

**APPENDIX B**

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**Ecological Risk Assessment Worksheet - Diquat**



## DERIVATION OF EECS

Section 3.0 of the Methods Document (ENSR 2004c) presents the details of the exposure scenarios considered in the risk assessments. The following sub-sections describe the scenarios that were evaluated for bromacil. Note that in many cases, units were converted during the calculations (e.g., lb/acre converted to mg/cm<sup>2</sup>). These conversions were not included in the equations presented below.

### Direct Spray

Plant and wildlife species may be unintentionally impacted during normal application of a terrestrial herbicide as a result of a direct spray of the receptor or the waterbody inhabited by the receptor, indirect contact with dislodgeable foliar residue after herbicide application, or consumption of prey items sprayed during application. These exposures may occur within the application area (consumption of prey items) or outside of the application area (waterbodies accidentally sprayed during application of terrestrial herbicide). Generally, impacts outside of the intended application area are accidental exposures and are not typical of BLM application practices. The following direct spray scenarios were evaluated:

#### Direct Spray of Terrestrial Wildlife

Small mammal or Insect 100% Dermal Absorption

$$\text{Surface Areas (A): cm}^2 = 12.3 \times \text{BW}^{0.65}$$

Where: BW = body weight in grams

$$\text{Amount deposited on } \frac{1}{2} \text{ receptor (Amnt): } 0.5 \times A \times R$$

Where: A = Surface area in cm<sup>2</sup>

R = Application rate in lb a.i./acre

Small mammal 1<sup>st</sup> order

$$\text{Proportion absorbed over period T (Prop): } 1 - \exp(-k T)$$

Where: k = First order dermal absorption rate (hour<sup>-1</sup>)

T = Time (24 hours)

$$\text{Absorbed Dose: Amnt} \times \text{Prop} \div \text{BW}$$

#### Ingestion of Food Items Contaminated by Direct Spray

All herbivorous receptors ingestion acute

$$\text{Concentration on food (C): } R \times rr$$

Where: R = Application rate (lb a.i./acre)

rr = Residue rate as determined from Kenaga nomogram (mg/kg per lb/acre)

$$\text{Dose estimates (D): } C \times A \div \text{BW}$$

Where: C = Concentration on food (mg/kg food)

A = Wet weight food ingestion rate (kg/day)

BW = Body Weight

All herbivorous receptors ingestion chronic

$$\text{Initial concentration on food (C0): } R \times rr \times \text{Drift}$$

Where: R = Application rate (lb a.i./acre)

rr = Residue rate as determined from Kenaga nomogram (mg/kg per lb/acre)

Drift = 1

$$\text{Concentration on food at time T: } C0 \times \exp(-k \times T)$$

Where: C0 = Concentration on food at time zero (mg/kg food)

k = Decay Coefficient:  $\ln(2) \div t50$  (days<sup>-1</sup>)

T = Time (90 days)

$$\text{Time-weighted Average Concentration on vegetation (CTWA): } C0 \times (1 - \exp(-k \times T)) \div (k \times T)$$

$$\text{Dose estimates (D): } \text{CTWA} \times A \times \text{Prop} \div \text{BW}$$

Where: CTWA = Time Weighted Concentration on food (mg/kg food)

A = Wet weight food ingestion rate (kg/day)

Prop = Proportion of food impacted by direct spray (100%)

BW = Body Weight

Large carnivorous mammal ingestion acute

Amount deposited on small mammal prey (Amnt\_mouse):  $0.5 \times \text{SurfaceArea} \times R$

Where:  $R$  = Application rate (lb a.i./acre)

Dose estimates:  $\text{Drift} \times \text{Prop} \times \text{Amnt\_mouse} \div \text{BW\_mouse} \times A \div \text{BW}$

Where:  $\text{Drift} = 1$

$\text{Prop}$  = Proportion of food impacted by direct spray (100%)

$A$  = Wet weight food ingestion rate (kg/day)

$\text{BW}$  = Body Weight of carnivore

$\text{BW\_mouse}$  = Body weight of food (small mammal; mouse)

Large carnivorous mammal ingestion chronic

Initial concentration on mammal ( $C_0$ ):  $0.5 \times \text{SurfaceArea} \times R \div \text{BW\_smallmammal}$

Where:  $R$  = Application rate (lb a.i./acre)

$\text{SurfaceArea}$  = Surface area of food (small mammal; mouse)

$\text{BW\_smallmammal}$  = Body weight of food (small mammal; mouse)

Concentration absorbed in small mammal at time  $T$  ( $C_{90}$ ):  $C_0 \times \exp(-k \times T)$

Where:  $C_0$  = Concentration on food at time zero (mg/kg food)

$k$  = Decay Coefficient:  $\ln(2)/t_{50}$  (days<sup>-1</sup>)

$T$  = Time (90 days)

Dose estimates:  $C_{90} \times \text{FIR\_coyote} \times \text{Prop} \div \text{BW}$

Where:  $C_{90}$  = Concentration of herbicide in food at 90 days

$\text{FIR}$  = Wet weight food ingestion rate (mg/kg-day)

$\text{Prop}$  = Proportion of food impacted by direct spray (100%)

$\text{BW}$  = Body Weight

#### Accidental Direct Spray Over Pond

Mass in Pond ( $M_p$ ):  $A_p \times R$

Where:  $A_p$  = Area of pond

$R$  = Application rate (lb a.i./acre)

Concentration in Pond:  $M_p \div (V_p)$

Where:  $V_p$  = Volume of pond

#### Accidental Direct Spray Over Stream

Mass in Stream Reach ( $M_s$ ):  $A_s \times R$

Where:  $A_s$  = Area of stream affected by spray

$R$  = Application rate (lb a.i./acre)

Concentration in Pond:  $M_s \div (V_s)$

Where:  $V_s$  = Volume of stream reach affected by spray

#### **Off-Site Drift**

During normal application of herbicides, it is possible for a portion of the herbicide to drift outside of the treatment area and deposit onto non-target receptors. To simulate these off-site herbicide transport mechanisms, AgDRIFT® software was used to evaluate a number of possible drift scenarios. These models provide concentrations in media. Details of the model and calculations used to obtain soil and water concentrations are presented in the Methods document (ENSR, 2004). The surface water concentrations were used in the ERAs to estimate fish concentrations and consumption of these fish by an avian piscivore. The following presents those calculations:

