# Appendix E: Case Studies

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## Case Study 1: A galvanising business in a heavy industrial area

This example applies the HFSP to a proposed galvanising business in a heavy industrial area, close to a stream, to find out if the application requires a land use consent for the use of hazardous substances. The activity will include the use of baths of hydrochloric acid and molten zinc.

### Step 1: Describe hazardous substances likely to determine consent status

List the substances proposed to be used or stored on the site which are likely to determine the consent status.

#### Comment

*The HFSP has been calibrated on the weight of the pure substance (except for compressed gases, which are measured in cubic metres). Therefore, volumes need to be converted to weights, using the specific gravity, or density, of the substance. For mixtures, the weight of the pure substance is derived from its relative percentage in the mixture. However, it should be remembered that there are some cases where the substance rating already accounts for the dilution, notably for substances with corrosive properties, oxidising capacity and some toxic substances, in particular those used as pesticides.*

*In this case study, ammonium hydroxide containing more than 10% but less than 35% of ammonia in solution has a specific gravity of 0.89. Hydrogen peroxide is also classified according to concentration, while a 33% hydrochloric acid solution is generally regarded as commercial strength, and this concentration would rarely be exceeded. Consequently, no dilution factor needs to be applied, and the conversion of litres to tonnes yields the following weights.*

| Substance | Litres | Specific gravity | Tonnes |
|---|---|---|---|
| Hydrochloric acid [33%] | 3000 | 1.19 | 3.57 |
| Hydrogen peroxide [70%] | 25 | 1.29 | 0.032 |
| Ammonium hydroxide [30%] | 25 | 0.89 | 0.022 |

The substance list can be presented in a simple format, as follows.

| Name | Quantity (tonnes or cubic metres) | Form (liquid, powder, solid, gas) | Location |
|---|---|---|---|
| Hydrochloric acid [33%] | 3.57 t | Liquid | Inside, < 30 m from boundary |
| Hydrogen peroxide [70%] | 0.032 t | Liquid | Inside, < 30 m from boundary |
| Ammonium hydroxide [30%] | 0.022 t | Liquid | Inside, < 30 m from boundary |
| Sodium hydroxide | 1 t | Solid | Inside, < 30 m from boundary |
| Zinc ammonium chloride | 1 t | Solid | Inside, < 30 m from boundary |

## Step 2: Identify hazard rating

Use the information recorded in Appendix B or the rating criteria in Appendix A to find the Effect Types and corresponding hazard ratings for the substances being assessed, and note them in a table as shown below.

| Name | Hazard rating | | |
|---|---|---|---|
| | Fire/explosion effect type | Human health effect type | Environment effect type |
| Hydrochloric acid [33%] | – | High | Low |
| Hydrogen peroxide [70%] | High | Medium | – |
| Ammonium hydroxide [30%] | – | Medium | High |
| Sodium hydroxide | – | Medium | – |
| Zinc ammonium chloride | – | – | – |

### Comment

*The rating of substances for the purposes of the HFSP is done according to the criteria in Appendix A. For some commonly used substances the rating has already been established, and these are provided in Appendix B.*

*It is noted that, in terms of the application of the HFSP, the assessment of hydrochloric acid alone would have indicated the need for a land use consent. In this instance the HFSP would not need to be applied to other substances.*

## Step 3: Find base quantities

Use Table 3 in the main document to find the Base Quantities for each substance and record in a table, as below.

| Name | Base quantity (tonnes or litres) | | |
|---|---|---|---|
| | Fire/explosion effect type | Human health effect type | Environment effect type |
| Hydrochloric acid [33%] | – | 1 | 100 |
| Hydrogen peroxide [70%] | 1 | 10 | – |
| Ammonium hydroxide [30%] | – | 10 | 3 |
| Sodium hydroxide | – | 10 | – |
| Zinc ammonium chloride | – | – | – |

## Step 4: Calculate adjusted quantity by multiplying base quantities with adjustment factors

Refer to Table 4 in the main document to find the Adjustment Factors. This needs to be done in two steps:

1 listing the values for individual Adjustment Factors for the applicable Effect Types; and

2 multiplying the individual factors to obtain one overall Adjustment Factor for each Effect Type.

