Appendix 8

Further Detail on Recommendations

Waterside Boulevard

Opened in the summer of 2004, the facility has proved highly popular all year round. Once visitors pass through the entrance gate, they encounter cool bright sand, hammocks, folding beach chairs and the cool blue water of the pool itself, where they can swim from 8 am to midnight. The facility was designed by Berlin artist Susanne Lorenz.

Figure A8.1: The Badeschiff, Berlin, Germany

Figure A8.2: The Badeschiff, Berlin, Germany

Figure A8.3: The Badeschiff, Berlin, Germany

Figure A8.4: The Badeschiff, Berlin, Germany

Streets/Urban Beach

Streets Beach[24] is a unique, man-made swimming beach which overlooks the Brisbane River and Central Business District. Completed in June 1992, this man-made swimming beach is one of the major features of the South Bank Parklands. The beach area's main feature is a lagoon containing chlorinated fresh water, with enough water to fill five Olympic swimming pools. Surrounding this are sand beaches, palm trees, rocky creeks and subtropical trees and exotic plantings. Streets Beach is the venue of some of the biggest events held in the Parklands, with the annual New Year's Eve Party at South Bank being a primary example. The beach area was designed by Desmond Brookes International.

[24] http://www.visitsouthbank.com/attractions/streets_beach

Figure A8.5: Streets Beach, Brisbane

Paris Plage[25] is a summer facility that turns a street along the Seine into a beach for one month of the year. The initiative has been running for the past five years with much success.

[25] http://www.plages-urbaines.com/paris-plage/paris-plage-introduction.php

Neptune Health Centre, Tipton, West Midlands

Figure A8.6: Neptune Health Centre, Tipton, West Midlands

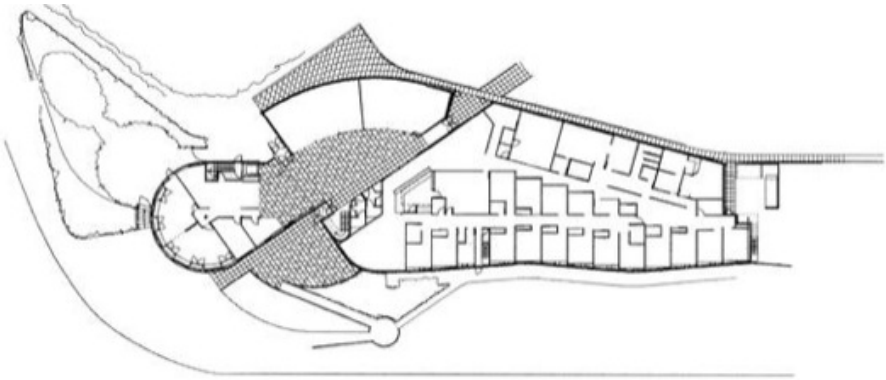

Figure A8.7: Plan view of Neptune Health Park, Tipton, West Midlands

Figure A8.8: Community Workshop, Neptune Health Centre, Tipton, West Midlands

Figure A8.9: Concourse, Neptune Health Centre, Tipton, West Midlands

Figure A8.10: Café and opticians, Neptune Health Centre, Tipton, West Midlands

Idea Stores

Idea Stores are normally provided as part of planning gain agreement in that they are a planning requirement as a part of a large retail development (e.g. a large supermarket). The facility offers the service of dropping off your child while doing their shopping within the adjacent retail facility or use other facilities within the Idea Store. Good examples of Idea Stores are in Bow, London (Figure 8.6 and at Crisp Street, East London (Figure A8.11)).

Figure A8.11:Idea Store, Crisp Street, East London

Appendix 5.2 Community Facilities Review, Urban Initiatives,

December 2008

Dublin Docklands Development Authority

Poolbeg Peninsula: Draft Planning Scheme

Community Facilities

4th December 2008

FINAL DRAFT

Urban Initiatives
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CONTENTS

1 INTRODUCTION

1.1.1 This report on community facilities recommends the amount, size, and suggested phasing of community facilities for the Draft Poolbeg Planning Scheme (2008).

1.1.2 Section 25 of the 1997 Docklands Act (as amended) requires that a Planning Scheme contain 'the proposed distribution and location of uses' and 'proposals relating to the development of amenities.' The number and estimated size of community facilities will be needed to place suggested locations of community facilities in the Draft Planning Scheme to meet the needs of existing and future residents of the Poolbeg Peninsula.

1.1.3 Colin Buchanan and Partners were commissioned by the Dublin Docklands Development Authority to make an audit of social and community infrastructure - 'the Colin Buchanan audit'. Their conclusions are summarised in appendix 5 of this report. The number of community facilities are based on a range of population thresholds proposed in the Colin Buchanan audit.

1.1.4 The types of community facilities proposed in the Colin Buchanan audit were considered and refined based on correspondence with the Dublin Docklands Development Authority over the course of developing the Draft Planning Scheme and in consultation with the local community and key stakeholders.

1.1.5 The Colin Buchanan report made recommendations primarily based on two estimated population scenarios; one predicting an additional 11,299 residents; and the second predicting an additional 17,299 additional residents.

1.1.6 The Draft Planning Scheme allows for approximately 750,000 square metres of development, 65% residential floorspace and 35% other uses including office and retail. This equates to a predicted additional residential population of 10,100, and a predicted additional working population of 16,000. This report considers community facilities to support the existing and predicted residential populations.

1.1.7 The size of community facilities will demand land, both built and unbuilt in the Draft Planning Scheme. Minimum floorspace, building footprint, playspace, and parking spaces for each type of community facility were estimated using previous consultants' reports, government standards, and planning and design data widely available to architects and landscape architects. The estimated land demands for development within the Draft Planning Scheme area can be found in appendix 8.

1.1.8 The location of community facilities should as a general rule be based around transport hubs and cultural or retail centres, but should still ensure ease of access by foot from the majority of residential dwellings on the Poolbeg peninsula. A list of suggested distances between homes, transport, and community facilities has been included in this report as guidance to developers.

2 PREDICTED POPULATION PROJECTION

2.1.1 The Draft Planning Scheme (2008) makes provision for approximately 750,000 square metres of development, of which approximately 400,000 square metres is residential development. Using an estimate of a mix of sizes of houses and apartments and an estimate of how many people would live in each bedroom on average, the predicted residential population is 10,100. A summary of the methodology used for this projection is located in appendix 6.

2.1.2 For reference, the Colin Buchanan audit made recommendations for community facilities primarily based on an assumed population, which varies from that predicted to result from the implementation of the Draft Planning Scheme.

Therefore, the rationale and recommendations for community facilities set out in this report are based on the recommendations of the Colin Buchanan audit, adjusted for the predicted population generated by the Draft Planning Scheme.

3 COMMUNITY FACILITIES

3.1 CONTEXT

3.1.1 The table below identifies the community facilities required in the Draft Planning Scheme.

Facility	Catchment population	Existing in study area	Existing Immediately outside study area	Facilities required for PS population of 10,100	**Facilities to be provided in Draft Planning Scheme**
Nursery / Crèche	1:2000	0	0	5	**5**
Primary School	1:2500 – 4,500	2	3	2 – 4	**1**
Secondary School	1:7000 – 15,000	0	2	0-1.5	**1**
Doctor's Surgery	1:2,500 – 3,000	1	0	3-4	**4**
Corner Shop	1:2,000 - 5,000	1	1	2 – 5	**2-5**
Post Office	1:5,000 – 10,000	1	0	1-2	**0-2**
Health Centre	1:9,000 – 1:12,000	0	0	0-1	**1**
Library	1:12,000 – 30,000	0	0	1	**1**
Church	1:9,000	2	2	1	**0**
Community Centre	1:7,000 – 15,000	1	0	0-1.5	**1**
Youth Club	1:7,000 – 11,000	0	0	0- 1.5	**1**
Sports Centre	1:25,000 – 40,000	0	2	0	**0**

3.2 SCHOOLS

3.2.1 It will be noted from the table that there are already schools within the study area and immediately outside it. The need for schools and school places has been investigated further and is explained below.

3.2.2 The Colin Buchanan audit was used as a basis for the recommendations in this report, with the exception of schools. The Colin Buchanan report identified the need to use the capacity of existing schools and alternatively to redevelop existing schools to add additional capacity. However, the Draft Planning Scheme does not have the ability to guarantee any development outside of its boundary, therefore the Draft Planning Scheme must plan for additional schools once capacity in existing schools has been taken up.

3.2.3 Primary Schools: The Colin Buchanan audit identified the need to provide 527 primary school places for 6900 residential units or 17,299 people. The Draft Planning Scheme provides for 4045 residential units or 10,100 people. The same ratio would require 311 primary school places. The Colin Buchanan audit identified 165 primary school places not taken in 5 nearby schools. This leaves 146 pupils with no places available. The average size of the nearby 5 primary schools (St. Matthew's, St. Mary's, St. Patrick's Boys, St. Patrick's Girls, and Scoil Mhuire) is 243 pupils, therefore 1 primary school site must be reserved in the Draft Planning Scheme.

3.2.4 Secondary/College: The Colin Buchanan audit identified the need to provide 100 secondary school places for 6900 residential units or 17,299 people. The Draft Planning Scheme provides for 4045 residential units or 10,100 people. The same ratio would require 57 secondary school places. The Colin Buchanan audit identified 400 secondary school places not taken in 2 nearby schools. This leaves 0 pupils with no places available. It is noted that there is a local desire for an additional secondary school. Therefore, the recommendation is for 1 additional site to be reserved in the Draft Planning Scheme that could, depending on the long-term development of the peninsula, be used for a secondary school or a second primary school should the Department of Education later determine that they need a site, or housing should neither of these scenarios take place.

3.2.5 The Colin Buchanan audit preferred methodology on schools has not been verified by the Department of Education although they have indicated that they will not apply their maximum standard to this type of site. The Department of Education will need to be convinced that the methodology is robust enough for the department to waive the need to start their own assessment. This assessment, if started, would likely not be complete until after the adoption of the Draft Planning Scheme.

3.3 DELIVERY OF COMMUNITY FACILITIES

3.3.1 Community facilities have been assigned to development sites across the Draft Planning Scheme area. The placement of each community facility should be carried out in line with the rollout of development and is based on current land availability and estimated population set out in appendix 6. In addition, the phasing of these facilities is rooted in urban design and placemaking principles to ensure that neighbourhoods develop over time across the Draft Planning Scheme area.

4 BENCHMARKING OF INTERNATIONAL EXAMPLES

4.1.1 The provision of community facilities was compared to similar new mixed use waterfront developments in Stockholm, Sweden and Vancouver, Canada. These examples were built on former industrial sites and also had existing residential neighbourhoods and facilities in close proximity, notably schools. A sensitivity test has been carried out against these two well-known examples. The findings are listed in appendix 7. In summary, a similar number of community facilities were provided in Stockholm and Vancouver.

5 COLIN BUCHANAN AUDIT SUMMARY

5.1 SUMMARY OF COLIN BUCHANAN REPORT – AUDIT OF SOCIAL AND COMMUNITY INFRASTRUCTURE FOR UP TO 17,299 NEW RESIDENTS

5.1.1 In July 2007, Colin Buchanan (CB) was commissioned by the DDDA to undertake a Civic Infrastructure Audit for Poolbeg and Sandymount. The draft report has been produced in October 2007 and the final report in February 2008. The report drew on guidelines from academic sources, primarily the work of Hugh Barton, (Barton et al (2000), Sustainable Communities, p.94 Sustainable Settlements (1995), Barton et al (2000), Sustainable Communities, Sustainable Communities (2003) and Shaping Neighbourhoods (2005)), and the UK charity Fields in Trust, which provide indicative local facility catchments. A detailed audit of community facilities and retail is listed in the *DDDA Civic Infrastructure Audit, Poolbeg & Sandymount*.

5.1.2 The Colin Buchanan report made recommendations primarily based on two estimated population scenarios; one predicting an additional 11,299 residents; and the second predicting an additional 17,299 additional residents. The main recommendations were made as follows:

5.1.3 Sport and Recreation – New areas will require physical linkages to residential areas in order to avoid the relative isolation that Poolbeg currently experiences. Linkages between Irishtown Nature Park and the South Bank Road should be encouraged in order to reduce this isolation.