#### Consumption of Fish From Contaminated Pond

Concentration in fish =  $C_w \times \text{BCF} \times \text{FCM TL2} \times \text{FCM TL3}$

Where:  $C_w$  = Concentration in water (obtained from model) mg/L

$\text{BCF}$  = Bioconcentration factor (L/kg fish)

$\text{FCM TL2}$  = Trophic Level 2 food chain multiplier (unitless)

$\text{FCM TL3}$  = Trophic Level 3 food chain multiplier (unitless)

Dose estimates ( $D$ ):  $C \times A \times \text{Prop} \div \text{BW}$

Where:  $C$  = Concentration in fish (mg/kg food)

$A$  = Wet weight food ingestion rate (kg/day)

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Prop = Proportion of food impacted (100%)  
BW = Body Weight

### **Accidental Spill to Pond**

To represent worst-case potential impacts to ponds, a spill scenario was considered. A truck or helicopter spilling an entire load of herbicide mixed for the maximum application rate into a 1/4 acre, 1 meter deep pond.

### Truck or Helicopter Spill into Pond

Concentrations in water (Cw):  $C_m \times V_{\text{spill}} \div V_p$

Where:  $C_m$  = Herbicide concentration in the truck or helicopter mixture (mg a.i./L)

$V_{\text{spill}}$  = Volume of the spill (L)

$V_p$  = Volume of the pond (L)

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**General note:** Exposure parameters and equations in the following tables are described in more detail in the *Vegetation Treatments Programmatic EIS Ecological Risk Assessment Methodology* (ENSR 2004) and Section 4 of the ecological risk assessment for this herbicide.

**TABLE B-1**

**Direct Spray of Terrestrial Receptors and Exposure from Indirect Contact with Foliage**

| Parameter   |                       | Pollinating Insect | Small Mammal | Units              |
|---|-----------------------|--------------------|--------------|--------------------|
| Duration of exposure (T)  |                       | 24                 | 24           | hours              |
| Body weight (BW)  |                       | 0.000093           | 0.02         | kg                 |
| Surface areas (A): $cm^2 = 12.3 \times BW(g)^{0.65}$ <sup>1</sup>                       |                       | 2.63               | 86.21        | cm <sup>2</sup>    |
| Application rates (R)   | Typical               | 1                  | 1            | lb/acre            |
|   | Maximum               | 4                  | 4            | lb/acre            |
| Amount deposited on 1/2 receptor (Amnt): $0.5 \times A \times R \times cf$ <sup>2</sup> | Typical               | 0.0147             | 0.4831       | mg                 |
|   | Maximum               | 0.059              | 1.9326       | mg                 |
| <b>Dose Estimate Assuming 100% Dermal Adsorption<sup>3</sup></b>                        |                       |                    |              |                    |
| Absorbed Dose: (Amnt × Prop) / BW   | Typical               | 1.58E+02           | 2.42E+01     | mg/kg bw           |
|   | Maximum               | 6.34E+02           | 9.66E+01     | mg/kg bw           |
| <b>Dose Estimate Assuming First Order Dermal Adsorption<sup>4</sup></b>                 |                       |                    |              |                    |
| First-order dermal absorption coefficient (k)   | Central estimate (ka) | 0.0231             | 0.0231       | hour <sup>-1</sup> |
|   |                       |                    |              |                    |
| Proportion absorbed over period T (Prop): $1 - \exp(-k \times T)$ <sup>5</sup>          | Typical               | 0.0048             | 0.0048       | unitless           |
|   | Maximum               | 0.0048             | 0.0048       | unitless           |
| Absorbed dose: (Amnt × Prop) / BW   | Typical               | 7.59E-01           | 1.16E-01     | mg/kg bw           |
|   | Maximum               | 3.04E+00           | 4.63E-01     | mg/kg bw           |

| RISK QUOTIENTS <sup>6</sup> - Direct Spray       | Toxicity Reference Value (mg/kg bw) <sup>7</sup> | Typical Application | Maximum Application |
|--|--|---------------------|---------------------|
| Small mammal - 100% absorption                   | 247  | 2.48E-02            | 9.93E-02            |
| Pollinating insect - 100% absorption             | 505  | 3.14E-01            | 1.26E+00            |
| Small mammal - 1st order dermal adsorption       | 247  | 1.19E-04            | 4.76E-04            |
| Pollinating insect - 1st order dermal adsorption | 505  | 1.50E-03            | 6.01E-03            |

| RISK QUOTIENTS - Indirect Contact <sup>8</sup>   | Toxicity Reference Value (mg/kg bw) <sup>7</sup> | Typical Application | Maximum Application |
|--|--|---------------------|---------------------|
| Small mammal - 100% absorption                   | 247  | 2.48E-03            | 9.93E-03            |
| Pollinating insect - 100% absorption             | 505  | 3.14E-02            | 1.26E-01            |
| Small mammal - 1st order dermal adsorption       | 247  | 1.19E-05            | 4.76E-05            |
| Pollinating insect - 1st order dermal adsorption | 505  | 1.50E-04            | 6.01E-04            |

<sup>1</sup> Surface area calculation for mammals from Stahl (1967; presented in USEPA 1993). No surface area calculation identified for insects. Mammalian equation used as a surrogate.

<sup>2</sup> A conversion factor (cf) of 0.011208493 was used to convert the application rate (R) from lb/acre to mg/cm<sup>2</sup>.

<sup>3</sup> 100% dermal absorption - all of the herbicide falling on the receptor was assumed to penetrate the skin within 24 hours.

<sup>4</sup> 1st order dermal absorption - absorption occurs over 24 hours, taking into consideration the potential for some herbicide to not be absorbed.

<sup>5</sup>  $\exp(-k \times T) = e^{-(k \times T)}$ , where e is a constant = 2.7828.

<sup>6</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.

<sup>7</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

<sup>8</sup> Exposure from indirect contact assumed to be 1/10 of direct spray exposure (Harris and Solomon 1992).

