BEFORE THE SOUTH TARANAKI DISTRICT COUNCIL

INDEPENDENT HEARING PANEL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the proposed South Taranaki District Plan

Statement of evidence of Jennifer Polich on behalf of Taranaki Energy Watch (TEW)

Date: 5 June 2016

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1 INTRODUCTION

1.1 My name is Jennifer Polich. I am a Principal Engineer at Sherpa Consulting Pty Ltd (Sherpa) based in Sydney, Australia.

1.2 I have been retained by Taranaki Energy Watch (TEW) to provide advice in relation to the risk issues associated with petroleum prospecting, exploration and production activities and how they may relate to land use planning in the context of the proposed update to the South Taranaki District Plan (STDP).

1.3 My qualifications are a Bachelor of Engineering (Chemical) and a Masters of Environmental Engineering and Management (MEnvEng). I have over 15 years experience in process safety and risk management in the chemical and related industries. I have been employed by Sherpa for ten years. I have previously been employed by Kellogg Brown and Root and Orica Australia Pty in risk engineering roles.

1.4 My prior experience relevant to this work includes a large number of QRA and land use planning studies relating to development of facilities handling large quantities of hazardous substances in the vicinity of other land uses. Projects include the WOSL Bulk Hydrocarbon Terminal (Auckland) with proposed adjacent prison development that was undertaken jointly for a Steering Committee comprising WOSL, NZ Department of Corrections and Liquigas. Other relevant work includes the QRA for the Wynyard Quarter tank terminals in relation to the change of land use for the Sea+City project (Auckland, New Zealand), QRA and land use planning studies for a number of complex industrial facilities including the Botany Industrial Park complex (Botany, NSW, Australia), an integrated ammonium nitrate manufacturing complex which includes bulk ammonia storage, nitric acid and AN plants, chloralkali and derivatives plants, cyanide manufacture (Qld, Australia) , and also fuel terminal expansions at Port Botany, (NSW, Australia).

I have also provided expert witness advice on similar risk and land use safety planning matters on behalf of various oil and gas companies in relation to the Auckland Unitary Plan process and Christchurch Recovery District Plan.

1.5 I am a Member of the Institute of Chemical Engineers (MIChemE).

2 CODE OF CONDUCT

2.1 I have read the Environment Court's Practice Note 2014 as it relates to the Code of Conduct for expert witnesses. My evidence has been prepared in compliance with the Code of Conduct. Except where I state that I am relying on the statements of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

2.2 I am engaged by Taranaki Energy Watch (TEW) as an independent expert. My company Sherpa Consulting Pty Ltd provides risk advisory services to a range of clients in the oil and gas and energy industry and also in many other industries. I am not, and will not behave as an advocate for any party. I have no other interest in the outcome of the proceedings.

3 SCOPE OF EVIDENCE

3.1 My evidence relates primarily to the proposed hazardous substance rules in Section 12, the energy rules in Section 13, and whether they apply adequate controls to ensure the appropriate location of hazardous facilities as this relates to the potential safety impacts of an abnormal incident at a hazardous facility.

3.2 I also comment on whether the rules appear sufficient to support the policy objectives relating to hazardous substances as per Section 2. This is a matter within my area of expertise.

3.3 My evidence focuses on safety risks associated with abnormal events involving hazardous substances (for example, loss of containment or loss of control and a subsequent fire or explosion) that may adversely affect the safety of people or cause damage to property.

3.4 My evidence does not cover operational or amenity issues such as traffic due to road tankers, noise, hydrocarbon emissions and odours etc. My evidence does not cover environmental or health impacts from hazardous facilities. I defer to Ms Louise Wickham on matters of air quality. I defer to Mr Greg Carlyon on matters of planning.

3.5 The reasons for my opinions are set out in the subsequent sections of this document and I confirm I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

3.6 In preparing this evidence I have read:

3.6.1 Relevant sections (Sections 1, 2, 12, 13 and 20 only) of the proposed South Taranaki District Plan (August 2015).

3.6.2 Documentation (examples of Hazardous Substances Management Plans and Emergency Response Plans) relating to a selection of resource consents issued in the Taranaki area and other areas in New Zealand. The specific items are referenced where relevant in my evidence.

3.6.3 New Zealand Health and Safety at Work Petroleum Exploration and Extraction Regulations 2016.

3.6.4 New Zealand Health and Safety at Work (Major Hazard Facilities) Regulations 2016

3.6.5 Health and Safety in Employment Pipelines Regulations 1999

3.6.6 ERM report, reference: 0300355L1 STDC_F_Rev 1, RE: Hazardous Substances Report 30 June 2015

3.6.7 Section 42A Officers Report Hazardous Substances FINAL with Appendices 2016-05-27

3.6.8 Section 42A Officers Report Energy FINAL with Appendices 2016-05-27

4 SUMMARY OF EVIDENCE

4.1 In summary my evidence states that:

1) Petroleum prospecting (specifically seismic testing), exploration and production activities should be included in the “major hazardous facility (or ERM alternative)” definition. Locational issues or effects on offsite land uses are not covered in Health and Safety at Work Regulations which focus on design matters and worker safety, hence the locational aspects need to be addressed by a consent process.