5.1.4 Green space provision is adequate within the study area. However, it is recommended that improvements be made to the layout of open space. This would improve the functionality and performance of open space. This is especially the case for Sean Moore Park, which is currently severed by Sean Moore Road.

5.1.5 The re-design of traffic flows to include a green bridge could open up the possibility of developing a community focal point in the park to offer the existing and incoming population an attractive focal point and thus create a link between the existing and future population. Such a development could include small scale commercial activities to improve patronage and increase passive surveillance.

5.1.6 A waterside boulevard and coastal walks and cycle ways should be provided within the new area and will be supported where they do not interfere with operational requirements of Dublin Port. The waterside boulevard also could encompass a 'street / urban beach'.

5.1.7 Education / Training – The predicted populations would significantly increase demand for places in primary schools. Both St. Matthew's National School and St. Mary's Star of the Sea National School were identified as schools with potential for redevelopment as an alternative to providing new school sites. It is important to note that whilst there is no secondary school within the area, there are two secondary schools (Ringsend Technical Institute and Marian College) within the wider catchment area.

5.1.8 The schools analysis is based on the ESRI sample survey and Department of Education standards. The standards were adjusted to reflect occupancy trends within the study area, and the predicted residential population on the peninsula.

5.1.9 Parks - Sean Moore Park is considered to be vastly underutilised. There is the potential for the cross-use of Sean Moore Park by both St Matthew's and St Mary's

schools for play and sports space. If this option were pursued, an area of the park would need to be secured to specifically meet the needs of the schools. Both schools have cramped sub-standard play / sports areas at present and would benefit from a large modern play / sports area. Such a development would require the creation of a mutually beneficial relationship between existing and future schools and the DCC / DDDA.

5.1.10 **Health** – It is recommended given the quantum of development that one to two health centres be provided as part of the new development. This centre should be located in a central and accessible location. As an alternative to the traditional health centre a primary care facility should be considered. The HSE currently recommend the provision of a primary care facility where a population in excess of 6,000 persons exists or is created. A primary care facility provides a one-stop shop that includes medical facilities such as including doctors, dentists, physiotherapists, pharmacists, day nurses etc, all provided under the one roof. As a primary care facility effectively groups facilities together, the facility needs to be located convenient to the population and public transport connections.

5.1.11 **Community Centre -** If large scale development is to proceed on the Poolbeg Peninsula it is recommended that a community centre and youth centre be provided in a location befitting their importance within the development.

5.1.12 **Cultural -** The Pigeon House Power Station has been earmarked as a potential community centre with a gross floor space of 7,000 sqm. However, given the physical isolation of the facility and its current state of repair, it does not represent an immediate or appropriate facility to alleviate the requirements of the area. This site does not appear to be adequate in the short term, to provide for the predicted population. Therefore, it is considered that a separate facility should be provided in a more central location within the study area.

5.1.13 **Library -** The provision of a library is considered to be necessary, however instead of a traditional library an Idea Store could be considered. The concept of the Idea Store originated in England and comprises of a library type development offering typical library facilities as well as computer access, classes, café and crèche facilities.

5.1.14 **Religious and Community Facilities –** The study area is currently adequately provided for in relation to Christian religious facilities. However, with the influx of such a large population, the provision of a multi-denominational facility should be considered in close proximity to the new residential area.

5.1.15 **Other Facilities** – It is necessary to consider arts and culture provision in light of population projections however the DDDA has commissioned a separate study to deal specifically with Arts and Cultural provision in the Docklands area as a whole.

5.1.16 **Shops** - A new District Centre should be considered in order to meet the retailing needs of the projected population locally and to maintain vitality, vibrancy and a sustainable local economy. A separate study has been commissioned from DTZ to plan for a District Centre on the Poolbeg Peninsula.

5.1.17 **Entertainment** – The predicted populations would require the provision of entertainment facilities in tandem with development. These facilities are likely to be market driven but should be developed in liaison with DDDA.

5.1.18 Development Opportunities identified in the Colin Buchanan Audit

- The improvement and enhancement of existing natural features and building stock that are used in conjunction with recreational facilities on Poolbeg Peninsula.

- In the short term the establishment of a relationship between both St. Matthew's National School and St. Mary's Star of the Sea National School with Sean Moore Park should be encouraged to create a mutually beneficial relationship. In the long term in conjunction with large scale development seek to increase capacity on both sites by extending existing building stock.
- A primary care facility acting as a one stop shop for all health related needs.
- The introduction of a small scale tele-working cottage on a derelict site to include crèche facilities providing the opportunity to work and live in the vicinity with their children close by.
- A new District Centre should be considered, in order to meet the retailing needs of the projected population locally and to maintain vitality, vibrancy and a sustainable local economy.
- Provision of entertainment facilities in tandem with development.

6 DRAFT PLANNING SCHEME POPULATION

6.1.1 The following information is used to predict the future population that will result from the Draft Planning Scheme. This predicted population is in turn used to calculate the number of types of community facilities required.

6.2 DRAFT PLANNING SCHEME HOUSING MIX AND APARTMENT STANDARDS

6.2.1 The following overall housing mix in the Draft Planning Scheme is recommended.

	1 bed	2 bed	3 bed	4 bed	Townhouses
Percent	20%	55%	20%	2%	3%
Number	809	2225	809	81	122

6.2.2 The DDDA Master Plan 2008 seeks to encourage families to live in the area, and therefore encourages the provision of a wide mix of dwelling types, sizes and tenures. Sustainable Urban Housing: Design Standards for New Apartments as incorporated by Dublin City Council in Section 4.5.0 of the Dublin City Development Plan, 2005-2011 (Variation No. 21), provides for larger apartments and promotes family occupation of such units. Section 4.5 of the Dublin City Development Plan, 2005-2011 (Variation No. 21) sets out a maximum of 20% 1-bed apartments and a minimum of 15% 3-bed (or more) apartments. The Authority recognises that the majority of units built in the Docklands Area are 2-bed apartments, and to redress the balance of apartments towards family living, a higher proportion of homes must be 3 bedrooms or more in the Draft Planning Scheme. All units must be built in accordance with minimum standards written in the Dublin City Development Plan, 2005-2011 (Variation No. 21) as measured by Net Internal Area. In addition, in order to respond to rapidly changing household sizes and types, the use of adaptable residential units will also be encouraged to ensure flexibility in meeting the future needs of differing households.

6.3 DRAFT PLANNING SCHEME HOUSING TENURE

6.3.1 The DDDA Master Plan 2008 commits the Draft Planning Scheme to deliver 20% of all residential units as social and affordable homes. These are allocated on the basis of housing need and the assessment criteria published by Dublin City Council. The Authority recognises that preference is given within the finite housing stock of social housing to families, especially large families.

6.4 UNITS BY DEVELOPMENT ZONE

6.4.1 The number of units that will be provided in each development zone across the Draft Planning Scheme area, is set out in the following table.

Development Zone	1 bed	2 bed	3 bed	4 bed	Townhouses	Total
Zone 1	466	1281	466	47	0	**2260**
Zone 2	0	0	0	0	0	**0**
Zone 3	189	521	189	19	122	**1041**
Zone 4	154	422	154	15	0	**745**
Total	**809**	**2225**	**809**	**81**	**122**	**4045**

6.5 POPULATION

6.5.1 The population is calculated based on an average number of people per unit. The 2006 Census identifies an average figure of 2.5 people per unit. This equates to a population of 10,114 people.

7 BENCHMARKING – VANCOUVER AND STOCKHOLM

7.1 CONTEXT

7.1.1 Following a request from the DDDA the recommendations for Community Facilities were set against comparators in Stockholm, Sweden and Vancouver, Canada, in particular schools, retail, and services. The two sites are comparable in the numbers of residents and amount of employment in the area, but with fewer constraints on development than occur in Poolbeg.

7.2 HAMMARBY SJÖSTAD, STOCKHOLM

7.2.1 Hammarby Sjöstad is built on former industrial brownfield land located on the south side of Hammarby Lake, to the south of the city centre, which has historically formed the natural border to the inner city area of Stockholm. The idea was to exploit the unique opportunity to expand the inner city with water as a central focus for the development, whilst at the same time transforming an old port and industrial area into a modern city district. Hammarby has a green focus, including a nearby incinerator to generate electricity from local waste and extra recycling and public transport provision

7.2.2 The name 'Hammarby Sjöstad' means 'city surrounding Hammarby Lake' and this new 200 hectare city district will comprise 9,000 apartments, housing a population of 20,000 people, and 200,000 sq m of commercial floor space attracting a further 10,000 people to work in the area. Approximately half of the total area has been

developed to date and it is anticipated that the final scheme will be completed by 2015.

7.3 EAST FRASERLANDS, VANCOUVER

7.3.1 Since 2003, the City of Vancouver has been engaged in a planning process to develop a new sustainable, complete community at East Fraserlands – 130 acres of industrial land south of Marine Way and east of Kerr Street to Boundary Road. The site was previously home to the Canadian White Pine Mill and remains zoned for industrial use. The nearby riverfront is also protected with a similar environmental designation to the SPA on Sandymount Strand – the urban design placed most development away from the river.

7.3.2 The current plan approved for the site is for a predominantly residential community of approximately 12,800 people in a variety of housing types with a commercial centre in the form of a 'High Street'. The new community would also include parks, a community centre, schools, childcare facilities, a riverfront walk, and other community facilities. The new community would be built out over a period of about 25 years.

7.4 BENCHMARKING – SCHOOLS

NUMBERS OF SCHOOL-AGED CHILDREN

7.4.1 The demographic trends of Irishtown/Ringsend/Sandymount were taken into account as a proxy for the future population of the entire area with Poolbeg included. Primary school-age children from 5 to 12 are around 8% of the population and secondary/college age children between 13 and 18 to be around 7% of the population.

7.4.2 Hammarby, Stockholm currently has around 12% of its population at school age (6-16). Therefore, the two estimates used in Poolbeg on the numbers of children catered for are almost exactly the same.

7.4.3 East Fraserlands, Vancouver had around 17% of its population from 0-14, and 15% of its population between 15-24. Therefore, the two estimates used in Poolbeg on the numbers of children catered for are almost exactly the same (the age range 5-18 represents about half of the years 0-24).

SIZE OF SCHOOLS

7.4.4 Design advice for new primary schools has been taken from the Department of Education - see http://www.education.ie/servlet/blobservlet/bu_tgd_022.pdf It gives a sample floor area size of 2200 sqm, and 1500 sqm of playspace for a 16-classroom primary school of 389 pupils (Source: 24.3 students per class in Ireland according to the 2007 OECD report Education at a Glance).

7.4.5 Department of Education and Science design standards for secondary schools/colleges can be found at http://www.education.ie/servlet/blobservlet/bu_tgd_023.pdf. No sample floor area has been given. A 30 classroom school of approx 3100 sqm floorspace required including sport area (770 pupils).

7.4.6 The Hammarby, Stockholm state school operating (ages 6-16) serves 370 children. Although the age ranges are slightly different, the size of school in terms of pupils is very comparable to that of Hammarby.

7.4.7 The Vancouver schools have required site sizes – 4400 square metres for a primary school of around 500 pupils (20% larger), and 5700 square metres for a secondary school of around 2,000 pupils. (125% larger). This is in line with most schools in North America – typically up to twice to size of a school found in Europe.

TOTAL NUMBERS OF SCHOOLS

7.4.8 **Primary Schools -** Taking into account the an 8% figure of primary-age children and assuming full takeup of local schools, this would amount to around 1 school for every 5000 population. There are currently places available for a population up to 9,000.

7.4.9 **Secondary Schools** - Taking into account a 7% figure of secondary-age children and assuming full takeup of local schools, this would amount to around 1 secondary school/college for every 11,000 population. There are currently places available for a population up to 17,000.