**TABLE B-2**

**Potential Risks to Small Herbivorous/Omnivorous Mammal (Deer Mouse) from Consumption of Contaminated Fruit (Acute Exposure Scenario)**

| Parameters/Assumptions                                |         | Value    | Units             |
|---|---------|----------|-------------------|
| Body weight (W)                                       |         | 0.02     | kg                |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>    |         | 0.0034   | kg dw/day         |
| Food ingestion rate (wet weight [ww]) ir <sup>2</sup> |         | 0.0146   | kg ww/day         |
| Application rates (R)                                 | Typical | 1        | lb/acre           |
|   | Maximum | 4        | lb/acre           |
| Residue rate - berries (rr) <sup>3</sup>              | Typical | 5.4      | mg/kg per lb/acre |
|   | Maximum | 40.7     | mg/kg per lb/acre |
| Concentration on berries (C): R × rr                  | Typical | 5.4      | mg/kg fruit       |
|   | Maximum | 162.8    | mg/kg fruit       |
| Dose estimates (D): C × ir / BW                       | Typical | 3.95E+00 | mg/kg bw          |
|   | Maximum | 1.19E+02 | mg/kg bw          |

| RISK QUOTIENTS <sup>4</sup> - Ingestion               | Toxicity Reference Value (mg/kg bw) <sup>5</sup> | Typical Application | Maximum Application |
|---|--|---------------------|---------------------|
| Small mammalian herbivore/omnivore – (acute exposure) | 247  | 1.60E-02            | 4.82E-01            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for rodents; where food ingestion rate (g dw/day) = 0.621 × (BW g)<sup>0.564</sup>; converted into kg dw/day.

<sup>2</sup> Assumes fruit is 77% water (USEPA 1993; Table 4-2 - value for fruit pulp and skin).

<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994) and are vegetation-specific.

<sup>4</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.

<sup>5</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-3**

**Potential Risks to Small Herbivorous/Omnivorous Mammal (Deer Mouse) from Consumption of Contaminated Fruit (Chronic Exposure Scenario)**

| Parameters/Assumptions  |                    | Value    | Units              |
|---|--------------------|----------|--------------------|
| Duration of exposure (T)  |                    | 90       | days               |
| Body weight (W)   |                    | 0.02     | kg                 |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>  |                    | 0.0034   | kg dw/day          |
| Food ingestion rate (wet weight [ww]) ir <sup>2</sup>   |                    | 0.0146   | kg ww/day          |
| Half life on vegetation (t <sub>50</sub> )  | Herbicide specific | 30       | days               |
| Application rates (R)   | Typical            | 1        | lb/acre            |
|   | Maximum            | 4        | lb/acre            |
| Residue rate - berries (rr) <sup>3</sup>  | Typical            | 5.4      | mg/kg per lb/acre  |
|   | Maximum            | 40.7     | mg/kg per lb/acre  |
| Drift (Drift)   | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Decay Coefficient (k): ln(2)/t <sub>50</sub> <sup>4</sup>   | Typical            | 0.0231   | days <sup>-1</sup> |
|   | Maximum            | 0.0231   | days <sup>-1</sup> |
| Initial concentration on berries (C <sub>0</sub> ): R × rr × Drift  | Typical            | 5.4      | mg/kg fruit        |
|   | Maximum            | 162.8    | mg/kg fruit        |
| Concentration on berries at time T: C <sub>0</sub> × exp(-k×T) <sup>5</sup>                                 | Typical            | 0.675    | mg/kg fruit        |
|   | Maximum            | 20.35    | mg/kg fruit        |
| Time-weighted Average Concentration on vegetation (CTWA): C <sub>0</sub> * (1-exp(-k×T))/(k×T) <sup>5</sup> | Typical            | 2.2722   | mg/kg fruit        |
|   | Maximum            | 68.5040  | mg/kg fruit        |
| Proportion of Diet Contaminated (PC)  | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Dose estimates (D): (CTWA × ir × PC) / BW   | Typical            | 1.66E+00 | mg/kg bw/day       |
|   | Maximum            | 5.01E+01 | mg/kg bw/day       |

| RISK QUOTIENTS <sup>6</sup> – Ingestion                 | Toxicity Reference Value (mg/kg bw/day) <sup>7</sup> | Typical Application | Maximum Application |
|---|--|---------------------|---------------------|
| Small mammalian herbivore/omnivore – (chronic exposure) | 1.64   | 1.01E+00            | 3.05E+01            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for rodents; where food ingestion rate (g dw/day) = 0.621×(BW g)<sup>0.564</sup>; converted into kg dw/day.  
<sup>2</sup> Assumes fruit is 77% water (USEPA 1993; Table 4-2 - value for fruit pulp and skin).  
<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994) and are vegetation-specific.  
<sup>4</sup> ln = Natural log function.  
<sup>5</sup> exp(-k×T) = e<sup>-k×T</sup>, where e is a constant = 2.7828.  
<sup>6</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>7</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-4**

**Potential Risks to Large Herbivorous Mammal (Mule Deer) from Consumption of Contaminated Vegetation (Acute Exposure Scenario)**

| Parameters/Assumptions                                | Value               | Units             |
|---|---------------------|-------------------|
| Body weight (BW)                                      | 70                  | kg                |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>    | 1.9212              | kg dw/day         |
| Food ingestion rate (wet weight [ww]) ir <sup>2</sup> | 6.4039              | kg ww/day         |
| Duration of exposure (D)                              | 1                   | day               |
| Application rates (R)                                 | Typical<br>1        | lb/acre           |
|   | Maximum<br>4        | lb/acre           |
| Residue rate - grass (rr) <sup>3</sup>                | Typical<br>36       | mg/kg per lb/acre |
|   | Maximum<br>197      | mg/kg per lb/acre |
| Concentration on grass (C): R × rr                    | Typical<br>36       | mg/kg grass       |
|   | Maximum<br>788      | mg/kg grass       |
| Drift (Drift)   | Typical<br>1        | unitless          |
|   | Maximum<br>1        | unitless          |
| Proportion of diet contaminated (PC)                  | Typical<br>1        | unitless          |
|   | Maximum<br>1        | unitless          |
| Dose estimates: (Drift × PC × C × ir) / BW            | Typical<br>3.29E+00 | mg/kg bw/day      |
|   | Maximum<br>7.21E+01 | mg/kg bw/day      |

| RISK QUOTIENTS <sup>4</sup> – Ingestion                | Toxicity Reference Value (mg/kg bw/day) <sup>5</sup> | Typical Application | Maximum Application |
|--|--|---------------------|---------------------|
| Large mammalian herbivore/gramivore – (acute exposure) | 32   | 1.03E-01            | 2.25E+00            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for herbivores; where food ingestion rate (g dw/day) = 0.577×(BW g)<sup>0.727</sup>; converted into kg dw/day.  
<sup>2</sup> Assumes grass is 70% water (USEPA 1993; Table 4-2 - lowest value for young grasses).  
<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994) and are vegetation-specific.  
<sup>4</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>5</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-5**