2) The selection of 200m as an arbitrary separation distance to sensitive facilities as a threshold for “major hazardous facility (or ERM alternative definition)” to be classified as a permitted activity is not supported by any basis. This distance is too small to support the STDP policy objective to “*ensure major hazardous facilities are* ***located,*** *designed, constructed and managed* ***to minimise risk to the extent practicable*** *and avoid unacceptable risk to the environment and human health”* for all types of hazardous facility that could potentially be proposed in the district. Based on my previous experience with quantitative consequence and risk modelling, as well as information in resource consent supporting information (an emergency plan for a production facility in Kupe) suggest that a distance of 1000m would be required to make the judgement that “risk to sensitive facilities has been minimised to the extent practicable” (with no additional assessment required) for all potential facilities, including cumulative risks from multiple facilities.

3) “Major hazardous facilities (or ERM alternative definition)” should not be “permitted” in any location or any zone. This type of facility should always require some form of formal assessment with sufficient accompanying information to demonstrate that effects to all receptors (not just sensitive receptors) in a particular location have been adequately assessed and the risk to people and property associated with abnormal releases of hazardous substances has been minimised.

5 OVERVIEW OF POLICY IN STDP

5.1 The key policy statements (Policies - Hazardous Substances.) in Section 2 of the STDP that relate to my evidence are:

2.8.5 Ensure major hazardous facilities are located, designed, constructed and managed to minimise risk to the extent practicable and avoid unacceptable risk to the environment and human health.

2.8.6 Ensure appropriate facilities and systems are provided to avoid accidental or unintentional release, or loss of control (such as spills and gas escapes) of hazardous substances.

2.8.7 To avoid duplication of the regulation of activities controlled by the Hazardous Substances and New Organisms Act 1996 (HSNO) and other workplace safety law by:

> (a) Generally providing for activities that meet the relevant requirements of the HSNO Act and other workplace safety law as permitted activities; and
>
> (b) Only requiring resource consents for activities that may have actual and potential effects that are cumulative, or where there is significant potential risk of adverse effects on the environment or human health.

2.8.8 Manage the use and storage of hazardous substances near any of the following:

> (a) Sensitive activities such as residential zones, educational facilities, community facilities and recreational areas;

2.8.9 Ensure that new sensitive activities are located so that they avoid or mitigate potential reverse sensitivity conflicts with existing lawfully established hazardous facilities.

5.2 The STDP seeks to “avoid any duplication of regulation with the HSNO Act and only apply controls to ensure the appropriate location and design of hazardous facilities”.

6 COMMENTS ON DEFINITIONS

6.1 The term “major hazardous facility” in the STDP is very similar to the term “”major hazard facility” in the Health and Safety at Work (Major Hazard Facilities). In my view this definition will lead to confusion due to the similar terminology but very different definitions and requirements. I agree with the ERM’s recommendation to alter the STDP terminology to an alternative term such as “significant hazardous facility” to avoid confusion.

6.2 Petroleum prospecting, exploration and production activities should be included in the “major hazardous facility (or ERM’s alternative)” definition. These activities should not be excluded on the basis of the New Zealand Health and Safety at Work Petroleum Exploration and Extraction Regulations 2016, as these regulations do not cover locational issues or effects on offsite land uses. They focus on matters of design and worker safety. I have also been advised that HSNO also focuses on design matters although there is some limited consideration of separation distances for hazardous substances storage locations.

6.3 The inclusion of *(c) The storage/use of more than 100,000L of petrol and (d) The storage/use of more than 50,000L of diesel* in the “major hazardous facility (or equivalent)”is unusual. Gasoline is a more hazardous product from a flammability respective than diesel hence gasoline tends to have lower thresholds in most jursidictions. In some planning documentation (for example in NSW and Queensland in Australia) there is a distinction between underground / above ground storage with larger amounts of underground storage triggering an assessment process. This definition would mean that that many retail service stations (which generally have underground fuel storage only) would be captured in the definition. See some examples in Attachment 1 from Australia for quantities of hazardous substances that trigger the need for a risk assessment as part of planning consent applications.

6.4 I also note that Section 20.5.2 (v) (e) introduces a requirement for a quantitative risk assessment (QRA) for all “large hazardous facilities”. The term “large hazardous facilities“ is not defined in the STDP. I generally support the use of some form of quantitative assessment in a consent application for toxic or flammable materials. For example consequence assessment for the worst credible scenario (eg blow out at well site, BLEVE at LLPG storage) will clearly show the effect zone and inform the need for a more detailed risk assessment to determine if the location is adequately separated from sensitive land uses. This could also assist to determine who affected parties may be and the extent of any emergency planning requirements.

6.5 I note that the qualitative risk assessments that I have reviewed show significant variation in the consequence assessment component for essentially the same event. For example a well blowout always has the potential to cause fatality (not minor injury as identified in some HSMPs), but the likelihood may be different depending on the safeguards and presence of people.

6.6 “Hazardous materials” are referred to in various parts of Section 12, 13. I assume that these are the same as “hazardous substances” which is included in the definitions in Section 1.

