Comments Land Contamination Technical Services RIS

QMDC comments on the Technical Services for Contaminated Land Consultation Regulatory Impact Statement

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Submission to:

Contaminated Land Review – Consultation RIS
Environmental Policy and Planning
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These comments are presented by the Chief Executive Officer, Geoff Penton, on behalf of the Queensland Murray-Darling Committee Inc. (QMDC). QMDC is a regional natural resource management (NRM) group that supports communities in the Queensland Murray-Darling Basin (QMDB) to sustainably manage their natural resources.

1.0 Background

QMDC and the communities we work closely with have identified waste management as an important NRM issue. Waste in its many forms (domestic, rural, industrial) provides not only challenges to the region's natural resources and assets but also opportunities for better NRM practices and strategies. Waste management is identified as a key issue requiring strategic regional planning and management as part of the Regional NRM Plan. Improved regulation of land contamination is an integral part of regional waste management.

2.0 General comments

QMDC asserts that Queensland's contaminated land policy and legislative framework needs to be strengthened to reflect the need to primarily avoid impact caused by waste generation and the disposal of hazardous contaminants. Currently it is mostly focussed on a mitigation or minimisation objective.

Critical to the review of Technical Services for Contaminated Land Consultation Regulatory Impact Statement (the RIS) is the need for an environmental, social and economic audit and analysis of the total number of current contaminated sites registered on the Environmental Management and Contaminated Land Registers.

Intelligent consideration of these registered lands and the cumulative impact of contamination on human health, land, water and air quality, current and future land use capacity and economic sustainability is urgent e.g. there are over 430 historically abandoned mine sites of which a significant number are contaminated in the QMDB.

Such important information and consideration is not being offered by the government to facilitate future land use in Queensland. Consequentially this means the RIS is based on values that support ongoing contamination regardless of existing contamination and its restrictions on land use, its hazards to health, its detriment to economic sustainability and its contradiction to community aspirations for a clean future with less toxic pollutants. This ongoing contamination is likely to have a detrimental impact on the development of tourism and increasing agricultural production, integral to government's identified pillars of economic security.

QMDC is concerned that common toxic contaminants (See Appendix 4 of the "Environmental Guidelines: Assessment, Classification and Management of Non-Liquid Wastes" (NSW EPA, 1997)) are ever increasing in Queensland. These are contaminants found in products, by-products and waste.

Ongoing development in Queensland is creating the opportunity for more industrial pollution and land use known to be associated with land contamination. The Australian And New Zealand Guidelines For The Assessment And Management Of Contaminated Sites (ANZECC Guidelines) lists 30 industries and land uses that are known to have been associated with land contamination (ANZECC & NHMRC, 1992). A similar list is also included in the "Contaminated Land Practice Standard" by the Australian Institute of Valuers and Land Economists (AIVLE, 1994). It contains 67 items and incorporates most of the ANZECC Guidelines items. Some of these are industries are expanding in Queensland.

The RIS should therefore be able to inform planning processes and mechanisms, in order to:

- define "no go" zones where land contamination is not acceptable;
- provide clear and predetermined standard environmental practices acceptable under legislation e.g. safe effluent disposal, defined buffer zones for activities and infrastructure against stream order classifications; and
- provide more efficient administrative processes so that a proposal for development if its impacts do not live within those threshold limits it is not allowed to proceed.

Management of land contamination action targets should focus on motivating changes in land use and industry production practices, by protecting and conserving regional and catchment environmental values and, as appropriate, undertake activities to arrest degradation and rehabilitate degraded areas.

Regional NRM Plans, and associated technical reports, regional profiles or overviews can provide important data on resource condition and trend analysis. These Plans therefore offer the RIS a better understanding on the waste reduction and recycling investment activities needed for the long term health and sustainability of a region's natural assets and its communities.

