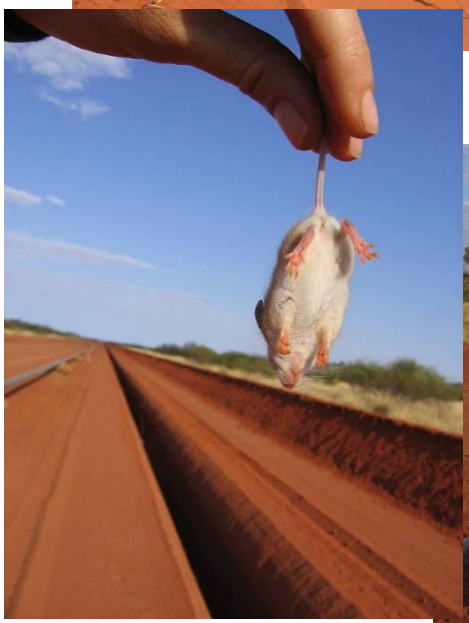

Abstract

During construction of onshore gas pipelines, long stretches of deep open trenches pose a threat to native fauna that inhabit the adjacent landscapes. In Western Australia there have been significant incidents resulting in large scale fauna deaths associated with pipeline construction.

In recent years, the regulatory environment for pipeline environmental management in Western Australia has become more rigorous. In particular, the conditions imposed for fauna management during pipeline construction have created a number of challenges.

With the growing demand for gas supplies to remote mining operations as well as ongoing gas exploration, there is likely to be an increase in the number of pipeline constructions across the state. MBS Environmental have Western Australian pipeline experience and in this presentation we identify significant challenges associated with fauna management, highlighting regulatory compliance requirements and detailing effective fauna management strategies.

Introduction

During the construction of onshore gas pipelines, long stretches of deep, open trenches may pose a threat to native fauna that inhabit the adjacent landscapes. Hazards to fauna from open trenches include:

- Falling into the trench, causing physical injury.
- Lack of shelter in the trench, causing:
    - Hypothermia (by night)
    - Heat injury or dehydration (by day).
    - Increased predation within the confined trench environment.
- Surface or groundwater that has collected in the trench causing drowning.
- Burial within the trench as it is back filled.
- Death due to physical encounter with mobile equipment or light vehicles.
- Stress to individuals due to repeated capture and release during the construction process.
- Restricted range and territory, causing increased conflict and competition in the surrounding area.

Unless these hazards are understood and adequately managed, high levels of fauna mortalities can and have occurred during gas pipeline construction. These mortalities are unacceptable to regulators (EPA 2004) and have come to the attention of the press (ABC News 2004), environmental activists and politicians (Robin Chapple 2004). Fauna injury or death in open trenches may also contravene the *Animal Welfare Act 2002* which provides for prosecution in cases where animals are caused unnecessary harm.

In this presentation we draw from our gas pipeline experience to evaluate the effectiveness of different fauna management measures at both the approval stage and during pipeline construction activities. These measures have been implemented during a variety of Western Australian on shore gas pipeline projects and may be imposed by regulators in explicit project approval (Ministerial) conditions, or as approved management plans. The list of measures presented is not exhaustive.

MBS Environmental has gained pipeline fauna management experience through involvement with several gas pipeline projects located in different parts of Western Australia with the majority being within the Pilbara region. Conclusions presented should be taken in this context, however some management measures may be effective in differing environments and equally relevant to buried onshore pipelines carrying slurry, oil or water.

Evaluations presented, are solely based on our experience in pipeline fauna management and do not represent project-specific data or constitute a scientific analysis. To establish scientifically verified findings and conclusions, a control would be required. In this case, the control would consist of an unmanaged duplicate section of trench located in a comparable environment and left open for a similar duration as the active trench. This is not a practical proposition and therefore pipeline fauna management may be as much an art as it is a science.