**Potential Risks to Large Herbivorous Mammal (Mule Deer) from Consumption of Contaminated Vegetation (Chronic Exposure Scenario)**

| Parameters/Assumptions  |                    | Value    | Units              |
|---|--------------------|----------|--------------------|
| Duration of exposure (T)  |                    | 90       | day                |
| Body weight (BW)  |                    | 70       | kg                 |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>  |                    | 1.9212   | kg dw/day          |
| Food ingestion rate ( wet weight [ww]) ir <sup>2</sup>  |                    | 6.4039   | kg ww/day          |
| Half life on vegetation (t <sub>50</sub> )  | Herbicide specific | 30       | days               |
| Application rates (R)   | Typical            | 1        | lb/acre            |
|   | Maximum            | 4        | lb/acre            |
| Residue rate - grass (rr) <sup>3</sup>  | Typical            | 36       | mg/kg per lb/acre  |
|   | Maximum            | 197      | mg/kg per lb/acre  |
| Drift (Drift)   | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Decay Coefficient (k): ln(2)/t <sub>50</sub> <sup>4</sup>   | Typical            | 0.0231   | days <sup>-1</sup> |
|   | Maximum            | 0.0231   | days <sup>-1</sup> |
| Initial concentration on grass (C <sub>0</sub> ): R × rr × Drift  | Typical            | 36       | mg/kg grass        |
|   | Maximum            | 788      | mg/kg grass        |
| Concentration on grass at time T: C <sub>0</sub> × exp(-k×T) <sup>5</sup>                                   | Typical            | 4.5      | mg/kg grass        |
|   | Maximum            | 98.5     | mg/kg grass        |
| Time-weighted average concentration on vegetation (CTWA): C <sub>0</sub> * (1-exp(-k×T))/(k×T) <sup>5</sup> | Typical            | 15.1483  | mg/kg vegetation   |
|   | Maximum            | 331.5794 | mg/kg vegetation   |
| Proportion of diet contaminated (PC)  | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Dose estimates: (CTWA × ir × PC) / BW   | Typical            | 1.39E+00 | mg/kg bw/day       |
|   | Maximum            | 3.03E+01 | mg/kg bw/day       |

| RISK QUOTIENTS <sup>6</sup> – Ingestion                  | Toxicity Reference Value (mg/kg bw/day) <sup>6</sup> | Typical Application | Maximum Application |
|--|--|---------------------|---------------------|
| Large mammalian herbivore/gramivore – (chronic exposure) | 0.33   | 4.20E+00            | 9.19E+01            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for herbivores; where food ingestion rate (g dw/day) = 0.577×(BW g)<sup>0.727</sup>; converted into kg dw/day.

<sup>2</sup> Assumes grass is 70% water (USEPA 1993; Table 4-2 - lowest value for young grasses).

<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994) and are vegetation-specific.

<sup>4</sup> ln = Natural log function.

<sup>5</sup> exp(-k×T) = e<sup>-k×T</sup>, where e is a constant = 2.7828.

<sup>6</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.

<sup>7</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-6**

**Potential Risks to Carnivorous Mammal (Coyote) from Consumption of Contaminated Small Mammals (Acute Exposure Scenario)**

| Parameters/Assumptions  |         | Value    | Units           |
|---|---------|----------|-----------------|
| Body weight (BW)  |         | 12       | kg              |
| Body weight small mammal (BW_mouse)   |         | 0.02     | kg              |
| Surface area small mammal (A)   |         | 86.21    | cm <sup>2</sup> |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>  |         | 0.5297   | kg dw/day       |
| Food ingestion rate ( wet weight [ww]) ir <sup>2</sup>  |         | 1.6554   | kg ww/day       |
| Duration of exposure (D)  |         | 1        | day             |
| Application rates (R)   | Typical | 1        | lb/acre         |
|   | Maximum | 4        | lb/acre         |
| Amount deposited on small mammal prey (Amount_mouse): $0.5 \times A \times R$ <sup>3</sup>                                      | Typical | 0.4831   | mg              |
|   | Maximum | 1.9326   | mg              |
| Drift (Drift)   | Typical | 1        | unitless        |
|   | Maximum | 1        | unitless        |
| Proportion of diet contaminated (PC)  | Typical | 1        | unitless        |
|   | Maximum | 1        | unitless        |
| Dose estimates: $[(\text{Drift} \times \text{PC} \times \text{Amount\_mouse}) / \text{BW\_mouse}] \times \text{ir} / \text{BW}$ | Typical | 3.33E+00 | mg/kg bw        |
|   | Maximum | 1.33E+01 | mg/kg bw        |

| RISK QUOTIENTS <sup>4</sup> – Ingestion     | Toxicity Reference Value (mg/kg bw) <sup>5</sup> | Typical Application | Maximum Application |
|---|--|---------------------|---------------------|
| Large carnivorous mammal – (acute exposure) | 50   | 6.66E-02            | 2.67E-01            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987); where food ingestion rate (g dw/day) = 0.0687×(BW g)<sup>0.822</sup>; converted into kg dw/day.  
<sup>2</sup> Assumes mammals are 68% water (USEPA 1993).  
<sup>3</sup> Surface area (A) and body weight of mouse receptor presented in Table B-1. Surface area calculation for mammals from Stahl (1967; presented in USEPA 1993).  
<sup>4</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>5</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