7.4.10 Hammarby, Stockholm is planned to have 22,000 residents to be served by 3 schools (2 state and 1 private) serving ages 6-16. The Hammarby plan also estimates that around half of school places will be provided outside the area. Although the age ranges are slightly different, the overall schools model for Poolbeg is very comparable to that of Hammarby.

7.4.11 East Fraserlands, Vancouver is planned to have 12,800 to be served by 2 schools (1 primary serving ages 5-12 and 1 secondary serving ages 13-18). A capacity of 719, over half of required primary school places, was identified in surrounding areas. A need for a secondary school was identified, but was clearly labelled as optional in case the education authorities took up different school site options in the medium-to-long term.

7.5 BENCHMARKING - RETAIL

ESSENTIAL SHOPS AND SERVICES

7.5.1 For Poolbeg it is recommended that a range of 'essential' shops and services, including: laundrette/dry cleaner and corner store (based on Barton, *Sustainable Neighbourhoods)*. There should be around 1 essential shop or service for every 2-5,000 residents to a total of 6 (e.g. 3 sets) for 20,000 residents.

7.5.2 Hammarby, Stockholm currently has built 8 essential shops and services for 11,000 residents thus far.

7.5.3 The East Fraserlands masterplan only allows small convenience retail stores outside of the high street and town centre.

DISTRICT CENTRE

7.5.4 The Draft Planning Scheme has recommended a total of 15-20,000 square metres of usable floorspace to build a retail centre for South East Dublin. No further detail on the breakdown of sizes and range of retail shops have been provided.

7.5.5 Hammarby, Stockholm currently has built 35 comparison retail and 24 restaurants and bars for 11,000 residents thus far. This would amount to around 6,700 square metres of usable floorspace at 80 square metres per unit plus one supermarket at 2,000 square metres.

7.5.6 The East Fraserlands, Vancouver masterplan allocated 23,350 square metres of retail development to serve a community of 12,800. This included one supermarket

(3,700 sq m) and one department store (2,350 sq m), medium-sized stores (930-1500 sq m each with a cap of 5,600 sq m) and half of the floorspace should be from a range of small stores, cafes, food services, and restaurants.

7.6 BENCHMARKING - SERVICES

SURGERIES, BANKS, POST OFFICES, LIBRARIES, SPORT, AND LEISURE

7.6.1 In Hammarby, 1 GP practice, 1 sports centre, 1 football pitch, and 1 basketball court for 11,000 people built thus far.

7.6.2 In Vancouver, 1 community centre, 6 crèches, 10.2 hectares of public open space, 5 playspace greens at 0.1 ha minimum, and 1 playing field / sport centre connected to a secondary school are to be delivered for 12,800 people.

7.7 BENCHMARKING - REFERENCES

HAMMARBY, STOCKHOLM

7.7.1 Web Site: http://www.stockholm.se/Fristaende-webbplatser/Fackforvaltningssajter/Exploateringskontoret/Ovriga-byggprojekt-i-innerstaden/Hammarby-Sjostad/In-english/

7.7.2 Hammarby, Stockholm: Case study published by the Commission for Architecture and the Built Environment, London. http://www.cabe.org.uk/default.aspx?contentitemid=1318

7.7.3 *Hammarby Sjöstad.* Published by Hammarby Sjöstad Development Office.

7.7.4 *Hammarby Sjöstad: a new city district with emphasis on water and ecology.* Published by Hammarby Sjöstad Development Office.

EAST FRASERLANDS, VANCOUVER

7.7.5 Web Site: http://vancouver.ca/commsvcs/currentplanning/current_projects/east_fraserlands/index.htm

7.7.6 East Fraserlands Official Development Plan (2006) http://vancouver.ca/commsvcs/currentplanning/current_projects/east_fraserlands/9393signedversion.pdf

7.7.7 VFK and West Fraserlands Review & Inventory of Community Facilities (2005) http://vancouver.ca/commsvcs/currentplanning/current_projects/east_fraserlands/050615_VFK_ReviewReport.pdf

8 TYPICAL FLOORSPACE AND GROUNDSPACE OF COMMUNITY FACILITIES

8.1 CONTEXT

8.1.1 The amount of floorspace and land requirements of different community facilities are sourced from the design guide for schools found in the Department of Education and Science; design guides for health centres found in the Department of Health and Children; and retail stores found in diverse sources such as the Metric Handbook: Planning and Design Data and local planning applications. The typical floorspace are set out as follows:

8.2 CRECHE

8.2.1 The Dublin City Development Plan 2006-11 has a standard of 0.26 childcare places per dwelling. The Health and Safety Executive has a limit of 20 children maximum per room. Floorspace standards can be found at http://www.dohc.ie/publications/pdf/si20060505.pdf?direct=1, p. 52.

8.2.2 4-room crèche for 80 pupils, this would be a floorspace requirement of 280 square metres at 3.5 sq m per pupil. An 'adequate' outdoor play space is also required nearby. Assumptions: building footprint 280 m2 / playspace 200 m2.

8.3 PRIMARY SCHOOL

8.3.1 Department of Education and Science design standards can be found at http://www.education.ie/servlet/blobservlet/bu_tgd_022.pdf

8.3.2 Sample floor area size of 1500 sqm, 1000 sqm of play space for a 10-classroom school (240 pupils) Assumptions: building footprint 750 m2 / playspace 1000 m2.

8.4 SECONDARY SCHOOL / COLLEGE

8.4.1 Department of Education and Science design standards for 'post-primary schools' can be found at http://www.education.ie/servlet/blobservlet/bu_tgd_023.pdf.

8.4.2 30 classroom school of approx 3100 sqm floorspace required including sport area (770 pupils) with 3000 sq m hard open space and appropriate playing fields Assumptions: building footprint 1200 m2 / playspace 15000 m2 (hard space plus 2 pitches).

8.5 SURGERY

8.5.1 No guidelines can be found at the Department of Health and Children or the Royal Academy of Medicine in Ireland. According to Australian Academy of Medicine, an optimum day surgery is around 425 m2 (http://www.aams.org.au/contents.php?subdir=library/history/day_surgery/&filename=as_aug_87_guidelines)

8.5.2 Assumptions: building footprint 425 m2 / playspace 0 m2.

8.6 SUPERMARKET

8.6.1 A retail strategy for the former IGB site has been produced by DTZ outlining their assumptions for a supermarket anchor on the site of 10,000 sq m2.

8.6.2 Assumptions: building footprint 6000 m2 / parking 5000 m2.

8.7 LIVE- WORK SPACE

8.7.1 Live-work spaces should be able to accommodate around 4 workers. The English Partnership study 'Employment Densities: A Full Guide Final Report' suggests that this use requires around 50 m2 per worker for a floorspace total of 200 m2.

8.7.2 Assumptions: building footprint 200 m2 / parking 0 m2.

8.8 SMALL OFFICE

8.8.1 Small offices should be able to accommodate around 12 workers. The English Partnerships study 'Employment Densities: A Full Guide Final Report' suggests that this use requires around 20 m2 per worker for a floorspace total of 240 m2.

8.8.2 Assumptions: building footprint 240 m2 / parking 0 m2.

All of the following dimensions are taken from 'The Metric Handbook: Planning and Design Data'. It is a source of basic dimensions expected for several different types of uses.

8.9 RETAIL SHOP

8.9.1 A retail shop is suggested to be 80 m2 excluding storage.

8.9.2 Assumptions: building footprint 120 m2 / playspace 0 m2.

8.10 BANK OR BUILDING SOCIETY

8.10.1 A banking building is suggested to be 200 m2 excluding storage.

8.10.2 Assumptions: building footprint 250 m2 / parking 0 m2.

8.11 POST OFFICE

8.11.1 A retail shop / post office is suggested to be 80 m2 excluding storage.

8.11.2 Assumptions: building footprint 120 m2 / playspace 0 m2.

8.12 LIBRARY

8.12.1 A library is suggested to be 2000 m2 excluding storage.

8.12.2 Assumptions: building footprint 1200 m2 / parking 500 m2.

8.13 COMMUNITY HALL

8.13.1 A hall is suggested to be 1000 m2.

8.13.2 Assumptions: building footprint 500 m2 / playspace 200 m2.

8.14 SPORT CENTRE

8.14.1 A sports centre is suggested to be 2000 m2 excluding storage.

8.14.2 Assumptions: building footprint 750 m2 / small pitches 1500 m2.

8.15 SWIMMING POOL

8.15.1 A 50m swimming pool with changing rooms is suggested to be 1500 m2 excluding storage.

8.15.2 Assumptions: building footprint 1700 m2 / playspace 0 m2.

8.16 PERFORMANCE SPACE / THEATRE / CINEMA

8.16.1 A 6-screen cinema is suggested to be 5000 m2 excluding storage.

8.16.2 Assumptions: building footprint 2500 m2 / parking 10000 m2.

8.17 MUSIC STUDIO

8.17.1 A small music studio is suggested to be 1000 m2 excluding storage.

8.17.2 Assumptions: building footprint 1000 m2 / parking 0 m2.

8.18 EXHIBITION HALL

8.18.1 A small exhibition hall is suggested to be 1000 m2 excluding storage.

8.18.2 Assumptions: building footprint 1500 m2 / parking 500 m2.

Appendix 5.3 Technical Land-Use Planning Advice (Required under Reg. 27 of SI 74 of 2006) for DDDA in relation to Dublin Waste to Energy Project, VOMS/Dublin Bay Power, ESB Poolbeg, NORA at Ringsend, Dublin, HSA, July 2008

Technical Land-use Planning Advice

(Requested under Reg. 27 of SI 74 of 2006)

For

DDDA

In relation to

Dublin Waste-to-Energy Project,

UOMS/ Dublin Bay Power,

ESB Poolbeg,

NORA

At

Ringsend, Dublin

30 July 2008

Report compiled by:

Patrick Conneely

(HSA Inspector)

Contents

1. Executive Summary

This document has been prepared following a request for land-use planning advice in the vicinity of the named establishments from Dublin Docklands Development Authority (DDDA).
In formulating its advice, the Authority considered potential major accidents involving Natural Gas, LPG and Diesel, and the potential for impact of these on the surrounding people and the environment.
The Authority is still assessing the pre-construction safety report submitted by NORA and is continuing to review the other sites to ensure that the bunding and secondary and tertiary retention arrangements meet current good practice requirements.

2. General Introduction

This document contains the basis for the conclusions of the HSA ('the Authority') with regard to the request for land use planning advice from DDDA ('the Planning Authority') in relation to Dublin Waste-to-Energy (DWE), National Oil Reserves Agency (NORA, Dublin Bay Power (UOMS) and ESB Poolbeg ('the Establishments') at Ringsend Dublin.
DWE and NORA are/would be upper–tier Seveso sites under the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, S.I 74 of 2006 ('the regulations'), while the other 2 are lower-tier sites. Consequently the request falls within the remit of the Authority to offer technical advice in relation to land-use planning.
It should be noted that under the above regulations the following apply:

- The responsibility for safety on the site rests with the Operator.
- The operator is responsible for the appointment of competent persons to look after safety matters.
- The Establishments will be required, under the above regulations, to demonstrate to the Authority, at any time, that it has taken all necessary measures to prevent major accidents occurring and to limit the consequences of any such major accidents for man and the environment, and demonstrate that it has a safety management system in place.
- The Establishments will be subject to regular inspection by Inspectors of appropriate technical expertise from the Authority, and a proportion of these will be unannounced.
- The Authority acknowledges the role of the Fire Authority in relation to the general obligations to fire safety on the operator under the Fire Services Act of 1981 (as amended).
- In the event of any 'development' that could have significant repercussions for major accident hazards, planning permission will be required.

For the upper-tier sites these additional requirements will apply:

- They will be required to produce a Safety Reports that will demonstrate they are taking all necessary measures for the prevention and mitigation of major accidents. This document will be required to be made available to members of the public who request it.
- The operator will be required to prepare an Internal Emergency Plan for the establishment.
- The Local Competent Authorities will be required to prepare an External Emergency Plan.
- The operator will be required to regularly provide information to the public on the actions to take in the event of an emergency.

In developing its advice, the Authority takes account of the requirements of the regulations as set out above.

