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Fingal County Council
Comhairle Contae Fhine Gall

P0014-04

Date: 9 August, 2007

Register Ref.: F07A/0075 /ADD. INFO

Development: Alterations to an existing tank farm consisting of the provision of 5 no. new overground stainless steel chemical storage tanks and associated steel platforms and service racks (to match existing) with an area of 172 square metres approximately and an overall height of 11.500 metres approximately, modifications to existing bund walls, as a replacement for the proposed removal of 15 no. existing underground tanks, with an area of 680 square metres approximately, with the exception of 2 no. tanks which are to be retained. The project includes remedial works to the nearby existing underground tank basins and the provision of new services pertinent to the proposed development. The works shall be carried out in three phases.

The facility is located in the southern part of the existing manufacturing facility on Watery Lane.

This application consists of a variation to a previously permitted development on an activity for which a licence under Part IV of the Environmental Protection Agency Act 1992 (as amended for the Protection of the Environment Act, 2003) is required and will be notified to the Environmental Protection Agency.

The development consists of modifications to an establishment within the meaning of the European Communities (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2006.

Location: Swords Laboratories, Watery Lane, Swords, Co. Dublin

Applicant : Swords Laboratories

Application Type : Permission

Licensing Unit,
Environmental Protection Agency,
P.O. Box 3000
Johnstown Castle
Co. Wexford.

Reg. Ref.: F07A/0075

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Fingal County Council
Comhairle Contae Fhine Gall

Planning Officer : Kiaran Sweeney

Date Received : 2 August, 2007

Attached is a copy of the Additional Information for the above development. Your report would be appreciated within the next **12 Days.**

Yours faithfully,

for **SENIOR EXECUTIVE OFFICER**

JACOBS

Jacobs Engineering Ireland Limited
Merrion House
Merrion Road
Dublin 4
Ireland
Telephone: +353 1 269 5666
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2nd August 2007

Planning Division
Development Control Section
Fingal County Council
County Hall
Swords
Fingal
Co. Dublin

Re: Additional Information
Planning Ref No: F07A/0075
Decision Order No. 0933 dated 16th March 2007

Dear Sir / Madam

We enclose herewith additional information on the above planning permission as requested.

BMS have held consultations with the Health and Safety Authority (HSA) so as to reach agreement on the anticipated potential impacts of this development and the recommended ameliorative actions required.

The attached report represents the result of such consultations and agreements. The report has been amended in its entirety to reflect the request for additional information and the potential new scenarios physically and statistically modelled.

Sections 4.4 to 5.0, an addition to the existing report, deal directly with the additional information as requested.

We wish to confirm that as a result of our analysis, a tertiary fire water collection system is being proposed, the details of which are attached.

The proposed works entail minor adjustments to the existing underground surface water and fire water drainage system and the addition of new "Acco" type collection drains in the tanks area.

JACOBS

We hope this is satisfactory, if you have any queries please do not hesitate to contact me.

Yours sincerely,

Gerry Loughrey
Director for Architecture
FOR Jacobs

awn consulting

The Osmosis Building, Clonshaugh Business & Technology Park, Dublin 17. Tel: +353 (0)1 847 4220. Fax: +353 (0)1 847 4257

CONFIDENTIAL TECHNICAL REPORT

POTENTIAL IMPACTS OF MAJOR ACCIDENT HAZARDS ASSOCIATED WITH THE PROPOSED NEW 5 NO. VERTICAL ATMOSPHERIC 50 M^3 STAINLESS STEEL TANKS FOR WASTE SOLVENT STORAGE IN THE SOLVENT TANK FARM AT SWORDS LABORATORIES (REPORT UPDATED IN RESPONSE TO HSA MEETING ON SITE ON 28/2/07 AND FINGAL COUNTY COUNCIL REQUEST FOR ADDITIONAL INFORMATION F07A/0075

FOR

Swords Laboratories
Swords
Co. Dublin

Prepared by: **Dr Fergal Callaghan AMIChemE**
Our reference: FC/06/3437WR01(Rev 2a)
Date: 31st July 2007

CONTENTS

1.0 INTRODUCTION

2.0 SITE DESCRIPTION

3.0 IDENTIFICATION OF MAH SCENARIOS

4.0 MODELLING OF POTENTIAL IMPACT OF MAH

5.0 CONCLUSIONS

1.0 INTRODUCTION

AWN Consulting Ltd were instructed by Swords Laboratories, Watery Lane, Swords, Co. Dublin to identify possibly major accident hazards associated with the operation of a waste solvent storage facility comprising 5 no. 50 m^3 stainless steel storage tanks.

This report contains an assessment of the possible Major Accident Hazards (MAH) associated with the impacts of a Major Accident (MA) Tank Farm, with respect to possible off site impacts.

AWN prepared this report for submittal to the Health and Safety Authority and for submission to Fingal County Council as part of a planning application for the above mentioned tanks, in January 2007.

AWN and Swords Laboratories personnel subsequently met with the HSA on site at Swords Laboratories on 28th February 2007 and Mr Gareth Doran of the HSA requested the following additional items be included in the report:

- Assume 70% overtopping of the bund (worst case) and determine where the liquid would flow and where it would be likely to form a pool, and whether it would run onto the Arch Chemicals site
- The VCE calculation is based on the premise that the tank is only 5% full, is this the minimum fill level?

Both of these items are addressed in this report.

Swords Laboratories also received a request for additional information from Fingal County Council with respect to the above application (ref F07A/0075), which stated:

- In regard to the requirements of the Health and Safety Authority, the applicant is requested to submit a written assessment of the likelihood and consequences of a catastrophic loss of containment of a dangerous substance from the proposed tanks, with particular focus on any possible impact, i.e. bund overtopping as a major accident hazard scenario

- Furthermore the applicant is advised that Fingal County Council are currently preparing a masterplan for Swords Town Centre in accordance with Objective Swords 8 of the County Development Plan 2005 – 2011. Urban designers and landscape architects have been engaged in this regard and an element of the project includes the enhancement and regeneration of the of the River Ward Valley throughout Swords. It is therefore hoped and planned that a greater usage of this amenity be made with regard to that stretch of the River Ward to the east of the site. In light of the above you are requested to revisit your statement of page 3 / 4, Section 3 of submitted AWN report. The applicant is requested to clarify the full extent and nature of the likely impact on this area with particular regard to its increased use as a public amenity

For reference, the AWN statement on Page 3/4 Section 3 was:

The predicted dangerous dose (for an explosion) is predicted to extend just 2m outside the site boundary for the tank at the southern end of the bund, however the ground in this area is scrub land and there is a 5m vertical drop down a vertical to 1:1 slope to the bed of the Ward River. This is not an area which is public use and therefore any slight impact on this area is of no significance. It can therefore be concluded that there are no significant impacts associated with explosion impacts from the proposed waste solvent tank farm.

It can be seen that the dangerous dose threshold contour (for a pool fire) is predicted to remain largely within the BMS site boundary with the exception of the eastern boundary, which is adjacent to the Ward River. The dangerous dose threshold contour does not impact on any residential area. The area of the Ward River which is impacted is steeply sloping river bank which is overgrown with scrub vegetation and is not used for amenity purposes.

1.1 Consequence Analysis and Risk Assessment – An Introduction

Trevor Kletz in his seminal work on the subject stated that the essential elements of consequence analysis and risk assessment for a Major Accident scenario are (i) how often is a Major Accident Hazard (MAH) likely to occur and (ii) Consequence Analysis – what is the impact of the incident [1]:

Kletz also commented that another way of expressing this method of QRA is:

How often?

How big?

So what?

The "how often?" question is answered by using Fault Tree Analysis (FTA). FTA was first developed by Bell Telephone Laboratories in 1961 for missile control launch reliability and further developed by Haasl at the Boeing Company [2] and was first applied to the process industries by Rasmussen in 1975 [3].

The FTA process involves using a combination of simple logic gates (AND and OR gates), to create a failure model for a process or an installation. The frequency or probability of the top event is calculated from failure data for more simple events.

A fault tree is developed by first defining the top event, in FTA for MAH this may be events such as a release of toxic gas, an explosion, or the loss of containment of a material.

A series of events which lead to the top event are then developed and the relationship between events is defined, using AND and OR gates. The probability or frequency of occurrence of individual events is then obtained from generic data, or from manufacturers data and the probability or frequency of the top event is then calculated.

The frequency data for failure of pipes, tanks and protection systems for the FTA in this assessment has been obtained from the American Institute of Chemical Engineers PERD Data Tables [4].

The 'how big' element of the QRA is conducted using the BREEZE HAZ modelling software, produced by Trinity Consultants Inc., USA. A Consequence Analysis model was developed for each process vessel in question, using the BREEZE HAZ suite of software models.

BREEZE HAZ has 13 models, developed by the US EPA, US Air Force, US Army, US Gas Research Institute, Dutch TNO and UK HSE, which can be used for quantitatively predicting the effects of explosions, fireballs, BLEVEs (Boiling Liquid Expanding Vapour Explosions), pool fires, jet fires and vapour cloud explosions and for predicting the dispersion of pools of solvent and toxic gas releases.

The "so what" element is perhaps the most contentious issue associated with QRA, as one is essentially asking what is an acceptable level of risk, in this case risk of fatality, posed by a facility.

It is widely accepted that "no risk" scenarios do not exist. The occupier of a house with gas fired central heating is exposed to the risk posed by the presence of a natural gas supply in the house. Statistics from the UK Health and Safety Executive (UK HSE Risks associated with Gas Supply, 1993) show that the risk of death from gas supply events in the UK (risks include explosion, asphyxiation by fumes from poorly vented heaters, poisoning by gas leaks) is approximately 1.1 in a million. In other words, for every 10 million persons living in houses with a gas supply, 11 will die from events related to the supply.