6.7 Sensitive activities are defined under Section 1.11 of the Plan as any of the following activities: RESIDENTIAL ACTIVITIES, VISITOR ACCOMMODATION, COMMUNITY ACTIVITIES (including Marae), OPEN SPACE, CAMPING GROUNDS/MOTOR CAMPS, EDUCATION FACILITIES, PAPAKAINGA DEVELOPMENT, HOUSING FOR THE ELDERLY, Cafés, Restaurants, and hospitals. For activities in the NATIONAL GRID YARD, OPEN SPACE is excluded from the definition of SENSITIVE ACTIVITY. I generally support this definition as it relates to hazardous substances and hazardous facilities.

With regards to OPEN SPACE, the main concern in relation to hazardous substances risk due to abnormal incidents is areas where populations of people occur so this may be covered by COMMUNITY ACTIVITIES. However I note that “sensitive activities” also is used in relation to performance standards around air quality and amenity issues hence OPEN SPACE has considerations other than hazardous substances.

7 ADEQUACY OF RULE 12.3.1

7.1 The Taranaki area has a large number of petroleum activities, including seismic testing programmes, exploratory drilling, existing oil and gas well sites and associated production facilities and more are proposed. Petroleum prospecting, exploration and production activities generally meet the definition of hazardous facility under the STDP as they use, store or handle hazardous substances.

7.2 Section 12 of the STDP deals with rules for Hazardous Substances. Section 12.3 details performance standards that must be met for a facility to meet the definition of "permitted activity". A permitted activity does not require a resource consent and hence does not undergo any detailed assessment. The performance standard relevant to safety to achieve permitted activity status is:

12.3.1 Activities
1. Hazardous facilities shall be located no closer than 200m of a sensitive activity.

7.3 I note that the ERM report (doc ref 0300355L1 STDC_F_Rev 1) Section 3.4 states that "The selection of 200m is an arbitrary distance as it is difficult of predict the potential range of effects for the varying range and scale of hazardous facilities that could occur; however, the intention is that more than the neighbouring property would be considered".

7.4 I agree that it is not possible to set a distance that is appropriate for all types of hazardous facilities. I note that whilst my evidence focuses on petroleum activities, these rules would apply to other types of facility that may be proposed in the district such as a water treatment works handling chlorine, a food processing plant with a refrigeration system containing ammonia, an agricultural supplies warehouse with large quantities of ammonium nitrate fertilisers or toxic pesticides, or a facility storing a large amount of LPG for fuel purposes.

7.5 It is my opinion that setting an "arbitrary" distance of 200m to cover all types of hazardous facility does not provide an adequate basis to ensure the appropriate location of hazardous facilities minimises risk (as per policy objective 2.8.2). This approach does not take even attempt to account for specific risk effects (eg

injury or fatality from ignited hydrocarbon events or storage or use of explosives) associated with abnormal incidents.

7.6 This rule is not adequate to support policy statements 2.8.5, 2.8.6, 2.8.8 or 2.8.9 as it does not:

a) Provide any supporting evidence that the 200m proposed in the Plan is a sufficiently conservative assessment to reduce the risks to surrounding locations from petroleum prospecting, exploration or production activities (or any other hazardous facility that may be proposed or existing) to such low levels that no further assessment is required. There appears to be supporting evidence (obtained from Council records) that there are potential effects well outside 200m for typical activities occurring in Taranaki. This is summarised in Table 1 which shows potential for injury or fatality effect distances greater than 200m. (My experience in quantitative consequence and risk modelling indicates that there are many hazardous materials where abnormal events (eg LPG BLEVEs, release of chlorine or ammonia) could have fatality or injury, or property damage effects well outside 200m. Some other types of activities would have smaller effects due to abnormal incidents, eg hydrocarbon tank fires, flaring activities).

b) Account for risks to other areas of occupancy or property that could be within the 200m distance. This includes occupancies such as workplaces within buildings (for example a milking shed) or outdoor places of work (eg farming activities or other industries) that are not covered by the sensitive activity definition.

c) Take into account cumulative risk issues where a sensitive activity (or other occupancy) may be exposed to risk from multiple hazardous facilities.

d) Account for changes in the scale of the hazardous facility. For example a hazardous facility may initially involve exploration activities ie drilling a small number of wells, but then may move into a production phase with greater storages of hazardous materials hence greater risk to surrounding land uses. There does not appear to be a trigger for re-assessment in the STDP.

e) Account for any changes in surrounding land use and potential for reverse sensitivity on hazardous facilities. For example the separation distance may be measured across a site boundary eg extend across a farm boundary. It is not clear how the landowner is made aware of this and what it may mean if the landowner builds a new building (workplace) or dwelling that reduces the separation distance.

f) Identify whether there are any circumstances where additional risk management or emergency response planning measures may need to be implemented

outside the 200m area separating the sensitive activity from the hazardous facility.

g) Provide a clear definition for the starting point of measurement of the 200m separation distance. A hazardous facility is defined in the STDP as "*all activities and sites involving hazardous substances"* and site is defined as "*all that land contained in one or more allotment, section or parcel upon which an activity is established or proposed to be established*". This could be interpreted as measuring 200m from the hazardous facility boundary to a sensitive activity. This may become unnecessarily conservative if the hazardous facility is on a large site with hazardous substances handled well away from the boundary.