TABLE B-7

Potential Risks to Carnivorous Mammal (Coyote) from Consumption of Contaminated Small Mammals  
(Chronic Exposure Scenario)

| Parameters/Assumptions  |         | Value    | Units              |
|---|---------|----------|--------------------|
| Duration of exposure (T)  |         | 90       | day                |
| Body weight (BW)  |         | 12       | kg                 |
| Body weight small mammal (BW_mouse)   |         | 0.02     | kg                 |
| Surface area small mammal (A)   |         | 86.21    | cm <sup>2</sup>    |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>  |         | 0.5297   | kg dw/day          |
| Food ingestion rate (wet weight [ww]) ir <sup>2</sup>   |         | 1.6554   | kg ww/day          |
| Application rates (R)   | Typical | 1        | lb/acre            |
|   | Maximum | 4        | lb/acre            |
| Drift (Drift)   | Typical | 1        | unitless           |
|   | Maximum | 1        | unitless           |
| Decay coefficient (k): $\ln(2)/t_{50}$ <sup>3</sup>   | Typical | 0.0231   | days <sup>-1</sup> |
|   | Maximum | 0.0231   | days <sup>-1</sup> |
| Initial concentration on mammal<br>(C <sub>0</sub> ): $(0.5 \times A \times R) / BW\_mouse$                         | Typical | 24.1571  | mg/kg mammal       |
|   | Maximum | 96.6284  | mg/kg mammal       |
| Concentration absorbed in small mammal at time T<br>(C <sub>90</sub> ): $C_0 \times \exp(-k \times T)$ <sup>4</sup> | Typical | 0.1157   | mg/kg mammal       |
|   | Maximum | 0.4627   | mg/kg mammal       |
| Proportion of diet contaminated (PC)  | Typical | 1        | unitless           |
|   | Maximum | 1        | unitless           |
| Dose estimates (D) : $(C_{90} \times ir \times PC) / BW$  | Typical | 1.60E-02 | mg/kg bw/day       |
|   | Maximum | 6.38E-02 | mg/kg bw/day       |

| RISK QUOTIENTS <sup>5</sup> – Ingestion        | Toxicity Reference Value<br>(mg/kg bw/day) <sup>6</sup> | Typical<br>Application | Maximum<br>Application |
|--|---|------------------------|------------------------|
| Large mammalian carnivore – (chronic exposure) | 0.51  | 3.13E-02               | 1.25E-01               |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987); where food ingestion rate (g dw/day) = 0.0687 × (BW g)<sup>0.822</sup>; converted into kg dw/day.  
<sup>2</sup> Assumes mammals are 68% water (USEPA 1993).  
<sup>3</sup> ln = Natural log function.  
<sup>4</sup>  $\exp(-k \times T) = e^{(-k \times T)}$ , where e is a constant = 2.7828.  
<sup>5</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>6</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-8**

**Potential Risks to Insectivorous Bird (American robin) from Consumption of Contaminated Insects (Acute Exposure Scenario)**

| Parameters/Assumptions                                |         | Value    | Units             |
|---|---------|----------|-------------------|
| Body weight (BW)                                      |         | 0.08     | kg                |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>    |         | 0.0112   | kg dw/day         |
| Food ingestion rate (wet weight [ww]) ir <sup>2</sup> |         | 0.0363   | kg ww/day         |
| Duration of exposure (D)                              |         | 1        | day               |
| Application rates (R)                                 | Typical | 1        | lb/acre           |
|   | Maximum | 4        | lb/acre           |
| Residue rate - insects (rr) <sup>3</sup>              | Typical | 45       | mg/kg per lb/acre |
|   | Maximum | 350      | mg/kg per lb/acre |
| Concentration on insects (C): R × rr                  | Typical | 45       | mg/kg insect      |
|   | Maximum | 1400     | mg/kg insect      |
| Drift (Drift)   | Typical | 1        | unitless          |
|   | Maximum | 1        | unitless          |
| Proportion of diet contaminated (PC)                  | Typical | 1        | unitless          |
|   | Maximum | 1        | unitless          |
| Dose estimates (D) : (Drift × PC × C × ir) / BW       | Typical | 2.04E+01 | mg/kg bw          |
|   | Maximum | 6.35E+02 | mg/kg bw          |

| RISK QUOTIENTS <sup>4</sup> - Ingestion     | Toxicity Reference Value (mg/kg bw) <sup>5</sup> | Typical Application | Maximum Application |
|---|--|---------------------|---------------------|
| Small insectivorous bird – (acute exposure) | 150  | 1.36E-01            | 4.23E+00            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for all birds; where food ingestion rate (kg dw/day) = 0.0582×(BW)<sup>0.651</sup>.  
<sup>2</sup> Assumes insects are 69% water (USEPA 1993; Table 4-1 - value for grasshoppers and crickets).  
<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994).  
<sup>4</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>5</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-9**

**Potential Risks to Insectivorous Bird (American robin) from Consumption of Contaminated Insects  
(Chronic Exposure Scenario)**

| Parameters/Assumptions  |                    | Value    | Units              |
|---|--------------------|----------|--------------------|
| Duration of exposure (T)  |                    | 90       | day                |
| Body weight (BW)  |                    | 0.08     | kg                 |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>  |                    | 0.0112   | kg dw/day          |
| Food ingestion rate ( wet weight [ww]) ir <sup>2</sup>  |                    | 0.0363   | kg ww/day          |
| Half life on insect (t <sub>50</sub> )  | Herbicide specific | 30       | days               |
| Application rates (R)   | Typical            | 1        | lb/acre            |
|   | Maximum            | 4        | lb/acre            |
| Residue rate - insects (rr) <sup>3</sup>  | Typical            | 45       | mg/kg per lb/acre  |
|   | Maximum            | 350      | mg/kg per lb/acre  |
| Drift (Drift)   | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Decay coefficient (k): ln(2)/t <sub>50</sub> <sup>4</sup>   | Typical            | 0.0231   | days <sup>-1</sup> |
|   | Maximum            | 0.0231   | days <sup>-1</sup> |
| Initial concentration on insects<br>(C <sub>0</sub> ): R × rr × Drift                                       | Typical            | 45       | mg/kg insect       |
|   | Maximum            | 1400     | mg/kg insect       |
| Concentration on insects at time T<br>(C <sub>90</sub> ) : C <sub>0</sub> × exp(-k×T) <sup>5</sup>          | Typical            | 5.625    | mg/kg insect       |
|   | Maximum            | 175      | mg/kg insect       |
| Time-weighted Average Concentration on insects<br>(CTWA): C <sub>0</sub> × (1-exp(-k×T))/(k×T) <sup>5</sup> | Typical            | 18.9354  | mg/kg insect       |
|   | Maximum            | 589.1005 | mg/kg insect       |
| Proportion of diet contaminated (PC)  | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Dose estimates (D): (CTWA × ir × PC) / BW   | Typical            | 8.58E+00 | mg/kg bw/day       |
|   | Maximum            | 2.67E+02 | mg/kg bw/day       |

| RISK QUOTIENTS <sup>6</sup> - Ingestion       | Toxicity Reference Value<br>(mg/kg bw/day) <sup>7</sup> | Typical<br>Application | Maximum<br>Application |
|---|---|------------------------|------------------------|
| Small insectivorous bird – (chronic exposure) | 12  | 7.15E-01               | 2.23E+01               |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for all birds; where food ingestion rate (kg dw/day) = 0.0582×(BW)<sup>0.651</sup>.  
<sup>2</sup> Assumes insects are 69% water (USEPA 1993; Table 4-1 - value for grasshoppers and crickets).  
<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994).  
<sup>4</sup> ln = Natural log function.  
<sup>5</sup> exp(-k×T) = e<sup>-k×T</sup>, where e is a constant = 2.7828.  
<sup>6</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>7</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-10**