Table 1.1 below presents the annual fatality rates, and the risk of fatality, for a number of activities (from CIRIA Report 152, 1994) in the UK.

Risk	Annual Fatality Rate (per 1000, 000 people at risk)	Annual Risk of Fatality
Motorcycling	20,000	1 in 50
Smoking (all causes)	3000	1 in 333
Smoking (cancer)	1200	1 in 830
Fire fighting	800	1 in 1250
Farming	360	1 in 2778
Police work (non-clerical)	220	1 in 4545
Road accidents	100	1 in 10,000
Fires	28	1 in 35,700
Natural gas supply to house	1.1	1 in 909,090
Lightning strike	0.5	1 in 2,000,000

Table 1.1 Annual fatality rates for a variety of activities

Kletz has shown that the average industrial worker is exposed to a risk of accidental death of somewhere around 1×10^{-3} per year, for all situations (work, home, travel).

Kletz has argued, that a risk of fatality which is 1% of the possible risk of death normally posed to individuals in their normal day to day activities, which is equal to 1×10^{-5} risk of death per annum, would be considered acceptable.

However, it has since been more widely accepted by regulatory agencies in Ireland (HSA) , UK (HSE) and the US (USEPA) than an individual risk of fatality of 1×10^{-6}/year (1 in 1,000,000 per year), for off-site impacts of Major Accident Hazard Facilities, is considered acceptable for most off site land uses and a risk of fatality of 0.3×10^{-7}/year (1 in 3,333,333 per year) is considered acceptable for sensitive land uses such as schools, hospitals and crèche facilities.

1.2 Land Use Planning and Risk Assessment

The Health and Safety Authority (HSA), is the Competent Authority in Ireland as defined by S.I. No. 74 of 2006 European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2006.

The HSA is responsible for ensuring that the impacts of facilities which fall within the remit of this legislation are taken into account with respect to land use planning.

The HSA has published detailed guidelines for assessment of explosion and thermal radiation impacts, with respect to acceptable limits outside the boundary of a facility, in the event of an incident and the Authority uses the concept of "dangerous dose" to set the minimum distance from the point of release that various landuses could be considered appropriate

The dangerous dose is defined as:

The overpressure or thermal dose which gives all of the following effects; - severe distress to almost everyone - a substantial fraction would require medical attention - some people might be seriously injured, and require prolonged medical attention - any (a few%) highly susceptible people might be killed [5].

The publication 'Safety Cases' within the Control of Industrial Major Accident Hazards (CIMAH) Regulations 1984 cites 14kPa as the distance to a dangerous dose for typical housing and 7 kPa for sensitive developments, and 14 kPa is used as the dangerous dose by the HSA.

The following table on blast damage is provided in "Guidelines for Evaluating Characteristics of Vapor Cloud Explosions, Flash Fires and BLEVEs" published by the American Institute of Chemical Engineers. (Note: 1kPa = 10mbar = 0.01barg)

Side-on overpressure (kPa)	Description of Damage
0.15	Annoying noise
0.2	Occasional breaking of large window panes 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

With respect to thermal dose the HSA has stated:

Exposure to thermal radiation can be expressed in terms of thermal dose units ($(kW/m^2)^{4/3}.s$) with kW/m^2 being the radiation level and s the exposure time in seconds. Consequence distances for thermal effects are based on an assumed 75 seconds exposure and correspond to 50% fatality (inner), 1% fatality (Middle) & the (outer) threshold of fatality for vulnerable persons-

Zone	Distance to
Inner	Source-1800 TDU
Middle	1800-1000 TDU
Outer	1000- 500 TDU

The publication 'Safety Cases' within the Control of Industrial Major Accident Hazards (CIMAH) Regulations 1984 indicates that 500 thermal dose units $(kW/m^2)^{4/3}.s$) as the limit for blistering of skin and could be very serious for elderly people whilst a 1000 thermal dose units is the threshold of lethality for a typical population and could include some severe injuries and is used as the dangerous dose by the HSA.

It is also appropriate, in land use planning terms, to consider the non-fatal impacts on humans.

2.0 SITE DESCRIPTION

Swords Laboratories is one of two bulk pharmaceutical plants owned and operated by Bristol-Myers Squibb (BMS) in Ireland.

Swords Laboratories manufactures bulk pharmaceuticals which are shipped to BMS finishing plants around the world where they are used as the key ingredients in the production of tablets, capsules and other healthcare treatment. The Swords plant commenced manufacturing operations in 1964 and is one of the company's key suppliers of bulk pharmaceuticals. The bulk products are shipped to BMS finishing plants around the world where they are used as the key ingredients in the production of tablets, capsules and other healthcare treatments.

Over the last 40 years Swords Laboratories has maintained its focus as a world class manufacturing facility and Centre of Excellence in process research and development. Many of the corporation's new drug lines are launched at this plant. The Swords facility is the primary site within BMS for the scale-up and development of new processes. For this reason it is of strategic importance to the company. Its success is demonstrated by continued expansion since initial establishment of the chemical development facility in 1984. Over 400 people are now employed at the facility.

As with any modern bulk pharmaceutical synthesis facility, the site comprises a number of distinct and interlinked elements including a bulk pharmaceutical manufacturing building, raw materials and finished product warehousing, tank farms, Central Utilities elements and administration and office buildings. As part of BMS commitment to environmental protection, BMS propose to construct 5 no. 50 m^3 316 stainless steel tanks in the solvent recovery tank farm to hold mixed waste solvent.

The location of proposed tanks is shown in Figures 2.1, 2.2 and 2.3.

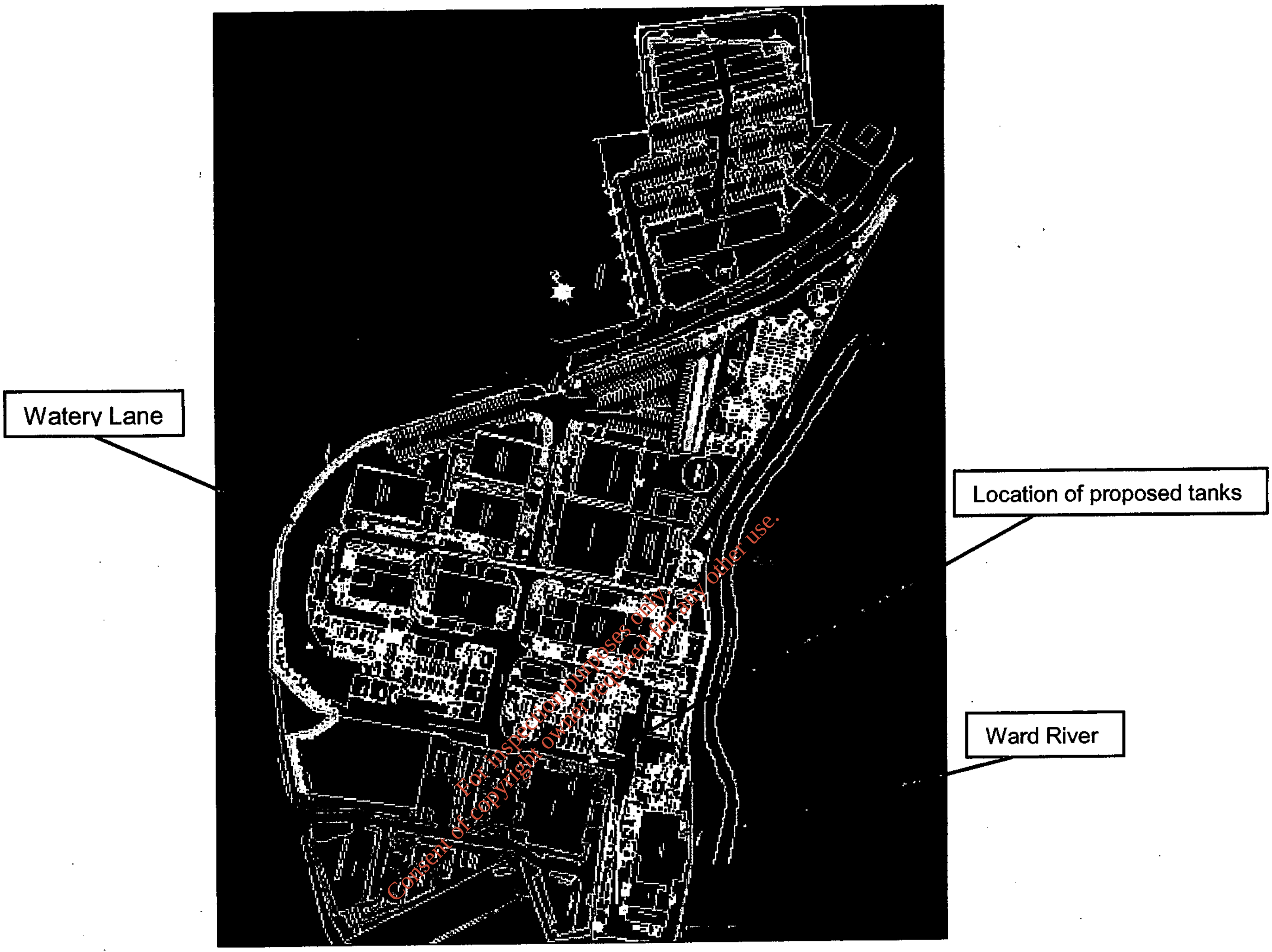

Figure 2.1 Location of Proposed Solvent Storage Tanks on Swords Laboratories Site

