



# REQUEST FOR PROPOSAL

**R15- 124 IP**

Date issued: October 29, 2015

## **AERIAL INSECTICIDE APPLICATION, TUSSOCK MOTH PROGRAM**

**THE CITY OF COLORADO SPRINGS  
FORESTRY DIVISION**

### **PRE-PROPOSAL CONFERENCE**

A Pre-Proposal Conference is scheduled for this solicitation at 9:00 A.M. on Thursday,  
November 5, 2015.

**PROPOSALS ARE DUE NO LATER THAN**

**MONDAY, NOVEMBER 30, 2015 AT 2:00 P.M.**

#### ***Contact***

Izabela Podlecki  
Contracting Specialist  
Colorado Springs, CO 80903-2599  
(719) 385-5287  
FAX (719) 475-8477  
[ipodlecki@springsgov.com](mailto:ipodlecki@springsgov.com)

<b>PROJECT BRIEF DESCRIPTION</b>
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<b>See Exhibit 5 - Scope of Work</b>
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**Brief Description:**

The City of Colorado Springs is soliciting Request for Proposals with the intent to establish a fixed unit price contract on a per acre basis with a qualified firm to provide aerial application of the insecticide, *Bacillus thuringiensis* var. *kurstaki* (Bt.k.) Foray 48B over forested and urban acres in Colorado Springs during the time frame specified herein. The aerial spraying will be against the Douglas-fir tussock moth (*Orgyia pseudotsuga*) and western spruce budworm (*Choristoneura occidentalis* Freeman) on behalf and in cooperation with the City. The contract requires the vendor to provide the spray material.

The resulting contract with the awarded Offeror shall have an initial term of the date of execution to July 30, 2016.

Please read the entire solicitation package and submit a Proposal for evaluation in accordance with the instructions. All forms and signature areas contained in the solicitation package must be completed in full and submitted along with the price proposal which will constitute the Proposal.

SECTION INDEX

SECTION I	PROPOSAL INFORMATION
SECTION II	PROPOSAL CONTENT
SECTION III	EVALUATION FACTORS
SECTION IV	CONTRACT GENERAL TERMS
SECTION V	APPENDICES/EXHIBITS

## SECTION I

### 1.0 PROPOSAL INFORMATION

Section I provides general information to potential Offerors, such as proposal submission instructions and other similar administrative elements.

#### GENERAL INFORMATION

The City of Colorado Springs is using the [Rocky Mountain E-Purchasing System](#) for soliciting Proposals and proposals from vendors. This system will provide you with convenient online access to all Proposal and proposal information for City of Colorado Springs, as well as many other local agencies throughout Colorado. To receive email alerts of open requests for Proposal or requests for proposal in your field, please register with [Rocky Mountain E-Purchasing System](#), and complete your online registration. If you are currently registered as a vendor with them, you do not need to register again.

If there are accompanying plans with this project, the fee (if any) will also be listed. Local vendors need to come in to our office to pick up the plans. Other interested parties can order the plans online and arrange payment and/or shipping of the project documents via check, Visa/MasterCard and your Fed-Ex number.

This particular solicitation is fully downloadable at no charge.

### 1.1 SUBMISSION OF PROPOSAL

- a. **Sealed Proposals** are to be submitted to:

Izabela Podlecki  
Contracts Specialist  
30 S. Nevada Avenue, Suite 201  
Colorado Springs, CO 80903

\*\*\*\*\*NO LATE OFFERS WILL BE ACCEPTED\*\*\*\*\*

- b. **Date/Time:** Proposals shall be received on or before **2:00 pm MDT, Monday, November 30, 2015.**
- c. **Identification of Proposal:**  
Proposals shall be submitted in a sealed envelope(s) or container(s) with the solicitation number, date for submission of offer and the Offeror's name clearly marked on the outside of the envelope(s) or container(s).

**RFP No. and Title: R15-124 IP AERIAL INSECTICIDE APPLICATION TUSSOCK MOTH PROGRAM**

**Due Date: November 30, 2015**

**Company:**

- d. Any offer that is submitted without being properly marked may be opened for identification prior to the deadline for receipt of proposal and then resealed.

### 1.2 PRE-PROPOSAL CONFERENCE

A pre-proposal conference is scheduled for **Thursday, November 5 2015, 9:00 A.M.**, City of Colorado Springs Co., 30 S Nevada Ave., **Conference Room 201**, Colorado Springs, CO 80903. This meeting is not mandatory. However all prime contractors are urged to attend. Photo ID is required to access the building.

### 1.3 NUMBER OF COPIES

Offerors shall submit one unbound original set and **six (6)** copies of the proposal documents. This will greatly facilitate the evaluation process. The proposal shall remain the property of the City of Colorado Springs. The unbound original copy shall be clearly marked '**ORIGINAL**'.

### 1.4 SPECIAL TERMS

Please note the following definitions of terms as used herein:

- The term "Request for Proposal (RFP)" means a solicitation of a formal, negotiable proposal/offer. The offer is accepted which is deemed by The City of Colorado Springs to be most advantageous in terms of the criteria designated.
- The term "Offeror" means the person, firm, or corporation which submits a formal proposal and which may or may not be successful in being awarded the contract.
- The term "Contractor" or "Consultant" means the Offeror who is awarded the contract to provide the products or services specified.
- The term "Statutory" means requirements of Colorado law.

### 1.5 RFP OBJECTIVE

The objective of this RFP is to provide sufficient information to enable qualified Offerors to submit written proposals to the City of Colorado Springs. The RFP is not a contractual offer or commitment to purchase products or services. The Offeror may present options and variables to the scope while still meeting the minimum requirements of this solicitation. Innovative proposals/solutions are encouraged and considered in the selection and/or award.

All information must be legible. Any and all corrections and or erasures must be initialed. Each proposal shall be accompanied by a transmittal letter signed in ink by an authorized representative of the Offeror. The contents of the proposal submitted by the successful Offeror may become part of any contract awarded as a result of this solicitation.