### Comment

*The choice of Adjustment Factors depends on substance and site-specific aspects. In this case, no separation distance to the site boundary is greater than 30 metres. This influences the choice of Adjustment Factor FF3 for the Fire/Explosion Effect Type. Although the Human Health Effect Type also includes an Adjustment Factor for separation distance, this is only applicable to gases to account for the effects of toxic gases on human health. Also of interest is the proximity of a stream, which influences the choice of Adjustment Factor FE2 for the Environmental Effect Type. Finally, all substances are stored above ground with the exception of the hydrochloric acid and the molten zinc (zinc ammonium chloride), which is constantly in use.*

Record the Adjusted Quantities in a table such as the one below.

| Name | Adjusted quantity (tonnes or litres) | | |
|---|---|---|---|
| | **Fire/explosion effect type** | **Human health effect type** | **Environment effect type** |
| Hydrochloric acid [33%] | – | 0.3 | 9 |
| Hydrogen peroxide [70%] | 1 | 10 | – |
| Ammonium hydroxide [30%] | – | 10 | 0.9 |
| Sodium hydroxide | – | 30 | – |
| Zinc ammonium chloride | – | – | – |

## Step 5: Calculate quantity ratios

Calculation of Quantity Ratios requires dividing the Proposed Quantity of a substance by the Adjusted Threshold for each Effect Type. Record the results in a table, as shown below.

| Name | Quantity ratio (QR) | | |
|---|---|---|---|
| | **Fire/explosion effect type** | **Human health effect type** | **Environment effect type** |
| Hydrochloric acid [33%] | – | 11.900 | 0.3967 |
| Hydrogen peroxide [70%] | 0.0320 | 0.003 | – |
| Ammonium hydroxide [30%] | – | 0.003 | 0.0356 |
| Sodium hydroxide | – | 0.033 | – |
| Zinc ammonium chloride | – | – | – |
| **Total QR** | **0.0320** | **11.939** | **0.4323** |

## Step 6: Determine the proposal's consent status

Select the highest Total Quantity Ratio of the three Effect Types and compare it with the ratios in the Consent Status Matrix to see whether the facility requires a resource consent. If the Quantity Ratio for one or more of the Effect Type exceeds the index for the zone where the facility is proposed, a resource consent will be required.

## Discussion

Largely as a result of the large quantity of hydrochloric acid used on the site, the Quantity Ratios for the Human Health Effect Type is greater than the consent status index generally set for industrial areas. The proposed development would therefore require a resource consent.

A sample sheet showing the above calculations as carried out with the HFSP Spreadsheet Calculation Package is provided below.

| Applicant | | Case Study No. 1 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contact name | | A galvanising business in a heavy industrial area | | | | | | | | | | | | | | | | |
| **Ref No.** | **Substances on this site** | **CAS no.** | **Effect type** | **Hazard rating** | **Base quantity** | **Form** | **Distance to boundary less than 30 m? Yes/No** | **Adjacent to water? Yes/No** | **Type of activity A/Ground B/Ground use** | **FF** | **FH** | **FE** | **Product of adjustment factors** | **Adjusted quantity A** | **Proposed quantity** | **Fire/ explosion quantity ratio FQ** | **Human health quantity ratio HQ** | **Environ-ment quantity ratio EQ** |
| 1 | **Hydrochloric acid** (concentrated solution) | 7647-01-0 | Fire/explosion | – | – | Liquid | y | | u | | | | | | 3.570 | | | |
| | | | Human health | High | 1 | | | | | 1.00 | 1.00 | 0.30 | 0.3 | 0.30 | | | 11.9000 | |
| | | | Environment | Low | 100 | | | y | | 1.00 | 0.3 | 0.30 | 0.09 | 9.00 | | | | 0.3967 |
| 2 | **Hydrogen peroxide >52%** | 7722-84-1 | Fire/explosion | High | 1 | Liquid | y | | a | 1.00 | 1.00 | 1.00 | 1 | 1.00 | 0.032 | 0.0320 | | |
| | | | Human health | Medium | 10 | | | | | 1.00 | 1.00 | 1.00 | 1 | 10.00 | | | 0.0032 | |
| | | | Environment | – | – | | | y | | | | | | | | | | |
| 3 | **Ammonia solution (<35%)** | 1336-21-6 | Fire/explosion | – | – | Liquid | y | | a | | | | | | 0.032 | | | |
| | | | Human health | Medium | 10 | | | | | 1.00 | 1.00 | 1.00 | 1 | 10.00 | | | 0.0032 | |
| | | | Environment | High | 3 | | | y | | 1.00 | 0.3 | 1.00 | 0.3 | 0.90 | | | | 0.0356 |
| 4 | **Sodium hydroxide** | 1310-73-2 | Fire/explosion | – | – | Solid | y | | a | | | | | | 1.000 | | | |
| | | | Human health | Medium | 10 | | | | | 3.00 | 1.00 | 1.00 | 3 | 30.00 | | | 0.0333 | |
| | | | Environment | – | – | | | y | | | | | | | | | | |
| 5 | **Zinc ammonium chloride** | 52628-25-8 | Fire/explosion | – | – | Solid | y | | u | | | | | | 1.000 | | | |
| | | | Human health | – | – | | | | | | | | | | | | | |
| | | | Environment | – | – | | | y | | | | | | | | | | |
| **Total quantity ratios** | | | | | | | | | | | | | | | | **0.0320** | **11.9387** | **0.4322** |