3. The Assessment by the Authority

3.1 Introduction

The functions of the Authority are set out in appendix 1. One of its many functions relates to the provision of land use planning advice to planning authorities, which is a legal obligation under SI 74 of 2006.
However there are a number of general exclusions contained in the regulations, the most relevant being as follows:

The occurrence outside an establishment of -

- the transport of dangerous substances by road, rail, internal waterways, sea or air
- associated intermediate temporary storage
- the transport of dangerous substances in pipelines and pumping stations.

Then there are some activities, not listed as exclusions, which do not come within the scope of the regulations:

- The Authority's advice does not deal with site selection or the suitability of one site over another.
- Activities related to site development /construction are not within the remit of the Authority in the context of the provision of Land-use planning advice.

3.1.1. The Establishment area

The establishment is considered to be the area within the security fence footprint where the dangerous substances are processed and stored.
This decision was taken in respect of previous planning applications and has been retained following discussions between the Authority and EU Commission officials and representatives of the other EU member states.

3.1.2 Explanation of technical terms

This report makes reference to specific terminology related to consequence and risk assessment modelling.
The way in which the Authority develops its general technical advice and the criteria it uses are set out in Appendix 2, where many of the technical issues related to risk assessment are explained.

3.1.3 Hazards Considered

The 'Dangerous Dose' hazards that were considered by the Authority for the determination of the risk posed by this establishment were:

- Loss of containment of Diesel or similar products followed by fire giving rise to thermal dose of 1000 TDU.
- LPG BLEVE: overpressure effects to 140 mbar and thermal effects to 7KW/m2.
- Jet Fire from a natural gas release: Thermal dose to 1000 TDU, based on 30 second exposure.

*A **dangerous dose** is defined as one where

- There is severe distress to almost everyone.
- A substantial fraction requires medical attention.
- Highly susceptible people might be killed.

3.2 Methodology

The main consequence-modelling package used for analysis in this case was PHAST v6.53 (DNV Technica) and the spreadsheets included in the CCPS *Chemical Process Quantitative Risk Analysis*, 2nd Edition publication. Reference was also made to a number of relevant technical publications and these are listed at various points in the document.

3.3 Key Assumptions for Analysis

Upon examination of loss history databases and also through consultation, judgement and experience, the Authority chose a selection of events, from across the span of the sites to determine the potential overall off-site consequences.
The key assumptions are outlined below for each stage of the risk assessment process.

3.3.1 Inventories

The following are the significant notified inventories that were used in developing the advice, after the consideration of all the dangerous substances stored and their potential and likelihood to cause a major accident (some of the substances proposed for the DWE plant are considered incapable of causing a major accident and are ignored for the generation of LUP advice).

Dublin Waste-to-Energy:

	Dangerous Substances	Qty Tonne	Seveso Cat.	Upper Threshold
1	LPG (Propane)	2	Named	200
2	Diesel Oil	100	Named	25,000

NORA:

	Dangerous Substances	Qty Tonne	Seveso Cat.	Upper Threshold
1	Diesel Oil	82,700	Named	25,000

UOMS/Dublin Bay power Ltd.:

	Dangerous Substances	Qty Tonne	Seveso Cat.	Upper Threshold
1	LPG (Propane)	2	Named	200
2	Diesel Oil	9000	Named	25,000
3	Natural Gas	9	Named	200

ESB Poolbeg:

	Dangerous Substances	Qty Tonne	Seveso Cat.	Upper Threshold
1	LPG (Propane)	2	Named	200
2	Diesel Oil	14,000	Named	25,000
3	Natural Gas	9	Named	200

Table 1: Notified Inventories

3.3.2 Site Layout / Location of dangerous substances

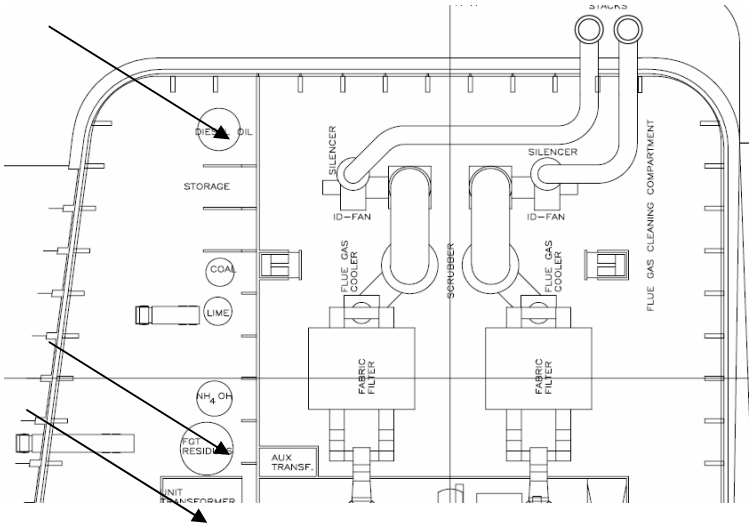


Fig. 1 Layout of Proposed DWE

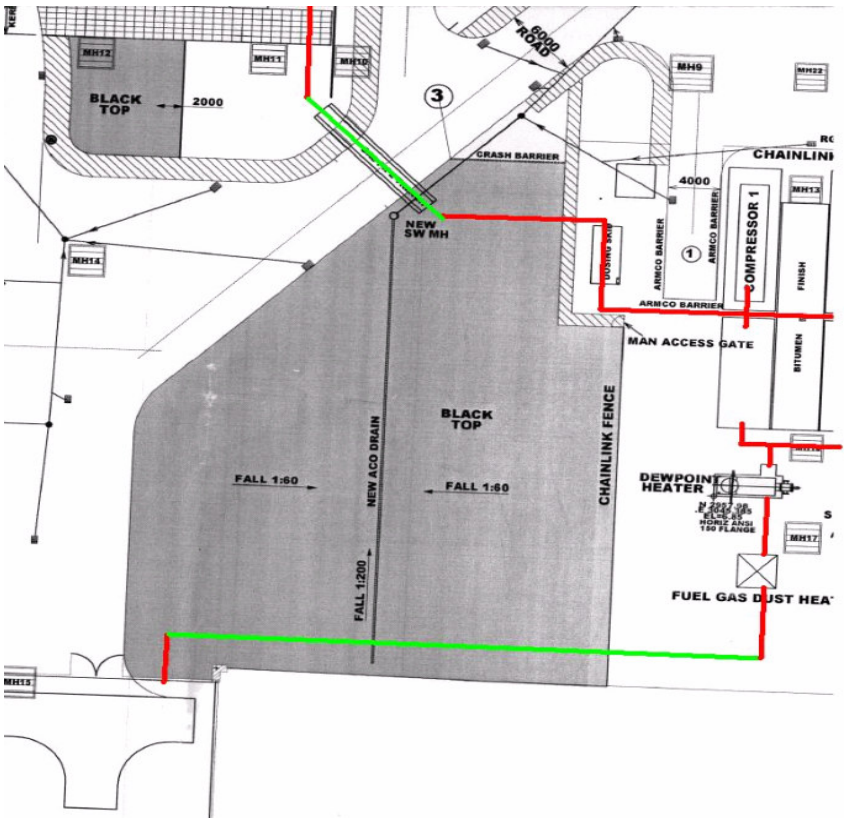


Fig. 2 Location of Natural Gas Pipeline (Red = aboveground) at Dublin Bay power

Fig. 3 Location of Natural Gas Pipeline (yellow) at ESB Ringsend

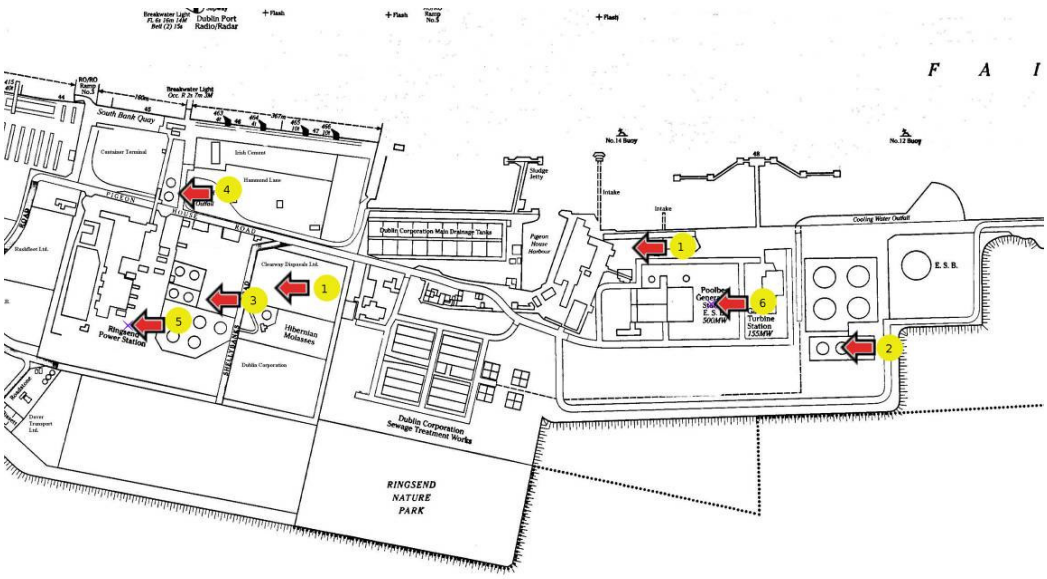


Fig. 4 Location of consequence sources for LUP

3.3.3 Scenarios Selected for Modelling

1. Pool Fire following catastrophic failure of a Diesel/Class III(1) tank. While normally this would not be considered, the possibility of material getting off site and finding a strong ignition source and the presence of hazards on adjacent sites which have the potential to initiate this event allowed for it to be included.

2. Rupture of natural gas pipeline and subsequent VCE has been discounted as the scientific literature does not consider it credible. It has been suggested, in relation to NG pipelines, that modelling a jet fire is a suitable approach for setting safety distances. The Gas Research Institute of Canada (GRI-00/0189 – *A Model For Sizing High Consequence Areas Associated With Natural Gas Pipelines*, 2000) has proposed such a model. A rule has been proposed in the USA using the same method (Federal Register, Vol. 68, No. 18, January 28 2003). An article in the *Journal of Hazardous Material*s (A123 (2005) 1-12) proposes a similar approach, with formulae setting out distances to 50% and 1% fatality endpoints. The Centre for Chemical Process Safety gives a similar method in their C*hemical Process Quantitative Risk Analysis*, 2nd Edition publication. Building Proximity Distances are set out in I.S. 328:2003 and I.S. 329:2003 for transmission and distribution pipelines. They also refer to particular situations being subject to specific risk assessment, as does EN 14161:2003

   Considering the location of the sites, the extent of pipework on the sites (both above and below ground), the associated installations, the presence of other dangerous substances and the other sites covered by the regulations in the immediate vicinity, it is considered appropriate to treat the Natural Gas pipelines in a similar way to other major hazard sources on Seveso sites, rather than as isolated transmission pipelines. For that reason the consequence planning distances are set out to 1800, 1000 and 500 Thermal Dose Units endpoints, based on a 30 s exposure. The method specified in the CCPS QRA book (see above) was used to obtain the appropriate distances. It would seem reasonable to use the boundary between the middle and outer zone as approximating to 1 cpm for societal risk calculations.

3. Overpressure & thermal effects from a 2 tonne LPG BLEVE

3.3.4 Input Data for Risk Assessment

The pool fires were taken to be of a radius of 50m unless it was clear they could be significantly less.
The Propane release was based on the largest tank size on site.
The natural gas Jet Fire scenario presumed a 30 second exposure.

3.3.5 Rationale for Exclusion (or future exclusion) of Scenarios

The assumptions are conservative but considered suitable for consequence based advice and are taken to bound the other events (Natural Gas Flash Fire & Fireball) that are not included.
If the operators demonstrate full tertiary containment on site the probability of Pool Fire may be excluded and the advice revised accordingly.
A detailed QRA of the ESB Ringsend site may produce more accurate risk contours on which to base land-use planning advice in that area.