The Pipeline Construction Process

The onshore pipeline construction process consists of a number of stages, which can be summarised (with some simplification) as:

- **Survey:** Marking out the pipeline corridor and trench line. Potholing may also be conducted to locate foreign services, including cables and other pipelines.
- **Clear and grade:** Vegetation and topsoil stripping on the pipeline corridor and other work areas.
- **Pipe stringing:** Delivery of pipe sections to the corridor and setting out in preparation for welding.
- **Welding:** cleaning of joints, welding, testing, repair and coating to join individual sections into pipe 'strings'.
- **Trenching:** Cutting a trench for the pipe using trenching machines, rock saws, excavators, rock hammers and explosives. Trenches are typically one to two metres deep depending on the size and type of pipe and the required depth of cover, though in some places such as creek crossings the trench may be much deeper. This is shown in Plate 1.
- **Lowering-in and backfill:** Each pipe string is laid in the trench, often padded (underlain) and shaded (covered) with layers of specially screened or imported material before being filled to ground level with trench spoil material.
- **Special crossings:** Technically difficult crossings of foreign services such as rivers, cables, roads, and railways are dealt with separately, often using HDD (horizontal direct drilling) methods where open trench is not an option.
- **Tie-in:** Pipe strings and special crossings are welded together in the trench. Access is via benched-back and ramped excavations known as 'bellholes'.
- **Reinstatement:** Backfill of bellholes, disposal of excess rock or trench spoil, reinstatement of the soil profile, re-spreading of vegetation and implementation of erosion control works (dune crossings, watercourse bed and banks).

- **Hydrotesting, facilities work and commissioning:** The pipeline is pressurised with water to test its integrity. Engineering or fabrication work at above-ground facilities (such as receiver stations or compressor stations) may continue for several months after pipe laying activities are complete.

Plate 1: Open Trench with Strung Pipe on Right and Lowering in Machine at Rear

Clear and grade, trenching and reinstatement activities represent the greatest environmental risks. This presentation will focus on the open trench stage, in particular the risks to fauna, and how those risks are understood and managed by regulators and pipeline construction companies.

Each stage has a very different production rate, and the spread from 'clear and grade' to 'tying-in' and 'reinstatement' may represent an active area several hundred kilometres long on major pipeline projects. A dedicated crew and supervisor with highly specialised equipment is typically assigned to each stage.

The process is not always a linear progression from one end of the line to the other, especially in complex or urban environments with many special crossings or space constraints. In such environments, combined or 'Poor Boy' crews may be formed to start and complete a very short pipe string before moving to the next section. Construction managers are under intense pressure to stick to budgets and deadlines resulting in crews and equipment being mobilised and demobilised to alternative sections of the pipeline at very short notice.

Fauna Management Measures

Assessment and Planning

As with any type of development, effective environmental management requires a thorough understanding of the surrounding environment. This includes:

- Habitat changes, including habitat condition.
- The species of animals likely to be encountered within each habitat type.
- The climactic conditions over the duration of the project.

Understanding the environment and the risks from open trench allows more effective impact assessment, discussions with regulators and other stakeholders during the initial planning and development of practical and effective management plans.

Application of blanket conditions for fauna management on pipelines as a whole, or for a large project which spans different environments and seasons, is ineffective and does not guarantee an outcome of minimal fauna death. On large projects where the risks will change with time and location, it may be preferable that Ministerial conditions specify a comprehensive, auditable management plan, rather than listing a number of blanket measures.

Day to day assessment planning during construction is also critical to achieving outcomes. This may include monitoring of weather forecasts, daily fauna numbers and species and close liaison with construction crews and managers on construction forecasts.

Inspection in Pairs

Daily inspections of open trenches and the subsequent removal of trapped fauna comprises the primary fauna management method implemented for pipeline projects. Entry into the trench is generally regarded as a 'confined space entry' and not permitted without special training and specific safety controls. Fauna handlers retrieve fauna from the trench using nets and 'jiggers' mounted on extendable poles (Plate 2).

For some projects, the requirement to inspect open trench in pairs is explicitly set in Ministerial Conditions of approval. In others, the requirement may only be for a given number of trench fauna handlers to be on site (and deployed as seen fit).

From our experience ,particularly in lager diameter pipelines, inspection in pairs is critical for effective fauna management, to:

- Enable sighting of the entire trench base from both sides,
- Minimise stress and risk of injury to both animals and handlers during fauna capture,
- Reduce safety risks to fauna handlers when working away from other construction crews.

Fauna can often be retrieved by one person, but this method usually requires twice the amount of time for task completion compared to that of paired teams.

We believe that there should be flexibility incorporated into the paired fauna team method, as it can be more efficient for one handler to inspect pipe-laid or part-filled trench located in low fauna density environments and areas with shorter sections of open trench, provided that assistance is close at hand if required. 'Open trench' should be well defined in project documentation so that it is clear which excavations require inspection in pairs.