## Case Study 2: A panel-beating and spray-painting shop in a commercial area

This example uses a moderately sized panel-beating and spray-painting facility in a commercial area to demonstrate the HFSP. The storage of degreasers, thinners and paints is the major aspect of this operation. The facility is not near a water body.

### Step 1: Describe hazardous substances likely to determine consent status

List the substances proposed to be used or stored on the site which are likely to determine the consent status.

#### Comment

*For most substances in this case study, the proprietary name is not known, and information is only available with respect to the generic properties of the substances. For this reason, the paints (solvent-based) are conservatively assumed to be both flammable and corrosive. The degreaser has been rated according to the general properties of solvents. As organic solvents generally have a specific gravity of less than 1, an averaged specific gravity value of 0.75 has been assigned for conversion purposes. The thinner, including the waste thinner, has been rated on the basis of its main component xylene.*

*As the specific gravity of the paints is not known, the conversion of proposed quantities is based on an estimated specific gravity of 1.*

The substance list can be presented in a simple format such as the following.

| Name | Quantity (tonnes or cubic metres) | Form (liquid, powder, solid, gas) | Location |
|---|---|---|---|
| Degreaser (solvent) | 0.015 t | Liquid | Inside, < 30 m from boundary |
| Thinner (xylene based) | 0.1 t | Liquid | Inside, < 30 m from boundary |
| Waste thinner (xylene based) | 0.05 t | Liquid | Inside, < 30 m from boundary |
| Lacquer paints | 0.1 t | Liquid | Inside, < 30 m from boundary |
| Enamel paints | 0.06 t | Liquid | Inside, < 30 m from boundary |
| Fibreglass resin (styrene) | 0.01 t | Solid | Inside, < 30 m from boundary |
| Acetylene | 8 $m^3$ | Gas | Inside, < 30 m from boundary |
| Oxygen | 8 $m^3$ | Gas | Inside, < 30 m from boundary |

## Step 2: Identify hazard rating

Use the information recorded in Appendix B or the rating criteria in Appendix A to find the Effect Types and corresponding hazard ratings for the substances being assessed, and note them in a table such as the one below.

| Name | Hazard rating | | |
|---|---|---|---|
| | **Fire/explosion effect type** | **Human health effect type** | **Environment effect type** |
| Degreaser (solvent) | *Medium* | *Medium* | *High* |
| Thinner (xylene based) | Medium | Low | – |
| Waste thinner | Medium | Low | – |
| Lacquer paints | *Medium* | *Medium* | *High* |
| Enamel paints | *Medium* | *Medium* | *High* |
| Fibreglass resin (styrene) | Medium | Low | Medium |
| Acetylene | High | – | – |
| Oxygen | Medium | – | – |

### Comment

*Because substance specific information for some of the materials used on the site is not available, a precautionary approach in assigning hazard ratings is required. This is represented by a medium hazard ratings for the Fire/Explosion and Human Health Effect Types, and a high hazard rating for the Environmental Effect Type.* In the table above, default settings are indicated by *italics.*