3.3.6 Consequence Contours

The consequence contours from the identified events are set out in the following table.

	Hazard Source	Inner	Middle	Outer
1	LPG (Propane) 2t [ESB Poolbeg, DWE]	19	32	55
2	Diesel Oil Pool Fire Poolbeg	65	100	136
3	Diesel Oil Pool Fire NORA	65	100	136
4	Diesel Oil Pool Fire Dublin Bay Power	30	50	70
5	Natural Gas Pipeline & assoc equipment[Dublin Bay Power]-from point indicated	77	96	125
6	Natural Gas Pipeline etc[ESB Poolbeg]-from point indicated	138	175	232

They are represented on a map in figure 5 (below).

3.3.7 Other Issues Addressed by the Authority

The Authority will continue to examine Safety Reports and other documents submitted by the operators on the implementation of measures at the establishments that might further reduce the consequence profile. In the event of a significant change in the hazards or risks presented by the establishments, this LUP advice will be reviewed.

4. HSA Comment on the Establishments' own Assessment

The Major Accident Hazids supplied by Dublin Bay Power and ESB Ringsend, the assessment supplied by DWE in its planning application and the draft pre-construction safety report submitted by NORA provided the information for the assessment on which this advice is based.

5. Societal Risk

Using the approximate risk integral[1] method (employed by the UK HSE) and taking the individual risk level to be 1cpm at the outer edge of the middle zone and 0.3cpm in the outer zone and 0.1 cpm immediately outside that, will allow the DDDA to carry out any necessary Societal Risk calculations in relation to suitable development not explicitly covered by this advice.

At 0.1 cpm, the following would present tolerable levels of societal risk:

- 112 residential units on a 1 hectare development
- 2000 Office workers (not 7/24 occupancy) on a 1 hectare development
- 1300 Industrial workers on a 1 hectare development

Notwithstanding that, for any future plans for very-high density and/or very sensitive developments in the vicinity, a separate societal risk assessment may be necessary in order to furnish appropriate technical advice.

6. Advice

The LUP advice for those zones is as follows:

[1] D. A. Carter (1995). "The Scaled Risk Integral -A Simple Numerical Representation of Case Societal Risk for Land Use Planning in the Vicinity of Major Accident Hazards." Loss Prevention & Safety Promotion in the Process Industries, Volume II, Elsevier Science BV.

Zone	Advice
Inner Zone Source-1800 TDU Source-600 mbar	Industrial [subject to consultation], Occasional occupation by small number
Middle Zone 1800-1000 TDU 600-140 mbar	Commercial & industrial <100 persons, retail & catering <250m^2
Outer Zone 1000 -500 TDU 140-70 mbar	Commercial, retail & catering, industrial, small housing developments.

Fig. 5 LUP zones

Appendix 1 Role of HSA (Legal Framework)

1. Background

The Health and Safety Authority was set up under the Safety Health & Welfare at Work Act, 1989.
As the name implies, it is primarily concerned with the health and safety of people at work.
The principal functions, as set out in Section 16 of that Act (now Section 34 of the 2005 act) are:

- To make arrangements for enforcement of relevant legislation
- To promote, encourage and foster the prevention of accidents
- To encourage & foster measures directed towards the promotion of health and safety of persons at work

The Authority is divided up into operational units.
The Process Industries Unit (PIU) is responsible for the implementation of the Seveso Regulations and provision of Land-use Planning advice thereunder.

2. Seveso II Legal Context

The Authority, acting as the Central Competent Authority under the EC (Control of Major Accident Hazards involving Dangerous Substances) Regulations, 2006 (SI 74 of 2006), gives technical advice to a planning authority when requested, under regulation 27(1), in relation to

- The siting of new establishments,
- Modifications to an existing establishment to which Article 10 of the Directive applies
- Proposed development in the vicinity of an existing establishment

SI 74 of 2006 implements EU Directive 96/82/EC [Control of Major-accident Hazards involving Dangerous Substances] as amended by directive 2003/105/EC. Article 12 of that Directive states:
'Member States shall ensure that their land-use and/or other relevant policies and the procedures for implementing those policies take account of the need, in the long term, to maintain appropriate distances between establishments covered by this Directive and residential areas, areas of public use and areas of particular natural sensitivity or interest, and, in the case of existing establishments, of the need for additional technical measures in accordance with Article 5 so as not to increase the risks to people.'
The Major Accident Hazard Bureau/ Joint Research Centre of the European Commission have produced guidance in this area for the National Competent Authorities, concerning the status of technical advice furnished to planning authorities:
'It is recognised that consideration of major-accidents is only one input to the process of land-use planning controls and policies…. many other considerations can be relevant, and that these may already be elaborated in various national policies and implemented in national, regional or local structure and development plans.'

Exclusions
It should be noted that the Regulations exclude certain activities:
"These Regulations shall not apply to -

(a) any property occupied by the Defence Forces and any land or premises referred to in section 268(1) of the Defence Act, 1954 (No. 7 of 1954);

(b) Hazards created by ionising radiation;

(c) The occurrence outside an establishment of -

(i)the transport of dangerous substances by road, rail, internal waterways, sea or air,

(ii) Intermediate temporary storage associated with a subparagraph (i) activity,

(iii) The loading or unloading of dangerous substances at docks, wharves or marshalling yards,

(iv) The transport to and from another means of transport at docks, wharves or marshalling yards, and

(v) The transport of dangerous substances in pipelines and pumping stations.

(d) the activities of extractive industries associated with exploration for, and the exploitation of, minerals in mines and quarries or by means of boreholes (not excluded are thermal processing operations and storage involving dangerous substances);

(e) waste land-fill sites (not excluded in some situations are operational tailings pond disposal activities).

It should also be noted that biological agents are not within the definition of 'dangerous substance' and are therefore not covered by the Regulations.

In giving its advice, the Authority considers only the effects of credible major accident scenarios at the establishment and does not deal with routine emissions. It is the understanding of the Authority that such emissions will be subject to EPA or Local Authority scrutiny and control.
The Authority's advice does not deal with site selection or the suitability of one site over another.
Activities related to site development / construction are not within the remit of the Authority in the context of the provision of Land-use planning advice.

In general, in assessing the risks or consequences of major accidents, the Authority will always look for the best estimate. Where there are uncertainties, it will tend to take a conservative approach and favour that which will overestimate the consequence or risk rather than underestimate it.

Appendix 2 Criteria for Land Use Planning

1. Policy in Relation to Siting of New Establishments

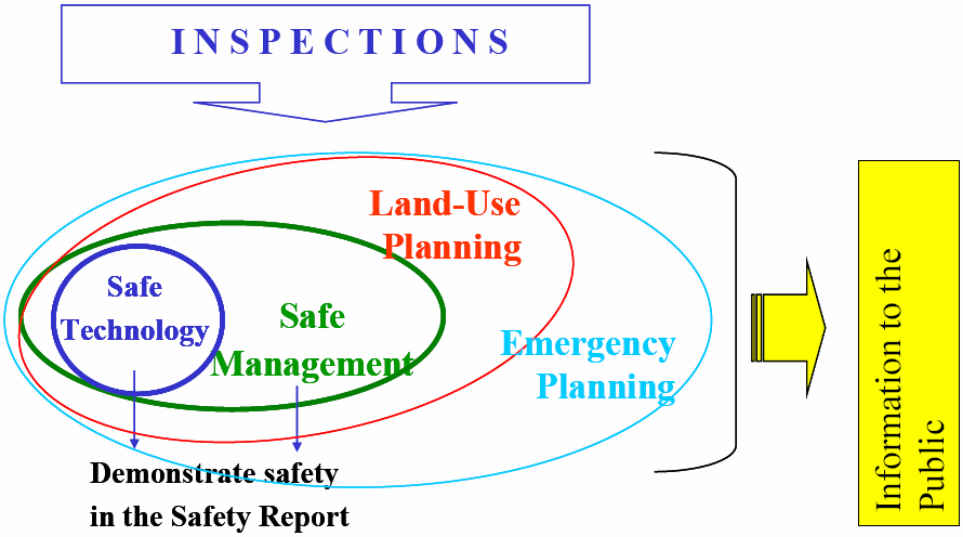
The question considered by the HSA when it provides technical advice to a planning authority relating to a new establishment is:
'If operational, would the risks posed by this establishment be tolerable?'
The Board-approved policy of the HSA in relation to LUP for new establishments states that:
'It is ... necessary to demonstrate for new "Greenfield/Brownfield" establishments that they do not present a risk of a dangerous dose greater than 5×10^{-6}/yr. to their current neighbours or a risk of a dangerous dose greater than 1×10^{-6} /yr. to the nearest residential type property. This may be relaxed in respect of neighbours where the new development is the same/similar to the existing neighbours; for example new oil storage depot being set up in a location already occupied by tank farms.
The Authority will seek from the operators of proposed establishments a detailed consequence and risk assessment in order to help it formulate a response to a request for advice on a planning application.
The Authority will also consider any potential impact on local access/egress arrangements in the context of public behaviour in the event of an emergency and access for emergency services.
The Authority will give consideration to any other issues it deems relevant to a particular application notwithstanding what has been indicated above'

2. Technical Basis for Advice – the context of Land-use Planning

There are, as yet, no European or international standards for the provision of Land-use Planning advice. An EU working group (European Working Group on Land-use Planning), which has been in existence since 2002, was set up to consider the implementation of Article 12. The HSA represents Ireland on this group. This document has now reached final draft status, has been adapted by the Committee of Central Competent Authorities in October 2006, and is awaiting final approval.
The Authority provides LUP advice in the context of the best practice described in that document.
It is worth noting a number of points from that document in relation to the context of LUP (and therefore the advice of the HSA to planning authorities).

- As pointed out on page 7 of the document, Article 12 **does not apply retrospectively**, but relates only to future developments.
- LUP is only one of the many tools for the protection of people and the environment, as represented in the following graphic:

- In the context of the Directive, it is but one of many elements available in relation to major accident hazards:



At present in the EU, a variety of approaches are taken in developing LUP advice, including

- The use of generic distance tables, where the distance relates to activity or storage quantity
- Consequence only. i.e. the distance is related to the consequence
- Risk & Consequence i.e. the likelihood of the consequence is estimated

At present, the Authority takes either a 'consequence' or a 'risk and consequence approach' in relation to developments, depending on the nature of the activity. For new establishments, a 'risk & consequence' approach is usually taken.
Advice is provided concerning the potential effects of major accidents at establishments.

2.1 Establishment

Establishment is defined in the Regulations-
"Establishment" means the whole area under the control of the same person where dangerous substances are present at or above the qualifying quantities (…in schedule 1) in one or more installations, and for this purpose two or more areas that contain installations under the control of the same person and separated only by a road, railway or inland waterway will be treated as one whole area.
In practice, the establishment is usually considered to be the area within the security fence footprint where the hazardous substances are processed and stored. This area comes under the remit of the regulations. This approach has historically being taken and has been retained following discussions between the Authority and EU Commission officials and representatives of the other EU member states.

2.2 Major Accident

The Regulations define a major accident as follows:
"Major accident" means an occurrence such as a major emission, fire or explosion resulting from uncontrolled developments in the course of the operation of any establishment, leading to a serious danger -

(a) to human health, or

(b) to the environment,

whether immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.'

Major accidents inevitably involve a loss of containment of a dangerous substance.
The general approach adopted by the Authority is, therefore, to identify credible 'loss of containment' hazards, identify the consequences if such hazards were realised and, in certain cases, estimate the likelihood of those consequences.
Because Land-use planning concentrates on matters related to off-site risks, these form the focus of the approach. Lesser, but more likely, events are therefore not usually included as they do not have off-site impacts.
The Authority examines the process and material inventories of the proposed establishment to determine the location of inventories of dangerous substances that have the potential for an off-site impact in the event of a major accident. Bulk storage tanks, gas cylinders, pipelines, process and storage areas, road tankers etc. are all likely sources.