Plate 2: Pair of Fauna Officers inspecting Open Trench

Trench Inspection Deadlines

For all of the projects that we have worked on, Ministerial Conditions have set a time limit (typically 3.5 to 4.5 hours after sunrise) for completion of open trench inspections. We consider this to be a critical measure in preventing fauna deaths from heat injury, dehydration or hypothermia. While it is difficult to reliably determine in the field, we believe that this is the principal cause of fauna mortalities

(particularly reptiles) from pipeline trenching activities, for summer or spring projects in arid regions such as the Pilbara.

Many animals rely on shade to help regulate their body temperature in arid environments, providing protection both from direct radiation and heating of the ground. As the sun climbs in the sky, the amount of shade in the trench may dwindle to nothing, depending on the time of year, latitude and orientation of the trench.

Trench Lengths and Handler Numbers

To meet inspection deadlines, there must be sufficient fauna handlers to inspect the amount of trench that is open. The most important driver of trench inspection rates is fauna density (captures per kilometre), and fauna resource planning must consider this.

Trench inspection rates can drop below one kilometre per hour where the trench fauna density is high. Within the Pilbara region we have recorded well over 30 animals per kilometre of open trench, depending on factors such as the overnight temperature and quality of the surrounding habitat. High fauna densities can be managed to some extent by holding compatible species and releasing them together at a suitable site or by employing a third person in each 'pair' to log and release animals.

While it is not really possible to control fauna densities, scheduling pipeline work for cooler, drier times of the year when fauna are less active or abundant can help. Some of our projects have had restrictions on the time of year when trench could be open, although this was primarily intended to prevent open trench in the cyclone season which carries the risk of mass drownings and where high temperatures and humidity pose increased mortality risk.

The type of fauna can also impact on inspection rates. Some species of dragons and hopping mice, for instance, are notoriously difficult to catch and encountering even a few can threaten inspection deadlines on any given day. This is hard to predict and control resulting in the planning of inspections to enable completion with plenty of time to spare.

Walking speeds above a moderate stroll (3.5 kilometres per hour) does not allow the trench to be inspected with sufficient care to sight smaller animals (e.g. geckoes) and we suggest this should be treated as an upper limit guide for trench inspection rates. Trench deadlines should not be met at the expense of conducting effective inspections.

Some of the projects that we have worked on have prescribed the number of fauna handlers that are to be employed for trench inspections, and the maximum amount of trench that can be open at any time. On other projects, there has been no prescribed number of fauna handlers or limit on the amount of open trench, provided that inspection deadlines are met.

Open trench limits can greatly increase the time and cost of pipeline construction, if they are too restrictive or do not take into account the construction methodology. Lowering in and trenching often face hold-ups for completely different reasons and if the spread is too tight, one crew will often be waiting for the other, standing still at a very high hourly cost.

Generally, it is far cheaper to employ more fauna handlers, to provide construction managers with the flexibility required for reasonably continuous production; however a very high degree of communication, cooperation and planning is required. We have also found that there is a practical limit on the number of teams that can be managed at any given time.

Construction managers are generally under intense budget pressure and reluctant to overstaff fauna teams for contingencies (such as a breakdown on the lowering-in side), if given the option. Attempting to form and mobilise teams at short notice to cover additional open trench can be extremely difficult- this has in some cases lead to failures to meet deadlines (and costly shutdowns).

We suggest that a combined approach to ensuring inspection deadlines can be taken in approval conditions, comprising both:

- A project upper limit on open trench that is sufficient to provide reasonable flexibility to construction managers. This should consider the types of habitat likely to be encountered and the risk to fauna i.e. the length of open trench in cleared agricultural land may safely be much greater than a relatively pristine environment with likely profusion of reptiles in warm climatic conditions.
- A daily limit on open trench, based on the number of handlers available onsite, plus some contingency.

Practical issues such as breakdowns and access[1] can also threaten inspection deadlines. These are generally within the control of the fauna team, and a high standard of preparation and planning is essential. Fauna teams must be self-motivated and self-sufficient, to set out on site well ahead of other work crews.

Shelters

Many projects require the installation of shade shelters in the trench, and generally this is set in Ministerial Conditions. Shelter spacing is generally 50 to 100 metres.