Figure 2.2 Location of proposed solvent tanks showing details of immediate surroundings

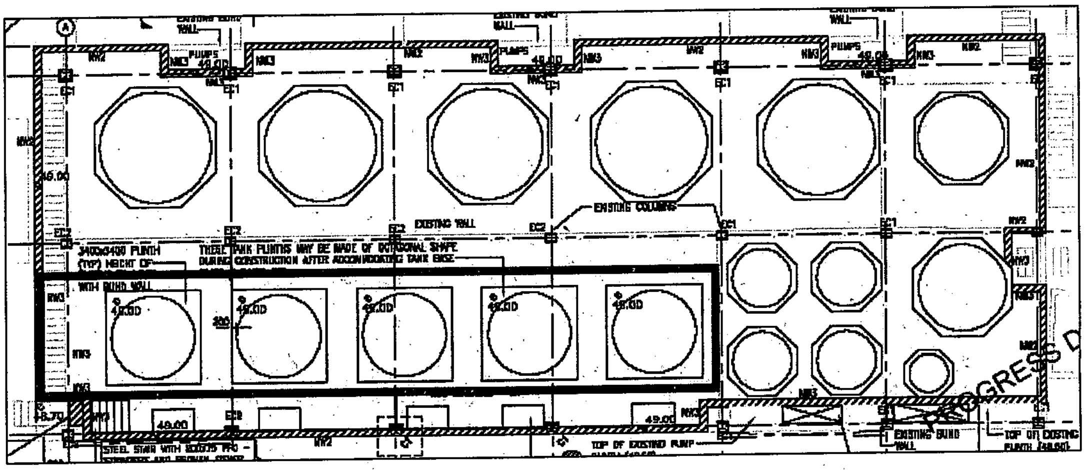

Figure 2.3 Location of 5 no. new stainless steel waste solvent storage tanks in bund (outlined in red)

The waste solvent tanks could contain one or more of the following solvents:

- Methanol
- MIBK (Methyl Isobutyl Ketone)
- Acetone
- Methylene Chloride
- Isopropanol (IPA)
- Ethyl acetate
- Butanol
- Isopropyl acetate
- Toluene

3.0 IDENTIFICATION OF ACCIDENT AND MAH SCENARIOS

A HAZID assessment, following guidance from a number of best practice publications from the ICHEME and the European Process Safety Centre and also following a review of the UK HSE Voluntary Reporting Database for Loss of Containment Accidents [6, 7, 8].

The aim of the HAZID was to identify potential MAH (major Accident Hazard) scenarios, where a MAH is defined as:

"an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of an establishment and leading to a serious danger to human health and/or the environment, immediate or delayed, inside or outside the establishment and involving one or more dangerous substances".

Once potential MAH scenarios are identified they can be further investigated by site specific consequence modelling to determine whether or not the accident scenario identified is indeed a MAH.

The accident scenarios identified and associated risk ratings are listed in Table 3.1, and the key to interpreting table 3.1 is shown in Tables 3.2 – 3.5.

No.	Potential Accident Scenarios	F	S	R	Risk Level	Action
	Waste Solvent Storage Tanks					
1	Minor LOC(Guillotine failure of pipeline during unloading)	3	2	6	Tolerable	No further action req'd
2	Minor LOC(Bulk tank leak - pinhole leak)	3	2	6	Tolerable	No further action req'd
3	Minor LOC(Bulk tank leak due to valve failure)	3	2	6	Tolerable	No further action req'd
4	Major LOC(Bulk tank catastrophic structural tank failure)	1	4	4	Trivial	No further action req'd
5	Major LOC(Bulk tank failure due to overpressure from vent blocking)	2	4	8	Tolerable	No further action req'd
6	Major LOC(Bulk tank failure due to implosion from vent blocking)	2	4	8	Tolerable	No further action req'd
7	Minor LOC(Bulk tank overflow due to overfilling)	3	2	6	Tolerable	No further action req'd
8	Major LOC and minor fire	3	2	6	Tolerable	No further action req'd
9	Vapour cloud explosion within almost empty tank	2	5	10	Moderate	**Full Risk Assessment**
10	Major LOC and major fire	2	5	10	Moderate	**Full Risk Assessment**
11	Major LOC and immediate explosion	2	4	8	Tolerable	No further action req'd

Table 3.1 Potential accident scenarios for Waste Solvent Tank Farm

Severity	Category	H&S Impact on site	H&S impact offsite	Environment Impact
0	Negligible	none	none	none
1	Minor	minor injury	none	none
2	Appreciable	multiple injury	discomfort	discolour air/water
3	Severe	permanent disability	screening	minor short term
4	Very Severe	single fatality	minor injuries	significant short term
5	Catastrophic	multiple fatality	major inj/fatality	habitat or species loss

Table 3.2 Key to severity rating

Frequency	Description	Frequency range
1	Virtually impossible	< 1 x 10 -8
2	Improbable	1 x 10-8 to 1 x 10-5
3	Unlikely	1 x 10-5 to 1x10-3
4	Infrequent	1x10-3 to 1 x 0.1
5	Occasional	0.1 to 10
6	Frequent	> 10

Table 3.3 Key to frequency rating

Risk Rating	Risk Level	Action and Timescale
<4	Trivial	Generally no further action required
5 to 8	Tolerable	No additional controls required
9 to 11	Moderate	Efforts should be made to reduce risk
12 to 14	Substantial	Take immediate steps to reduce risk and cease activity until risk reduced
>15	Intolerable	Do not start activity or if started, cease immediately

Table 3.4 Key to risk interpretation

It can readily be seen from Table 3.1 that the there are two scenarios with the potential to result in a MAH. These are:

A vapour cloud explosion within an almost empty tank, the likelihood of which should be very low due to the ATEX zoning and selection of appropriate electrical equipment for the tank farm. Nevertheless, such a scenario is possible.

and:

A major fire in the bund following a catastrophic LOC (Loss of Containment) event leading to the entire contents of the tank flooding the bund with subsequent ignition to form a confined pool fire.

The modelling of the consequences of these two scenarios is described in the following Section of the report.

4.0 MODELLING OF POTENTIAL IMPACT OF MAH

The modelling approach and impact assessment for the two MAH scenarios chosen is described in the following paragraphs

4.1 Vapour Cloud Explosion

The waste solvent tanks could contain one or more of the following solvents:

- Methanol
- MIBK (Methyl Isobutyl Ketone)
- Acetone
- Methylene Chloride
- Isopropanol (IPA)
- Ethyl acetate
- Butanol
- Isopropyl acetate
- Toluene

The magnitude of an explosion resulting from the ignition of a vapour cloud of a compound is proportional to the heat of combustion of the material. The Heat of Combustion ($\Delta_c H^o$) is the energy released as heat when a compound undergoes complete combustion with oxygen. The chemical reaction is typically a hydrocarbon reacting with oxygen to form carbon dioxide, water and heat. It may be expressed with the units; energy/mole of compound, energy/mass of compound or energy/volume of compound.

Given that a mixture of materials may be present in any one of the solvent tanks, the heats of combustion of each material were obtained from US Government NIST Data and are listed in Table 4.1.

	Heat of Comb
	kCal/mol
Methanol	-173
MIBK	-883
Acetone	-431
Methylene Chloride	-144
Isopropyl Alcohol	-479
Ethyl acetate	-539
Butanol	-638
Ethanol	-327
Isopropyl Acetate	-688
Toluene	-937

Table 4.1 Heats of combustion of materials which could be present in tanks

It can be seen from Table 4.1 that Toluene has the greatest heat of combustion value. For the purposes of this assessment it will be assumed that an explosion could occur within a tank in which the only material present was toluene and therefore the vapour in the tank is an air/toluene mixture.

This is a conservative approach as in reality the likelihood is that the tank will contain other materials with lower heats of combustion and therefore lower associated explosive energy, however the toluene vapour cloud explosion represents worst case impacts for a MAH scenario.

The stoichiometric combustion ratio of toluene with oxygen is as follows:

$$C_7H_8 + 9\,O_2 \longrightarrow 7CO_2 + 4H_2O$$

1 mole of air contains 3.76 moles of N_2 and 1 mole of O_2.

The starting composition for an explosive event in the atmosphere of a tank containing toluene is therefore:

$$C_7H_8 + 9\,O_2 + 9 \times 3.72\,N_2$$

The initial gas mixture is therefore as per Table 4.2

Compound	Moles	Mole fraction
$C_6H_{12}O$	1	0.0228
O_2	9	0.2053
N_2	33.84	0.7719
Total	43.84	1

Table 4.2 Initial gas mixture

If it is assumed that the unlikely scenario whereby the tank is emptied to the point where it contains 5% liquid toluene and 95% vapour, the volume of the vapour is 47.5m^3 at an assumed ambient temperature of 10°C (283K) (annual average temperature at Dublin Airport).

Response to Health and Safety Authority Query from meeting on 28/2/07: *Swords Laboratories have confirmed that the 5% full is the minimum that the liquid level in the tank will be reduced to.*

1 mole of vapour = 22.4 litres at 273 K

1 mole of vapour = 23.2 litres at 283K

47,500 litres/ 23.2 litres = 2045.6 moles of vapour

The amount of toluene in this volume that could combust is:

2045.6 x 0.0228 = 46.6 moles of toluene

The energy of combustion is therefore:

46.6 moles x (937 kCal/mole) = 43,721 kCal

1 kg of TNT = 1120 kCal

therefore the TNT mass equivalent of the explosion is 39.04 kg TNT.