In QMDC's opinion, land contamination is equally a historical, current and future problem and recommends broadening the policy objectives. The overarching contaminated land reform program needs to establish best practice for managing land contamination to include planning and development control processes that address site specific and *cumulative impact*s.

Queensland is fast becoming a cess pit for an extensive array of mining activities that produce hazardous contaminants e.g. drilling fluid, brine, leachate, $PM^{2.5}$ dust etc

QMDC asserts the RIS needs to implement and address best technical service practices which adequately address the unique operations of a specific project and the nature of the hazardous contaminant.

A more strategic and environmentally responsive RIS relies on the purpose of the RIS incorporating NRM principles and key actions. Addressing land contamination in terms of improving or maintaining resource condition and meeting aspirational targets for Queensland's regional assets will improve the capacity of regional communities to achieve waste management aspirations encapsulated in the NRM Plans. This level of responsiveness is clearly needed to enable the alignment of state and regional planning processes.

QMDC recommends the inclusion of a threshold limit approach in the assessment processes. This approach would provide greater clarity and certainty because thresholds limits would help to define those natural resource assets identified as being both nationally and regionally at risk to the impacts caused by activities and infrastructure associated with the land contamination.

Setting threshold limits for natural assets (water (surface and groundwater); vegetation and biodiversity; land and soils; air) will help the contaminated land professionals to identify whether a new development or existing industries or businesses can operate without generating or disposing of levels of hazardous waste that will cause unacceptable impacts on those assets within the defined threshold limits. For reasons of environment and human health there may be no acceptable limit for contamination e.g. the disposal of carcinogenic materials to soil.

3.0 Specific comments

3.1 Policy objectives

QMDC asserts that there is a need to review the range of exposure settings for application in Australia because of the past and existing policy, planning, and regulatory influences on soil quality and uses and the potential site specific and cumulative impacts of the current mining boom in the state.

QMDC is concerned that contamination of agricultural land by mining activities may in the future lead to failure of produce to comply with the Australian Food Standards Code, or create problems with export market standards. Maximum Residue Limits and Maximum Permitted Concentrations for contaminants in commercially-produced foods, whilst taking protection of health into consideration, tend to be based upon what is achievable with good agricultural practice rather than purely toxicological/public health grounds.

A further policy consideration is the principle, of 'maximum beneficial land use', which represents an ideal situation where remediation of contaminated sites occurs to the point where the land becomes suitable for all potential uses. If such remediation does not occur, and only one particular type of land use is deemed safe or permitted to occur on a contaminated site, then clearly there need to be planning control mechanisms so that changes to more sensitive land uses are restricted. This was recommended in the ANZECC position paper, '*Financial Liability for Contaminated Site Remediation'* (1994):

> 'Governments should put in place appropriate mechanisms within the planning process to ensure that potentially contaminated land is not rezoned to allow a more sensitive use without adequate assessment of environmental and human health risks and appropriate remediation where necessary.'

The health and safety of employees on a contaminated site is another policy consideration. Although exposure, for example, to volatiles must comply with standards set by WorkSafe Australia), and workers potentially exposed during remediation of a site are afforded protection under occupational health and safety procedures and standards, the exposure settings and their associated default exposure ratios are intended to be used for the derivation of investigation levels. They are not necessarily to be translated into 'response' or 'acceptance' levels.

Site and contaminant specific factors will be important in the derivation of acceptance or response levels, as may risk management and community consultation strategies. QMDC, however believes it is necessary to continue to develop best practice in this area to validate the approach taken, and in particular to keep investigational criteria under review in the light of any site-specific sampling data.

QMDC believes a need to ensure a general understanding of the use and intention of '**investigation levels**'. This general understanding must also align to community aspirations and values.

