

**Government  
of Alberta ■**

# **Environmental Code of Practice for Hydrologic Tracing Analysis Studies**

**Effective September 30, 1996**

*Made under the Environmental Protection and Enhancement Act,  
RSA 2000, cE-12*

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***ENVIRONMENTAL CODE OF PRACTICE FOR  
HYDROLOGIC TRACING ANALYSIS STUDIES***  
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# ***ENVIRONMENTAL CODE OF PRACTICE FOR HYDROLOGIC TRACING ANALYSIS STUDIES***

## **ALBERTA ENVIRONMENTAL PROTECTION**

### **Preface**

**1(1)** The Code of Practice for Hydrologic Tracing Analysis Studies is incorporated by the *Substance Release Regulation* (A.R. 124/93), under the authority of section 36 of the *Environmental Protection and Enhancement Act*. Persons responsible for activities affected by this Code must meet all its requirements to ensure that their activities are in compliance with Alberta's environmental laws. In addition to the requirements of this Code of Practice, persons responsible carrying out hydrologic tracing analysis studies must comply with all requirements of the *Environmental Protection and Enhancement Act*, its associated regulations, and all other applicable laws.

**(2)** Persons responsible for activities affected by this Code must register with Alberta Environmental Protection prior to commencing a hydrologic tracing analysis study. Section 4 of this Code deals with registration in greater detail.

### **Introduction**

**2(1)** This Code of Practice outlines the minimum requirements that hydrologic tracing analysis studies must meet to ensure environmental protection. Persons responsible carrying out hydrologic tracing analysis studies within the Province of Alberta must comply with these requirements. As well, persons responsible should consult with persons or parties that may be affected by the study in accordance with the following requirements.

- (a) A person responsible planning a hydrologic tracing analysis study shall publish notice of the proposed study in a newspaper having general circulation in the area of the proposed study, at least 30 days prior to the proposed study, and if necessary, shall hold a public meeting to answer any questions the public may have concerning the proposed study.
- (b) The person responsible shall inform all water withdrawal users in the river reach under study, at least 7 days prior to commencement of the hydrologic tracing analysis study, of
  - (i) the date or dates the hydrologic tracing analysis study or studies will be conducted on,
  - (ii) the approximate time at which the peak concentration of the tracer-dye will pass the water-user withdrawal point, and
  - (iii) the anticipated peak concentration of the tracer-dye.

- (c) In the event a hydrologic tracing analysis study is cancelled, the person responsible shall, at the earliest opportunity, inform the Director and all water withdrawal users of the cancellation and of any changes that will be made in the study schedule as a result of the cancellation.

(2) Questions or concerns regarding the application or contents of this Code of Practice can be made to:

Alberta Environmental Protection  
Northeast Boreal & Parkland Regions  
Regional Director  
5th Floor, 9820 - 106 Street  
Edmonton, AB T5K 2J6  
Phone: (403)427-5836  
Fax: (403)422-5120

or:

Alberta Environmental Protection  
Northwest Boreal & Northern East Slopes Regions  
Regional Director  
203, 111 - 54 Street  
Edson, AB T7E 1T2  
Phone: (403)723-8395  
Fax: (403)723-8542

or:

Alberta Environmental Protection  
Southern East Slopes & Prairie Regions  
Regional Director  
201 Deerfoot Square  
2938 - 11 Street N.E.  
Calgary, AB T2E 7L7  
Phone: (403)297-7605  
Fax: (403)297-5944

## **Definitions**

**3(1)** In this Code of Practice,

- (a) "hydrologic tracing analysis study" means a study in which dissolved or suspended material such as salts, radioisotopes or fluorescent dyes are used to determine the path or rate of movement and dispersion of a substance;
- (b) "point of complete mixing" occurs when the cross sectionally averaged concentration of tracer-dye is within 5 percent of the fully mixed concentration;

- (c) "water-user withdrawal points" are deemed to include, but are not limited to, potable water supply intakes, livestock watering points, or irrigation withdrawal points.

**(2)** Terms that are defined in section 1 of the *Environmental Protection and Enhancement Act* and in the *Substance Release Regulation* (A.R. 124/93) have the same meaning when they are used in this Code of Practice, unless otherwise defined or modified within this Code of Practice.