## Step 3: Find base quantities

Use Table 3 in the main document to find the Base Quantities for each substance and record them in a table such as shown below.

| Name | Base quantity (tonnes or $m^3$) | | |
|---|---|---|---|
| | **Fire/explosion effect type** | **Human health effect type** | **Environment effect type** |
| Degreaser (solvent) | 30 | 10 | 3 |
| Thinner (xylene based) | 30 | 30 | – |
| Waste thinner | 30 | 30 | – |
| Lacquer paints | 30 | 10 | 3 |
| Enamel paints | 30 | 10 | 3 |
| Fibreglass resin (styrene) | 30 | 30 | 30 |
| Acetylene | 10,000 | – | – |
| Oxygen | 10,000 | – | – |

## Step 4: Calculate adjusted quantity by multiplying base quantities with adjustment factors

Refer to Table 4 in the main document to find the Adjustment Factors. This needs to be done in two steps:

1 listing the values for individual Adjustment Factors for the applicable Effect Types, and

2 multiplying the individual factors to obtain one overall Adjustment Factor for each Effect Type.

### Comment

*In this case, no special circumstances apply. The facility is less than 30 metres from the site boundary, and information obtained from the council's district plan shows that the site is not located in the vicinity of a water body. Inquiries at the regional council have ascertained that the facility is not sited near a potable water resource.*

Most of the substances used on the site are in liquid form, with the exception of acetylene and oxygen (gases) and fibreglass resin (solid). Although the substances are in use, the amount used represents only a part of the whole quantity. According to the guidance provided in the step-by-step guide to the HFSP, the substances held on the site are therefore regarded as being in storage.

Most Adjustment Factors, except for those relating to substance form in the case of fibreglass and the gases, are therefore set at 1. It should be noted that Adjustment Factor FH2 for the Human Health Effect Type does not apply at all in this case because all substances that have been assigned a hazard level for this Effect Type are either liquids or solids.

Record the Adjusted Quantities in a table as below.

| **Name** | **Adjusted quantity (tonnes or cubic metres)** | | |
|---|---|---|---|
| | **Fire/explosion effect type** | **Human health effect type** | **Environment effect type** |
| Degreaser (solvent) | 30 | 10 | 3 |
| Thinner (xylene based) | 30 | 30 | – |
| Waste thinner | 30 | 30 | – |
| Lacquer paints | 30 | 10 | 3 |
| Enamel paints | 30 | 10 | 3 |
| Fibreglass resin (styrene) | 90 | 90 | 90 |
| Acetylene | 1000 | – | – |
| Oxygen | 1000 | – | – |

## Step 5: Calculate quantity ratios

Calculation of Quantity Ratios requires dividing the Proposed Quantity of a substance by the Adjusted Threshold for each Effect Type. Record this in a table such as the one below.

| Name | Quantity ratio (Q) | | |
|---|---|---|---|
| | Fire/explosion effect type | Human health effect type | Environment effect type |
| Degreaser (solvent) | 0.0005 | 0.0015 | 0.0050 |
| Thinner (xylene based) | 0.0033 | 0.0033 | – |
| Waste thinner | 0.0017 | 0.0017 | – |
| Lacquer paints | 0.0033 | 0.0100 | 0.0333 |
| Enamel paints | 0.0020 | 0.0060 | 0.0200 |
| Fibreglass resin (styrene) | 0.0001 | 0.0001 | 0.0001 |
| Acetylene | 0.0027 | – | – |
| Oxygen | 0.0027 | – | – |
| **Total Q** | **0.0163** | **0.0226** | **0.0584** |

## Step 6: Determine the proposal's consent status

Select the highest Total Quantity Ratio of the three Effect Types and compare it with the ratios in the Consent Status Matrix to see whether the facility requires a resource consent.

If the Quantity Ratio for one or more of the Effect Type exceeds the consent status index for the zone where the facility is proposed, a resource consent will be required.

## Discussion

The proposed panel-beating shop has low Quantity Ratios for the Fire/Explosion and Human Health Effect Types. The Quantity Ratio for the Environmental Effect Type is somewhat higher, but still below 0.5, which is a common threshold for permitted activities in industrial zones. A consent may, however, be required for some commercial and all residential and other zones. The spray-painting booth may also require an air discharge consent, depending on regional rules.