Some regulatory authorities have noted that since specific soil response criteria have not been established in Australia, the health-based investigation levels tend to be seen as *de facto* acceptance criteria by many consultants. QMDC argues that there are likely to be occasional instances where the existing investigation criteria are inadequately protective of ecosystems or groundwater resources, and perhaps even under-protective of humans if all possible exposure pathways are investigated and taken into account. This means that there always remains a need to consider sites on their respective merits, rather than unthinkingly comparing soil sample analytical results to established criteria.

International efforts to develop sophisticated exposure and risk assessment models may resolve some of these problems, but it does appear likely that there will always be a place for professional judgement and a site-specific approach.

QMDC is concerned that exposure settings have been somewhat arbitrarily chosen based upon available information about patterns of land usage. QMDC therefore asserts that categories will need to be kept under review to ensure they remain appropriate, and to allow for important variations to be incorporated as required.

Potential contamination is possible from new chemical compounds that were previously unknown given technical advancements in industry e.g. CSG General Beneficial Use Approvals.

Exposure assumptions (including indoor/outdoor activity patterns, soil ingestion, home-grown food production and consumption patterns) similarly need to be kept under review. Improving methodologies to study issues specific to contamination and rehabilitation at every opportunity, will improve knowledge on the links and differences between theoretical exposure scenarios and likely actual exposure patterns, making them as clear as possible.

The National Land and Water Resources Audit (NLWRA) reported in 2000 that a total of 48,000 ha of land was estimated to be affected by salinity in Queensland (CoA 2001). The Australian Bureau of Statistics reported in 2002, however, that the current area of saline land in Queensland was 107 000 ha (ABS 2002). This represents a more than twofold increase in saline area in just two years. This increase in area is attributable mainly to landholders' greater understanding or recognition of salinity. The NLWRA has estimated that if no preventive measures are taken, the saline area will increase to about 3.1 million ha by the year 2050".

Daniel Brough (Department of Natural Resources and Water) in a report assessing land in Queensland affected by salinity states that, "the value of assets affected by salinity is not well quantified", and notes that the costs to the community of salinity affecting agricultural land will potentially be significant. Productive land is a finite resource. The communities of Queensland will bear the full cost of the loss of productive land, to a potentially irreversible salinity outbreak.
http://www.derm.qld.gov.au/environmental_management/state_of_the_environment/state_of_the_environment_queensland_2007/state_of_the_environment_queensland_2007_contents/land_salinity.html

The sustainability of prime agricultural land and Australia's food security requires all industries and development to view the soil as a finite resource and not a receiving medium for a whole range of toxic substances.

3.2 Option 2

QMDC generally supports the shift of technical services to the private sector proposed in Option 2.

We do not however support the position the RIS promotes by assuming that in some cases it is not necessary or practical to remove all the contamination from a site in order to prevent environmental harm and/or public health risks. QMDC believes that this position tends to be misleading and at the very least requires specific examples to qualify such a position.

3.3 Environment Protection Act amendments

QMDC is concerned by the generally low quality application of economic analysis in environmental regulation reform. A good understanding of environmental economics and economic assessment would allow state and federal regulators and key decision makers to apply real fiscal calculations to reform proposals. Without this real data and information, we are not confident the proposed reforms to the Environmental Protection Act (EPA) are the best actions.

Estimates of cost of state regulation or of potential savings from reduced duplication are not available. Assigning unqualified emphasis on reforming environmental regulation in Queensland is unlikely to achieve significant economic improvement and could place environmental assets at risk. While, QMDC agrees, improvements can be made, the greentape discourse claiming burden on proponents and the need to fast track developments provide community little confidence that the wider economic and environmental issues of Australia's future are being carefully considered as part of this RIS.

3.4 Sustainable Planning Act amendments

QMDC asserts more consideration needs to be given to the proposed amendments to the SPA, specifically in context of:

- the probability of risk occurrence of, and magnitude of the consequences of, and unwanted adverse effect on a receptor;
- risk assessment and the process of establishing, to the extent possible, the existence, nature and significance of risk;
- the conceptual model and the text/schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of information from the phase 1 investigation and refined during subsequent phases of investigation; and
- the scientific analysis of source – pathway – receptor.