### 1.6 CONFIDENTIAL OR PROPRIETARY INFORMATION

If an Offeror believes that parts of an offer are confidential, then the Offeror must so specify. The Offeror must stamp in bold letters the term CONFIDENTIAL on that part of the offer which the Offeror believes to be confidential. The Offeror must submit in writing specific detailed reasons, including any relevant legal authority, stating why the Offeror believes the material to be confidential. Vague and general claims as to confidentiality will not be accepted. The City of Colorado Springs will be the sole judge as to whether a claim is general and/or vague in nature. All offers and parts of offers, which are not marked as confidential, will be automatically considered public information after the contract is awarded. The successful offer may be considered public information even though parts are marked confidential.

### 1.7 AMENDMENTS

Amendments to this RFP may be issued at any time prior to the time set for receipt of proposals. Offerors are required to acknowledge receipt of any Amendments (addenda) issued to this RFP by returning a signed copy of each amendment issued. Signed copies must be received on or before the time set for receipt of offers.

The City of Colorado Springs will post all addenda on the [Rocky Mountain E-Purchasing System](#). It is the Offeror's responsibility to check the website for posted addenda or contact the Contracting Specialist listed to confirm the number of Amendments which have been issued.

**1.8 WITHDRAWAL OR MODIFICATION OF OFFERS**

Any Offeror may modify or withdraw an offer in writing at any time prior to the deadline for submission of an offer.

**1.9 ACCEPTANCE**

- a) Any offer received shall be considered an offer, which may be accepted by the City of Colorado Springs based on initial submission without discussions or negotiations.
- b) By submitting an offer in response to this solicitation, the Offeror agrees that any offer it submits may be accepted by the City of Colorado Springs at any time within 60 calendar days from the date of submission deadline. The acceptance period of 60 calendar days from the date of submission will automatically be extended for an additional 60 calendar days unless the proposal expressly states that the acceptance period is limited to the initial 60 calendar day period.
- c) The City of Colorado Springs reserves the right to reject any or all offers and to waive informalities and minor irregularities in offers received, and/or to accept any portion of the offer if deemed in the best interest of the City of Colorado Springs. Failure of the Offeror to provide in its offer any information requested in the RFP may result in rejection for non-responsiveness.

**1.10 PROPOSAL PREPARATION COST**

The cost of proposal preparation is not a reimbursable cost. Proposal preparation shall be at the Offeror's sole expense and are the Offeror's total responsibility.

**1.11 AWARD**

The City of Colorado Springs intends to make an award using the evaluation criteria listed in the RFP to determine the best value considering all factors and criteria in the proposal submitted (see Section III for evaluation elements). Best value means the expected outcome of an acquisition that, in the City's estimation, provides the greatest overall benefit in response to the requirement.

**1.12 CONTRACT ADMINISTRATION**

The City of Colorado Springs, Forestry Division, shall be responsible for the administration of the contract and for compliance with the interpretation of scope, scheduled services and cost compliance.

**1.13 SCHEDULE OF EVENTS**

The upcoming schedule of events is tentatively scheduled as follows:

Advertise (Post on City Web-site)	<u>October 29, 2015</u>
Issue Request for Proposal	<u>October 29, 2015</u>
Pre-Proposal Conference	<u>November 5, 2015</u>
Proposal Due Date	<u>November 30, 2015 at 2:00 P.M.</u>
Short List Selection (if applicable)	TBD
Short List Interviews (if applicable)	TBD
Award of Contract (Letter of Intent)	TBD
Notice-to-Proceed	TBD

**1.14 INQUIRIES**

Questions about the RFP shall be emailed in writing and directed to Izabela Podlecki, at the following email address: ipodlecki@springsgov.com. A written response to any inquiry may be

provided in the form of an Amendment to the solicitation. See 1.8 Amendments. Questions must be received no later than November 11, 2015 – 2:00 P.M.

**The only acceptable method of submitting questions is by email to the Contracting Specialist. Faxes or physical mail delivery are not acceptable.**

**1.15 PERFORMANCE PERIOD**

The tentative period of performance is set from May 1 to July 31, 2016.

**1.16 DEBRIEFING**

Offerors not selected or placed on a short list may request a debriefing on the selection process as well as discussion of the strengths and weaknesses of their firm's proposal upon receipt of notification that their firm was not selected or short listed. Firms that were on the short list but not selected may request a debriefing after they have been notified that another firm was selected.

A debriefing may be scheduled by contacting the Contracting Specialist listed above. The Contracting Specialist must receive a written request for debriefing no later than ten (10) calendar days after issuance of a notification that an Offeror was not selected.

**1.17 DULY AUTHORIZED SIGNATURE**

The proposal must contain the signature of a duly authorized officer or agent of the Offeror's company empowered with the right to bind the Offeror.

**1.18 SUBSTANTIVE PROPOSALS**

By responding to this RFP, the Offeror certifies (a) that Offeror's proposal is genuine and is not made in the interest of, or on behalf of, an undisclosed person, firm, or corporation; (b) that Offeror has not directly or indirectly induced or solicited any other contractors to put in a false or sham Proposal; (c) that Offeror has not solicited or induced any other person, firm, or corporation to refrain or abstain from proposing a Proposal; (d) that Offeror has not sought by collusion to obtain for themselves any advantage over any other contractors or over the City of Colorado Springs; and (e) that Offeror has not violated or caused any person to violate, and shall not violate or cause any person to violate, the Colorado Code of Ethics (C.R.S. 24-18-101 et. seq.).

**1.19 OFFEROR'S QUALIFICATIONS**

Each Offeror may additionally be required to show that they have satisfactorily provided products and performed similar work with companies, organizations or municipalities in the past and that no claims of any kind are pending against such work. No proposal will be accepted from an Offeror who is engaged on any work, which would impair their ability to perform or finance this work. All such work shall be disclosed in the Proposal.

No proposal will be accepted from, nor will a contract be awarded to, any Offeror who is in arrears to the City of Colorado Springs, Colorado, upon any debt or contract, or who is in default, as surety or otherwise, upon any obligation to the City or is deemed to be irresponsible or unreliable by the City of Colorado Springs.

**1.20 NON-COLORADO CORPORATIONS**

Unless waived by the City of Colorado Springs, before or at the time that the contract is awarded to a corporation outside the State of Colorado, such corporation shall obtain authorization to do business in the State of Colorado, designate a place of business herein, and appoint an agent for service of process.