**Potential Risks to Herbivorous Bird (Canada goose) from Consumption of Contaminated Vegetation (Acute Exposure Scenario)**

| Parameters/Assumptions                                |         | Value    | Units             |
|---|---------|----------|-------------------|
| Body weight (BW)                                      |         | 3.72     | kg                |
| Food ingestion rate (dry weight [ww]) <sup>1</sup>    |         | 0.1369   | kg dw/day         |
| Food ingestion rate (wet weight [ww]) ir <sup>2</sup> |         | 0.9126   | kg ww/day         |
| Duration of exposure (D)                              |         | 1        | day               |
| Application rates (R)                                 | Typical | 1        | lb/acre           |
|   | Maximum | 4        | lb/acre           |
| Residue rate – vegetation (rr) <sup>3</sup>           | Typical | 35       | mg/kg per lb/acre |
|   | Maximum | 296      | mg/kg per lb/acre |
| Concentration on vegetation (C): R × rr               | Typical | 35       | mg/kg veg         |
|   | Maximum | 1184     | mg/kg veg         |
| Drift (Drift)   | Typical | 1        | unitless          |
|   | Maximum | 1        | unitless          |
| Proportion of diet contaminated (PC)                  | Typical | 1        | unitless          |
|   | Maximum | 1        | unitless          |
| Dose estimates: (Drift × PC × C × ir) / BW            | Typical | 8.59E+00 | mg/kg bw          |
|   | Maximum | 2.90E+02 | mg/kg bw          |

| RISK QUOTIENTS <sup>4</sup> – Ingestion   | Toxicity Reference Value (mg/kg bw) <sup>5</sup> | Typical Application | Maximum Application |
|---|--|---------------------|---------------------|
| Large herbivorous bird – (acute exposure) | 215  | 3.99E-02            | 1.35E+00            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for all birds; where food ingestion rate (kg dw/day) = 0.0582×(BW)<sup>0.651</sup>.  
<sup>2</sup> Assumes vegetation is 85% water (USEPA 1993; Table 4-2 - value for dicotyledons).  
<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994) and are vegetation-specific.  
<sup>4</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>5</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-11**

**Potential Risks to Herbivorous Bird (Canada goose) from Consumption of Contaminated Vegetation (Chronic Exposure Scenario)**

| Parameters/Assumptions  |                    | Value    | Units              |
|---|--------------------|----------|--------------------|
| Duration of exposure (T)  |                    | 90       | day                |
| Body weight (BW)  |                    | 3.72     | kg                 |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>  |                    | 0.1369   | kg dw/day          |
| Food ingestion rate ( wet weight [ww]) ir <sup>2</sup>  |                    | 0.9126   | kg ww/day          |
| Half life on vegetation (t <sub>50</sub> )  | Herbicide specific | 30       | days               |
| Application rates (R)   | Typical            | 1        | lb/acre            |
|   | Maximum            | 4        | lb/acre            |
| Residue rate - vegetation (rr) <sup>3</sup>   | Typical            | 35       | mg/kg per lb/acre  |
|   | Maximum            | 296      | mg/kg per lb/acre  |
| Drift (Drift)   | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Decay coefficient (k): ln(2)/t <sub>50</sub> <sup>4</sup>   | Typical            | 0.0231   | days <sup>-1</sup> |
|   | Maximum            | 0.0231   | days <sup>-1</sup> |
| Initial concentration on vegetation (C <sub>0</sub> ): R × rr × Drift                                       | Typical            | 35       | mg/kg veg          |
|   | Maximum            | 1184     | mg/kg veg          |
| Concentration on vegetation at time T (C <sub>90</sub> ): C <sub>0</sub> × exp(-k×T) <sup>5</sup>           | Typical            | 4.375    | mg/kg veg          |
|   | Maximum            | 148      | mg/kg veg          |
| Time-weighted average concentration on vegetation (CTWA): C <sub>0</sub> × (1-exp(-k×T))/(k×T) <sup>5</sup> | Typical            | 14.7275  | mg/kg veg          |
|   | Maximum            | 498.2107 | mg/kg veg          |
| Proportion of diet contaminated (PC)  | Typical            | 1        | unitless           |
|   | Maximum            | 1        | unitless           |
| Dose estimates (D): (CTWA × ir × PC) / BW   | Typical            | 3.61E+00 | mg/kg bw/day       |
|   | Maximum            | 1.22E+02 | mg/kg bw/day       |

| RISK QUOTIENTS <sup>6</sup> – Ingestion     | Toxicity Reference Value (mg/kg bw/day) <sup>7</sup> | Typical Application | Maximum Application |
|---|--|---------------------|---------------------|
| Large herbivorous bird – (chronic exposure) | 0.6  | 6.02E+00            | 2.04E+02            |

<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for all birds; where food ingestion rate (kg dw/day) = 0.0582×(BW)<sup>0.651</sup>.  
<sup>2</sup> Assumes vegetation is 85% water (USEPA 1993; Table 4-2 - value for dicotyledons).  
<sup>3</sup> Residue rates were obtained from the Kenaga nomogram as updated (Fletcher et al. 1994) and are vegetation-specific.  
<sup>4</sup> ln = Natural log function.  
<sup>5</sup> exp(-k×T) = e<sup>-k×T</sup>, where e is a constant = 2.7828.  
<sup>6</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>7</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-12**