The proposed amendments must apply all aspects of the precautionary principle to risk assessment, risk management, and risk communication. In QMDC's opinion the remediation goal should be the recovery of all impacted natural resources functional properties to support human, plant and animal life, rather than the mere goal of clean-up for an intended use/end user.

Soil contamination may, for example, also become a source of contamination for groundwater, surface water and air. Baseline soil monitoring, pro-active operational soil monitoring and timely management of contaminated soils are recognized environmental approaches to protect soil and related resources. Remediation costs often increase sharply when soil contamination spreads to other resources. Before the SPA is amended, the Department needs to ensure that the soil resource and associated environmental media are protected by the RIS.

QMDC asserts the RIS must be improved in order to address identified major flaws of conventional risk assessment. QMDC argues that what the RIS deems as acceptable levels of risk does not align to current public concern and the value communities place on preventing harm minor and serious to the environment, to food sources, to themselves, their families and communities, to the future generations.

Risk assessment assumes humans and the environment can absorb a certain amount of pollution and render it harmless, known as “assimilative capacity”. As stated earlier, QMDC is concerned that eliminating risk altogether is not the goal of risk assessment within the RIS— it is used to mitigate, manage and reduce risks, not to prevent harm.

Risk assessment focuses on quantifying and analysing problems, rather than solving them. It asks, “how much pollution is safe or acceptable; which problems are we willing to live with; how should limited resources be directed?” It does not ask, “how do we prevent harmful exposures; move toward safer and cleaner alternatives; involve society in identifying, ranking, and implementing solutions?”

Risk assessments use different models with high uncertainty. Current risk assessment is based on many different assumptions about exposure, dose-response and the extrapolation of results from animals to humans. In one exercise, 11 European governments established teams of scientists and engineers to work on a problem concerning accidental releases of ammonia. The result of the exercise was 11 different risk estimates ranging from 1 in 400 to 1 in 10 million.

The organizers concluded that “at any step of a risk analysis, many assumptions are introduced by the analysts and it must be recognized that the numerical results are strongly dependent on these assumptions.” (Contini et al. 1991, *Benchmark Exercise on Major Hazard Analysis*. (EUR 13386 EN Commission of the European Communities, Luxembourg))

Risk assessment allows dangerous activities to continue under the guise of “acceptable risk.” It allows the continuation of activities that lead to greater pollution and degradation of health under the premise that it is either safe or acceptable to those who are exposed. It prevents action.

Risk assessment is fundamentally undemocratic. The risk assessment process is most often confined to agency and industry scientists, and consultants. It traditionally does not include public or community perceptions, priorities, or needs, and does not use widespread public participation.

Risk assessment puts responsibility in the wrong place. It assumes that society as a whole must deal with environmental harm, because that is the price of “economic growth’. It diverts attention from those responsible for harm and those who created it. It focuses government resources on studying the problems rather than identifying safer alternatives to potentially dangerous activities.

Risk assessment often poses a choice between economic development and environmental protection. Governments and industry often tie ‘scientific’ process of risk assessment to cost-benefit analysis but fail to question who assumes the cost and who reaps the benefits.

The economic benefits of cleaner production have been clearly demonstrated but often not acknowledged. Also, the cost of under-regulating will typically be greater than overregulating, when considering the subsequent clean-up and health costs.

Terry Hardy in a report entitled *The Role of Human Factors in Safety Risk Assessment* (Great Circle Analytics, June 1, 2010) Retrieved from http://www.gcirc.com/images/role.pdf draws attention to are a number of factors that can negatively affect the integrity of a qualitative risk analysis.

Hardy states that researchers have shown that a number of biases affect how humans make judgments in the face of uncertainty. Such biases can affect risk assessments. Hardy lists some of those biases as follows:

- *Availability bias.* Availability bias is overestimating the available information.