Such corporation must furnish the City of Colorado Springs with a certificate from the Secretary of the State of Colorado to the effect that a certificate of authority to do business in the State of Colorado has been issued by that office and is still valid. There shall also be procured from the Colorado Secretary of State a certified copy of the designation of place of business and appointment of agent for service of process, or a letter from the Colorado Secretary of State that such designation of place of business and agent for service of process has been made.

## **1.21 PROCUREMENT RULES AND REGULATIONS**

All formal projects advertised by the City of Colorado Springs are solicited in accordance with the City's Procurement Rules and Regulations. The City's Procurement Rules and Regulations can be reviewed and/or downloaded from the City Procurement Services Division website [www.coloradosprings.gov/contracting](http://www.coloradosprings.gov/contracting). Any discrepancies regarding conflicting statements, decisions, irregularities, clauses, or specifications will be rectified utilizing the City's Procurement Rules and Regulations. It is the respondent's responsibility to advise the Contracting Specialist listed in these solicitation documents of any perceived discrepancies prior to the date and time the offer is due. Additionally, the City's Standard Specifications and General Provisions apply to all construction related projects.

## **SECTION II**

### **2.0 PROPOSAL CONTENT**

Section II provides instructions regarding the format and content required for proposals submitted in response to this solicitation.

### **2.1 PROPOSAL FORMAT**

The Offeror's written proposal should include the information in the format outlined below and must be limited to no more than twenty-five (25) pages. Offerors should include concise, but complete, information, emphasizing why the Offeror believes itself to be uniquely qualified to provide the required services. **A page shall be defined as 8-1/2" x 11"; single sided, with one inch margins, and a minimum font of 10.** The only exception to the 8-1/2" x 11" paper size is that the proposed project schedule can be submitted on 11" x 17" paper. Each 11" x 17" page for the schedule shall be counted in the overall page limitations above. The following listed Exhibits are not counted against the page limit:

- Exhibit 1: Proposal Certification, Representations & Certifications
- Exhibit 3: Exceptions
- Exhibit 4: Minimum Insurance Requirements

### **2.2 COVER LETTER**

The cover letter shall be no more than one page. No particular content is required.

### **2.3 PROPOSAL CERTIFICATION AND REPRESENTATIONS AND CERTIFICATIONS**

The Offeror must fill out and submit Exhibit 1 with its Proposal.

### **2.4 ORGANIZATIONAL BACKGROUND AND OVERVIEW**

The Offeror must provide a brief history and overview of its company and its organizational structure, with special emphasis on how this project will fit within that structure.

## **2.5 PRICE/COST PROPOSAL**

In the Price/Cost Area, the Offeror should provide firm fixed all-inclusive aerial spraying cost per acre. Offers must include sufficient detail to allow insight into the fairness and reasonableness of the price. The Offeror shall provide a cost for Observation Aircraft in their alternate proposal (see Exhibit 5 Section 5.28 Observation Aircraft).

In addition, although price may not be the most important factor, it is still very important to the City of Colorado Springs. The Offeror's pricing must be competitive as compared to the budget amount, market pricing in the industry, and the pricing of the other Offerors. It is highly recommended that the Offeror provide sufficient content and detail to answer completely the following questions.

1. How does the price compare to the industry competition?
2. If low, is it unrealistically low?
3. If high, is there demonstrated added value for the additional cost?
4. Can you see how the price was built? If so, do the costs look appropriate for the task?
5. Does the Offeror leave applicable costs out of the calculations? For instance, some will say travel is not included and will be an extra cost. This should be considered when comparing to other Offerors.
6. Are there additional costs not addressed that the City would incur if the Offeror were awarded the contract? If so, include those costs when comparing to the budget amount and the competition.

## **2.6 PAST PERFORMANCE/RELEVANT EXPERIENCE AND PERSONNEL**

In this area, the Offeror should provide at least three references or contracts demonstrating that it successfully provided services/products same or similar to those required in the RFP. The proposal should adequately explain how the projects were completed on schedule and within budget. It is highly recommended that the Offeror provide sufficient content and detail to answer completely the following questions.

1. Does the proposal include at least three references or past performance citations?
2. Are the references or past performance citations relevant to the requirements of the Statement of Work of the RFP?
3. Does the Offeror explain how they were successful on the projects provided as past performance?
4. Does the Offeror apply the past performance to the City requirement in such a way as to demonstrate added value due to experience?

## **2.7 TECHNICAL AREA**

In the Technical Area, the Offeror should address each work area in sufficient detail to demonstrate a clear and full understanding of the work. Innovations, efficiencies, and detailed specifics are all encouraged. It is highly recommended that the Offeror provide sufficient content and detail to answer completely the following questions.

1. Project Approach –
  - a. Does the proposal include a complete plan to accomplish each requirement, including subcontracting, if applicable?
  - b. Does the proposal demonstrate that appropriate and qualified personnel and equipment will be provided to carry out the requirement?
  - c. Is the proper level of effort directed toward each requirement? Does the level of effort look unrealistically low or unreasonably high?

- d. The proposal should also include an organizational chart which demonstrates clear and effective lines of authority, responsibility, and communication for management, supervisory, and technical personnel.

## 2. Planning –

- a. Does the Offeror provide evidence of sufficient planning to ensure the work is completed on schedule and within budget?
- b. Does the proposal demonstrate a firm understanding of the requirements and goals of the Statement of Work, as well as industry standards and reasonable expectations for a company in the industry?
- c. Does the proposal provide solutions to indicate that requirements and goals will be met on schedule?
- d. Does the technical solution seem realistic?
- e. Does it generally appear that the Offeror knows and thoroughly understands the business and requirement?

## 3. Equipment –

- a. Does the proposal thoroughly demonstrate the ability to provide all application and observational aircraft, insecticide, spraying equipment, pilots, ground support equipment and personnel as specified?
- b. Does it realistically define the operational requirements to effectively, accurately and uniformly apply insecticide to specified tree covered areas?
- c. Does the proposal specify that the Offeror will furnish sufficient aircraft needed to achieve the estimated production rate as required?
- d. Will the Offeror provide all guidance equipment, materials, computers, printers, personnel and services required for the system to be uses?

## 4. Personnel –

- a. Does the Offeror provide complete resumes, including education, experience, background information, accomplishments and other pertinent information for all key personnel?
- b. Does the resumes demonstrate adequate professional, technical and management levels to accomplish the work effectively and efficient?