**Potential Risk to Predatory Bird from Consumption of Contaminated Fish from Pond (Pond Impacted by Regular Application of Herbicide)**

| Parameters/ Assumptions                                    |         | Value    | Units         |
|--|---------|----------|---------------|
| Body weight (BW)   |         | 5.15     | kg            |
| Food ingestion rate (dry weight [dw]) <sup>1</sup>         |         | 1.02E-01 | kg dw/day     |
| Food ingestion rate (wet weight [ww]) ir <sup>2</sup>      |         | 4.07E-01 | kg ww/day     |
| Bioconcentration factor (BCF)                              |         | 1.03     | L/kg fish     |
| Food Chain Multiplier Trophic Level 2 (FCM_TL2)            |         | 1        | unitless      |
| Food Chain Multiplier Trophic Level 3 (FCM_TL3)            |         | 1        | unitless      |
| Proportion of diet contaminated (PC)                       |         | 1        | unitless      |
| Toxicity reference value (TRV)                             |         | 0.6      | mg/kg-bw/day  |
| Concentration in fish <sup>3</sup>                         | Typical | 1.15E-01 | mg/kg bw fish |
| (C <sub>fish</sub> ) : Pond_conc × BCF × FCM_TL2 x FCM_TL3 | Maximum | 4.62E-01 | mg/kg bw fish |
| Dose estimate (D) : (C <sub>fish</sub> × ir × PC) / BW     | Typical | 9.13E-03 | mg/kg bw/day  |
|  | Maximum | 3.65E-02 | mg/kg bw/day  |

| RISK QUOTIENTS <sup>4</sup> - Ingestion | Toxicity Reference Value (mg/kg bw/day) <sup>5</sup> | Typical Application | Maximum Application |
|---|--|---------------------|---------------------|
| Piscivorous bird – (chronic exposure)   | 0.6  | 1.52E-02            | 6.08E-02            |

Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>1</sup> Calculated using algorithm developed by Nagy (1987) for all birds; where Food Ingestion Rate (kg dw/day) = 0.0582\*(BW)<sup>0.651</sup>.  
<sup>2</sup> Assumes fish are 75% water (USEPA 1993; Table 4-2 - value for dicotyledons).  
<sup>3</sup> Pond concentrations presented in Table B-15.  
<sup>4</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.  
<sup>5</sup> Toxicity Reference Value (TRV) - TRVs relate the dose of a compound with a potentially adverse effect. TRVs (mg/kg bw) were selected during a review of the ecotoxicological literature.

**TABLE B-13**

**Potential Risks to Non-Target Terrestrial Plants from Direct Spray and Spray Drift**

| <b>DIRECT SPRAY</b>      | <b>Terrestrial Concentration<br/>(lb/acre)<sup>1</sup></b> | <b>Typical Species RQ<sup>2</sup></b> | <b>Rare, Threatened, and<br/>Endangered Species RQ<sup>2</sup></b> |
|--------------------------|--|---------------------------------------|--|
| Typical application rate | 1  | 2.13E+02                              | 6.25E+02   |
| Maximum application rate | 4  | 8.51E+02                              | 2.50E+03   |

| <b>OFF-SITE DRIFT - modeled in AgDrift<br/>TYPICAL APPLICATION RATE</b> |                                       |  |   |   |  |
|---|---------------------------------------|--|---|---|--|
| <b>Mode of<br/>Application</b>  | <b>Application<br/>Height or Type</b> | <b>Distance From<br/>Receptor (ft)</b> | <b>Soil Concentration<br/>(lb/acre)<sup>1</sup></b> | <b>Typical<br/>Species RQ<sup>2</sup></b> | <b>Rare, Threatened, and<br/>Endangered Species RQ<sup>2</sup></b> |
| Plane   | Non-Forested                          | 100                                    | 9.81E-02  | 2.09E+01                                  | 6.13E+01   |
| Plane   | Non-Forested                          | 300                                    | 4.46E-02  | 9.49E+00                                  | 2.79E+01   |
| Plane   | Non-Forested                          | 900                                    | 1.78E-02  | 3.80E+00                                  | 1.12E+01   |
| Helicopter  | Non-Forested                          | 100                                    | 8.92E-02  | 1.90E+01                                  | 5.58E+01   |
| Helicopter  | Non-Forested                          | 300                                    | 3.57E-02  | 7.59E+00                                  | 2.23E+01   |
| Helicopter  | Non-Forested                          | 900                                    | 1.78E-02  | 3.80E+00                                  | 1.12E+01   |
| Ground  | Low Boom                              | 25                                     | 8.92E-03  | 1.90E+00                                  | 5.58E+00   |
| Ground  | Low Boom                              | 100                                    | 4.43E-03  | 9.43E-01                                  | 2.77E+00   |
| Ground  | Low Boom                              | 900                                    | 6.82E-04  | 1.45E-01                                  | 4.26E-01   |
| Ground  | High Boom                             | 25                                     | 1.78E-02  | 3.80E+00                                  | 1.12E+01   |
| Ground  | High Boom                             | 100                                    | 6.99E-03  | 1.49E+00                                  | 4.37E+00   |
| Ground  | High Boom                             | 900                                    | 8.73E-04  | 1.86E-01                                  | 5.45E-01   |

| <b>OFF-SITE DRIFT - modeled in AgDrift<br/>MAXIMUM APPLICATION RATE</b> |                                       |  |   |   |  |
|---|---------------------------------------|--|---|---|--|
| <b>Mode of<br/>Application</b>  | <b>Application<br/>Height or Type</b> | <b>Distance From<br/>Receptor (ft)</b> | <b>Soil Concentration<br/>(lb/acre)<sup>1</sup></b> | <b>Typical<br/>Species RQ<sup>2</sup></b> | <b>Rare, Threatened, and<br/>Endangered Species RQ<sup>2</sup></b> |
| Plane   | Non-Forested                          | 100                                    | 4.55E-01  | 9.68E+01                                  | 2.84E+02   |
| Plane   | Non-Forested                          | 300                                    | 2.05E-01  | 4.37E+01                                  | 1.28E+02   |
| Plane   | Non-Forested                          | 900                                    | 5.35E-02  | 1.14E+01                                  | 3.35E+01   |
| Helicopter  | Non-Forested                          | 100                                    | 3.93E-01  | 8.35E+01                                  | 2.45E+02   |
| Helicopter  | Non-Forested                          | 300                                    | 1.52E-01  | 3.23E+01                                  | 9.48E+01   |
| Helicopter  | Non-Forested                          | 900                                    | 2.68E-02  | 5.69E+00                                  | 1.67E+01   |
| Ground  | Low Boom                              | 25                                     | 5.35E-02  | 1.14E+01                                  | 3.35E+01   |
| Ground  | Low Boom                              | 100                                    | 1.78E-02  | 3.80E+00                                  | 1.12E+01   |
| Ground  | Low Boom                              | 900                                    | 2.73E-03  | 5.81E-01                                  | 1.71E+00   |
| Ground  | High Boom                             | 25                                     | 8.03E-02  | 1.71E+01                                  | 5.02E+01   |
| Ground  | High Boom                             | 100                                    | 2.68E-02  | 5.69E+00                                  | 1.67E+01   |
| Ground  | High Boom                             | 900                                    | 3.49E-03  | 7.42E-01                                  | 2.18E+00   |