- *Confirmation bias.* Many studies have shown the propensity for humans to use existing information, and neglect nonconforming information, to confirm a pre-existing assumption, whether that assumption is true or not. In other words, people tend to see what they want to see. If one believes that tank overpressure will never be a problem, then they will search for all the ways a tank cannot possibly rupture and ignore other problems such as leakage at interfaces.

- *Hindsight bias*. Hindsight bias leads people to exaggerate in retrospect what was known in advance, often oversimplifying the chain of events. For example, if one knew from an accident investigation that structural failure was a contributing factor, then they might assign a high likelihood in a new hazard analysis to structural failure because of that investigation, when in fact a number of other random events may have also occurred to cause that particular accident.

- *Insufficient adjustment bias.* Studies have found that the final subjective probability can be highly dependent on the initial value chosen. For example, if the initial likelihood value is selected to be “very low,” but subsequent information shows that the likelihood of an event is actually high, the bias is to allow the likelihood to remain at the “very low” end of the scale, possibly raising it a bit to “low” based on the new information.

- *Representative bias.* This bias refers to overemphasizing similarities. For example, if a steel tank showed a low probability of a rupture based on previous tests and analyses, then the inclination is to assign the next tank under analysis that same likelihood. However, that next tank might be made of composite materials that have not been tested under similar conditions and therefore may not truly be similar to the previous tank. Representative bias can lead to what is known as base-rate neglect, where actual data and failure frequency are ignored.

- *Insensitivity to sample size.* This bias is similar to availability bias in that it implies an overreliance on a limited amount of data. It also comes from a philosophy that if something has worked before then it will work again, even if there are limited data to back up that conclusion.

- *Overconfidence bias.* Overconfidence is the tendency of humans to exaggerate their knowledge of uncertain events. Humans tend to become especially overconfident if they have had a string of successes without failure. For example, studies have shown that most people think they are better than average automobile drivers, in part because they have not been involved in a serious automobile accident. Their overconfidence is based on a series of successes and lack of feedback.

- *Organizational and personal bias.* Risk assessments can be biased by organizational or personal pressures. Most of the time this bias does not reflect a situation where fraud and abuse are present (although it can). Rather, this is usually an attempt to make an unacceptably high risk more acceptable, because higher risk requires justification and acceptance at a higher management level. For example, if a risk is shown as “catastrophic” and “high,” a panel may find ways to convince itself that the likelihood is something lower to avoid additional justification to senior management.

Hardy also identifies process failures in addition to biases that may affect a risk assessment:

- *Lack of standardization of risk matrices.* One problem area in risk assessment efforts is that different risk acceptance matrices are used within industries and between industries. The wording is usually different on these risk matrices, leading to potential confusion.

- *Misunderstanding about what the likelihood and severity definitions mean.* Five people could have five different interpretations of the likelihood and severity definitions. If there is not specific guidance and training on those meanings, with frequent refreshers, then everyone in a given room could agree on a risk level, but could in fact be agreeing on different things.
  Even if the same risk matrices are used within one organization, different projects can assign their own meanings. This problem becomes much worse when the likelihood definitions have no probabilistic values assigned. Even when probabilistic values are assigned to the likelihood definitions, there can be confusion if no units (e.g., likelihood per day, per hour, per second) are assigned to the probabilities. In addition, applying likelihood definitions meant for continuous operation based on time (such as in a chemical plant) may be incompatible with operations that are discrete (such as a rocket launch).

- *Making unrealistic assumptions about the system and operations.* Hazard analyses typically assume that the quality control procedures are adequate to assure that the design conforms to requirements, that testing will adequately verify the operation of the system, that the operators are trained and capable, and that operational procedures are clearly defined. Analysts must make assumptions or the analysis can become unreasonably large and unwieldy, but these assumptions may be incorrect and therefore bias the results of the assessment.