7.7 From a land use safety planning perspective, if an activity is to proceed with no assessment (i.e. is "permitted"), separation distances for a hazardous facility should be based on a demonstration that there is no injurious effect at sensitive locations. To achieve this, a rule-based separation distance for hazardous facilities to sensitive receptors that are permitted with no further consent process should be developed conservatively. This means that consequence (not risk) would be the appropriate basis for setting the separation distance.

7.8 However it is very difficult to develop a generic rule that is based on a separation distance that covers all potential types of hazardous facilities as appears to be the intent with Section 12.3.1. There is obviously a very wide variety of "potential effects" to neighbours from hazardous substances that could be considered with varying degrees of likelihood. This is evident in the information in Table 1 which covers effects from potential abnormal incidents only (not environmental issues).

7.9 It is my opinion, that to ensure a hazardous facility is "appropriately located" as per the policy in Section 2 and the objective of Section 12 of the SDTP, the STDP needs to require consideration of the risks to surrounding land uses from hazardous substance in a more differentiated way than applying a single arbitrary separation distance as a performance standard or rule. I note that Greymouth Petroleum has raised this matter stating that ""*A large production station (e.g., Oaonui or Kupe) is fundamentally different in scale from wellhead production facilities or a single well exploration site"* (see page 53. 91.23 , Proposed South Taranaki District Plan Section 42A Officers Report: Energy).

7.10 It is my opinion that if the STDP includes a separation distance that is used to define where permitted activities can occur, the separation distances to land

uses need to based on type of hazardous facility or activity at the facility for example different distances will apply to well sites, pipelines, production facilities. Suggested separation distances to sensitive activities based on this approach are shown in Table 2. Proposals inside these distances need to have a risk assessment completed. In summary these are:

Well sites	250m
Production facilities	1000m
Explosives storage	case by case as per HSNO (these may well be larger than 200m)
All others	No information available. I suggest 1000m.

7.11 It is noted that these separation distances focus on petroleum prospecting, exploration and production activities only.

8 ADEQUACY OF SECTION 13

8.1 Hazardous substances risks associated with most petroleum prospecting activities are not significant, with the exception of seismic testing. The permitted activities in Section 13.1.1 do not adequately cover the potential storage of explosives associated with seismic testing. They also do not cover any risk that may be associated with misfires (ie charges that cannot be initiated and are left in situ after completion of the seismic survey, as per Table 1, this could be a large number).

8.2 As per Table 1, required separation distances to sensitive locations from explosives storages can exceed 200m. I suggest the following modification: 13.1.1 (a) (iii) Petroleum prospecting, ~~including~~ excluding seismic exploration

9 ALTERNATIVE RISK BASED APPROACH

9.1 There are a number of examples of the planning system in Australia using a quantity basis for triggering a risk screening process for hazardous substances. Examples are included in Attachment 1. These approaches use the quantity of hazardous material to trigger the need for a specific risk assessment. They do

not set a separation distance where hazardous facilities are permitted with no further assessment. This is an alternative approach to setting separation distances in that it sets risk targets at a site boundary and at various surrounding land uses that vary based on sensitivity. I note that there is some guidance in NZ supporting the RMA that is similar but it does not seem to be referred to in the risk assessments in the HSMPs or AEEs I have seen in relation to the Taranaki area. (NZ guidance: https://www.mfe.govt.nz/sites/default/files/assessment-guide-for-haz-facilities-02.pdf).

10 OTHER MATTERS

10.1 In addition, to meet the policy objectives it is suggested that the following points also need to be addressed:

a) Providing trigger points for a risk assessment or re-assessment of risk if there is a proposed change to the hazardous facility or surrounding land use. This could be achieved by setting a threshold for change in quantities or scale of activities compared to the original consent. I note ERM suggest 20% change in quantity. That is not unreasonable from a risk perspective but the measurement basis would need to be defined (eg stored quantities, throughput change, number of wells etc).

b) Defining the minimum amount of information that is required to be provided to Council to allow consideration of cumulative effects. For example an overlay showing the extent of effects of a worst case event for a hazardous facility could be required to be supplied to Council for any facility capable of causing an ignited event or toxic release that HSNO applies to. This would enable consideration of cumulative risk issues. For example refer to Figure 3 which shows a property potentially affected by a number of existing hazardous facilities.

c) Defining the amount of information / consultation regarding level of risk and emergency planning to occur with land holders / activities potentially affected by a hazardous facility. The potentially affected landholders could be linked to the extent of area covered by the overlay above.

d) Section 12.3.4 Natural Hazards identifies flood and sensitive environmental receptors as constraints to location of a hazardous facility. Given that New Zealand has significant seismic activity risks which may affect the integrity of equipment in hazardous facilities, it would seem logical to acknowledge these in this section and require their consideration when locating a hazardous facility, either in terms of fixed

separation distances (if these can be meaningfully established) or via specific risk assessments.

10.2 Overall I consider that it is quite complex to develop a rule based separation distance approach to allow "permitted activities" that could cover all types of "major hazardous facility (or equivalent)". The distances would need to be set conservatively to minimise risk and hence I have recommended that these be differentiated for the most common facilities at Taranaki and also increased from 200m.