A sample sheet showing the above calculations as carried out with the HFSP Spreadsheet Calculation Package is provided on the next page.

| Applicant | Case Study No. 2 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contact name | A panel-beating and spraypainting shop in a commercial area | | | | | | | | | | | | | | | | |
| **Substances on this site** | **CAS no.** | **Effect type** | **Hazard rating** | **Base quantity** | **Form** | **Distance to boundary less than 30 m? Yes/No** | **Adjacent to water? Yes/No** | **Type of activity A/Ground B/Ground use** | **FF** | **FH** | **FE** | **Product of adjustment factors** | **Adjusted quantity A** | **Proposed quantity** | **Fire/ explosion quantity ratio FQ** | **Human health quantity ratio HQ** | **Environ-ment quantity ratio EQ** |
| **Generic liquid** Degreaser (solvent) | – | Fire/explosion | Medium | 30 | Liquid | n | | a | 1.00 | 1.00 | 1.00 | 1 | 30.00 | 0.015 | 0.0005 | | |
| | | Human health | Medium | 10 | | | | | 1.00 | 1.00 | 1.00 | 1 | 10.00 | | | 0.0015 | |
| | | Environment | High | 3 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 3.00 | | | | 0.0050 |
| **Xylene, mixed isomers** Xylene-based thinner | 1330-20-7 | Fire/explosion | Medium | 30 | Liquid | n | | a | 1.00 | 1.00 | 1.00 | 1 | 30.00 | 0.100 | 0.0033 | | |
| | | Human health | Low | 30 | | | | | 1.00 | 1.00 | 1.00 | 1 | 30.00 | | | 0.0033 | |
| | | Environment | – | – | | | n | | | | | | | | | | |
| **Xylene, mixed isomers** Xylene-based thinner – waste | 1330-20-7 | Fire/explosion | Medium | 30 | Liquid | n | | a | 1.00 | 1.00 | 1.00 | 1 | 30.00 | 0.050 | 0.0017 | | |
| | | Human health | Low | 30 | | | | | 1.00 | 1.00 | 1.00 | 1 | 30.00 | | | 0.0017 | |
| | | Environment | – | – | | | n | | | | | | | | | | |
| **Generic liquid** Lacquer paint | – | Fire/explosion | Medium | 30 | Liquid | n | | a | 1.00 | 1.00 | 1.00 | 1 | 30.00 | 0.100 | 0.0033 | | |
| | | Human health | Medium | 10 | | | | | 1.00 | 1.00 | 1.00 | 1 | 10.00 | | | 0.0100 | |
| | | Environment | High | 3 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 3.00 | | | | 0.0333 |
| **Generic liquid** Enamel paint | – | Fire/explosion | Medium | 30 | Liquid | n | | a | 1.00 | 1.00 | 1.00 | 1 | 30.00 | 0.060 | 0.0020 | | |
| | | Human health | Medium | 10 | | | | | 1.00 | 1.00 | 1.00 | 1 | 10.00 | | | 0.0060 | |
| | | Environment | High | 3 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 3.00 | | | | 0.0200 |
| **Styrene monomer** Fibreglass resin | 100-42-5 | Fire/explosion | Medium | 30 | Solid | n | | a | 3.00 | 1.00 | 1.00 | 3 | 90.00 | 0.010 | 0.0001 | | |
| | | Human health | Low | 30 | | | | | 3.00 | 1.00 | 1.00 | 3 | 90.00 | | | 0.0001 | |
| | | Environment | Medium | 30 | | | n | | 3.00 | 1.00 | 1.00 | 3 | 90.00 | | | | 0.0001 |
| **Acetylene** | 74-86-2 | Fire/explosion | High | 10,000 | Gas | n | | a | 0.10 | 3.00 | 1.00 | 0.3 | 3,000.00 | 8.000 | 0.0027 | | |
| | | Human health | – | – | | | | | | | | | | | | | |
| | | Environment | – | – | | | n | | | | | | | | | | |
| **Oxygen** | 7782-44-7 | Fire/explosion | Medium | 10,000 | Gas | n | | a | 0.10 | 3.00 | 1.00 | 0.3 | 3,000.00 | 8.000 | 0.0027 | | |
| | | Human health | – | – | | | | | | | | | | | | | |
| | | Environment | – | – | | | n | | | | | | | | | | |
| **Total quantity ratios** | | | | | | | | | | | | | | | **0.0163** | **0.0226** | **0.0584** |

## Case Study 3: A chemical warehouse in an industrial area

In this example, the HFSP is applied to a chemical warehouse proposed for an industrial zone. The warehouse will be used to store a wide range of chemicals, including pesticides. Minor scale mixing and filling of containers may also be carried out in the facility on an occasional basis.