### **2.8 KEY PERSONNEL**

The quality of personnel is extremely important in the City of Colorado Springs' decision-making process for awarding this contract. In this section, please submit brief resume(s) of key personnel in critical positions. Please attach copies of all required certifications and licenses.

### **2.9 PROPOSAL PRESENTATION**

Although not a section of the proposal, presentation is an important factor. Offerors should provide a highly professional product, which is complete, accurate, easily understood, and effectively presented.

**2.10 EXCEPTIONS**

All Offerors must complete and return with their proposal, Exhibit 3, Exceptions form. Some terms and conditions are simply not negotiable; Exceptions may be grounds for rendering the proposal unacceptable without further discussions.

**2.11 INSURANCE REQUIREMENTS**

The vendor shall provide the city purchasing office a Colorado certificate of insurance for his/her firm, and if subcontractors are used, for specified subcontractors prior to the start of any work under the contract. The minimum limits of coverage shall be:

Aircraft Liability--\$1,500,000 single limit for each occurrence for bodily injury and property damage.

Workers' Compensation Insurance covering all the vendor's employees who engage in any work under the contract.

Employer's Liability –	
Each Accident	\$100,000
Disease	\$100,000
Aggregate	\$500,000

Broad Form Comprehensive General Liability --\$1,500,000 combined single limit. This coverage is to include Premises/Operations Liability, Products and Completed Operations Coverage, Independent Vendor's Liability, Owner's and Vendor's Protective Liability and Personal Injury Liability.

Chemical Liability--\$100,000 per person, \$300,000 per occurrence for bodily injury; \$100,000 for each occurrence/aggregate for property damage, deductible to be no more than \$1,000. Must include coverage for treating in residential areas.

Automobile Liability -- \$1,000,000 single limit for each occurrence for bodily injury and property damage combined.

The City reserves the right to require higher limits on any contract provided notice of such requirements is stated in the solicitation. The City and localities where aerial applications under this contract will occur are to be named as additional insured. A thirty-day written notice of cancellation or nonrenewable shall be furnished by certified mail to the purchasing office at the address indicated on the solicitation. Vendor's signature on this contract constitutes certification that vendor shall obtain the required coverage as specified above within 10 days of notification of awarded contract.

**2.12 BOND REQUIREMENTS**

The Contractor shall furnish to the City of Colorado Springs one copy of; Performance Bond in the amount of 100% of the total contract within ten (10) calendar days after notification of award of a contract. The cost of all bonds shall be included in Contractor's proposal. Bond shall:

- a. Be for the full amount of the contract price.
- b. Guarantee the Contractor's faithful performance of the work under this contract
- c. Guarantee protection to the City of Colorado Springs against liens of any kind.
- d. Be, when a surety bond is furnished, from a surety company operating lawfully in the state of
- e. Colorado and shall be accompanied with an acceptable "Power-of-Attorney" form attached to bond copy.
- f. Be issued from a surety company that is acceptable to the City of Colorado Springs.
- g. Be submitted using the forms in the Exhibit section of this solicitation.

**2.13 LIQUIDATED DAMAGES**

If the Contractor fails to fully perform and complete the work in conformity to the provisions and conditions of the contract within the specified time limit set forth in the contract, including any extensions granted hereto, the Contractor shall pay to the City for each calendar day of delay until such time the contract is complete, liquidated damages at the applicable daily rate below. The amounts shown are considered to be liquidated damages to reimburse the City for the additional cost of construction engineering and contract administration services and in no case re considered a penalty.

Original Contract Amount	Amount of Liquidated Damages Per Day
Less than \$50,000	\$300.00
\$50,000 to \$100,000	\$500.00
\$100,000 to \$500,000	\$700.00
\$500,000 to \$1,000,000	\$900.00
Over \$1,000,000	\$1500.00

## **SECTION III**

### **1.0 EVALUATION AND AWARD**

Section III provides information regarding evaluation criteria and scoring. It also includes information regarding Offeror selection and award of the resultant contract.

### **3.1 EVALUATION CRITERIA**

#### **3.1.1 TECHNICAL AREA**

See Section II - Item 2.7

#### **3.1.2 PAST PERFORMANCE/RELEVANT EXPERIENCE**

See Section II - Item 2.6

#### **3.1.3 COST PROPOSAL**

See Section II - Item 2.5

#### **3.1.8 EXCEPTIONS AND INSURANCE**

See Section II – Items 2.9 and 2.10

### **3.2 SELECTION COMMITTEE**

A selection committee will screen all proposals. Through this process, the City will determine which proposals are acceptable or unacceptable. The City will notify, in writing, the participating firms whose proposals are deemed to be unacceptable. Those firms offering proposals deemed to be acceptable by the City will be evaluated and scored by the selection committee. This scoring will determine which Offerors are considered to be in the competitive range and may be the basis for an award decision without further steps.

If the selection committee elects not to award based upon evaluation scoring, it may engage in a forced elimination process. To inform this process, it may require oral presentations or interviews with the Offerors considered to be in the competitive range. If oral presentations or interviews are conducted, they may also be scored, or they may simply be considered as information supporting the forced elimination process. The selection committee may request revisions to the proposal from each of the Offerors at the conclusion of the interviews. However, if it is deemed necessary to seek revisions to the proposals at the conclusion of the interviews, then all interviewed Offerors will be requested to submit revisions, and the revisions will be scored accordingly. The goal of the forced elimination process is to reach consensus. The decision will be based on all relevant factors, based upon perception of best value and may or may not reflect scoring ranking.

The City also reserves the right to request best and final offers from all Offerors.

### **3.4 AWARD OF CONTRACT**

It is anticipated that there will be negotiations or discussions with Offerors. However, the City reserves the right to award without negotiations or discussions. The City also reserves the right to award a contract not necessarily or merely to the Offeror with the most advantageous price, but to the Offeror that demonstrates the best value to the City and the most substantiated ability to fulfill the requirements contained in this Request for Proposal. A contract prepared by the City will be finalized and/or negotiated with the successful Offeror. In the event a contract cannot be negotiated with the top ranked Offeror, the City may enter into negotiations with the second highest ranked Offeror, or the City may decide to call for new proposals. Immediately after the notice of award, the Contractor will begin planning in conjunction with the City of Colorado Springs staff (to be designated by the City) to ensure fulfillment of all its obligations. The Contractor may be expected to attend regular meetings as required by the City to assist in the preparation for startup.