10.3 I note that page 54, paragraph 211 of the S42 Evaluation of the Energy rules of the submission relating to differentiation states "*The benefits of this differentiation would be rules that are more tailored to the potential effects of activities of different nature and scale. These rules would provide a higher level of certainty, as well as flexibility to petroleum activity operators as smaller-scale activities with relatively low impacts would be provided for by the plan, while larger-scale activities with potential for higher impacts would have more stringent rules. The costs of this approach is the difficulty in defining the different types of petroleum activities in a way that appropriately manages the potential effects according to scale*". And then goes on to conclude that it is best to stick to one rule as a threshold for separation distances to sensitive uses that would then allow "permitted" status for significant hazardous facilities. I disagree with this conclusion.

I suggest the opposite, ie that this difficulty with rule based differentiation shows the importance of having a specific assessment for all significant hazardous facilities, and leads to the conclusion that "permitted" activity status (ie no assessment of effects) is not appropriate for significant hazardous facilities.

10.4 In my opinion, "major hazardous facilities (or ERM alternative definition)" should not be "permitted" in any location or any zone. This means petroleum prospecting (specifically seismic surveys), exploration or production activities should not have "permitted " status. This type of facility should always require some form of formal assessment with sufficient accompanying information to demonstrate that effects to all receptors (not just sensitive receptors) in a particular location have been adequately assessed and the risk to people and

property associated with abnormal releases of hazardous substances has been minimised.

Jennifer Polich
5 June 2016

Table 1: Examples of Potential Effect Distances from Hazardous Facilities from public information

Activity	Typical uses of hazardous substances	Type of effect from abnormal incident	Examples from publicly available information	Comments
Petroleum prospecting (including seismic testing)	Storage of explosives	Explosion in storage, overpressure and shrapnel / debris	Shell Todd resource application for 10,000kg Class 1.1 explosives storage. (ref: *STOS Kapuni 3D Seismic Survey -Mag Site Application and AEE*) The statutory requirements under Section 1.4 refers to "Safety Distances' required however the AEE does not appear to define what these are for this application, nor does it explain how the various HSNO requirements will be met .	It is assumed that the "Safety Distances" referred to in the AEE relate to the HSNO requirements and Associated Code of Practice (HSCOP55) for explosives which refer to AS2187.1 separation distances. For 10,000kg of Class 1.1 explosives this equates to 320m for Protected Works A and 480m Protected Works B. Refer to an overlay in Figure 1 and for definitions of protected works. It can be seen that the PWb extends over a building but it is not evident what this is from the documentation
	Use of explosives in seismic testing	Unexploded charge left in shot hole (misfire). This may explode at a later date.	HSFP, Shell Todd Stratford Council (8/4/16, obtained under FOI) suggests that 0.2% of seismic survey charges will misfire. This programme included 24,000 charges (as per AEE Appendix C), leading to the conclusion that there will be 48 undetonated charges remaining after the programme is completed. It should also be noted that other jurisdictions (eg Canada) suggest 1% misfire rate on average, which would mean 240 undetonated explosive charges. Refer to: http://www.worksafebc.com/regulation_and_policy/public_hearings/assets/pdf/2011ProposedAmendments/Part21.pdf)	In Australia around 75% of reportable incidents to explosives regulators are misfires (eg see https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0016/212605/significant-incident-reports-2013.pdf It is not clear how the residual risk is managed either currently or how this would be managed under the proposed STDP. Canadian guidelines are the most comprehensive eg http://www2.worksafebc.com/Publications/OHSRegulation/Part21.asp#SectionNumber:21.84.

Activity	Typical uses of hazardous substances	Type of effect from abnormal incident	Examples from publicly available information	Comments
Petroleum exploration (including drilling and well testing)	Drilling	Well blow out resulting in either: - immediately ignited jet fire type event (radiant heat) or - gas cloud with delayed ignited and flashfire	McKee blowout in 1995 (NZ), large lockdown zone during emergency response approximately 10km - anecdotal) HSFP Moturoa 5 Drill Site (New Plymouth) part of application for Ladn Use Consent. This provides an effect distance of 133m to 12.5kW/m^2 (corresponding to a10% probability of fatality). Injury distances (eg to 4.7kW/m2) are not provided but would be larger and in Sherpa's experience may reach 200 - 250m in some circumstances.	Other HSFPs reviewed for Taranaki identify well blow out and gas clouds but do not contain any quantitative information. The qualitative assessment is variable ranging from minor injury to fatality. Hence it is difficult to see how any assessment of risk or cumulative effects etc could be made. (eg - HSFP AEE Heatseeker Appendix 5 June 2013 shows well blowout consequences as "Moderate" – minor first aid, risk moderate)
	Flaring during well testing	Note that flaring is "normal" in the sense that is expected to occur during well testing and the environmental effects must therefore be managed. An abnormal case could be the flare fails to light, resulting in a flammable gas cloud. Another abnormal case could be the flare pit fails to adequately contain liquids / condensate and a large fire occurs that is not adequately shielded by the flare pit design.		No specific results but Sherpa's experience is that the heat radiation effect area from flare pits is smaller than 200m, however flaring is more frequent event and environmental issues may take precedence with regards to separation distances