- *Focusing on the worst credible event and ignoring more likely but less severe events.* System Safety analyses tend to focus on the worst credible event, and then determine risk based on the likelihood of that event. However, because risks are a combination of likelihood and severity, risks with less severe consequences cannot be ignored. For example, tornados may occur infrequently enough in some areas of the country to justify acceptance of the risk of tornado-level winds in structural design. But high winds with less strength may actually produce damage more frequently, requiring additional structural margins.

- *Failure to recognize when risks are not independent.* Correlated causes can lead to a higher overall system risk, and a failure to understand when causes are dependent can lead to an underestimation of risk.

- *Failure to realize that risks tend to be additive.* In reality, accidents occur because a number of unlikely events occurred in concert, usually involving hardware failures, human error, and procedural failures. When considered individually, these risks often are small, but when added together they create one large risk to the system. Risk analyses often focus on individual hazard causes and therefore may underestimate the risk to the system. Sometimes this process failure is referred to as conjunctive distortion, which is misjudging the probability of combined events relative to their individual values.

- *Failure to measure the effectiveness of the method.* Most quantitative models are validated against real data. However, qualitative methods are rarely validated. Although some organizations are interested in such an activity, resources are usually not available to compare the qualitative analysis to results in the field, often because the program has ended or because the system is operational and precious resources are spent running that system.

Personnel and organizations charged with developing and evaluating the risk assessments can also affect the quality of the outcome.

- *Lack of training and experience with risk assessment methodologies.* Sometimes the organization performing the risk assessment, or even the one evaluating the results, has little experience with that process. Inexperienced analysts may complete the analysis procedure, but they may not understand the significance of each step. In these cases parties can walk away thinking they have completed an acceptable safety analysis and review, when in fact no one truly understood what they had just analysed or the implications of the results. This can lead to a significant underestimation of the actual risk.

- *Only relying on experts with extensive experience to dictate the risk assessment.* While using inexperienced personnel can be a problem, relying on experts can also provide a false sense of security. Experience is a tremendous help when trying to perform risk assessments. However, in addition to the biases described above, there are some caveats with regard to relying on expert assessors:

  > Experience is based on one's memory of events, and people tend to be very selective of what they remember. What one decides to conclude from their experiences may be based on emotion or faulty logic.

Experience may be based on internal processing, and unless one is exposed to reliable feedback, they may actually be learning the wrong lessons.

Experience may not be applied consistently.

- *Failure to include the safety and management culture in the assessment of risk.* Evaluating the management culture and how that culture influences the assessment and reduction of risk can be difficult. But a failure to include management and organization factors in the assessment could result in a gross underestimation of the risk, as evidenced by a number of accidents with root causes tied to organizational factors.

3.5 Expanding the criteria requirements for contaminated land reports

QMDC supports expanding the criteria requirements, however we assert that this criteria needs to be determined before this Statement takes effect. The criteria are integral to the policy objectives and the integrity of the government's preferred option two. QMDC's support of option two is dependent on the scope and completeness of these criteria.

In QMDC's opinion the objectives of site investigations as well as the contents of a report need to be clearly articulated in legislation. These objectives should include:

- identifying sources of substance releases from approved development of projects in Queensland before they result in significant contamination to the soil resource;

- ensuring timely actions are taken to eliminate or control the sources of soil contamination and prevent or reduce the risk of contaminant transfer from impacted soils to other environmental media (air or water) or potential receptors; and

- ensuring timely assessment, management and reporting of all contaminated areas associated with approved development and projects and reduce the environmental impact associated with development approvals in Queensland.

3.6 Soil Disposal Permit

QMDC does not support repealing the requirement for a soil disposal permit from the EPA. The Statement is relying on a review that is not completed and has not provided sufficient evidence to support its claim that duplication and delays in processing are a real problem. How will soil disposal be monitored for compliance under the proposed Waste Management Regulation, who will be accountable if due process is not followed – the department? Compliance is a government responsibility. QMDC is of the view government departments responsible for compliance are under resourced and the over reliance of self-regulation and voluntary compliance is not in the best interests of community.