## SECTION IV

### 4.0 CONTRACT TERMS AND CONDITIONS

Please refer to Sample Contract Exhibit 2

## SECTION V

### APPENDICES/EXHIBITS

Exhibit 1	Proposal Certification and Representations and Certifications
Exhibit 2	Sample Contract
Exhibit 3	Exceptions
Exhibit 4	Minimum Insurance Requirements
Exhibit 5	Scope of Work
Exhibit 6	Performance Bond
Exhibit 7	Foray- Technical Manual
Exhibit 8	Map of the Area

**EXHIBIT 1 PROPOSAL CERTIFICATION**

1. Principal place of Business:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Does Offeror have an established office or facility in Colorado Springs? Yes\_\_\_ No\_\_\_  
If yes, indicate address below if different than Principal place of Business.

Colorado Springs facility - Year established \_\_\_\_\_ % of Services that will be provided from this location  
\_\_\_\_\_  
\_\_\_\_\_ %  
\_\_\_\_\_

2. \_\_\_ The ability to provide a certificate of insurance evidencing the required coverage types and limits specified in Minimum Insurance Requirements exhibit. (It will be necessary that this certificate reflect the City of Colorado Springs as an Additional Insured as applicable.)

Indicate your ability to comply with the following requirements:

The City shall be added as an Additional Insured to all liability policies: Yes\_\_\_ No\_\_\_

Your property and liability insurance company is licensed to do business in Colorado:  
Yes\_\_\_ No\_\_\_

Indicate the name of your property and liability insurance company here:  
Name: \_\_\_\_\_

Your property and liability insurance company has an AM best rating of not less than B+ and/or VII:  
Yes\_\_\_ No\_\_\_

Worker's Compensation Insurance is carried for all employees and covers work done in Colorado. Yes\_\_\_  
No\_\_\_

2. \_\_\_\_\_ One (1) copy of the current financial statements (if required). Enclose financial information in a separate envelope; do not bind with the other proposal copies. If review of the information is to be restricted to the City's financial officer, it must be marked accordingly.

Provide a response to the following: Are any lawsuits; federal, state or local tax liens; or any potential claims or liabilities pending against you, the firm, or the officers of the firm at this time?

Yes\_\_\_ No\_\_\_

If yes, provide details on a separate sheet and attach to your proposal.

3. \_\_\_ The completed and signed proposal. (Proposals must be identified according to the outline of this RFP document.) All required Exhibits are attached.

The Offeror certifies that no person or firm other than the Offeror or as otherwise indicated has any interest whatsoever in this offer or the Contract that may be entered into as a result of this offer and that in all respects the offer is legal and firm, submitted in good faith without collusion or fraud.

Offeror has delegated \_\_\_\_\_ as the Offeror's representative and contact for all questions or clarifications in regard to this Offeror. Telephone # (\_\_\_\_) \_\_\_\_\_ E-mail: \_\_\_\_\_.

## REPRESENTATIONS AND CERTIFICATIONS

### 1. INSURANCE REQUIREMENTS

This firm shall comply with all insurance requirements and will submit the Insurance Certificates prior to performance start date. If limits are different from the stated amounts, Contractor shall explain variance. Certain endorsements and “additionally insured” statements may require further clarification and specific statements on a project specific basis and should have been described in the Contractor’s proposal.

\_\_\_\_\_  
Initials for 1

### 2. ETHICS VIOLATIONS

- a. The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in this clause in its own operations and direct business relationships.
- b. When the Contractor has reasonable grounds to believe that a violation described in this clause may have occurred, the Contractor shall promptly report the possible violation to the City Contracts Specialist in writing.
- c. The Contractor must disclose with the signing of this Contract, the name of any officer, director, or agent who is also an employee of the City and any City employee who owns, directly or indirectly, an interest of five percent (5%) or more in the Contractor’s firm or any of its branches.
- d. In addition, the Contractor must report any conflict or apparent conflict, current or discovered during the performance of the Contract, to the City Contracts Specialist.
- e. The Contractor shall not engage in providing gifts, meals or other amenities to City employees. The right of the Contractor to proceed may be terminated by written notice issued by City Contracts Specialist if Contractor offered or gave a gratuity to an officer, official, or employee of the City and intended by the gratuity to obtain a contract or favorable treatment under a contract.
- f. The Contractor shall cooperate fully with the City or any agency investigating a possible violation on behalf of the City. If any violation is determined, the contractor will properly compensate the City.
- g. The Contractor agrees to incorporate the substance of this clause in all subcontracts under this contract.

\_\_\_\_\_  
Initials for 2

### 3. ILLEGAL ALIENS

If Provider has any employees or subcontractors, Provider shall comply with § 8-17.5, C.R.S. regarding Illegal Aliens – Public Contracts for Services, and this section of this Agreement. 8-17.5-102 includes, in part, that:

1. Provider shall not:
  - a. Knowingly employ or contract with an illegal alien to perform work under this Agreement; or

- b. Enter into a contract with a subcontractor that fails to certify to Provider that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this Agreement.
2. Provider has verified or attempted to verify that Provider does not employ any illegal aliens and, will participate in the E-Verify Program or State Department program in order to confirm eligibility of all employees who are newly hired to perform work under public contract for services.
  3. Provider will not use E-Verify Program or State Department program procedures to undertake pre-employment screening of job applicants while the public contract for services is being performed.
  4. If Provider obtains actual knowledge that a subcontractor performing work under this Agreement knowingly employs or contracts with an illegal alien, Provider shall:
    - a. Notify the subcontractor and the City within three days that Provider has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and
    - b. Terminate the subcontract with the subcontractor if within three days of receiving the notice under 4.a., the subcontractor does not stop employing or contracting with the illegal alien. However, the Provider shall not terminate the contract with the subcontractor if during this three day period:
      - i. The subcontractor provides information which establishes that the subcontractor has not knowingly employed or contracted with an illegal alien, and
      - ii. The Provider will not employ the illegal aliens in the performance of any City contract.
  5. Provider shall comply with any reasonable request by the Department of Labor and Employment made in the course of an investigation that the Department is undertaking pursuant to the authority established in §8-17.5-102(5), C.R.S.
  6. If Provider violates this provision, the City may terminate the Agreement for a breach of contract. If the Agreement is terminated, the Provider shall be liable for actual and consequential damages.