[1] On one project, a 40 minute drive around a river crossing was required to get from one section of open trench to the next

We believe this to be a critical control for a number of reasons such as providing protection from climatic extremes (shade and overnight warmth), providing protection from raptors and providing a place for animals to congregate where they can be easily sighted and retrieved. In our experience, hessian sacks have proven most effective, in terms of cost, ease of handling[2] and popularity with fauna. Shelters seem to be most popular with geckoes and all types of small mammals. Indeed, for summer projects we have generally found that nearly all live geckoes are retrieved from under shelters, most geckoes found in the open are found dead, although this may not be the case for winter projects.

In reality, it may be difficult to demonstrate the 'true' effectiveness of shelters from our retrieval statistics: just because we don't see many geckoes out in open trench doesn't mean they aren't there, buried or sheltering in crevices. We attempt to mitigate this by turning over as much rock or soil debris as is practicable within the deadline constraints, and occasionally we find animals.

Trench Plugs

It is a standard requirement on pipeline projects for gaps in the trench ('trench plugs') to be left at a certain minimum interval (typically around 1.2 kilometres). We have found this measure to be effective in allowing larger or more mobile fauna to self-rescue, though attention must be paid to ensure that the plug is suitably ramped to allow fauna to exit.

It is in any case standard practice for trenching to leave a gap at the end of each string for construction/ access reasons, to be excavated at lowering-in time- so this measure generally comes at little or no cost. The approved spacing should of course be consistent with the string length, and the plug should be wide enough to allow large fauna (stock, kangaroos, emus) to cross the pipeline.

Additional Inspections

One of our projects mandated several inspections: the 'standard' morning inspection, plus an afternoon/ evening inspection, and inspection 30 minutes before backfill. These requirements we found problematic to implement and generally of limited real benefit to fauna.

The requirement for inspection prior to backfill creates problems both for interpretation and implementation. As described above, there are several stages to laying and covering a pipe string: padding, lowering in, shading and final fill to ground level- something that did not seem to be recognised in the environmental approvals or project procedures. This again highlights the importance of consulting experienced constructors in the approvals for these projects (indeed, any

[2] Not forgetting that these must be removed prior to lowering in.

project). Significant issues have been experienced where approval documentation has been prepared by the potential user of the gas whose core business isn't building or operating pipelines.

Safety protocols allow nobody to work next to a pipe string being lowered in, which may take several hours or even all day. Once a string is in, it becomes near-impossible to sight or rescue most animals from underneath the pipe. For this reason we believe that pipe-laid trench is a greater danger to fauna than open trench and there should be explicit limits on the length of pipe trench set in approvals- however we are not familiar with any projects where this has been done.

Fortunately for the particular project where we encountered this condition, there was an engineering requirement for laid pipe to be covered by the end of the shift, and the lowering-in, padding and backfill operators were working as a tight combined crew. We were able to agree with the asset owner representatives (as project proponent, with ultimate responsibility for compliance) that the intent of the requirement would be met if we inspected the trench immediately prior to the commencement of lowering-in on a given string. Additional inspection of any trench or bellholes left open was undertaken as necessary prior to final backfill.

This arrangement can however put a great deal of pressure on the fauna team to inspect a string quickly, rather than effectively, while the lowering-in crews are waiting - particularly on fixed-price pipeline contracts. Careful daily planning and very close co-operation with the spread boss and crews is essential. A few animals were retrieved from the trench prior to lowering-in or shading, so the measure does have some (but limited) benefit. Providing members of the lowering-in / backfill crews with the training and equipment to remove any fauna that they see may be more cost-effective with similar actual environmental benefit.

In our experience, few animals will enter open trench during the day as they generally move at night and on this project (in the Pilbara summer), the risk of hypothermia for any animals trapped in the trench overnight was probably low. A small number of live animals were retrieved during afternoon inspections, however greater benefit in this case might have been had from another morning (rather than afternoon) inspection as an additional mitigation for heat-related fatalities.

In developing measures and setting out resources for a pipeline construction project, it should be remembered that trench is not the only hazard to fauna, albeit the most visible. Animals may perish as a result of clear and grade (destruction of habitat), physical construction of the trench (we have had numerous experiences of high localised mortality of burrowing frogs) and reinstatement (due to animals hiding in rock or vegetation stockpiles- we have heard anecdotes from reinstatement operators of high fauna mortalities). Inspections of high value habitats (such as habitat trees) or rock/ vegetation stockpiles might be considered in preference to additional trench inspections, depending on the habitat and the spread of the construction operations.