3.7 Notification requirements

QMDC does not support the proposal to amend EPA notification requirements and limit the period within which the purchaser has the right to rescind a contract. This right has been constituted in common law and has existed as a right based on legal precedence. The devastating impact contaminated land may have on the purchaser's proposed land use of the property subject to the contract must be seriously considered and the adequate notification be protected as part of due legal process.

3.8 Implementation, evaluation and compliance strategy

QMDC support the department having an increased education and awareness raising role to ensure auditors understand and fully adopt the role expected of them. We also support approved auditors being held accountable for their professional expertise and decision making with respect to contaminated land. It is however not clearly articulated within the RIS on what grounds the department can be held accountable once a report is submitted to the department and in their position as monitor of the overarching framework.
This we believe should be included within the RIS so all chains of responsibility and accountability are carefully considered and described.

4.0 Recommendations

QMDC recommends the following:

4.1 That Queensland's contaminated land policy and legislative framework be strengthened to reflect the need to primarily avoid impact caused by waste generation and the disposal of hazardous contaminants.

4.2 That a full audit be conducted to analyse all current and potential future environmental, social and economic impacts of the total number of current contaminated sites registered on the Environmental Management and Contaminated Land Registers.

4.3 That the RIS should inform planning processes and mechanisms, in order to:

- **define "no go" zones where land contamination is not acceptable.**
- **provide clear and predetermined standard environmental practices acceptable under legislation e.g. safe effluent disposal, defined buffer zones for activities and infrastructure against stream order classifications.**
- **provide more efficient administrative processes so that a proposal for development if its impacts do not live within those threshold limits it is not allowed to proceed.**

4.4 **That the Regional NRM Plans, and associated technical reports be accessed to provide important data on resource condition and trend analysis and investment activities needed for the long term health and sustainability of a region's natural assets and its communities e.g. suitability statements would then measure a site's suitability against asset condition and targets in Regional NRM Plans.**

4.5 **That the range of exposure settings for application in Australia be reviewed especially with regards to soil quality and the current and potential site specific and cumulative impacts of mining waste disposal and resource use activities.**

4.6 **That the principle, of 'maximum beneficial land use', where remediation of contaminated sites occurs to the point where the land becomes suitable for all potential uses be included in policy considerations. The remediation goal should be the recovery of all impacted natural resources functional properties to support human, plant and animal life.**

4.7 **That the health and safety of employees on a contaminated site is included as a policy consideration.**

4.8 **That a general understanding of the use and intention of 'investigation levels' be aligned to community aspirations and values.**

4.9 **That the wider economic and environmental issues of Australia's future are carefully considered as part of this RIS.**

4.10 **That all aspects of the precautionary principle be applied to proposed amendments in relation to risk assessment, risk management, and risk communication.**

4.11 **That the following of Hardy's suggestions to improve qualitative risk assessments are worthy of serious consideration to improve the RIS:**

- ***Measure the effectiveness of the risk assessment effort.*** **Engineers and scientists should not assume that their approach to risk assessment is valid. Questions to be considered are: do the risk assessment efforts work, would anyone know if they didn't work, and if they did not work what would be the consequences. Risk assessments should be subject to the same rigor as other engineering efforts. Resources should be made available to determine whether the likelihoods and severities identified in the qualitative analyses are consistent with the experience in the field and to learn if safety engineering and management are weakening.**

- ***Insist on quantitative bounds for qualitative likelihoods and severities.*** **Efforts should be made to justify that the risk falls within quantitative bounds through additional analyses, including quantitative assessments. Even with quantitative bounds on hazard likelihoods there can be misinterpretations, but without them there is no basis for the assessment.**

Similarly, it is important to understand the potential for large numbers of casualties and large property and environmental losses. Therefore, efforts should be made to perform quantitative consequence analyses to determine severity for potentially catastrophic risks.