The explosion of this mass equivalent of TNT was modelled using the US Army TNT Equivalent Model, the results of the modelling are as follows (all overpressure values are peak side overpressure):

INPUT DATA
Equivalent TNT mass:39.04 kg

RESULTS

CALCULATED OVERPRESSURES AT SPECIFIED DISTANCES

Specified Distance m	Surface Explosion Overpressure atm(g)	Free-Air Explosion Overpressure atm(g)
5.000	6.654	4.825
10.000	1.349	0.982
15.000	0.576	0.387
20.000	0.371	0.227
25.000	0.263	0.168
50.000	0.091	0.082
75.000	0.051	0.054

CALCULATED DISTANCES AT SPECIFIED OVERPRESSURES

Specified Overpressure atm(g)	Surface Explosion Distance m	
0.138	38.2	Maximum extent of dangerous dose for housing
0.197	30.13	Structural damage to steel frame buildings
0.28	24.18	Rupture of atmospheric liquid storage tanks

The model output for the distance to the following side on peak overpressures is shown in Figures 4.1 and 4.2:

Overpressure to dangerous dose (green),
Overpressure to major structural damage to steel frame buildings(yellow)
Overpressure to rupture of atmospheric liquid steel tanks (red)

Figure 4.1 Impact of explosion for new tank at southern end of bund

Figure 4.2 Impact of explosion for new tank at northern end of bund

It can be seen from the output data from the model that the theoretical worst case explosion could lead to structural damage to buildings and tanks that would largely be confined within the site boundary, with the exception of the tanks (which contain aqueous liquid) and one end of the (normally unoccupied) building which comprise the Arch Chemicals wastewater plant. The dangerous dose for residential areas is not exceeded outside the site boundary and therefore is not predicted to extend to any residential areas.

The predicted dangerous dose is predicted to extend just 2m outside the site boundary for the tank at the southern end of the bund, however the ground in this area is scrub land and there is a 5m vertical drop down a vertical to 1:1 slope to the bed of the Ward River. This is not an area which is public use and therefore any slight impact on this area is of no significance.

It can therefore be concluded that there are no significant impacts associated with explosion impacts from the proposed waste solvent tank farm.

4.2 Response to Fingal County Council Request for Additional Information F07A/0075

With respect to:

"the full extent and nature of the likely impact on this area with particular regard to its increased use as a public amenity";

the following comments are made:

The proposed 5 no. tanks will store waste solvent, and for the purposes of this assessment, it was assumed that the worst case scenario, where the liquid within the waste solvent tank could be entirely toluene, occurs, in order to predict the worst case explosion impacts.

Fresh toluene is already stored in the existing solvent storage tanks within the bund and therefore it is useful to model the potential impact of a vapour cloud explosion in one of the existing tanks, this predicted impact is shown in Figure 4.3.

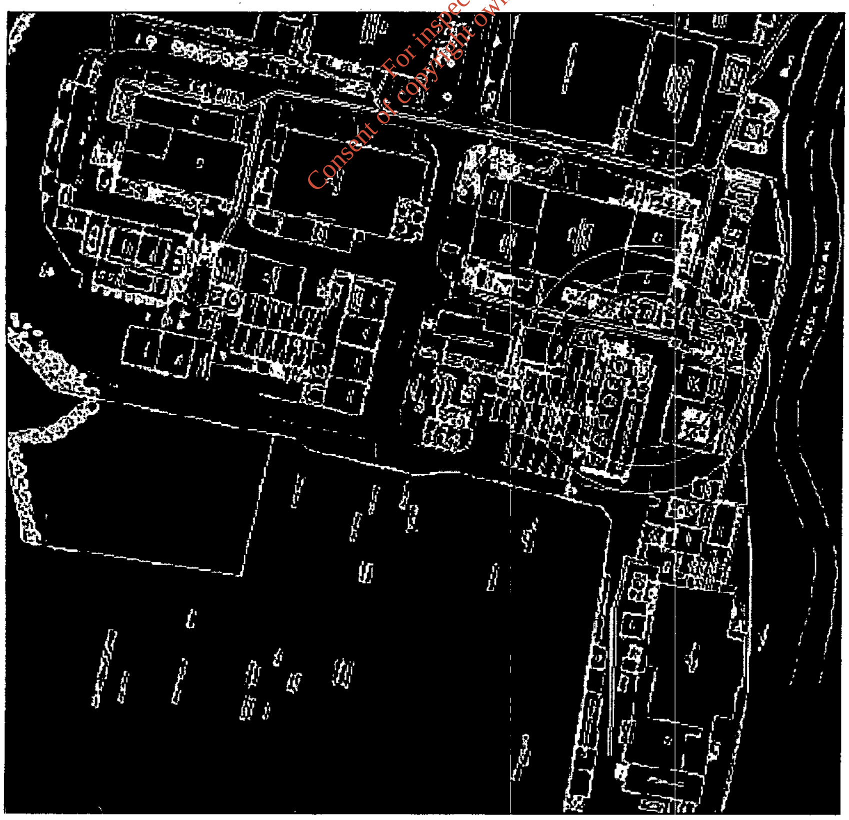

Figure 4.3 Impact of explosion for existing tank at northern end of bund

It can be seen from Figure 4.3 that the existing impact is practically identical to the predicted impact with the proposed waste solvent tanks in place, in that the impact is on the steep river bank immediately adjacent to the Swords Laboratories site, which, as has been previously stated is a vertical/1:1 slope and is on the opposite side of the river from the existing Park.

In summary, the addition of the new solvent waste tanks does not change in any significant way the existing impact of the Swords Laboratories site, with respect to explosion impacts.

It is important to note that the impacted area adjacent to the site boundary is inaccessible and will not be frequented by members of the public. Therefore, there will be no change to the potential for public amenity use of the Park, as a result of the installation of the proposed waste solvent tanks.

4.3 Confined Pool Fire

The Breeze Haz Confined Pool Fire Model was chosen to assess the off site impacts of the MAH scenario.

A confined pool fire occurs when liquid is ignited in a confined area. The area may be circular or rectangular. The vapour required to sustain the flame is provided by the liquid, which vaporizes as a result of ground heating and radiation from the flame.

The Confined Pool Fire model calculates the thermal radiation at various specified distances from the centre of the pool fire, and the distance to various specified radiation levels.

This model was originally developed for the U.S. Gas Research Institute (GRI).
by Risk and Industrial Safety Consultants, and was first published in "LFGRISK User's Manual", Gas Research Institute, Chicago, IL in 1996.

It is extremely difficult, and of little practical value, to model heat generated by the combustion of mixtures and it is accepted good practice to model the fire as being fuelled by the component with the greatest heat of combustion of those materials which comprise the mixture, which in this case is toluene. This is a worst case modelling scenario, and is likely to overstate the actual radiative heat generated by the fire, but is considered a suitably conservative approach.

The bunded area will have dimensions of 7m x 24m and the catastrophic failure of a full tank to form a pool will lead to a liquid layer 0.5m deep and 168 m^2 in area. F2 and D5 weather classes were modelled, to determine the effect of wind-speed on thermal radiation.

The model output was compared with the thermal radiation:

equal to the dangerous dose of 1000 TDU - 6.9 kW/m^2 for 75 sec (green)
equal to the dangerous dose of 1800 TDU - 10.8 kW/m^2 for 75 sec (yellow)
thermal radiation level which is acceptable for streets and roads 21 kW/m^2 (red)

CONFINED POOL FIRE MODEL - F2 SCENARIO

RECTANGULAR DIKE OR TANK FIRE

FUEL

Name	: TOLUENE
Pool temperature	: 20.0 °C

CONSTANT PROPERTIES

Molecular weight	: 92.14
Boiling point	: 110.65 °C
Critical temperature	: 591.8 K
Critical pressure	: 41.09 bar
Heat of combustion	: 4.06E+07 J/kg
Flame temperature	: 1300 K

CALCULATED PROPERTIES

Liquid compressibility factor	: 0.004
Liquid density	: 863.0 kg/cu m

DIMENSIONS

Pool Width	: 7 m
Pool Length	: 24m
Pool liquid height	: 0.3 m
Height of flame base	: 0.3 m
Height for Radiation Calculations	: 0.5 m

LOCAL AMBIENT CONDITIONS

Air temperature	: 20.0 °C
Ambient pressure	: 1.01 bar
Wind speed	: 2.0 m/s
Relative humidity	: 20.0%

RESULTS

Mass burning rate	: 0.077 kg/m² s
Flame length	: 25.28 m
Flame tilt from vertical	: 33.52°
Flame drag ratio	: 1.17
Maximum emissive power	: 140.0 kW/m²
Effective emissive power	: 139.18 kW/m²

Thermal flux (kW/m²)	Distance From center of Pool (m)
21.0	33.14
10.8	44.10
6.9	52.79

Distance from center of pool (m)	Thermal flux to horizontal target (kW/m²)	Thermal flux to vertical target (kW/m²)	Maximum flux to target (kW/m²)
10.97	72.81	44.02	87.73
14.62	51.71	51.79	73.51
18.28	38.41	40.57	56.51
21.93	28.53	33.20	47.30
29.24	14.78	22.72	27.12
36.55	7.39	15.19	16.89
43.86	3.84	10.25	10.95
58.48	1.28	5.18	5.33
87.72	0.28	1.93	1.95
146.20	0.04	0.58	0.58

Figure 4.4 F2 Toluene Pool Fire

The model output for the D5 scenario is as follows:

CONFINED POOL FIRE MODEL - D5 SCENARIO

RECTANGULAR DIKE OR TANK FIRE

FUEL
Name : TOLUENE
Pool temperature : 20.0 °C

CONSTANT PROPERTIES
Molecular weight : 92.14
Boiling point : 110.65 °C
Critical temperature : 591.8 K
Critical pressure : 41.09 bar
Heat of combustion : 4.06E+07 J/kg
Flame temperature : 1300 K

CALCULATED PROPERTIES
Liquid compressibility factor : 0.004
Liquid density : 863.0 kg/cu m

DIMENSIONS
Pool Width : 7 m
Pool Length : 24m
Pool liquid height : 0.3 m
Height of flame base : 0.3 m
Height for Radiation Calculations : 0.5 m

LOCAL AMBIENT CONDITIONS
Air temperature : 20.0 °C
Ambient pressure : 1.01 bar
Wind speed : 5.0 m/s
Relative humidity : 20.0%

RESULTS
Mass burning rate : 0.077 kg/m² s
Flame length : 25.28 m
Flame tilt from vertical : 58.18°
Flame drag ratio : 1.33
Maximum emissive power : 140.0 kW/m²
Effective emissive power : 139.59 kW/m²

Thermal flux (kW/m²)	Distance From center of Pool (m)
21.0	39.92
10.8	47.82
6.9	54.27

Distance from center of pool (m)	Thermal flux to horizontal target (kW/m²)	Thermal flux to vertical target (kW/m²)	Maximum flux to target (kW/m²)
10.97	Target in flame	Target in flame	Target in flame
14.62	96.66	17.51	100.98
18.28	81.52	38.47	95.46
21.93	67.68	39.58	80.25
29.24	39.50	32.84	52.53
36.55	15.70	23.97	28.66
43.86	5.54	13.75	14.83
58.48	1.10	5.25	5.36
87.72	0.16	1.56	1.57
146.20	0.02	0.41	0.41

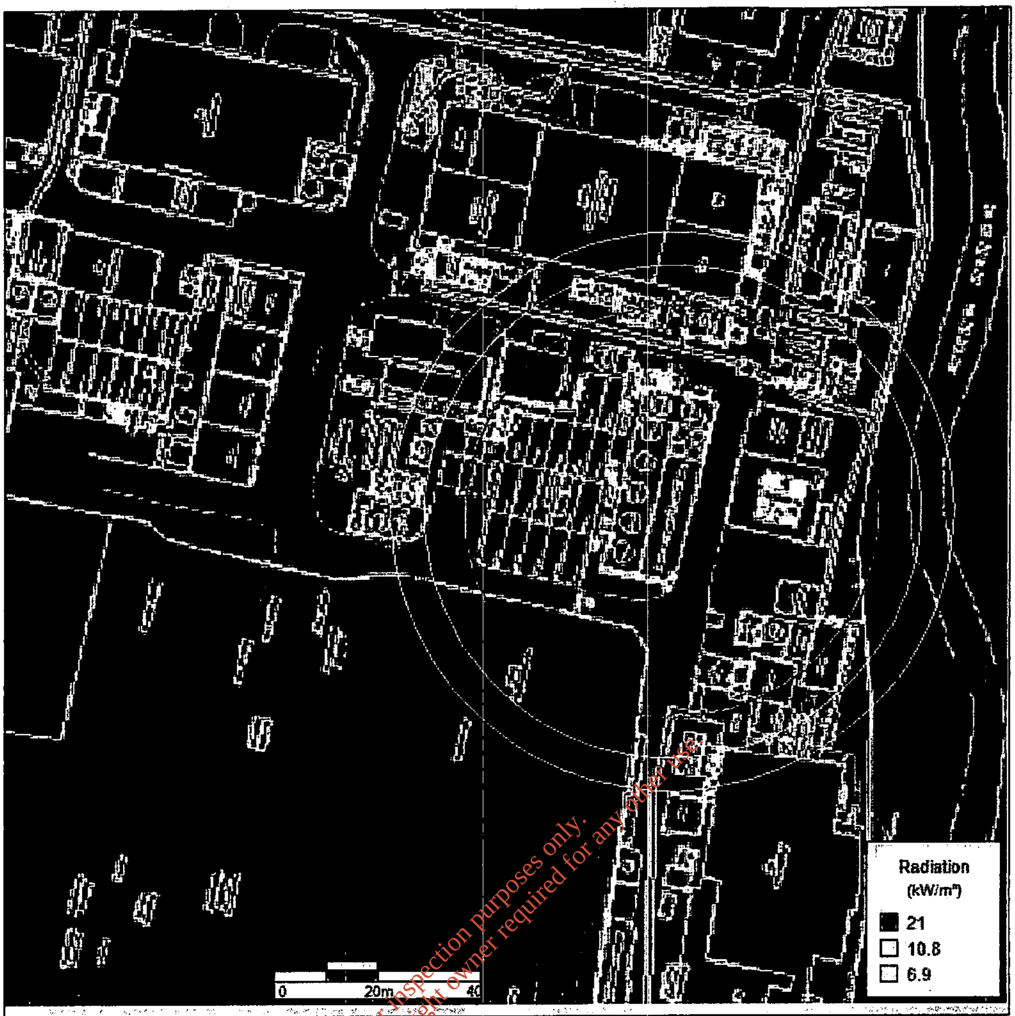

Figure 4.5 D5 Toluene Pool Fire

It can be seen that the dangerous dose threshold contour is predicted to remain largely within the BMS site boundary with the exception of the eastern boundary, which is adjacent to the Ward River. The dangerous dose threshold contour does not impact on any residential area. The area of the Ward River which is impacted is steeply sloping river bank which is overgrown with scrub vegetation and is not used for amenity purposes.

There are predicted thermal impacts on the Arch chemicals site but only aqueous tanks and a steel frame building are predicted to be impacted by the most onerous contour (the contour which sets an acceptable level for streets and roads) so the predicted impacts on Arch Chemicals are considered not significant. The solvent recovery plant and other structures which are located along the eastern boundary of the BMS site will have the effect of providing thermal screening between the pool fire and the eastern boundary, up to a height of circa 5m.

4.4 Response to Fingal County Council Request for Additional Information F07A/0075

With respect to:

"the full extent and nature of the likely impact on this area with particular regard to its increased use as a public amenity" and where the pool fire remains within the bund;

the following comments are made:

The proposed 5 no. tanks will store waste solvent, and for the purposes of this assessment, it was assumed that the worst case scenario, where the liquid within the waste solvent tank could be entirely toluene, occurs, in order to predict the worst case pool fire impacts.

However, it should be noted that fresh toluene is already stored in the tank farm at the moment, and therefore the scenario where a toluene pool fire in the bund could occur already exists. Therefore the installation of the waste solvent tanks will not materially change the impact that this bunded area currently has on the adjacent areas.

It is noted from the D5 scenario that there is a small predicted impact on a small portion (25m in length) of the eastern bank of the Ward River, however, as has been noted above, the impacted length is no different to the length of river bank which is currently being impacted.

The type of major accident which could lead to this scenario occurring is a catastrophic tank failure, followed by the ignition of the pool. Whilst the tank failure is instantaneous, the development of a fire to the point where it has reached its maximum intensity (which is the impact modelled), would take place over a period of time, and any observers in the Park would be able to see the fire developing and feel heat from the fire, and therefore would naturally tend to move away from the fire, rather than towards it.

The risk of a catastrophic tank failure, followed by a pool fire, occurring, is very low. From the Purple Book (reference Guidelines for Quantitative Risk Assessment, CPR 18E, "The Purple Book", Committee for the Prevention of Disasters, The Hague, 1999), an atmospheric tank has an associated risk of catastrophic failure of 1×10^{-5}

per annum x 5 no. tanks is equal to an annual risk of a tank failure occurring 5 x 10^{-5} per annum.

Once the failure occurs, an ignition source has to be present in order to ignite the liquid, and this is unlikely as the area in question is designed such that all electrical equipment within the area is suitable for use in an area which has an explosive atmosphere.

At a conservative estimate, it is assumed that the probability of an ignition source being present, from electrical equipment failure, is considered to be 1 x 10^{-3} per annum (US AICHE PERD Data Tables).

The probability of a pool fire occurring is therefore estimated at 5 x 10^{-8} per annum.

For comparison, the risk of being struck by lightning (from Table 1.1) is considered to be 5 x 10^{-7} per annum, so the risk of a pool fire occurring can be considered negligible.

In summary, it can be concluded that the proposed installation of 5 no. waste solvent storage tanks will not change the current situation with respect to impact on the adjacent park, and that the impact with respect to the current situation is only on a small section of the river bank. Furthermore that the nature of the impact is such that it would take some time to evolve, and anyone in this small area would have ample warning (by virtue that they would notice the fire and feel the heat from it) and time to vacate the area. The risk of the impact occurring is very low, and someone is statistically more likely to be struck by lightning in the Park than to be affected by the impacts of a pool fire in the bund.

4.5 Response to Fingal County Council Letter F07A/0075, Item 1, bund overtopping and associated impacts

Item 1 of the above letter states:

"In regard to the requirements of the Health and Safety Authority, the applicant is requested to submit a written assessment of the likelihood and consequences of a catastrophic loss of containment of a dangerous substance from the proposed tanks, with particular focus on any possible impact, i.e. bund overtopping as a major accident hazard scenario".

It is acknowledged that there is a theoretical risk of bund overtopping in the event of a catastrophic tank failure, this phenomenon is explored in the recent UK HSE Report No 333, "An experimental investigation of bund wall overtopping, and dynamic pressures on the bund wall following, catastrophic failure of a storage vessel".