### Step 1: Describe hazardous substances likely to determine consent status

List the substances proposed to be used or stored on the site which are likely to determine the consent status.

### Comment

*For this case study the issue is the large number of substances stored. In accordance with the HFSP, the procedure is carried out on 10 'priority substances'. These are the substances with the most hazardous properties and/or those stored in the largest quantities.*

*In this context, it is important to remember the necessary conversions of volumes to weights, using the specific gravity, or density, of the substance. In this case, however, no specific gravity for cypermethrin and glyphosate could be found, and an estimated specific gravity of 1 was used for the conversion.*

The substance list can be presented in a simple format such as the following.

| Name | Quantity (tonnes or cubic metres) | Form (liquid, powder, solid, gas) | Location |
|---|---|---|---|
| Diazinon | 1.3 t | Liquid | Inside, > 30 m from boundary |
| Dichlorvos | 0.84 t | Liquid | Inside, > 30 m from boundary |
| Cypermethrin | 0.525 t | Liquid | Inside, > 30 m from boundary |
| Dicamba | 0.72 t | Solid | Inside, > 30 m from boundary |
| 1,1,2 Trichloroethane | 3.6 t | Liquid | Inside, > 30 m from boundary |
| Catechol | 0.3 t | Solid | Inside, > 30 m from boundary |
| Iodine (crude) | 2 t | Solid | Inside, > 30 m from boundary |
| Iodine (solution) | 0.2 t | Liquid | Inside, > 30 m from boundary |
| Phosphoric acid | 1 t | Solid | Inside, > 30 m from boundary |
| Potassium hydroxide | 1 t | Solid | Inside, > 30 m from boundary |

## Step 2: Identify hazard rating

Use the information recorded in Appendix B or the rating criteria in Appendix A to find the Effect Types and corresponding hazard ratings for the substances being assessed, and note them in a table such as the one below.

| Name | Hazard rating | | |
|---|---|---|---|
| | **Fire/explosion effect type** | **Human health effect type** | **Environment effect type** |
| Diazinon | Medium | High | High |
| Dichlorvos | Low | High | High |
| Cypermethrin | – | Medium | High |
| Dicamba | – | Low | Low |
| 1,1,2 Trichloroethane | – | High | Low |
| *Catechol* | – | Medium | Medium |
| Iodine (crude) | – | Medium | *High* |
| Iodine (solution) | – | Medium | *High* |
| Phosphoric acid | – | Medium | – |
| Potassium hydroxide | – | Medium | – |

### Comment

*In the case of iodine, no information with respect to environmental effects was found, and the precautionary hazard rating was assigned for this Effect Type only.*

## Step 3: Find base quantities

Use Table 3 in the main document to find the Base Quantities for each substance and record them in a table such as shown below.

| Name | Base quantity (tonnes or $m^3$) | | |
|---|---|---|---|
| | Fire/explosion effect type | Human health effect type | Environment effect type |
| Diazinon | 30 | 1 | 3 |
| Dichlorvos | 100 | 1 | 3 |
| Cypermethrin | – | 10 | 3 |
| Dicamba | – | 30 | 100 |
| 1,1,2 Trichloroethane | – | 1 | 100 |
| *Catechol* | – | 10 | 30 |
| Iodine (crude) | – | 10 | 3 |
| Iodine (solution) | – | 10 | 3 |
| Phosphoric acid | – | 10 | – |
| Potassium hydroxide | – | 10 | – |

## Step 4: Calculate adjusted quantity by multiplying base quantities with adjustment factors

Refer to Table 4 in the main document to find the Adjustment Factors. This needs to be done in two steps:

1 listing the values for individual Adjustment Factors for the applicable Effect Types, and

2 multiplying the individual factors to obtain one overall Adjustment Factor for each Effect Type.