- ***Train analysts and evaluators on the meanings of qualitative likelihoods and severity classifications.*** **Training is essential to achieve a mutual understanding of the meanings of the classifications, especially where terms such as "frequent" or "critical" are concerned. This training does not have to be extensive, but without an opportunity for mutual understanding, the risk assessment effort is bound to be inconsistent and could lead to a gross misunderstanding of the risk.**

- ***Train analysts and evaluators on the potential biases in the process.*** **It is also important that analysts and evaluators understand the implications of intentional and unintentional bias and their own perceptions of risk. Biases are, in essence, mental shortcuts used to assess risk under uncertainty, and not all shortcuts are bad - "Garbage in, garbage out" is one such shortcut that warns against representative bias. But by understanding these biases we can guard against the potential for overconfidence.**

- ***Explicitly state and document assumptions.*** **Although assumptions are necessary to conduct any analysis, it is important for all members of an organization to understand, and agree to, the assumptions and the limitations in that analysis.**

- ***Include management and organizational factors as potential causes in system hazard analyses.*** **History has proven that cost, schedule, and management factors have the potential to lead to accidents. Although difficult to measure, and sometimes difficult to control, explicitly detailing these factors will bring this risk to the attention of decision makers.**
- ***Analyse risk individually for each cause and for each consequence.*** **Decomposing the risk allows a more complete and accurate picture of the system risk. Risk should be analysed for each cause, and for each phase.**

- ***Incorporate methods that use realistic models of risk.*** **Consideration should be given to accident models that take into account interdependencies of individual risk, recognizing when common causes can defeat redundancy and increase risk. Risk assessments should also reflect the reality that small risks can add up to create a hazardous condition, and analyses should include the use of risk summation and cumulative risk approaches. Therefore, a risk assessment should not only decompose risks, but also consider ways to "roll up" risk to determine cumulative effects.**

- ***Do not rely solely on scoring methods for safety risk assessment.*** **A major reason that scoring methods such as the risk acceptance matrix are used is because they are perceived as being easy to implement. In fact, if done correctly, risk assessment is a difficult and complex process. Therefore, in the face of difficult decisions on complex systems, decision-makers should**

not only rely on qualitative methods. Quantitative risk assessments should be used to verify the likelihood estimates, at a minimum, to assist in those decisions.

4.12 That the prescribed land contamination report criteria be determined and made available for public comment before the RIS takes effect e.g. if site management plans recommend not removing all contaminants, the criteria will include the need to:

- **conduct a robust risk analysis which takes into account site specific and cumulative impacts; and**
- **rely on industry standards that are not out of date and which adequately address the unique operation or activities of a specific development or project.**

4.13 That the objectives of site investigations as well as the contents of a report need to be clearly articulated in legislation. These objectives should include:

- **identifying sources of substance releases from approved development of projects in Queensland before they result in significant contamination to the soil resource;**
- **ensuring timely actions are taken to eliminate or control the sources of soil contamination and prevent or reduce the risk of contaminant transfer from impacted soils to other environmental media (air or water) or potential receptors; and**
- **ensuring timely assessment, management and reporting of all contaminated areas associated with approved development and projects and reduce the environmental impact associated with development approvals in Queensland.**

4.14 That the requirement for a soil disposal permit not be repealed from the EPA.

4.15 That public access to the EMR and CLR registers is made available on departmental websites at no cost.

4.16 That the proposal to amend EPA notification requirements and limit the period within which the purchaser has the right to rescind a contract is not allowed.

4.17 That it is clearly articulated within the RIS on what grounds the department can be held accountable once a report is submitted to the department and in their position as monitor of the overarching framework.

4.18 That the RIS clearly identifies what measures or mechanisms are needed to measure adequate management of contaminated land for a proposed land use.