The above report notes that up to 70% of the contents of a tank may overtop a bund, depending on where the tank ruptures and the extent of the rupture.

It has been assumed, therefore, that 70% of the contents of the 50,000 litre storage tank overtop the bund following a catastrophic tank failure.

A topographical survey of the bund in which the proposed tanks will be situated, and the surrounding area, was conducted by Swords Laboratories, in order to determine the likely flow path of any liquid generated by a bund overtopping event.

Figure 4.6 shows the ground levels in the immediate vicinity of the bund in which the proposed tanks will be situated.

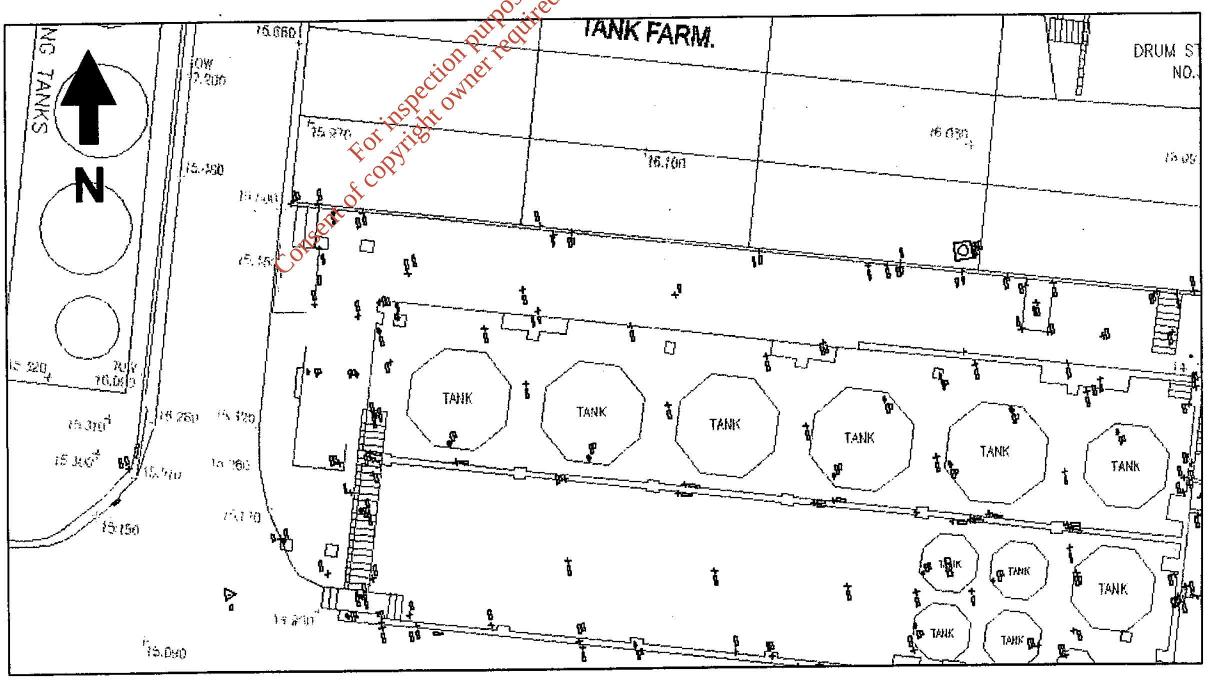

Figure 4.6 Ground levels in vicinity of bund in which proposed tanks will be located

It can be seen from Figure 4.6 that ground levels along the surface of the site road to the north and west of the bund begin at 15,66m AOD to the north and decrease to 15.48 m AOD, and the to 14.9 – 15.0m AOD, at the south western corner of the bund. It can therefore be seen that there is a fall on the road surface of some 0.5m as one moves from the north western corner of the bund to the south western corner of the bund. Any liquid overtopping the western wall of the bund would therefore tend to flow in a southerly direction along the site road.

There is a concrete boundary wall along the western boundary of the roadway. This wall separates the Arch Chemicals site from the Swords Laboratories site and the top of the wall is some 0.8m above the road surface (16.09 m AOD) at its lowest point. This wall would prevent any liquid on the road from flowing onto the Arch site, and as has been noted above, in any case, liquid on the road will flow in a southerly direction, following the contour of the road.

Figure 4.7 shows the topography to the south and east of the bund.

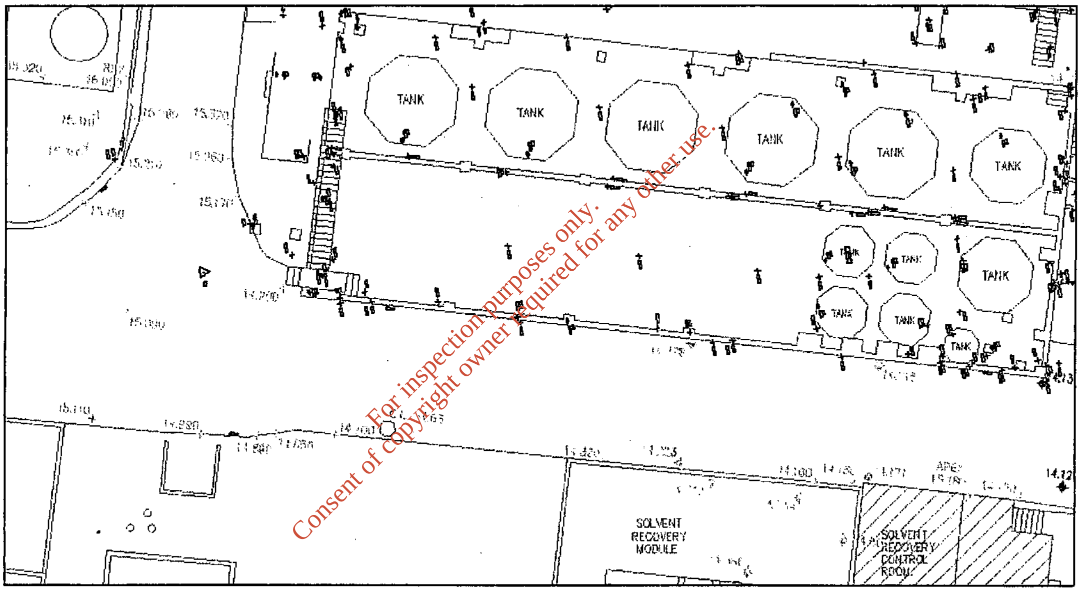

Figure 4.7 Topography to south and east of bund

It can be seen from Figure 4.7 that the road slopes from a high point of 15.09 – 15.110 m AOD along the centre of the road at the south western corner of the bund and then slopes sharply in an easterly direction to reach 14.120 m AOD near the south eastern corner of the bund, which is a drop of almost 1 metre along the length of the bund. It can therefore be determined that liquid overtopping the bund walls would tend to flow in an easterly direction away from the Arch Chemicals site and to the east of the bund.

The topography further to the east of the bund is shown in Figures 4.8 and 4.9. It can be seen from this figure that the ground continues to slope to the east, so that any liquid overtopping the bund would tend to continue flowing east, away from the Arch Chemicals site.