Activity	Typical uses of hazardous substances	Type of effect from abnormal incident	Examples from publicly available information	Comments
Petroleum production	Storage and handling of LPG type products	Leak, fire, flashfire or BLEVE (large fireball) if impingement on LPG inventory occurs	*OENZ Site Emergency Plan Manual* OEUP-NZ1000-MAN-SAF-001 for Kupe shows fatality zone of 600m and evacuation distance of 1000m for an LPG bullet BLEVE (obtained under FOI)	This suggests that facilities within 1000m could be taken as the separation distance for a production facilities within which a consent is required.
	Well operations	Well blow out Flaring to assist to control blow out – as per comments above	As above	As above
	Oil and gas pipelines	Leak jet or pool fire, potential for flammable gas cloud	Pipelines are not covered by HSNO or the STDP. There do not appear to be any minimum separation distances.	Refer to Figure 2 which shows pipelines close to houses. Pipelines are vulnerable to external interference and also may affect surrounding land uses if a leak occurs. A minimum distance should be defined. This could be based on distance to 4.7kW/m2 for an ignited event.
	Gas reinjection and underground storage	Large leaks from storage to atmosphere	30,000kg/hr of methane leaking and 2000 residences evacuated. (*The Chemical Engineer magazine, February 2016*)	

Table 2: Suggested Distances from Major Hazardous Facilities (or Equivalent)

Activity	Typical uses of hazardous substances	Type of effect from abnormal incident	Separation distance from hazardous facility (measured from location of hazardous substance activity) to sensitive facility	Comments
Petroleum prospecting (including seismic testing)	Storage of explosives	Explosion in storage, overpressure and shrapnel / debris	As per HSNO which is based on proposed quantity. This will need to be case by case.	Needs to be case by case (or very large). In my opinion it is not possible to set a distance or it needs to be linked to a quantity and type of explosives
	Use of explosives in seismic testing	Unexploded charge left in shot hole (misfire). This may explode at a later date.	30m to be maintained around any misfires. Period to be defined based on type of explosive (eg biodegradable or not?)	It is not clear how the residual risk is managed either currently or how this would be managed under the proposed STDP. Canadian guidelines are the most comprehensive and suggest a separation of 30m
Petroleum exploration (including drilling and well testing)	Drilling	Well blow out resulting in either: - immediately ignited jet fire type event (radiant heat) or - gas cloud with delayed ignited and flashfire	250m	Injury distances (eg to 4.7kW/m2) are not provided in Taranaki examples but would in Sherpa's experience may reach 200 - 250m in some circumstances. .
	Flaring during well testing	Note that flaring is "normal" in the sense that is expected to occur during well testing and the environmental effects must therefore be managed. An abnormal case could be the flare fails to light, resulting in a flammable gas cloud. Another abnormal case could be the flare pit fails to adequately contain liquids / condensate and a large fire occurs that is not adequately shielded by the flare pit design.	This would be smaller than well site or production facility distance	No specific results but Sherpa's experience is that the heat radiation effect area from flare pits is smaller than 200m, however flaring is more frequent event and environmental issues may take precedence with regards to separation distances

Activity	Typical uses of hazardous substances	Type of effect from abnormal incident	Separation distance from hazardous facility (measured from location of hazardous substance activity) to sensitive facility	Comments
Petroleum production	Storage and handling of LPG type products	Leak, fire, flashfire or BLEVE (large fireball) if impingement on LPG inventory occurs	1000m	Based on Origin ERP
	Well operations	Well blow out Flaring to assist to control blow out – as per comments above	250m	Injury distances (eg to 4.7kW/m2) are not provided in Taranaki examples but would be larger and in Sherpa's experience may reach 200 - 250m in some circumstances. .
	Oil and gas pipelines	Leak jet or pool fire, potential for flammable gas cloud	200m	A minimum distance should be defined. This could be based on distance to 4.7kW/m2 for an ignited event. Sherpa's experience is that this can be 200m or more for a high pressure case pipeline eg see *AS2885.1 (2012) – Pipelines Gas and Liquid Petroleum Design And Construction* Appendix Y
	Gas reinjection and underground storage	Large leaks from storage to atmosphere	1000m	

FIGURE 1: 10,000 KG EXPLOSIVES PWA AND PWB OVERLAY AND EXTRACT FROM AS2187.0 AND AS2187.1

protected works

The classes of protected works are as follows:

Class A: Public street, road or thoroughfare, railway, navigable waterway, dock, wharf, pier or jetty, marketplace, public recreation and sports ground or other open place where the public is accustomed to assemble, open place of work in another occupancy, river-wall, seawall, reservoir, water main (above ground), radio or television transmitter, main electrical substation, private road which is the principal means of access to a church, chapel, college, school, hospital or factory.

Class B: Dwelling house, public building, church, chapel, college, school, hospital, theatre, cinema or other building or structure where the public is accustomed to assemble, shop, factory, warehouse, store, building in which any person is employed in any trade or business, depot for the keeping of flammable or dangerous goods, major dam.