## **Registration**

**4(1)** In addition to any information required by the Director under the *Approvals and Registration Procedure Regulation* (A.R. 113/93), the person responsible shall complete the registration form attached to this Code of Practice and forward it to the Director.

**(2)** The person responsible shall also provide the following information on the proposed hydrologic tracing analysis study in writing to the Director at the time of registration.

- (a) Information outlining the study which includes
  - (i) the name and address of the person responsible who will conduct the study;
  - (ii) the purpose of the study;
  - (iii) the type of tracer-dye to be used, its concentration, and the volume to be used in the study;
  - (iv) the time interval over which the tracer-dye injections and sampling will take place; and
  - (v) the name and address of all water withdrawal users in the mixing zone of the river under study.
- (b) A location map outlining the watershed boundary and depicting the river reach in which the study will take place.
- (c) A 1:50,000 topographic map which indicates
  - (i) the river reach under study;
  - (ii) all water-user withdrawal points in the study reach;
  - (iii) all tracer-dye injection points; and
  - (iv) all tracer-dye sampling points.
- (d) Information pertaining to the river flow and its hydraulic characteristics at the tracer-dye injection points, specifically

- (i) the historical monthly average flow in the study reach for the period of study;
  - (ii) the 1-in-10 year low flow of 30 days duration or 30Q10 in the study reach for the period of the study;
  - (iii) the best estimates of the hydraulic characteristics of the river in the study reach, including its mean width, depth, velocity, and water-surface slope, for the period of study; and
  - (iv) an estimate of the projected average river flow for the period of study.
- (e) An estimate of the distance from the point where the tracer-dye will be injected to the point of complete mixing, in accordance with Appendix "A".
  - (f) Contingency plans in the event of a tracer-dye spill.

### **Person Responsible's Duty**

**5** The person responsible shall comply with all requirements of this Code of Practice.

### **Study Requirements**

**6(1)** The hydrologic tracing analysis study shall be carried out under the continuous supervision of the person responsible.

**(2)** Rhodamine WT dye shall be used as the tracer-dye, unless an alternate tracer-dye is authorized by the Director under section 6(4).

**(3)** Rhodamine WT shall be diluted with an equal volume of methanol in order to produce a neutrally buoyant mixture with lower viscosity and surface tension characteristics.

**(4)** If an alternate tracer-dye is desired for use, the person responsible shall obtain prior written authorization for its use from the Director. The person responsible shall apply in writing to the Director and shall provide the following information:

- (a) the reason why Rhodamine WT is not adequate as the study tracer-dye;
- (b) short-term toxicity information on the proposed tracer-dye's LC<sub>50</sub> or LD<sub>50</sub>;
- (c) long-term toxicity information on the proposed tracer-dye, preferably from microcosm experiments using 1/50th to 1/100th of the LC<sub>50</sub> concentration for 90 days or longer;



- (d) any available carcinogenicity and mutagenicity data for the proposed tracer-dye;
  - (e) any available environmental chemistry data, including sorption, volatility, and bioconcentration, for the proposed tracer-dye;
  - (f) proposed maximum concentration of tracer-dye after the point of complete mixing based on appropriate supporting information that documents maximum permissible levels for drinking water or freshwater aquatic life, and aesthetic considerations; and
  - (g) any other information required by the Director.
- (5) The person responsible shall inject the tracer-dye at least 10 centimetres below the free-flowing surface of the river. The tracer-dye shall be injected in a manner that does not result in its accumulation in calm or stagnant water.
- (6) The person responsible shall not inject tracer-dye in shallow or stagnant regions of the stream. The tracer-dye shall be injected in the central 75 percent of the flow. Side injections shall only take place at the periphery of the central 75 percent of the flow.
- (7) The concentration of Rhodamine WT shall not exceed 10 parts per billion at any time after the point of complete mixing, or at any water-user withdrawal point for human, industrial, or livestock use within the mixing zone.