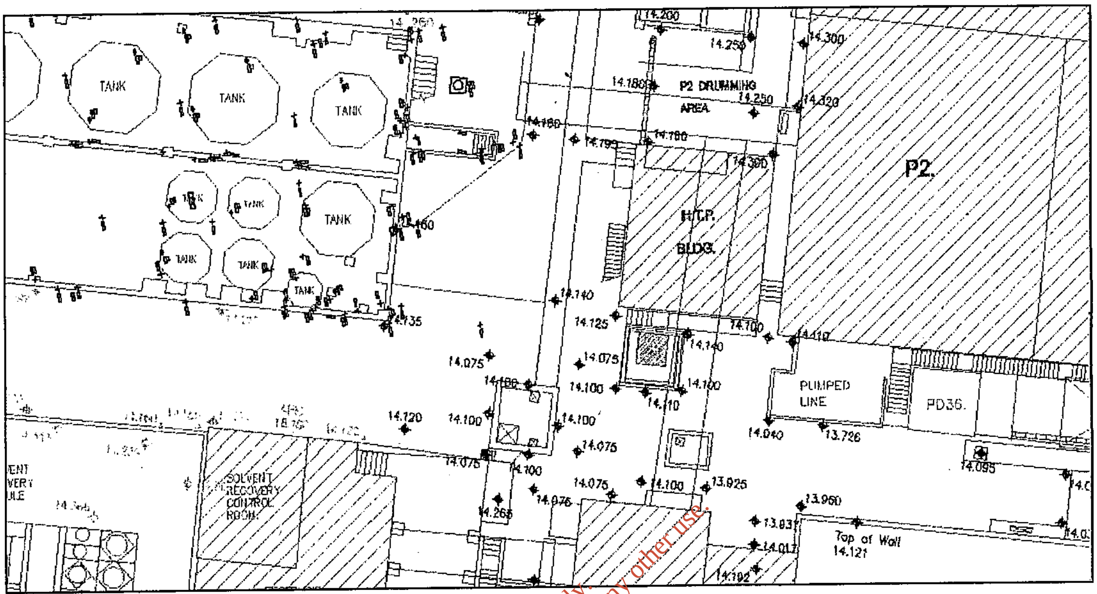

Figure 4.8 Topography to the east of the bund

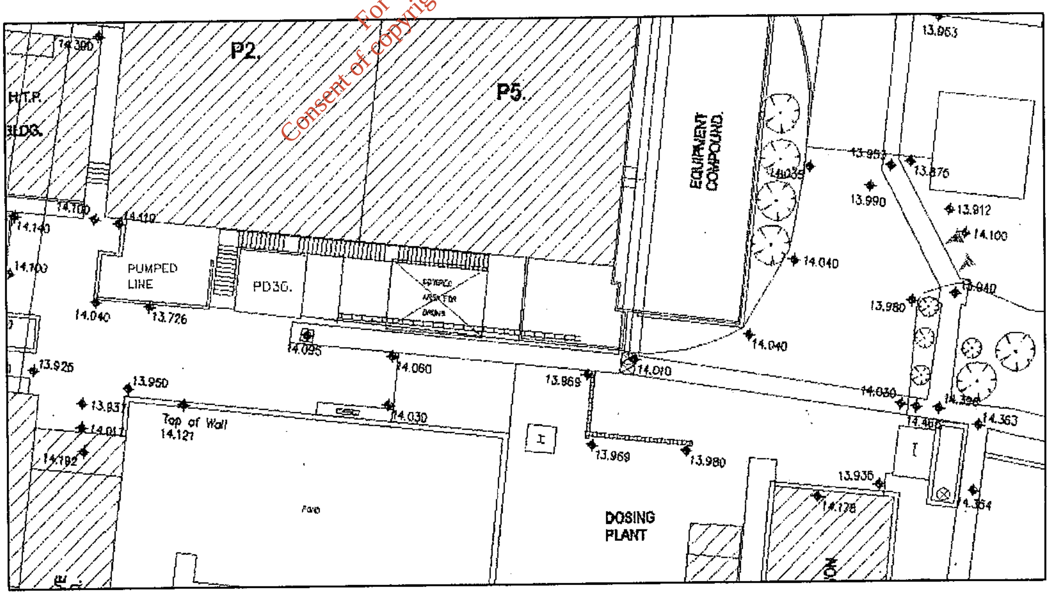

Figure 4.9 Topography further to the east of the bund

It can be seen from Figure 4.9 that liquid would tend to pool on the roadway in two distinct areas. The first is in the vicinity of the area marked "pumped line" above, where there is a low point of 13.726m AOD, and the area is bounded by "high points" at 14.04 m AOD and 14.06m AOD, which gives an approximate pool area of 18m x 5m with a maximum depth of 0.31 metres and a maximum pool volume of 14.1 m^3 .

The remainder of the liquid (20.9 m^3) would continue on and pool in the vicinity of the Dosing Plant.

The roadway is drained by road gulleys which drain to the on site wastewater treatment plant. An estimate of the time taken for these pools to drain away can be calculated as follows:

From P 53, Vol 2 of Wallingford Tables Vol 1, HR Wallingford, 1999;

100mm pipe and 1/100 slope
and Ks = 0.06
Discharge rate at full bore = 7.5 litres/sec

(Note, this assumes a 1:100 slope for the drainage line, it is more likely that the line is laid at the traditional slope of 1:50 but the additional safety margin allows for any settling along the length of the pipe which may have occurred over time).

Based on a maximum pool volume of 14,100 litres (ignoring any losses to the road gulleys as the liquid travels along the road), and a drainage rate from a single gully of 7.5 litres per second, the first pool would take some 1884 seconds (0.52 hours) to drain away completely.

The second pool would take some (20,900/7.5) = 0.78 hours to drain away and would be expected to have a pool area similar to the first pool.

The first pool is shielded from the Park by the Pump House and the second pool is shielded from the Park by the Cooling Towers and therefore, in the unlikely even that a pool fire should occur in either of these areas, one could expect thermal shielding from these structures with respect to any occupants in the Park.

Figures 4.10 and 4.11 show the theoretical predicted thermal radiation impact on the Park, for the D5 fire model only (the worst case weather conditions), without thermal shielding.

It can be seen that there is a marginal predicted impact on the Park, but for the second pool, but it should be noted that this is for the pool at its maximum diameter, and that this diameter will be decreasing, as the pool drains away. As with the scenario of the pool fire in the bund, the risk of the fire occurring is extremely low and the scenario is such that any occupants of the Park would have adequate time and warning to remove themselves from the vicinity of the fire.

Finally, toluene is already stored in the bunded area, so the modelled accident scenario is a possible scenario for the current storage scenario and the modelled impacts will not change if the additional tanks are put in place.

Response to Fingal County Council Request for Additional Information F07A/0075, Item B

With respect to:

"the full extent and nature of the likely impact on this area with particular regard to its increased use as a public amenity" and the potential impact of a pool fire outside the bunded area and assuming bund overtopping occurs;

the following comments are made:

The proposed 5 no. tanks will store waste solvent, and for the purposes of this assessment, it was assumed that the worst case scenario, where the liquid within the waste solvent tank could be entirely toluene, occurs, in order to predict the worst case pool fire impacts.

However, it should be noted that fresh toluene is already stored in the tank farm at the moment, and therefore the scenario where the bund could overtop and a toluene pool fire could occur outside the bund could occur, already exists. Therefore the installation of the waste solvent tanks will not materially change the impact that this bunded area currently has on the adjacent areas.

It can be seen from Figures 4.10 and 4.11 that there is a small predicted impact on a small portion (approximately 60m in length) of the eastern bank of the Ward River from a bund overtopping event and subsequent pool fire, however, as has been noted above, the impacted length is no different to the length of river bank which is currently being impacted.

The type of major accident which could lead to this scenario occurring is a catastrophic tank failure, bund overtopping, followed by the ignition of the pool. Whilst the tank failure is instantaneous, the development of a fire to the point where it has reached its maximum intensity (which is the impact modelled), would take place over a period of time, and any observers in the Park would be able to see the fire developing and feel heat from the fire, and therefore would naturally tend to move away from the fire, rather than towards it.

The risk of a catastrophic tank failure, followed by a pool fire, occurring, is very low. From the Purple Book (reference Guidelines for Quantitative Risk Assessment, CPR 18E, "The Purple Book", Committee for the Prevention of Disasters, The Hague, 1999), an atmospheric tank has an associated risk of catastrophic failure of 1 x 10^{-5} per annum, so for 5 no. tanks, the risk of an event occurring is 5 x 10^{-5} per annum.

Once the failure occurs, an ignition source has to be present in order to ignite the liquid.

At a conservative estimate, it is assumed that the probability of an ignition source being present, from electrical equipment failure, is considered to be 1 x 10^{-3} per annum (US AICHE PERD Data Tables).

The probability of a pool fire occurring is therefore estimated at 5 x 10^{-8} per annum.

For comparison, the risk of being struck by lightning (from Table 1.1) is considered to be 5 x 10^{-7} per annum, so the risk of a pool fire occurring outside the bund, with subsequent impacts on the park, can be considered negligible.

In summary, it can be concluded that the proposed installation of 5 no. waste solvent storage tanks will not change the current situation with respect to impact on the adjacent park, and that the impact with respect to the current situation is only on a small section of the river bank. Furthermore that the nature of the impact is such that it would take some time to evolve, and anyone in this small area would have ample warning (by virtue that they would notice the fire and feel the heat from it) and time to vacate the area. The risk of the impacts from a pool fire external to the bund occurring is very low, and someone is statistically more likely to be struck by lightning in the Park than to be affected by the impacts of a pool fire.

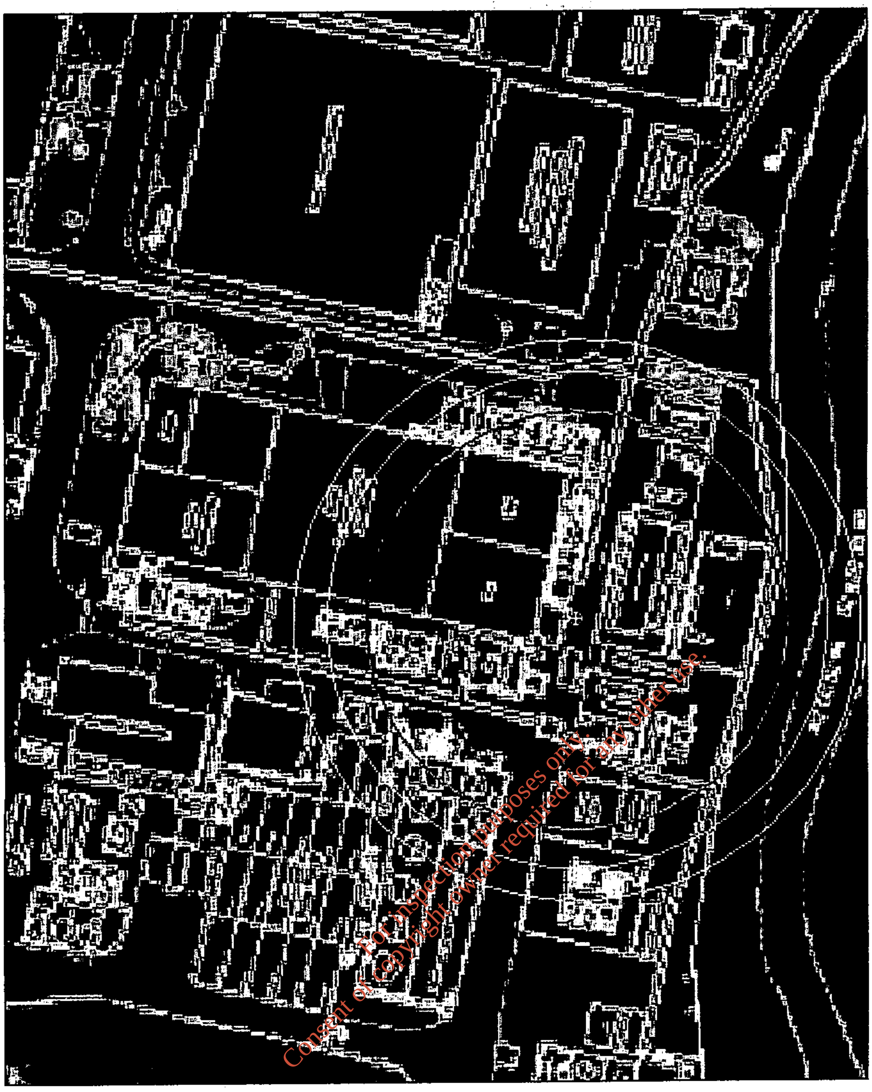

Figure 4.10 D5 thermal radiation impact from first pool

Figure 4.11 D5 thermal radiation impact from second pool

5.0 CONCLUSIONS

It was concluded that the worst case MAH scenarios associated with the proposed tank farm would not result in significant impacts to either the Arch Chemicals site, to the adjacent park or to surrounding residential area with most impacts occurring within the area of adjacent river bank which is steeply sloped, covered in scrub vegetation and not normally accessible to the general public.