2.3 Credible Scenario

Credible accident scenarios that are considered (depending on the particular establishment) include major spills, releases of flammable or toxic vapours, fires, vapour cloud explosions and boiling liquid evaporating vapour explosions [BLEVE's].
The selection of credible scenarios is a critical part of any analysis. In selecting such scenarios, the HSA has particular regard to the Purple Book, the CCPS, reports published by the UK Health and Safety Executive (HSE) and other reliable sources.
Some events are not considered credible:

- Earthquake is ruled out, based on a paper by the Dublin Institute for Advanced Studies. *(A. W. B. JACOB, Seismic Hazard in Ireland. International Association of Seismology and Physics of the Earth's Interior and European Seismological Commission. The Practice of Earthquake and Hazard Assessment. Ed. by Robin K. McGuire, 150-152, 1993.)*

Using a methodology set out in a UK HSE commissioned research report (*CRR 150 1997, The calculation of aircraft crash risk in the UK)* aircraft crash can be ruled out other than for sites near an airport or significant flight path.
Other off-site initiators of major accidents are considered on a case-by-case basis. They will not be included if -

- The event is of equal or lesser damage potential than the events for which the plant has been designed.
- The event has a significantly lower frequency of occurrence than other events with similar uncertainties and could not result in worse consequences than those events.
- The event cannot occur close enough to the plant to affect it.
- The event is included in the definition of another event.
- The event is slow in developing and there is sufficient time to eliminate the source of the threat or to provide adequate response.

On the other hand, instantaneous failure of storage tanks and pressure vessels may be considered credible, as are full-bore pipeline failures and fires in storage areas.
The precise events chosen are based around 'Event Trees', which describe the different scenarios that could result from the loss of containment. An example, for a leak of flammable pressurised gas, is given below.

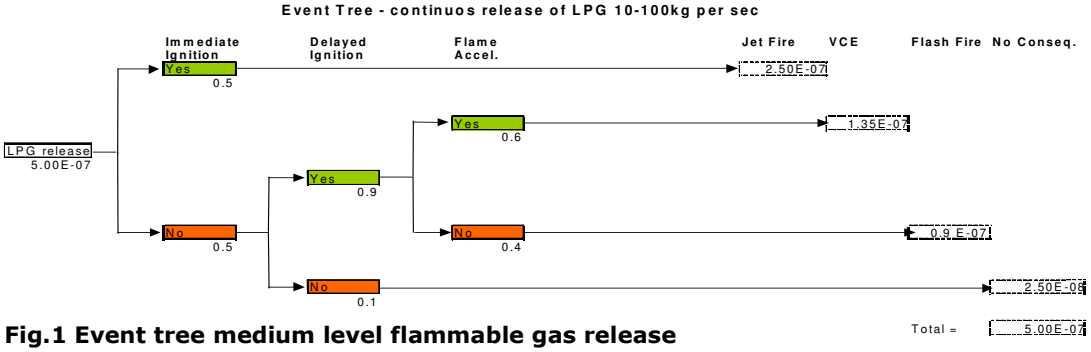


Fig.1 Event tree medium level flammable gas release

The HSA tend to use a high probability of on-site ignition even though more detailed models might predict lower probabilities.
For many events the weather will be an important variable. The HSA will often use weather data from the nearest weather station in F_2 and D_5 conditions (see note 3, appendix 3 on dispersion modelling), as supplied by Met Eireann and re-formatted by the Authority. If the site is a very great distance from any of the named weather stations then the Authority will use the F_2/D_5 weather-stability pairs for dispersion modelling, assuming a split of 25% F_2 and 75% D_5; this will give a more conservative result than using data from any of the known stations.
For new establishments the Authority performs an 'Intermediate Quantitative Risk Assessment (QRA)', in that a representative set of incidents is chosen and historical frequency values are applied. Given the conservative approach adopted by the Authority, insofar as off-site risk is concerned, this will yield results equivalent to a detailed QRA.

2.4 The Consequences of Major Accidents

Different types of physical effects could result, depending on the hazard:

Hazard	Effect
Release of Toxic material	Contamination of air/water
Vapour Cloud explosion, Physical Explosion	Overpressure wave, Heat flux Physical effects of projectiles
Pool Fire, Jet Fire, BLEVE Flash fire	Heat Flux

Table 1: Major Accident Consequences

2.4.1 Effects of overpressure

A 'level of concern' at which these effects could be experienced must be chosen in order to draw conclusions about impact
The effects of overpressure are set out below:

Side-on Overpressure (kPa)	Description of Damage
0.15	Annoying noise
0.2	Occasional breaking of large windowpanes already under strain
0.3	Loud noise; sonic boom glass failure
0.7	Breakage of small windows under strain
1	Threshold for glass breakage
2	"Safe distance," probability of 0.95 of no serious damage beyond this value; some damage to house ceilings; 10% window glass broken.
3	Limited minor structural damage
3.5-7	Large and small windows usually shattered; occasional damage to window frames
5	Minor damage to house structures
8	Partial demolition of houses, made uninhabitable
7-15	Corrugated asbestos shattered. Corrugated steel or aluminum panels fastenings fail, followed by buckling; wood panel (standard housing) fastenings fail; panels blown in
10	Steel frame of clad building slightly distorted

15	Partial collapse of walls and roofs of houses
15-20	Concrete or cinderblock walls, not reinforced, shattered
18	Lower limit of serious structural damage 50% destruction of brickwork of houses
20	Heavy machines in industrial buildings suffered little damage;steel frame building distorted and pulled away from foundations
20-28	Frameless, self-framing steel panel building demolished; rupture of oil storage tanks
30	Cladding of light industrial buildings ruptured
35	Wooden utility poles snapped; tall hydraulic press in building slightly damaged
35-50	Nearly complete destruction of houses
50	Loaded tank cars overturned
50-55	Unreinforced brick panels, 25-35 cm thick, fail by shearing or flexure
60	Loaded train boxcars completely demolished
70	Probable total destruction of buildings; heavy machine tools moved and badly damaged

Table 2: Damage Produced by Blast

Source: Guidelines for Evaluating Characteristics of Vapor Cloud Explosions, Flash fires and BLEVEs, CCPS 1994, ISBN 0-8169-0474-X, based on the work of Glasstone (1977)).
(Note 1 kPa = 10 mbar)

The Second Canvey Report has a table for overpressure effects on humans:

O/Pressure (psi)	O/pressure (mbar)	O/Pressure (kPa)	Human Effects
5	340	34	Threshold of eardrum damage
10	690	69	Threshold of lung damage
40	2760	276	Threshold of mortality

Table 3: Effects of Overpressure on Humans

2.4.2 Effects of Thermal Radiation

Similarly, the effects of heat radiation can be listed:

Radiation Intensity (kW/m^2)	Structural Damage
37.5	Sufficient to cause damage to process equipment
25	Minimum energy to ignite wood at indefinitely long exposures (non-piloted)
12.5	Minimum energy for piloted ignition of wood, melting of plastic tubing.
9.5	Pain threshold reached after 8 sec; second degree burns after 20 seconds
4	Sufficient to cause pain to personnel if unable to reach cover in 20 sec., secondary burns likely, 0% lethality.

1.6	Will cause no discomfort for long exposure

Table 4: Effects of Thermal Radiation (World Bank, 1985)

2.4.3 Threshold Levels of concern (Dangerous Dose)

The threshold 'levels of concern' used by the Authority are:

Consequence	Level of Concern
Contamination of air	Dangerous Dose (Concentration varies with substance & exposure length)
Overpressure wave Missiles	600 mbar, 140 mbar, 70 mbar Distance travelled by a % of projectiles, 100m for cylinders/drums
Heat Flux, Thermal Dose	1800, 1000, 500 TDU

Table 5:Levels of Concern used by HSA

A dangerous dose is defined as one where there is severe distress to almost everyone. A substantial fraction requiring medical attention. Highly susceptible people might be killed. It assumes that most people are/can go indoors and will be less likely to suffer a dangerous dose therein (with the exception of overpressure, where in certain circumstance they may be more at risk due to building damage).

Where a full risk-based approach is taken, the levels of concern are:

Consequence	Level of Concern
Contamination of air with toxic	Dangerous Dose (Concentration varies with substance)
Overpressure wave Missiles	Dangerous Dose = 140 mbar Distance specific to event: a % travel distance, 100m for cylinders/drums
Heat Flux, Thermal Dose	Dangerous Dose = 1000 TDU (75s exposure for Pool & Jet Fire, Fireball duration for BLEVE)

Table 6: Dangerous Dose for different consequences

A thermal dose unit (TDU) is a measure of the heat flux and its duration. 1000 TDU is taken as the 'dangerous dose' based on research work commissioned by the HSE (CRR 285 of 2000- Thermal Radiation Criteria for Vulnerable Populations) [8].
The 140mbar side-on overpressure figure is taken as the 'dangerous dose' for overpressure, and the 70mbar figure is the limit for sensitive developments i.e. no fatalities even for sensitive developments (*Safety Cases for Consultation Distances For Major Hazard Installations*, P97 – see ref 8, appendix 3))
To calculate the distances from the source at which these endpoints could be expected, commercial software is used. The modelling software typically used by the Authority includes PHAST (DNV Technica), ALOHA (US EPA), TSCREEN (US EPA), methods from the American Institute of Chemical Engineers' Centre for Chemical Process Safety and the Yellow Book (note 1, appendix 3 gives a brief outline of these software programmes)
To determine how likely it is that these effects will happen, other software is used, most usually RISKPLOT.

The output of all this analysis is a series of individual risk profiles overlaid on a map of the establishment and its surroundings, illustrating the individual risk of receiving a dangerous dose.

2.5 Tolerable Risk

The following table, taken from The Second Canvey Report lists some common risks of accidental fatality:

Event	No. of Fatalities	Chance of the Average Individual Being Killed
Motor vehicle accidents	7,219	1.3 chances in 10 000 a year*
Accidents in the home	6,717	1.2 chances in 10 000 a year*
Accidents at work	753	0.3 chances in 10 000 a year**
Others	3,646	0.6 chances in 10 000 a year*
Total	18,335	

* Averaged over the total population of Great Britain.
** Averaged over 22 million employees.

Table 7: Risk of death from accidents

The risk of death from natural causes for different age-groups is shown in the following table:

Risk of death from natural causes in age groups	
Age	**Risk**
0- 4	34.4 in 10 000 a year
5-14	1.9 " " "
15-24	3.0 " " "
25-34	4.8 " " "
35-44	16.2 " " "
45-54	55.0 " " "
55-64	147.7 " "
65-74	422.3 " "
75-84	1, 073.0 " "
85+	2, 023.5 " "

Table 8: Risk of death from natural causes

Statistics available from the HSA on occupational fatality rates:

Economic sector	Fatalities		Total at work (QNHS 2002)	Rates per Million
	Total 2002	Worker 2002		
A - Agriculture, Forestry and Hunting	13	11	121,700	115
B - Fishing	3	3		
C – Mining and Quarrying	2	2	310,400	22.5
D - Manufacturing	7	5		
E – Electricity, Gas and Water Supply	2	0		
F- Construction	21	20	183,200	109.1
G – Wholesale and Retail	1	0	249,100	0
H – Hotels and Restaurants	0	0	108,700	0
I - Transport, Storage, Communication	8	7	108,900	64.2
J - Financial Intermediation	0	0	226,400	4.4
K – Real Estate, Renting and Business Activities	1	1		
L - Public Admin, Defence and Social Security	2	2	82,000	24.3
M – Education,	0	0	260,000	0
N – Health and Social Work	0	0		
O - Other	1	1	94,900	10.5
Total	61	52	1,745,500	34.9

Table 9: Fatality Rates per million Workers

Risk that is broadly acceptable is that which is trivial in comparison to the risk experienced in daily life. At the other end of the scale there clearly is a level of risk that is unacceptable. In deciding on LUP criteria the HSA concluded that for the general residential public an individual risk of dangerous dose greater than 1×10^{-5} (i.e. 1 in 100,000) per year would not be tolerable for developments around existing establishments, and for new establishments it should not exceed 1×10^{-6} (i.e. 1 in 1,000,000).