Fauna Handler Certification

Some of our gas pipeline projects have required trench fauna handlers to be issued with a Licence to Take Fauna from the Department of Environment and Conservation (DEC). The idea of this requirement is to ensure that handlers are suitably qualified to identify and handle fauna; however the intent of the licensing system is really to regulate deliberate trapping and holding of native animals, not rescue and release, so may not be appropriate. On other projects, Licences to Take Fauna have not been required, but it was necessary to demonstrate to DEC that all handlers were suitable for the role.

We believe that the identification of animals, while important, should be secondary to protection of their welfare and survival- including timely completion of trench fauna inspections. To fulfil their role effectively, we believe that it is more important that handlers are able to:

- Understand the subtleties of the environment they are working in and the effect of sometimes seemingly minor changes as the lateral extent of the pipeline changes. They need to be able to use this understanding to better plan the fauna management measures necessary to minimise fauna death or dislocation.
- Walk long distances in harsh conditions, carrying their gear and under time pressure.
- Safely handle animals and give appropriate aid where necessary.
- Communicate and work closely with construction crews.
- Work safely on a construction site.

Some projects allow handlers with minimal experience (assistants) to be employed for trench inspections, provided that they are working with another handler who has sufficient experience in fauna identification, handling and release / treatment. This provides a reasonable degree of flexibility in staffing. We have found that many (but certainly not all) construction workers with no directly relevant education or experience have made capable fauna assistants, however their availability is rarely guaranteed and so should be used for contingencies, rather than base load work.

Taking one project as a typical example, over 80% of animals found in the trench were accounted for by just 15 species. Fauna handlers with little or no prior experience with the local fauna are generally able to identify most species with reasonable confidence after a few days exposure, however we recommend that a senior fauna handler or zoologist verifies the identifications from time to time and provides feedback to improve accuracy.

Restricting the Duration of Open Trench

Some projects set a limit on the amount of time that any given section of trench may be open (typically seven to 14 days, and less in designated environmentally sensitive areas). In terms of fauna found in the trench, such requirements appear to have a diminishing return- generally, as the trench gets older, fewer and fewer animals are found.

Animals may learn over a period of days to exclude the trench from their ranges- but this may be at the expense of restricted territories, increased competition and conflict, an impact which is rather harder to measure and assess. The trench also may become less hospitable as the subsoil dries and hardens; fewer insects and consequently fewer larger animals are attracted to the trench..

Treating Bellholes as Open Trench

In some projects, while there has been provision for bellholes (the ramped and benched excavations that allow access for repairs or tie-ins) to remain open longer than 'mainline' open trench, open trench inspection requirements have still been enforced for bellholes, or bellholes greater than a certain length.

Problems can arise where impractical bell-hole definitions are used. A bellhole must leave enough pipe uncovered (typically two to three sections) to allow it to be shifted into place for tying-in, and exemptions must allow for this. Again, consultation with pipeline constructors at the approval stage can be critical if achievable measures are to be developed.

We believe that fauna deaths in bellholes are extremely unlikely in most circumstances. In our experience, very, very few animals are sighted in bellholes, and those that are usually leave via a ramp. To keep or send fauna people back to inspect bellholes when mainline trenching may be tens or hundreds of kilometres ahead, is a poor use of resources and achieves little actual environmental benefit.

The focus of fauna management at bellholes should, in our view, be about ensuring that bellholes are properly constructed, with adequate ramps for fauna of all types and sizes to use. If there is a residual concern for fauna ingress, it can be addressed with fencing (shadecloth or geotextile may be effective for smaller animals).

Installation of Ladders

Some approvals or management plans require the installation of fauna escape ladders (in addition to exit ramps). These may be wooden ramps, pieces of vegetation or ladders constructed out of hessian/ shadecloth ladders.

We have seen little evidence that fauna use these ladders: larger and more mobile fauna are seen to run past ladders without a second glance, smaller fauna are often found adjacent to ladders, or sometimes under them, taking advantage of the shade offered. Some types of dragons, for instance, do indeed climb vegetation and posts out on the open plains, but do not appear to demonstrate this behaviour in the open trench.

The Problem with Burrowing Frogs

Our experience is that large numbers of burrowing frogs are often found in open trenches. Unfortunately, almost all are found dead. This tends to adversely skew mortality statistics: on one project, the mortality rate was up to 30% including burrowing frogs, but only 5% excluding burrowing frogs, an issue that had to be explained at length to a proponent concerned about its reputation.