The risk of a MAH occurring was found to be extremely low and it was concluded that the MAH scenarios modelled posed and insignificant level of off-site risk, and that placement of the additional tanks in the bund will not change the risk profile of the Swords Laboratories site.

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6. Hazard Identification Methods, European Process Safety Centre, 2003.

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OUTLINE OF EXISTING SITE DRAINAGE SYSTEM

THERE ARE 2 SITE DRAINAGE SYSTEMS LOCAL TO THE WASTE TANK FARM BUND:

1.) PROCESS DRAINAGE:
THIS CONSISTS OF AN UNDERGROUND CONCRETE SUMP (NOTED S1) WHICH RECEIVES PROCESS FROM THE PROCESS DRAINAGE LINE RUNNING PARALLEL TO THE MAIN PRODUCTION BUILDING. THE SUMP ALSO RECEIVES ALL SPILLAGES ONTO THE ROADWAY IN THE GENERAL AREA (ADJACENT ROADS ALL SLOPE TOWARDS S1), VIA 6No. TRAPPED STAINLESS STEEL GULLIES (GY1 TO GY6).
SUMP S1 IS EMPTIED BY A RISING MAIN WHICH FEEDS INTO THE PROCESS DRAINAGE LINE AT IP.27, FROM WHERE IT GRAVITY FEEDS TO THE SITE TREATMENT PLANT.

2.) FIREWATER OVERFLOW FROM SOLVENT RECOVERY PLANT:
THIS CONSIST OF A RAISED COLLECTION CHAMBER ADJACENT TO THE SOLVENT RECOVERY MODULE AND A 600mm DIA. STAINLESS STEEL PIPE RUNNING UNDERGROUND. THIS PIPE FEEDS INTO THE CONCRETE DUCT SURROUNDING THE STAINLESS STEEL PROCESS LINE AT THE FIRESTATION AND TRANSFERS TO THE SITE FIREWATER RETENTION TANK VIA THIS DUCT. THIS SYSTEM HAS A CAPACITY IN EXCESS OF 800 CUB.m/HOUR. THE FIREWATER RETENTION TANK HAS A CAPACITY OF 1500 CUB.m APPROX.

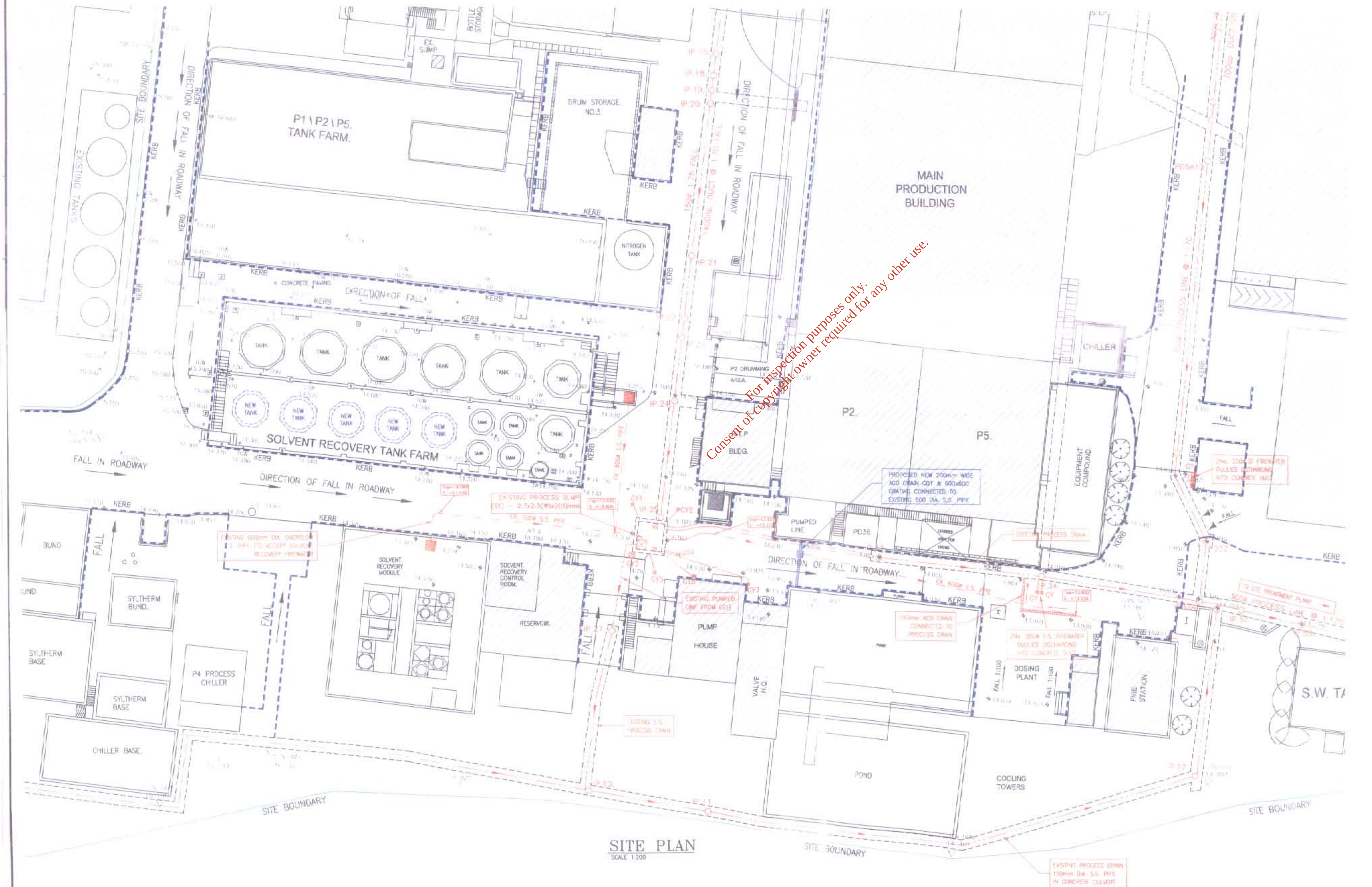
COLLECTION OF SOLVENT SPILLAGE DUE TO BUND OVERTOPPING:

THE TOTAL SPILLAGE DUE TO BUND OVERTOPPING RESULTING FROM RUPTURE OF A 50 CUB.m STORAGE VESSEL IS ESTIMATED TO BE 75% OF THE VOLUME STORED (REFER TO HSE RESEARCH REPORT 333). THIS EQUATES TO 37.5 CUB.m
AS ALL THE ROADS/SITE SURROUNDING THE BUND ARE KERBED AND GRADED TO FALL TOWARDS SUMP S1. THE 35 CUB.m SPILLAGE WILL PARTIALLY FLOW INTO THE GULLIES SURROUNDING S1 AND THE REMAINDER WILL FLOW PASS S1 AND INTO THE PROPOSED GRATED DRAIN GD1 EXTENDING ACROSS THE ROADWAY. THE NEW GRATED DRAIN WILL FEED DIRECTLY DOWN INTO THE EXISTING 600mm DIA. FIREWATER PIPELINE AND THE SOLVENT WILL CONTINUE TO THE FIREWATER RETENTION TANK VIA THE EXISTING PROCESS DUCT. THE GRATING/PIPEWORK SYSTEM HAS THE CAPACITY OF 800 CUB.m/HOUR. THE 35 CUB.m OF SOLVENT SPILLAGE CAN BE ACCOMODATED IN 2.8 MINUTES

NOTES

INDEX

(red line)	SITE PROCESS DRAINAGE
(dashed line)	KERB/BUILDING LINE
(hatched line)	NEW GRATED DRAIN
(line)	SITE BOUNDARY



SITE PLAN
SCALE 1:200

REV	DATE	DESCRIPTION	APPROVED
A	26.07.07	ISSUE PRELIMINARY	SM

ISSUE: PRELIMINARY

ISSUE FOR CONSTRUCTION | CUSTOMER APPROVAL

DESIGNED	DRAWN	REVIEWED	APPROVED
S.M	R.O.C.		

CLIENT

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PROJECT
WASTE TANK FARM UPGRADE PHASE A

TITLE
PROPOSED MODIFICATION TO SITE DRAINAGE TO PICK UP OVERSPILL FROM TANK FARM BUND

SCALE BOX A1=1: A3=1:	FILE REFERENCE 07D010	
SCALE 1:200	DISCIPLINE CIVIL	
DATE 23.07.07	DRAWING NUMBER 27232-C3-013	REV A