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Initials for 3

**4. COOPERATION WITH OTHER CONTRACTORS**

Other City activities/contracts may be in progress or start during the performance of this contract. The Contractor shall coordinate the work harmoniously with the other contractors or City personnel.

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Initials for 4

**5. INTERNET USE**

Should the Contractor require access to City Internet resources in the performance of this requirement, a "Contractor's Internet Use Agreement" form must be separately signed by each individual having access to the City Network. The completed Contractor's Internet Use Agreement will be maintained with this agreement. Inappropriate use of the City Network will be grounds for immediate termination of this Contact.

---

Initials for 5

**6. LITIGATION**

If awarded the contract, Contractor shall notify the City within five (5) calendar days after being served with a summons, complaint, or other pleading in any matter which has been filed in any federal or state court or administrative agency. The Contractor shall deliver copies of such document(s) to the City's Procurement Services Manager. The term "litigation" includes an assignment for the benefit of creditors, and filings of bankruptcy, reorganization and/or foreclosure.

\_\_\_\_\_  
Initials for 6

**7. CONTRACTOR'S REGISTRATION INFORMATION**

Offeror's firm verifies and states that they are (check all that apply):

- \_\_\_\_\_ Small Business
- \_\_\_\_\_ Minority Owned Business/Small Disadvantaged Business
- \_\_\_\_\_ Woman Owned Business
- \_\_\_\_\_ Veteran Owned Business
- \_\_\_\_\_ Service-Disabled Veteran Owned Business
- \_\_\_\_\_ HUBZone Business

Note: The City accepts self-certification for these categories in accordance with Small Business Administration (SBA) standards. The SBA size standards are found on the SBA website <https://www.sba.gov/content/am-i-small-business-concern>.

\_\_\_\_\_  
Initials for 7

**8. CONTRACTOR PERSONNEL**

- a) The Contractor shall appoint one of its key personnel as the "Authorized Representative" who shall have the power and authority to interface with the City and represent the Contractor in all administrative matters concerning this Contract, including without limitation such administrative matters as correction of problems modifications, and reduction of costs.
- b) The Authorized Representative shall be the person identified in the Contractor's Proposal, unless the Contractor provides written notice to the City naming another person to serve as its Authorized Representative. Communications received by the City Contracts Specialist from the Authorized Representative shall be deemed to have been received from the Contractor.
- c) The Contractor shall appoint a "Point of Contact" (POC) who shall be responsible for the day-to-day management and supervision of the contract performance. Before commencing the contract, the Contractor shall provide the City in writing with information regarding how to contact the POC including, for example, his or her name, telephone number, facsimile number, pager number, if any, address, and information relating to other means of communication.

The individual, \_\_\_\_\_ (Name)  
 with position, \_\_\_\_\_ (Title)  
 Can be reached at \_\_\_\_\_  
 Work telephone number: \_\_\_\_\_

Home telephone number: \_\_\_\_\_  
Cellular telephone number: \_\_\_\_\_  
E-mail address: \_\_\_\_\_

\_\_\_\_\_  
Initials for 8

**9. CONTRACTOR'S ACCEPTANCE OF CREDIT CARD PAYMENT METHOD**

The Contractor hereby accepts payment using the City's VISA card program. Contractor must submit any necessary paperwork that the City Contracts Specialist needs to complete and return.

\_\_\_\_\_  
Initials for 9

**10. CONTRACTOR'S CERTIFICATION**

The undersigned hereby affirms that:

- a. He/She is a duly authorized agent of the Contractor;
- b. He/She has read and agrees to the City's standard terms and conditions attached.
- c. The offer is presented in full compliance with the collusive prohibitions of the State of Colorado. The Contractor certifies that no employee of its firm has discussed, or compared the offer with any other Offeror or City employee and has not colluded with any other Offeror or City employee.
- d. The Contractor certifies that it has checked all of its figures, and understands that the City will not be responsible for any errors or omissions on the part of the Contractor in preparing its bid.
- e. By submitting an offer the Contractor certifies that it has complied and will comply with all requirements of local, state, and federal laws, and that no legal requirements have been or will be violated in making or accepting this solicitation.

I hereby certify that I am submitting the proposal based on my company's capabilities to provide quality products and/or services on time.

\_\_\_\_\_  
Initials for 10

**11. CONTRACTOR CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS:**

- a. The Offeror certifies to the best of its knowledge and belief, that (i) the Offeror and/or any of its Principals Are ( ), Are not ( ) presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;
- b. Have ( ), Have not ( ), within a three year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state, local) contract or subcontract; violation of Federal or state antitrust statutes relation to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statement, tax evasion, or receiving stolen property; and

- c. Are ( ), Are not ( ) presently indicated for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in any paragraphs above.
1. The Offeror shall provide immediate written notice to the City Contracts Specialist if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reasons of changed circumstances.
  2. The certification in paragraph 1. above, is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the City, the City Contracts Specialist may terminate the contract resulting from this solicitation for default. Termination for default may result in additional charges being levied for the costs incurred by the City to initiate activities to replace The awarded Contractor.

\_\_\_\_\_  
Initials for 11

## **12. ACCEPTANCE OF CITY CONTRACTS SPECIALIST'S SOLE AUTHORITY FOR CHANGES**

The Contractor hereby agrees (if awarded a contract for this effort), that any changes to the scope of work, subsequent to the original contract signing, shall be generated in writing and an approval signature shall be obtained from the City Contracts Specialist prior to additional work performance.