The measures that we have discussed are not effective for controlling mortalities of burrowing frogs (such as *Neobatrachus aquilonius*, the Northern Burrowing Frog), and no practicable measures are apparent to us. Burrowing frogs are extremely susceptible to rapid overheating and dehydration if disturbed and uncovered by earthworks. Many may be fatally injured or killed directly by trenching works.

We have considered watering the trench to delay dehydration in burrowing frogs, but are concerned that this would attract other fauna to the trench- and in any case we do not think that this measure would be effective. We believe that burrowing frogs disturbed by trenching bury themselves into the base of the trench (where they cannot be seen during inspections) and only emerge when they are already very close to death, possibly in a final attempt to find water.

We have however retrieved a small number of live frogs from open trench, even in very hot conditions, and some of these have recovered with treatment. Increasing the frequency of trench inspections may increase the likelihood of finding emerging frogs that can survive, but only marginally and at high cost.

Other measures such as wetted sawdust bags may be effective in tropical environments for terrestrial frogs, but we do not think they will be effective for burrowing frogs in the Pilbara. Potholing for, and relocation of, burrowing frog pods ahead of trenching is a possible, but untested measure. Greater understanding of potential locations would be needed to justify such a measure.

Correspondence we have had with the Western Australia Museum confirms that these frogs are highly abundant, widely distributed and the mortalities are not considered environmentally important. It may be necessary to gain environmental approval for ‘acceptable losses’ of burrowing frogs on future pipeline projects, although the issue of animal welfare remains.

Conclusion

In this presentation, we have discussed a number of measures for fauna management on gas pipeline projects, and offered on an opinion on which are the most effective, or how they are best implemented. In summary, we offer the following key points for consideration in the environmental approval or construction of a gas pipeline:

- Understand the environment in which you are going to construct. This includes things such as habitat changes, species of animals likely to be encountered within each habitat type and the climatic conditions at the time of construction for the duration of construction. Comprehensive understanding of the risk will allow more effective impact assessment, discussions with regulators and other stakeholders during the initial planning and development of practical and effective management plans.
- Application of blanket conditions for fauna management on pipelines as a whole is ineffective and does not guarantee an outcome of minimal fauna death.
- Fauna management measures should focus on minimising fauna death and dislocation. Whilst gaining additional scientific information is also important, it is a secondary role and should be seen as a benefit, not a driver for fauna management,
- Open trench fauna inspections should be done in pairs. 'Open trench' should however be clearly defined and consider all the stages of construction.
- Morning trench inspection deadlines should be set appropriate to the location and time of year. Inspection rates are largely driven by fauna numbers.
- Limits on open trench help ensure that deadlines are met, but can be costly. In general, construction managers should be allowed to open trench within a reasonable upper limit, provided that inspection deadlines relevant to the location and climate can be met by additional fauna handlers.
- Shelters and trench plugs are effective, cheap and easily implemented. Attention should be paid to plug ramps to ensure they form effective exits. Fauna ladders, while cheap, appear to offer no benefit.
- Additional trench inspections may have some, but limited, benefit. Inspections prior to backfill may be difficult to implement. Fauna resources may be better used elsewhere.
- The duration and/ or length of exposed pipe-laid trench should be limited to the practicable minimum.
- Individual fauna handlers need not have extensive experience in fauna identification, handling and treatment, provided the team as a whole has sufficient experience. The ability to work effectively as part of a fast-moving construction operation in harsh environments is often more important.

- Bellhole fauna inspections are of little value, but ramp construction should be carefully checked to ensure that fauna can exit. 'Bellholes' should be properly defined to be exempt from trench inspections.
- Burrowing frogs are often killed in disproportionately large numbers by pipeline construction. There appears to be little that can be done, but this should be identified in project approvals.
- Constant planning and close liaison with the crews, spread boss and construction manager is essential to implementing fauna management on gas pipelines.
- Experienced constructors should be involved in the development of approval documentation and management measures to ensure that the measures are practical, before they are put forward for approval and become binding on the project.

We expect the natural gas infrastructure in Western Australia to grow extensively over the coming years, to supply growing populations and an increasing number of large resources projects. Provided that the lessons learned from previous projects are considered in project approvals and management plans, we believe that the hazards to fauna can be adequately managed for future projects, while meeting the commercial and engineering objectives. Please let us know if we can help with your pipeline project.

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