### Comment

*The relevant district plan shows that the site is not located in the vicinity of a water body. Inquiries at the regional council have ascertained that the facility is not sited near a potable water resource.*

*This facility is located on a large site, and the processing and storage areas are more than 30 metres from the site boundary as well as being inside a warehouse. However, in this particular case, the large separation distance to the site boundary does not influence the choice of Adjustment Factors. Separation distance influences Adjustment Factor FF3 for the Fire/Explosion Effect Type, which does not apply to any of the substances stored on the site. For the Human Health Effect Type, separation distance influences Adjustment Factor FH2 only if the substance is a gas. As none of the substances listed are gases, this Adjustment Factor does not apply.*

Record the Adjusted Quantities in a table as shown below.

| Name | Adjusted quantity (tonnes or m$^3$) | | |
|---|---|---|---|
| | Fire/explosion effect type | Human health effect type | Environment effect type |
| Diazinon | 30 | 1 | 3 |
| Dichlorvos | 100 | 1 | 3 |
| Cypermethrin | – | 10 | 3 |
| Dicamba | – | 90 | 300 |
| 1,1,2 Trichloroethane | – | 1 | 100 |
| Catechol | – | 30 | 90 |
| Iodine (crude) | – | 30 | 9 |
| Iodine (solution) | – | 10 | 3 |
| Phosphoric acid | – | 30 | – |
| Potassium hydroxide | – | 30 | – |

## Step 5: Calculate quantity ratios

Calculation of Quantity Ratios requires dividing the proposed quantity of a substance by the Adjusted Threshold for each Effect Type. Record them in a table such as the one below.

| Name | Quantity ratio (QR) | | |
|---|---|---|---|
| | Fire/explosion effect type | Human health effect type | Environment effect type |
| Diazinon | 0.0433 | 1.3000 | 0.4333 |
| Dichlorvos | 0.0084 | 0.8400 | 0.2800 |
| Cypermethrin | – | 0.0525 | 0.1750 |
| Dicamba | – | 0.0080 | 0.0024 |
| 1,1,2 Trichloroethane | – | 3.6000 | 0.0360 |
| Catechol | – | 0.0100 | 0.0033 |
| Iodine (crude) | – | 0.0667 | 0.2222 |
| Iodine (solution) | – | 0.0200 | 0.0667 |
| Phosphoric acid | – | 0.0333 | – |
| Potassium hydroxide | – | 0.0333 | – |
| **Total QR** | **0.0517** | **5.9638** | **1.2189** |

## Step 6: Determine the proposal's consent status

Select the highest Total Quantity Ratio of the three Effect Types and compare it with the Consent Status Indices to see whether the facility requires a resource consent.

If the Quantity Ratio for one or more of the Effect Types exceeds the consent status index for the zone where the facility is proposed, a resource consent will be required.

## Discussion

Based on the calculated Quantity Ratios for the Human Health and Environmental Effect Types, the proposed facility would – on the basis of the 10 substances assessed – require a consent in all zones. Even the large separation distances available in this situation do not decrease the Quantity Ratios as separation distance is only of importance with respect to fire and explosion effects, and in the case of gases for the Human Health Effect Type.

It is noted that, as per the example above, a number of substances on their own would push the Quantity Ratios above the Consent Status Indices. In this instance the HFSP would not need to be applied to all substances.

A sample sheet showing the above calculations as carried out with the HFSP Spreadsheet Calculation Package is provided on the next page.