\_\_\_\_\_  
Initials for 12

**EXHIBIT 2 SAMPLE CONTRACT**



**MUNICIPAL SERVICE CONTRACT**

<b>CONTRACT NUMBER:</b>		<b>PROJECT NAME/TITLE</b>	
<b>VENDOR/CONTRACTOR</b>			
<b>CONTACT NAME:</b>		<b>TELEPHONE</b>	<b>EMAIL</b>
<b>ADDRESS:</b>			
<b>FEDERAL TAX ID #</b>		<b>PLEASE CHECK ONE:</b>	<input type="checkbox"/> CORPORATION <input type="checkbox"/> INDIVIDUAL <input type="checkbox"/> PARTNERSHIP
<b>CITY CONTRACTING SPECIALIST</b>	<i>NAME &amp; PHONE#</i>	<b>CITY DEPT REP</b>	<i>Name &amp; Phone# &amp; Department Name</i>
<b>NOT TO EXCEED CONTRACT AMOUNT:</b>		<b>CITY ACCOUNT #</b>	<i>Acct Code (5) Fund (3) Dept (4) Project (7)</i>

THIS CONTRACT, in the Not to Exceed amount of \$ \_\_\_\_\_ made and entered into this \_\_\_\_ day of \_\_\_\_\_ 201X by and between the Pikes Peak Rural Transportation Authority (PPRTA), the City of Colorado Springs, Colorado, a municipal corporation, in the County of El Paso, State of Colorado, party to the first part hereinafter in the Contract Documents referred to as the "City", and \_\_\_\_\_, and trading as an individual or acting as partners consisting of or a corporation organized and existing under the laws of the State of Colorado, hereinafter in the Contract Documents called the "Contractor"; party of the second part.

**1. CONTRACTOR SHALL PROVIDE ALL MATERIALS, LABOR, AND EQUIPMENT TO PERFORM SAID SERVICES FOR THE CITY OF COLORADO SPRINGS:** \_\_\_\_\_

In consideration of said compensation payments, the Contractor agrees to perform all services, work, and/or provide all materials, supplies and equipment, and to carry out the provisions of this Contract in a good and workmanlike manner to the satisfaction of the City. If the performance of this Contract involves the services of others or the furnishing of equipment, supplies or materials, the Contractor agrees to pay for the same in full and at the time of payment by the City, to certify in writing to the City that said payments have been so made.

**2. INSURANCE** Contractor understands and agrees that Contractor shall have no right of coverage under and all existing or future City comprehensive, self or personal injury policies. Contractor shall provide insurance coverage for and on behalf of Contract that will sufficiently protect Contractor, or Contractor's agents, employees, servants or other personnel, in connection with the services work which are to be provided by Contractor pursuant to this contract, including protection from claims for bodily injury, death, property damage and lost income. Contractor shall provide worker's compensation insurance coverage for Contractor and all Contractor personnel. Contractor shall file applicable insurance certificates with the City and shall also provide additional insurance as follows: **A CURRENT CERTIFICATE OF INSURANCE IS REQUIRED PRIOR TO COMMENCEMENT OF SERVICES LISTING THE CITY AS ADDITIONALLY INSURED.**

**3. TERM OF CONTRACT.** The term of this contract shall commence on \_\_\_\_ and shall terminate on \_\_\_\_ unless earlier terminated under this contract, or otherwise changed by Contract modification. The City shall have the unilateral option of extending services beyond the term of the contract, including all options, for a period not to exceed a total of six (6) months if additional time is necessary to solicit and award a new contract. Options to extend services shall be exercised upon written notification (mailed or otherwise furnished) to the contractor at least fifteen (15) days prior to the expiration date of the contract.

**4. NOTICE.** Any notice to the parties required under this contract shall be in writing delivered to the person designated below as Contract Coordinator at the indicated address unless otherwise designated in writing. Only postage by United States mail or in hand delivery shall be utilized.

<u>FOR THE CITY</u>	<u>FOR THE CONTRACTOR</u>
Contact: _____	Contact: _____
Address: _____	Address: _____
City/State: _____	City/State: _____
Zip: _____	Zip: _____

**5. ADDITIONAL TERMS AND PROVISIONS.** The following listed additional provisions are made a part of this contract and attached hereto, \_\_\_\_\_

**6. COMPLIANCES.** In the conduct of the said services/work or the labor, supplies, equipment or materials contemplated hereunder, the Contractor shall comply will all applicable state, federal and local law, rules and regulations, technical standards or specifications issued by the City. Contract must qualify for and obtain any required licenses prior to commencement of work.

**7. INDEPENDENT CONTRACTOR.** Contractor understands and agrees that the Contractor and Contractor's employees, agents, servants or other personnel are not City employees. Contractor shall be solely responsible for payment of salaries, wages, payroll taxes, unemployment benefits or any other form of compensation or benefit to Contractor or any of Contractor's employees, agents, servants or other personnel performing the service or work or supplying equipment or materials specified herein, whether it be of a direct or indirect nature. Further in that regard, it is expressly understood and agreed that for such purposes neither Contractor nor Contractor's employees, agents, servants or other personnel shall be entitled to any City payroll, insurance, unemployment, worker's compensation, retirement or any other benefits whatsoever.

**8. NON-DISCRIMINATION.** Contractor will not discriminate against any employee or applicant for employment because of race, color, sex, national origin, religion, age, handicap or veteran status. Contractor will, where appropriate or required, take affirmative action to ensure that applicants are employed, and that employees are treated, during employment, without regard to their race, color, sex, or national origin. Contractor will cooperate with the City in using Contractor's best efforts to ensure that Disadvantaged Business Enterprises are afforded the maximum opportunity to compete for subcontracts or work under this contract.

**9. HOLD HARMLESS.** Contractor shall indemnify, defend and hold harmless the City, its officers, agents and employees from and against any and all loss, damages, injuries, claims, cause or causes of action, or any liability of any kind whatsoever resulting from, or arising out of or in connection with the services/work or equipment/materials provided by Contractor pursuant to this contract.

**10. ASSIGNMENT.** Contractor shall not assign or otherwise transfer this contract of any right or obligations therein without first receiving prior written consent of the City.

**11. FISCAL OBLIGATIONS OF CITY**

This Agreement is expressly made subject to the limitations of the Colorado Constitution and Section 7-60 of the Charter of the City of Colorado Springs. Nothing herein shall constitute, nor be deemed to constitute, the creation of a debt or multi-year fiscal obligation or an obligation of future appropriations by the City Council of Colorado

Springs, contrary to Article X, § 20, Colo. Const., or any other constitutional, statutory, or charter debt limitation. Notwithstanding any other provision of this Agreement, with respect to any financial obligation of the City which may arise under this Agreement in any fiscal year after the year of execution, in the event the budget or other means of appropriation for any such year fails to provide funds in sufficient amounts to discharge such obligation, such failure (i) shall act to terminate this Agreement at such time as the then-existing and available appropriations are depleted, and (ii) neither such failure nor termination shall constitute a default or breach of this Agreement, including any sub-agreement, attachment, schedule, or exhibit thereto, by the City. As used herein, the term "appropriation" shall mean and include the due adoption of an appropriation ordinance and budget and the approval of a Budget Detail Report (Resource Allocations) which contains an allocation of sufficient funds for the performance of fiscal obligations arising under this Agreement.