## **Reporting**

**7(1)** The person responsible shall complete a report on the hydrologic tracing analysis study no later than 3 months after study completion. This report shall contain the following information in tabular form, and may be supplemented by graphical form:

- (a) Information on any cross-sectional surveys completed at the injection and downstream measuring sites. The surveys shall cover the channel from the top of the bank on each side, and show the bed and bank levels with respect to the water surface elevation on the day of the survey;
- (b) If the tests were conducted under winter conditions, the ice thickness at each cross-section survey site;
- (c) A plan or table summarizing the cross section locations and distances along the river between cross-sections;
- (d) Velocity of flow measurement across each cross-section;
- (e) The discharge in the river at the time of measurements; and

- (f) The measurements of the tracer-dye cloud as it passes the measuring station, including time, concentration, and location across the cross-section.

(2) The person responsible shall immediately report any contravention of this Code of Practice by telephone to the Director of Pollution Control Division at (403) 422-4505. The Director of Pollution Control Division may require the person responsible to provide a further written report of any contravention.

### **Record Keeping**

8 The person responsible shall retain the following information for a hydrologic tracing analysis study on file for a period of 5 years from completion of the study, and shall make it available for review upon request by the general public or Alberta Environmental Protection.

- (a) Information outlined in section 4(2);
- (b) Any written authorization given by the Director pursuant to section 6(4);
- (c) The report on the hydrologic tracing analysis study required under section 7(1).

### **Code Amendment**

9 This Code of Practice will be reviewed every 10 years beginning in 2006. Alberta Environmental Protection will accept and compile written comments on the contents of this Code at any time, and will review all comments received at the next 10 year review. The Director may institute a review and amendment of this Code of Practice at any time. All proposed amendments to this Code of Practice will be reviewed by government, industry, and the interested public. The Director shall have the final decision on amendments made to this Code of Practice. Amendments to this Code of Practice shall become effective when published by Alberta Environmental Protection.

### **Effective Date**

10 This Code of Practice is effective September 30, 1996.

## APPENDIX "A"

### FORMULAS FOR DETERMINING LENGTH OF MIXING ZONE

These equations are suitable for modelling discharges occurring in the central 75 percent of flow. Where discharges to be modelled are not located in the central 75 percent of flow and a representative mixing analysis of the discharge is required, study injection and sampling points may be adjusted to ensure representative sample locations are chosen for the discharge of interest.

The length of the mixing zone shall be estimated by the following formulas:

For a single point midchannel injection (continuous or slug)

$$L_m = \frac{0.2 UW^2}{e_z}$$

For a single-point side-bank injection (continuous or slug)

$$L_m = \frac{0.4 UW^2}{e_z}$$

where

$L_m$  is the length of the mixing zone (metres)

$U$  is the mean velocity of flow (metres per second)

$W$  is the average channel width (metres), and

$e_z$  is the transverse dispersion coefficient, in metres squared per second, given by

$$K_z = \frac{e_z}{dU^*}$$

where

$K_z$  is a dimensionless coefficient

$d$  is the mean depth of flow (metres), and

$U^*$  is the shear velocity of the flow (metres per second)

The dimensionless coefficient  $K_z$  is a function of the sinuosity of the river ( $S_n$ ) and the width-to-depth ratio ( $W/d$ ). It is given as:

$$K_z = 0.237 + 0.001 (W/d) \quad \text{for } S_n \leq 1.2$$

$$K_z = C + 0.0017 (W/d) \quad \text{for } S_n > 1.2$$

where

$$C = 3.1 (S_n) - 3.30$$

The shear velocity of the flow  $U^*$  is given by:

$$U^* = (gdS)^{1/2}$$

$g$  is the acceleration due to gravity ( $9.81 \text{ m/s}^2$ );

$S$  is the water-surface slope in metres per metre;

$C$  is a dimensionless constant.

Equations (1) and (2) are dimensionally correct and may be used with units other than those of the SI system, such as foot-pound units, if done consistently.

## **REGISTRATION FORM**

### **Code of Practice for Hydrologic Tracing Analysis Studies**

Name and address of person responsible:

Contact person:

Telephone and fax numbers:

Date(s) study/studies will be conducted:

River reach under study:

Attach all information required by section 4(2) of the Code of Practice.

I acknowledge that I have reviewed a copy of the Code of Practice for Hydrologic Tracing Analysis Studies, and that I am bound by this Code of Practice, and by any subsequent amendments to it.

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Signature of Person Responsible

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Date

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For office use only:

Date Received: \_\_\_\_\_

Registered by:

\_\_\_\_\_  
Director's Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

Registration Number: \_\_\_\_\_