<sup>1</sup> a.i. = active ingredient.

<sup>2</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.

**TABLE B-14**

**Potential Risks to Aquatic Species from Accidental Spill to Pond (Acute Exposure)**

| Parameters/Assumptions                          | Value     | Units |
|---|-----------|-------|
| <b>Volume of pond (Vp)</b>                      | 1,011,715 | L     |
| <b>Volume of spill</b>                          |           |       |
| Truck (Vspill <sub>t</sub> )                    | 757       | L     |
| Helicopter(Vspill <sub>h</sub> )                | 529.9     | L     |
| <b>Herbicide concentration (Cm)<sup>1</sup></b> |           |       |
| Truck mixture (Cm <sub>t</sub> )                | 19,174.30 | mg/L  |
| Helicopter mixture (Cm <sub>h</sub> )           | 9,5871.49 | mg/L  |

| Scenario                   | Concentrations in water<br>(Cw): Cm × Vspill / Vp | Units | Risk Quotients <sup>2</sup> |                          |                              |
|----------------------------|---|-------|-----------------------------|--------------------------|------------------------------|
|                            |   |       | Fish                        | Aquatic<br>Invertebrates | Non-Target<br>Aquatic Plants |
| Truck spill into pond      | 14.35   | mg/L  | 1.91E+01                    | 1.02E+02                 | 1.91E+04                     |
| Helicopter spill into pond | 50.21   | mg/L  | 6.70E+01                    | 3.59E+02                 | 6.70E+04                     |

<sup>1</sup> Based on herbicide mixed for the maximum application rate, where truck spray rate is 25 gallons per acre and helicopter spray rate is 5 gallons per acre. Cm = [application rate x (1/spray rate)] converted from lb/gallon to mg/L.  
<sup>2</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.

**TABLE B-15**

**Potential Risk to Aquatic Species from Direct Spray of Pond and Stream (Acute Exposure)**

| Parameters/Assumptions   |         | Value       | Units          |
|--|---------|-------------|----------------|
| <b>Pond</b>  |         |             |                |
| <b>Application rates (R)</b>   | Typical | 1           | lb/acre        |
|  | Maximum | 4           | lb/acre        |
| <b>Area of pond (Area)</b>   |         | 0.25        | acre           |
| <b>Volume of pond (Vol)</b>  |         | 1,011,715   | L              |
| <b>Mass sprayed on pond (R x Area)</b>                               | Typical | 113,398     | mg             |
|  | Maximum | 453,592     | mg             |
| <b>Concentration in pond water (Mass/Volume)</b>                     | Typical | 0.1121      | mg/L           |
|  | Maximum | 0.4483      | mg/L           |
| <b>Stream</b>  |         |             |                |
| <b>Width of stream</b>   |         | 2           | m              |
| <b>Length of stream impacted by direct spray</b>                     |         | 636.15      | m              |
| <b>Area of stream impacted by spray (Area)</b>                       |         | 1,272.3     | m <sup>2</sup> |
| <b>Depth of stream</b>   |         | 0.2         | m              |
| <b>Instantaneous volume of stream impacted by direct spray (Vol)</b> |         | 254,460     | L              |
| <b>Mass sprayed on stream (R x Area)</b>                             | Typical | 0.314       | lb             |
|  | Maximum | 1.258       | lb             |
| <b>Mass sprayed on stream - converted to mg</b>                      | Typical | 142,607.060 | mg             |
|  | Maximum | 570,428.239 | mg             |
| <b>Concentration in stream water (Mass/Vol)</b>                      | Typical | 0.5604      | mg/L           |
|  | Maximum | 2.2417      | mg/L           |

| Scenario                                  | Concentration in water (mg/L) | Risk Quotients <sup>1</sup> |                       |                           |
|---|-------------------------------|-----------------------------|-----------------------|---------------------------|
|   |                               | Fish                        | Aquatic Invertebrates | Non-Target Aquatic Plants |
| <b>Acute</b>                              |                               |                             |                       |                           |
| Direct spray to pond - Normal Application |                               |                             |                       |                           |
| Typical application                       | 1.12E-01                      | 1.49E-01                    | 8.01E-01              | 1.49E+02                  |
| Maximum application                       | 4.48E-01                      | 5.98E-01                    | 3.20E+00              | 5.98E+02                  |
| Direct spray to stream - Accidental Spray |                               |                             |                       |                           |
| Typical application                       | 5.60E-01                      | 7.47E-01                    | 4.00E+00              | 7.47E+02                  |
| Maximum application                       | 2.24E+00                      | 2.99E+00                    | 1.60E+01              | 2.99E+03                  |
| <b>Chronic</b>                            |                               |                             |                       |                           |
| Direct spray to pond - Normal Application |                               |                             |                       |                           |
| Typical application                       | 1.12E-01                      | 6.59E-01                    | 2.55E+01              | 3.74E+02                  |
| Maximum application                       | 4.48E-01                      | 2.64E+00                    | 1.02E+02              | 1.49E+03                  |
| Direct spray to stream - Accidental Spray |                               |                             |                       |                           |
| Typical application                       | 5.60E-01                      | 3.30E+00                    | 1.27E+02              | 1.87E+03                  |
| Maximum application                       | 2.24E+00                      | 1.32E+01                    | 5.09E+02              | 7.47E+03                  |

<sup>1</sup> Risk Quotient = Estimated Dose/Toxicity Reference Value.

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