2.6 Criteria Used in other countries for Land-Use Planning

The following are some of the better-developed criteria:

UK HSE	
Maximum tolerable worker individual risk	1 in 1,000 per annum
Maximum tolerable public individual risk	1 in 10,000 per annum
Benchmark for new plant and developments	1 in 100,000 per annum
Broadly acceptable public individual risk	1 in 1,000,000 per annum
Land-use Planning - Residential development unrestricted	1 in 1,000,000 per annum (Dangerous Dose)
Netherlands	
Maximum tolerable public individual risk for existing situations	1 in 100,000 per annum
Maximum tolerable public individual risk for new developments	1 in 1,000,000 per annum
Maximum tolerable public individual risk around airports, above which re-housing is required.	1 in 20,000 per annum
Broadly acceptable public individual risk	1 in 1,000,000 per annum
Australia	
Acceptable risk to the public in residential zones from hazardous industries	1 in 1,000,000 per annum
Hospital, Schools, Child-care	0.5 in 1,000,000 per annum
Acceptable total risk within hazardous industrial zones	1 in 10,000 per annum

Table 10: Various National risk criteria (fatality unless otherwise stated)

2.7 Presentation of Risk

Risk figures can be confusing. The following figure shows some of the different ways that risk can be presented.

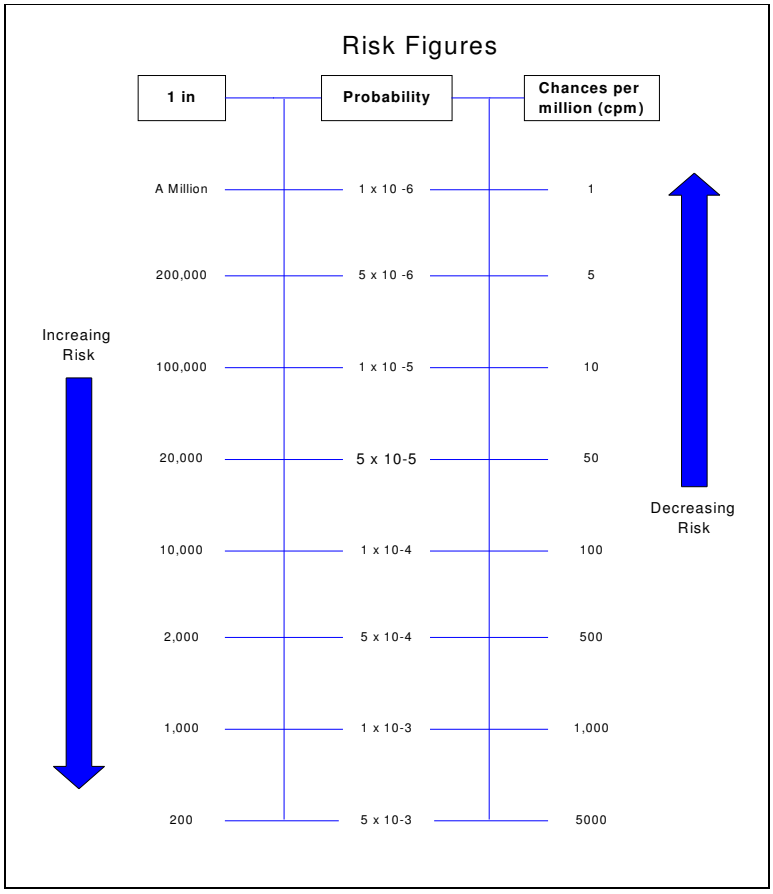


Figure 2: Ways of Presenting Risk

2.8 Classification of Development Types

In giving LUP advice, the HSA classify developments under one of the following categories:

- Residential
- Retail and catering
- Commercial
- Industrial
- Sensitive e.g. hospital, some schools, outdoor leisure complexes etc.: developments of this nature are subject to special analysis

The following table sets out the risk zones that are estimated for the purposes of offering land-use planning advice:
(figures are related to the individual risk of receiving a dangerous dose, per year)

Zone	Risk (R)
Zone 1.	$> 1 \times 10^{-5}$ (i.e. > 10 cpm)
Zone 2.	$1 \times 10^{-6} < R < 1 \times 10^{-5}$ (i.e. 1 - 10 cpm)
Zone 3.	$0.3 \times 10^{-6} < R < 1 \times 10^{-6}$ (i.e. 0.3 – 1 cpm)

Table 11: Risk zones for LUP

The LUP advice for the different zones is as follows:

Zone 1:	Advise against residential, office and retail, permit occasionally occupied developments e.g. pump houses, transformer stations. Consult with H.S.A re. Industrial development.
Zone 2:	Permit workplace development. Permit residential densities from 28 to 90 persons /ha., density increasing as risk decreases across the zone in developed areas and 22 to 70 persons/ha. in less developed areas. Permit modest retail and ancillary local services Advise against shopping centres, large-scale retail outlets, undue concentration of restaurant/pub facilities.
Zone 3:	No restrictions except for sensitive developments, which would be subject to consultation if inside the consultation range and should not be at a risk greater than $0.3.10^{-6}$ Sensitive developments include crèches, schools, hospitals, and nursing homes. Locations of major public assembly will be subject to individual assessment.

Table 12: LUP Advice zones based on Risk

The advice with respect to housing density in Zone 2 is based on consideration of the analysis given in "A Worst Case" Methodology for Risk Assessment of Major Accident Installations" in Process Safety Progress [Vol. 19, No. 2].

Use of the criteria as outlined above will provide a basis for the advice on the acceptability of a new 'Seveso' establishment and for justifying a separation distance between Seveso establishments and off-site developments. These criteria do not guarantee an absence of risk but suggest a tolerable level, given that major accidents with offsite damage are relatively uncommon. They represent an attempt to balance a potential for harm against a social requirement that large tracts of land should not be unnecessarily sterilised for future development.
The criteria will be subject to on-going review and revised in the light of new knowledge and ongoing experience.

2.9 Societal Risk

The approach as set out above includes an element of societal risk in terms of the advice for each of the zones ('residential densities from 28 to 90 persons per ha.' 'modest retail', 'large-scale' etc.). In most cases no further assessment of societal risk is necessary. However, for very-high density or very sensitive developments or for developments in the vicinity of highly populated areas a separate societal risk assessment may be necessary.

2.10 Consequence-based approach

It is the view of the Authority that, for existing sites and for those sites presenting thermal or overpressure hazards only, it may be more appropriate to take a consequence-based approach (Note 2 of appendix 3 gives an overview of consequence and risk based assessments). This takes into account the additional physical damage to buildings and structures resulting from these types of hazards, over and above the direct harm to people that result from toxic exposure. It also reflects the omni-directional nature of these hazards. The following scenarios are considered:

- instantaneous loss of contents from tanks, drums or cylinders
- full-bore rupture of pipelines and smaller leaks
- bund overtopping
- pool, bund and building fires
- drum projectiles
- releases from reaction vessels in the event of loss of control
- road tanker failures leading to spillage , fire or explosion
- vapour cloud explosions
- solid-phase explosions

In general, the worst credible scenarios are selected.
The advice zones for a consequence-based approach are as follows:

Thermal and Overpressure Effects:

Zone	Advice
Inner Zone Source-1800 TDU Source-600 mbar	Industrial [subject to consultation], Occasional occupation by small number
Middle Zone 1800-1000 TDU 600-140 mbar	Commercial & industrial <100 persons, retail & catering <250m^2
Outer Zone 1000 -500 TDU 140-70 mbar	Commercial, retail & catering, industrial, small housing developments.

3. Major Accidents, Land-use Planning Advice and Environmental Effects

The Authority's technical advice to the planning authority deals with the potential effects of major accidents. In relation to the environment the advice is concerned only with those environmental effects that are related to major accidents and it does not consider routine emissions, which are within the remit of the local authority or EPA, and subject to license.

Currently, there is no common approach within the EU on suitable scenarios or endpoints for the assessment of Major Accidents to the Environment (MATTEs) within the framework of the Seveso II directive. Consequently, such assessment tends to be more qualitative than the approach concerning major accidents and the potential effect on human receptors. This qualitative approach is due to the highly variable nature and sensitivity of environmental receptors, allied to the lack of suitable sensitivity data for all receptors, and the multiplicity of such receptors in the environment.

The approach of the HSA, in the consideration of environmental effects associated with Seveso II establishments, is also conscious of the requirements placed on operators (current or proposed) by Regulation 9 of S.I. No. 74 of 2006. In assessing the consequences of potential worst-case credible accidents and their impacts on the environment, the HSA concentrates on Regulation 9(2)(e), requiring operators to use best practicable means –

- to prevent a major emission of dangerous substances resulting from uncontrolled developments from any part of the establishment, into the environment, and
- for rendering harmless and inoffensive such substances as may be so emitted.

The Seventh Schedule to S.I. 74 of 2006 lists the criteria for notification of accidents to the Commission. Major accident hazards should have this type of potential in order to be considered.

More practical information on what might constitute a major accident to the environment is given in guidelines from the HSA in relation to major accidents to the environment [*Guidance on Interpretation of Major Accident to the Environment (rev 5)*- Oct 2003] which in turn is adapted from guidance issued by the UK Department of the Environment, Transport and the Regions.

A major accident to the environment will occur as a result of a major emission, fire or explosion resulting from uncontrolled developments in the course of the operation of any establishment and resulting in significant damage to the natural or man-made environment. This damage could be relatively long lasting but not necessarily irreversible. Recovery of habitats can take considerably longer depending on the dangerous substance in question. The assessment of major accidents to the environment focuses on the specific risks to sensitive receptors within the local environment, the extent of consequences to such receptors, and on the ability of such receptors to recover.

HSA Approach

The approach of the Authority, therefore, is to examine potential impacts to the environment from the identified credible major accident hazards and satisfy itself that appropriate 'best practicable means' are/will be in place to prevent such impacts. Best practicable means might constitute adequate bunding for storage tanks containing dangerous substances allied with tertiary containment to prevent migration off-site of any overtopping fraction, or contaminated fire fighting water, for example.

The potential for initiating a major accident due to natural phenomena is also examined. For example, the effect of flooding, storm damage, subsidence is considered in relation to the potential effect on storage tanks and storage areas, as well as important site utilities. The operator must demonstrate that other potential initiators have been considered (lightning for example) and control/mitigation measures employed where required
While the 'best practicable means' standard is also applied to control of gaseous loss of containment events (e.g. suitably-sized catch pots for reaction vessels), the consequences of such releases are examined as part of the general major accident scenarios for human receptors.

Article 12 of the amended Directive requires Member States to 'take account of the need, in the long term, to maintain appropriate distances between establishments covered by this Directive and residential areas, buildings and areas of public use, major transport routes as far as possible, recreational areas and areas of particular natural sensitivity or interest...'

Where the Authority notes such areas in the vicinity of an establishment it undertakes further analysis to satisfy itself that an appropriate distance can be maintained. Appropriate distances are not specified in the Directive. However a separation distance will be considered appropriate if it is sufficient to enable the installation and operation of suitable control and mitigation measures, and/or is such that the risk of serious damage is low in the event of a major release.

4. Petroleum Bulk Stores, Land Use Planning and Environmental Criteria

Background

The earlier part of this appendix has set out the general approach of the Authority regarding the provision of Land Use Planning (LUP) advice and the previous section elaborated further in relation to the environment.

This document sets out the Authority's position in formulating land-use planning advice for new petroleum bulk store installations with particular consideration of appropriate environmental criteria.

In the case of new installations at existing establishments, a similar approach will be adopted. In some instances, due to spatial constraints on older sites, or other considerations relating to their layout, particular site-specific measures may have to be designed in order to fulfil the 'best practicable means' criteria. In these cases consultation with the Authority at an early stage in the design process with justification on how the proposed design in terms of meeting the 'best practicable means' criteria.