TABLES 3.2.3.2

QUANTITY DISTANCES FOR THE STORAGE OF DIVISION 1.1, 1.5

NEQ stored (Q) kg	Separation distance (D), m					
	Protected works—Class A* as defined in AS 2187.0	Protected works—Class B† as defined in AS 2187.0		Vulnerable facilities‡	To other explosives storage	
		Unmounded	Mounded		Unmounded§	Mounded§
50	25	180	50	180	18	9
100	25	180	58	210	23	12
200	35	180	52	260	29	15
300	45	180	68	300	33	17
400	55	180	82	330	36	18
500	63	180	95	360	39	20
1 000	100	180	150	450	48	24
1 500	135	200	200	510	55	28
2 000	160	240	240	560	61	31
2 500	185	280	280	610	66	33
3 000	205	305	305	650	70	35
4 000	235	350	350	710	77	39
5 000	255	380	380	760	83	42
7 500	295	435	435	870	94	47
10 000	320	480	480	960	105	52

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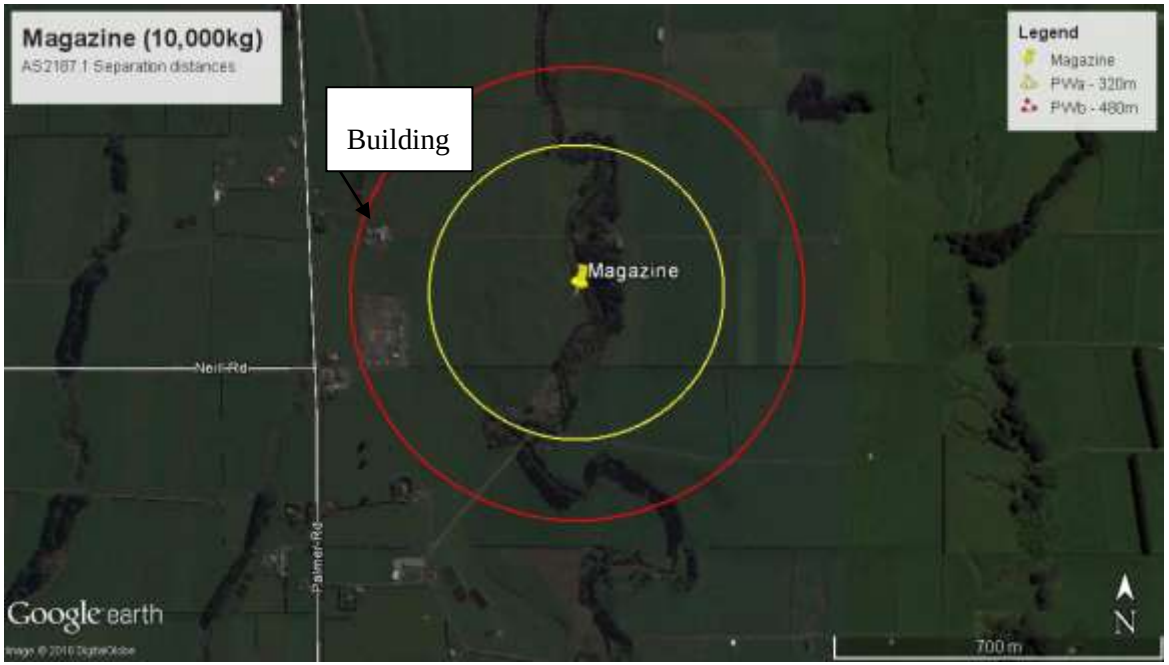


FIGURE 2: PIPELINE VERY CLOSE TO HOUSE

FIGURE 3: PROPERTIES POTENTIALLY AFFECTED BY MULTIPLE FACILITIES - CUMULATIVE RISK ISSUE (KAPUNI)

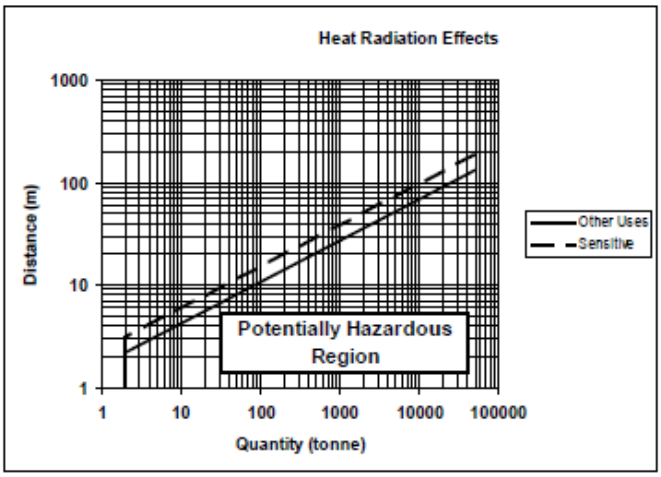
ATTACHMENT 1 – THRESHOLDS that trigger need for assessment of hazardous substances in consent process

1) NSW – SEPP33

In NSW Australia *State Environmental Planning Policy 33 Potentially Hazardous and Offensive Development* (SEPP33) and its guidance material *Hazardous and Offensive Development Application Guidelines Applying SEPP 33* (2011) provide thresholds above which a hazard analysis needs to be conducted to confirm that offsite risk levels are acceptable based on acceptability criteria in guidance material. The approach to the risk assessment can be qualitative, semi quantitative or quantitative. Typical thresholds are:

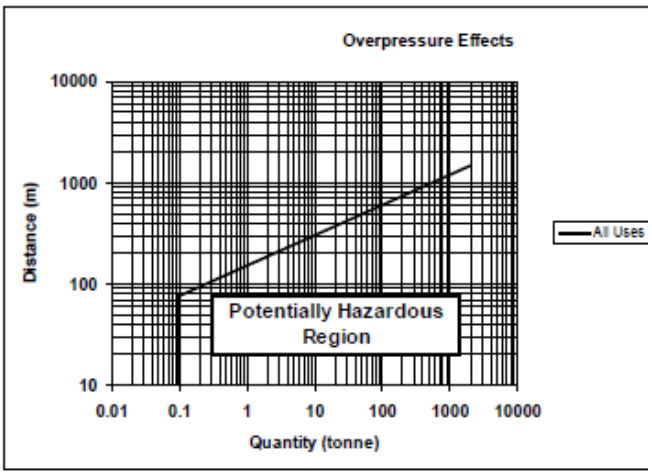
- For LPG , 10 tonnes if above ground
- Class 3 flammable materials a graph is used – see below

Figure 8: Class 3PGI Flammable Liquids



- Explosive materials a graph (based on AS2187) is used – see be

Figure 5: Class 1.1 Explosives



2) Queensland - Model Planning Scheme Development Code for Hazardous Industries and Chemicals (Workplace Health and Safety Qld)

A similar approach is taken although there is a self-assessable and assessable threshold

- Class 3 / combustible risk assessment thresholds - self-assessable

Flammable liquids – DG class 3	PG II or PG III	Aboveground tanks and package stores with natural ventilation	> 10 000 – ≤ 60 000 L
		Underground tanks	> 10 000 – ≤ 500 000 L
Combustible liquids with a flashpoint ≤ 93˚C	n/a	Package stores with natural ventilation	> 10 000 – ≤ 100 000 L
		Aboveground or underground tanks	> 10 000 – ≤ 500 000 L

- Class 3 / combustible risk assessment thresholds - assessable

Flammable liquids – DG class 3	PG I	Any	> 500 L
	PG II or PG III	Activities that involve: • elevated temperature or pressure, or • chemical reactions that cause a temperature rise or generate a gas.	> 1000 L
		Storage areas with any of the following attributes: • co-located with fire-risk hazardous chemicals or toxic substances above minor storage • mechanically ventilated, or • located within or attached to a building.	> 10 000 L
		Any other aboveground storage or handling	> 60 000 L
Combustible liquids with a flashpoint ≤ 93˚C	n/a	Aboveground tank(s) within a multi-story building	> 1000 L
		Storage areas with any of the following attributes: • co-located with fire-risk hazardous chemicals or toxic substances above minor storage • mechanically ventilated • located within or attached to a building, or • tanks > 6m in diameter.	> 10 000 L
		Any other package store	> 100 000 L
		Any other aboveground storage or handling	> 500 000 L

Table 7.1 Model assessable development code for hazardous chemicals

Performance outcomes	Acceptable outcomes
PO1 Off sites risks from foreseeable hazard scenarios involving hazardous chemicals are commensurate with the sensitivity of the surrounding land use zones.	**AO1.1** Off site impacts or risks from any foreseeable hazard scenario does not exceed the dangerous dose at the boundary of land zoned for vulnerable or sensitive land uses as described below: Dangerous dose a) for any hazard scenario involving the release of gases or vapours: i. AEGL2 (60 minutes) or if not available ERPG2 ii. An oxygen content in air < 19.5% or > 23.5% at normal atmospheric pressure. b) For any hazard scenario involving fire or explosion: i. 7 kPa overpressure ii. 4.7 kW/m^2 heat radiation. If criteria AO1.1 (a) or (b) cannot be achieved, then the risk of any foreseeable hazard scenario shall not exceed an individual fatality risk level of 0.5×10^{-6}/year.
	AO1.2 Off site impacts or risks from any foreseeable hazard scenario does not exceed the dangerous dose at the boundary of a commercial or community activity land use zone as described below: Dangerous dose a) for any hazard scenario involving the release of gases or vapours: i. AEGL2 (60 minutes) or if not available ERPG2 ii. An oxygen content in air < 19.5% or > 23.5% at normal atmospheric pressure. b) For any hazard scenario involving fire or explosion: i. 7 kPa overpressure ii. 4.7 kW/m^2 heat radiation. If criteria AO1.2 (a) or (b) cannot be achieved, then the risk of any foreseeable hazard scenario shall not exceed an individual fatality risk level of 5×10^{-6}/year.
	AO1.3 Off site impacts or risks from any foreseeable hazard scenario does not exceed the dangerous dose at the boundary of an industrial land use zone as described below: Dangerous dose a) for any hazard scenario involving the release of gases or vapours: i. AEGL2 (60minutes) or if not available ERPG2 ii. An oxygen content in air < 19.5% or > 23.5% at normal atmospheric pressure. b) For any hazard scenario involving fire or explosion: i. 14 kPa overpressure ii. 12.6 kW/m^2 heat radiation. If criteria AO1.3 (a) or (b) cannot be achieved, then the risk of any foreseeable hazard scenario shall not exceed an individual fatality risk level of 50×10^{-6}/year.