| Applicant | | Case Study No. 3 | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contact name | | A chemical warehouse in an industrial area | | | | | | | | | | | | | | | | |
| Ref No. | Substances on this site | CAS no. | Effect type | Hazard rating | Base quantity | Form | Distance to boundary less than 30 m? Yes/No | Adjacent to water? Yes/No | Type of activity A/Ground B/Ground use | FF | FH | FE | Product of adjustment factors | Adjusted quantity A | Proposed quantity | Fire/ explosion quantity ratio FQ | Human health quantity ratio HQ | Environ-ment quantity ratio EQ |
| 1 | Diazinon | 333-41-5 | Fire/explosion | Medium | 30 | Liquid | y | | a | 1.00 | 1.00 | 1.00 | 1 | 30.00 | 1.300 | 0.0433 | | |
| | | | Human health | High | 1 | | | | | 1.00 | 1.00 | 1.00 | 1 | 1.00 | | | 1.3000 | |
| | | | Environment | High | 3 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 3.00 | | | | 0.4333 |
| 2 | Dichlorvos | 62-73-7 | Fire/explosion | Low | 100 | Liquid | y | | a | 1.00 | 1.00 | 1.00 | 1 | 100.00 | 0.840 | 0.0084 | | |
| | | | Human health | High | 1 | | | | | 1.00 | 1.00 | 1.00 | 1 | 1.00 | | | 0.8400 | |
| | | | Environment | High | 3 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 3.00 | | | | 0.2800 |
| 3 | Cypermethrin | 52315-07-8 | Fire/explosion | – | – | Liquid | y | | a | | | | | | 0.525 | | | |
| | | | Human health | Medium | 10 | | | | | 1.00 | 1.00 | 1.00 | 1 | 10.00 | | | 0.0525 | |
| | | | Environment | High | 3 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 3.00 | | | | 0.1750 |
| 4 | Dicamba | 1918-00-9 | Fire/explosion | – | – | Solid | y | | a | | | | | | 0.720 | | | |
| | | | Human health | Low | 30 | | | | | 3.00 | 1.00 | 1.00 | 3 | 90.00 | | | 0.0080 | |
| | | | Environment | Low | 100 | | | n | | 3.00 | 1.00 | 1.00 | 3 | 300.00 | | | | 0.0024 |
| 5 | 1,1,2-Trichloro-ethane | 79-00-5 | Fire/explosion | – | – | Liquid | y | | a | | | | | | 3.600 | | | |
| | | | Human health | High | 1 | | | | | 1.00 | 1.00 | 1.00 | 1 | 1.00 | | | 3.6000 | |
| | | | Environment | Low | 100 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 100.00 | | | | 0.0360 |
| 6 | Catechol | 120-80-9 | Fire/explosion | – | – | Solid | y | | a | | | | | | 0.300 | | | |
| | | | Human health | Medium | 10 | | | | | 3.00 | 1.00 | 1.00 | 3 | 30.00 | | | 0.0100 | |
| | | | Environment | Medium | 30 | | | n | | 3.00 | 1.00 | 1.00 | 3 | 90.00 | | | | 0.0033 |
| 7 | Iodine Crude | 5553-56-2 | Fire/explosion | – | – | Solid | y | | a | | | | | | 2.000 | | | |
| | | | Human health | Medium | 10 | | | | | 3.00 | 1.00 | 1.00 | 3 | 30.00 | | | 0.0667 | |
| | | | Environment | High | 3 | | | n | | 3.00 | 1.00 | 1.00 | 3 | 9.00 | | | | 0.2222 |
| 8 | Iodine Solution | 5553-56-2 | Fire/explosion | – | – | Liquid | y | | a | | | | | | 0.200 | | | |
| | | | Human health | Medium | 10 | | | | | 1.00 | 1.00 | 1.00 | 1 | 10.00 | | | 0.0200 | |
| | | | Environment | High | 3 | | | n | | 1.00 | 1.00 | 1.00 | 1 | 3.00 | | | | 0.0667 |
| 9 | Phosphoric acid | 7664-38-2 | Fire/explosion | – | – | Solid | y | | a | | | | | | 1.000 | | | |
| | | | Human health | Medium | 10 | | | | | 3.00 | 1.00 | 1.00 | 3 | 30.00 | | | 0.0333 | |
| | | | Environment | – | – | | | n | | | | | | | | | | |
| 10 | Potassium hydroxide | 1310-58-3 | Fire/explosion | – | – | Solid | y | | a | | | | | | 1.000 | | | |
| | | | Human health | Medium | 10 | | | | | 3.00 | 1.00 | 1.00 | 3 | 30.00 | | | 0.0333 | |
| | | | Environment | – | – | | | n | | | | | | | | | | |
| Total quantity ratios | | | | | | | | | | | | | | | | 0.0517 | 5.9638 | 1.2189 |