Legislative basis

Under the Seveso II Directive [96/82/EC as amended by 2003/105/EC] there is a requirement to ensure that the objectives of preventing major accidents and limiting the consequences of such accidents are taken into account in the land use policy of member states. Furthermore, there is a requirement to take account of the need, in the long term, to maintain appropriate distances between establishments covered by the Directive and residential areas, areas of public use and areas of particular natural sensitivity or interest. Such appropriate distances are not specified in the Directive or transposing Regulations, but would generally be considered sufficient if they allow the installation of suitable control and mitigation measures to provide adequate protection to the environment, or if their extent is such that the risk of serious damage to the environment is low in the event of a major release. Under the EC (Control of Major Accident Hazards involving Dangerous Substances) Regulations, 2006 [SI 74 of 2006], which transpose the Seveso II Directive, and specifically relating to the general duties of operators, Reg. 9(1)(b) requires the operator to take all necessary measures to limit the consequences of any major accident to man and the environment, while 9(2)(c) further qualifies this by stating that such necessary measures shall include the making of arrangements to ensure that the use, handling, storage, and transport of dangerous substances in the establishment are, so far as is reasonably practicable, without risk for man and the environment, and 9(2)(e) that the use of best practicable means to prevent a major emission into the environment from any part of the establishment of dangerous substances resulting from uncontrolled developments in that establishment, and for rendering harmless and inoffensive such substances as may be so emitted.

Petroleum Bulk Stores & Major Accidents to the Environment

The Directive specifically applies to "major accidents" as defined. That is to say, an occurrence such as a major emission, fire or explosion resulting from uncontrolled developments in the course of the operation of any establishment, leading to a serious danger to human health or the environment, whether immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances. By definition therefore, a major accident can only be considered under the terms of the Directive, if it is caused by a dangerous substance as defined under Parts 1 and 2 of Annex 1 of the Directive. Automotive petrol and other petroleum spirits (including diesel) are listed as named substances in Part 1 of the First Schedule of S.I. 74 of 2006 and as such are dangerous substances. In addition, other relevant substances are classified under the generic category of Dangerous to the Environment, and are therefore also considered dangerous substances under the terms of the Directive. Materials not so classified as a dangerous substance, or not provisionally classified as a dangerous substance, though they may possess other properties that could cause ecological disruption, are outside the scope of the Seveso II Directive.

Many of the larger petroleum bulk stores are located adjacent to areas of natural sensitivity (ports, etc.). Such locations may also be designated as candidate Special Areas of Conservation (cSAC's), or by virtue of populations of significant bird populations, as Special Protection Areas (SPA's). As such, the potential consequence to the natural environment as a result of a major spillage event to that environment is likely to be

severe. However, the long-term (and perhaps even short-term) consequences associated with some materials may be less significant. Non-persistent oils, such as kerosene for example, by virtue of their relatively quick degradation rate, will pose a lesser danger to the environment than the more persistent oils (crude oil for example).
Along with spillage of inventory, the generation of contaminated firewater in the event of a major fire must also be considered.

Bunds
Prevention of a major emission into the environment, in the context of petroleum bulk stores, is generally provided by bunding. The general requirement is for 110% of the largest tank, or 25% of the total tank volume, where more than one tank exists in the bund, whichever is the larger figure. The statutory requirements of S.I. No. 313 of 1979 (Dangerous Substances (Petroleum Bulk Stores) Regulations) must be complied with. In addition, the UK's HSE publication "The Storage of Flammable Material in Tanks (HSG 176)" provides further guidance on an appropriate approach to spillage containment.

Risk Assessment
In terms of site-specific environmental risk assessment, the EPA's Guidance Note on the Storage and Transfer of Scheduled Activities provides a detailed approach (under Section 5 of that document). Additionally, it sets assessment criteria based on the German Environment Agency's approach of using water hazard classes – i.e. either non-hazardous or one of the following classes: WHC 1 – low hazard, WHC 2 – hazardous, or WHC 3 – severe hazard. Assignment of the WHC class is based on the risk phrases of the materials involved, and other considerations such as biodegradation rate, bioaccumulation etc. The full detail of how this class is assigned can be obtained directly from the German Environment Agency website at http://www.umweltbundesamt.de/wgs-e/index.htm, (where a search can be made using CAS numbers or the substance name). In addition, the downloads section demonstrates how substances and mixtures can be self-classified based on the risk phrases as applied by the Classification, Packaging and Labelling stream of legislation (Directive 67/548/EEC as amended and Directive 99/45/EC).

Furthermore, EPA's Guidance Note goes on to provide a simple risk category table based on this risk classification criteria and associated quantities stored -

WHC Class			
Vol. (m3) or mass T	1	2	3
<0.1	A	A	A
0.1 – 1	A	A	B
1 – 10	A	B	C
10 – 100	A	C	D
100 – 1000	B	D	D
>1000	C	D	D

Generally, category A equates to low risk, B to medium risk, while categories C and D equate to higher risk. Particular consideration needs to be given in relation to sensitive environmental receptors in cases of overground facilities of category D and underground facilities of categories C and D. Section 5.3 of the guidance note provides detail on retention requirements associated with each WHC class while Section 6 provides guidance on the design and operation of retention facilities (bunds), which are categorised as Class 1, 2 or 3 on the basis of low, moderate, or high hazard potential. The EPA Guidance note should be consulted for further detailed information. It should be noted that the nature of dangerous substances and their associated volumes stored at petroleum bulk stores is likely to classify such sites as category C or D, that is to say possessing a high potential for pollution in the event of a major release, and would ordinarily require containment systems to be designed to a high standard. Provision for holding contaminated firewater should be facilitated into the overall containment design. Key activities with major accident potential should be provided with independent levels of protection (e.g. independent high level alarms and leak detection system, allied with physical secondary

and tertiary containment). Again, referral is made to the EPA guidance for specific detailed design criteria appropriate to these categories.

Bund Overtopping

The issue of bund overtopping is not dealt with specifically in the EPA guidance document. It is examined by the HSA as a potential scenario with respect to Seveso II establishments in terms of the provision of LUP advice. Such a scenario is considered highly unlikely but credible, and the consequences in terms of the Seventh Schedule of the Regulations (i.e. will a major accident to the environment ensue?) and the receptors that will be affected, have to be considered. Again, referring to those sites that would qualify as possessing a higher potential for pollution, then provision for containment of the overtopping fraction in the event of catastrophic failure must also be considered in the overall design to take account of this scenario. For example, the provision of tertiary containment and associated drainage systems to contain and hold up to 110% of the maximum calculated overtopping fraction is considered by the Authority to be an appropriate approach. How tertiary containment is provided will very much depend on site-specific conditions. Therefore, consultation should be made early at the design stage with the Authority in order to ensure that the proposed approach is satisfactory.

References Cited

1. 'Criteria for land-use Planning' – Appendix 3 of 'Land Use Planning Advice for Mayo Co. Council', HSA, April 2004
2. The Storage of Flammable Liquids in Tanks – HSG 176 – Health and Safety Executive
3. S.I. 74 of 2006 – European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations
4. Directive 2003/105/EC of the European Parliament and of the Council of 16 December 2003 amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances
5. S.I. 313 of 1979 – Dangerous Substances (Petroleum Bulk Stores) Regulations 1979
6. Environmental Protection Agency IPC Guidance Note on Storage and Transfer of Materials for Scheduled Activities, May 2003
7. Environmental Protection Agency (Draft) Guidance Note to Industry on the Requirements for Fire-Water Retention Facilities, 1995 ISBN 1 899965 165

Appendix 3 – Software, approaches to risk assessment, weather

1. Software Models

(a) ALOHA:

ALOHA, available from the US Environmental Protection Agency, is an emergency response model intended primarily for rapid deployment by responders, as well as for use in emergency preplanning. It incorporates source strength, as well as Gaussian and heavy gas dispersion models and an extensive chemical property library. More than 700 pure chemicals and a small number of aq. Solutions are included in ALOHA's chemical library.

ALOHA quality assurance has been performed in two stages:

(1) ALOHA source and dispersion estimates have been systematically tested against output from similar models.

(2) ALOHA evaporation rate estimates have been compared against measured rates from both boiling and non-boiling pools. Neutrally buoyant gas concentration predictions have been compared against concentrations measured during Project Prairie Grass. Heavy gas dispersion predictions have been compared against DEGADIS predictions for six heavy gas field releases (Desert Tortoise, Goldfish, Maplin Sands, Burro, Eagle, and Thorney Island).

The latest version can also be used to model thermal and overpressure effects.

(b) PHAST

PHAST is a commercially available software package produced by DNV Technica. PHAST stands for Process Hazard Analysis Software Tool. PHAST is designed for use in assessing situations which present potential hazards to life, property and the environment and to quantify their severity.

It uses a built-in chemical and parameter database for 46 substances, with incomplete data for many more.

It uses the Unified Dispersion Model (UDM) to estimate dispersion of releases to the atmosphere. The model has been well validated.

PHAST can also be used to model thermal and overpressure effects.

2. Consequence and risk based hazard assessments

2.1 Consequence based Approach:

The "consequence based" approach (for which sometimes the term "deterministic approach" is used) is based on the assessment of consequences of conceivable accidents, without quantifying the likelihood of these accidents. The concept behind the use of this approach is to avoid tackling the uncertainties related to the quantification of the frequencies of occurrence of the potential accidents.

The extent of consequences provides a measure of the severity of the potential accidents independently of their likelihood. These are used as a criterion in the "consequence based" approach. The consequences of the accidents are taken into consideration quantitatively by estimating the distance to which the physical magnitude describing the consequences reach (e.g. a threshold toxic concentration corresponding to the beginning of the undesired effect such as fatality), for a given exposure period.

Several conceptual approaches which are relevant to determining a consequence distance can be used, for example:

- for toxic releases, determination of a distance corresponding to a lethal toxic dose or serious injury (e.g. LC1%, that is the Lethal Concentration corresponding to the "first death" or lethality 1%);
- for thermal effects from fires, determination of a distance corresponding to a thermal radiation which, for a given exposure period, can cause burns likely to be lethal or cause serious injury;
- for explosions, determination of a distance corresponding to an overpressure likely to be lethal or cause serious effects.

2.2 Risk based Approach:

Another category of approach used is the "risk based" approach (also known as the "probabilistic" approach). Various names have been used for this category, such as Probabilistic Risk Assessment (PRA), Probabilistic Safety Analysis (PSA), and Quantified Risk Assessment (QRA). Their purpose is to evaluate the severity of the potential accidents, and to estimate the likelihood of occurrence. For estimating the likelihood of scenarios various methods are in use, ranging from simple selection of scenarios and frequencies from the relevant databases to the application of sophisticated tools, such as Event Tree and Fault Tree Analysis. In that sense, and since explicit calculation of the frequencies of possible accidents takes place, the "risk based" methods seem to be more

complete in the analysis of risk than the methods previously described. However, they are more complicated, more time-consuming and more expensive.
In general, the "risk based" approaches define the risk as a combination of the consequences derived from the range of possible accidents, and the likelihood of these accidents. Therefore, they usually consist of five phases:
• identification of hazards,
• estimation of the probability of occurrence of the potential accidents (taking into account the safety/preventative measures and systems),
• estimation of the consequences of the accidents,
• integration into overall risk indices.
• comparison of the calculated risk with acceptance criteria.
Risk may be expressed in terms of (i) the individual risk, defined as the probability of fatality (or a specified level of injury) due to an accident in the installation for an individual being at a specific point, and (ii) the societal risk, defined for different groups of people, which is the probability of occurrence of any accident resulting at fatalities greater than or equal to a specific figure.

3. Weather Stability Classes
Weather conditions in hazard studies are generally described in terms of an atmospheric stability condition and a wind-speed e.g. D_5 indicates Pasquill stability class D with a wind speed of 5m/s.The Pasquill stability class (see table below) is a measure of the air turbulence which in turn is influenced by the level of solar radiation. The level of air turbulence influences the rate at which gas clouds dissipate to safe levels as they drift away from the source of the release.

Wind at 10m height	Solar Radiation			Night time cloud cover	
	Strong	Moderate	Slight	>=4/8	<=3/8
<2	A	A-B	B		
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

The classes A-F determine the stability is as follows:
A: extremely unstable
B: moderately unstable
C: slightly unstable
D: neutral
E: slightly stable
F: moderately stable

References

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