**12. CHANGE ORDERS.** The funds appropriated for this contract are equal to or exceed the awarded contract amount. The Contractor and the City agree and acknowledge as a part of this contract, that no change order or other form or order or directive may be issued by the City which requires additional compensable work to be performed, which work causes the aggregate amount payable under the contract to exceed the amount appropriated for this contract as listed above, unless the Contractor has been given a written assurance by the City that lawful appropriations to cover the costs of the additional work have been made or unless such work is covered under a remedy-granting provision in this contract. The Contractor and the City further agree and acknowledge as a part of this contract that no change order or other form or order or directive which requires additional compensable work to be performed under this contract shall be issued by the City unless funds are available to pay such additional costs, and regardless of any remedy-granting provision included within this contract, the Contractor shall not be entitled to any additional compensation for any additional compensable work performed under this contract, and expressly waives any rights to additional compensation, whether by law or equity, unless prior to commencing the additional work, the Contractor was given a written change order describing the additional compensable work to be performed, and setting forth the amount of compensation to be paid, which change order was signed by the authorized City representative. It is the Contractor's sole responsibility to know, determine, and ascertain the authority of the City representative signing any change order under this contract.

**13. CONTRACT INTERPRETATION.** No amendment or modification of this contract shall be valid unless expressed in writing and executed by the parties hereto in the same manner as the execution of this contract. The laws of the State of Colorado shall govern this contract. This is a completely integrated contract and contains the entire contract of the parties, and any prior written or oral contracts which are different from the terms, conditions and provisions of this contract shall be of no effect and shall not be binding upon either party. Any judicial action under the terms of this contract shall be exclusively in the District Court for El Paso County, Colorado.

**14. COMPLIANCE WITH IMMIGRATION AND CONTROL ACT.** Contractor certifies that Contractor has complied with the United States Immigration and Control Act of 1986. All persons employed by Contractor for performance of this contract have completed and signed Form I-9 verifying their identities and authorization for employment.

**15. TERMINATION OF CONTRACT.**

- A. In the event of default by the Contractor, the City may give ten (10) days written notice to the Contractor of the City's intent to terminate the contract. Contractor shall have ten (10) days from notification to remedy the conditions constituting the default. Failure to cure may result in immediate termination for default.
- B. The City may terminate the contract at any time it is found that reason beyond the control of either the City or Contractor make it impossible or against the City's interest to complete the contract. The City may also terminate this contract at any time if it is found that the Contractor has violated any term or condition of this contract or that Contractor has failed to maintain worker's compensation insurance or other insurances provided for in this contract. In such case the Contractor shall have no claims against the City except for the value of the work performed up to the date the contract is terminated.
- C. In the event that this contract is terminated in accordance with the section, the City may take possession of any work and may complete any work by whatever means the City may select.
- D. The City may terminate performance of this contract in whole, or from time to time, in part if the City determines that a termination is in the City's interest. The Contractor after receipt of a Notice of Termination shall stop work as specified under the contract, place no further subcontracts or orders for

materials terminate all subcontracts to the extent they relate to the termination, assign title and interest of all work and material used in the work.

- E. If the contract is terminated for convenience, The City will conduct an audit of the Contractor's costs to determine reasonable costs expended to date of termination, or the City may determine the contractor's costs based on the schedule of values or exact cost of any bid item (s) completed and accepted. The Contractor will not be reimbursed for any anticipated profit. The cost that is most advantageous to the City will be used for determining final payment to Contractor.

**16. DELIVERY AND TAXES.** The City may cancel this contract or any portion thereof if delivery is not made when and as specified, time being the essence of this contract. Contractor shall pay the City for any loss or damage sustained by the City because of failure to perform in accordance with this contract. The contractor shall pay all sales and use taxes required to be paid to the State of Colorado on the work covered by this contract. The Contractor shall execute and deliver and shall cause his subcontractors to execute and deliver to the City, certificates as required, to permit the City to make application for refunds of said sales and use taxes as applicable. The City is a municipal corporation and therefore, not subject to state and local sales tax, use tax or federal excise taxes.

**17. BOOKS OF ACCOUNT AND AUDITING.** The Contractor shall make available to the City if requested, true and complete records, which support billing statements, reports, performance indices, and all other related documentation. The City's authorized representatives shall have access during reasonable hours to all records, which are deemed appropriate to auditing billing statements, reports, performance indices, and all other related documentation. The Contractor agrees that it will keep and preserve for at least seven years all documents related to the Contract which are routinely prepared, collected or compiled by the Contractor during the performance of this contract. The City's Auditor and the Auditor's authorized representatives shall have the right at any time to audit all of the related documentation. The Contractor shall make all documentation available for examination at the Auditor's request at either the Auditor's or Contractor's offices, and without expense to the City.

**18. INDEMNIFICATION CLAUSE**

Contractor shall indemnify, hold harmless and, not excluding the City's right to participate, defend the City of Colorado Springs and other participating entities, its officers, officials, agents, and employees (hereinafter referred to as "Indemnitee") from and against all liabilities, claims, actions, damages, losses, and expenses including without limitation reasonable attorneys' fees and costs, (hereinafter referred to collectively as "claims") for bodily injury or personal injury including death, or loss or damage to tangible or intangible property caused, or alleged to be caused, in whole or in part, by the negligent or willful acts or omissions of Contractor or any of its owners, officers, directors, agents, employees or subcontractors. This indemnity includes any claim or amount arising out of or recovered under the Workers' Compensation Law or arising out of the failure of such contractor to conform to any federal, state or local law, statute, ordinance, rule, regulation or court decree. It is the specific intention of the parties that the Indemnitee shall, in all instances, except for claims arising solely from the negligent or willful acts or omissions of the Indemnitee, be indemnified by Contractor from and against any and all claims. It is agreed that Contractor will be responsible for primary loss investigation, defense and judgment costs where this indemnification is applicable. In consideration of the award of this contract, the Contractor agrees to waive all rights of subrogation against the City, its officers, officials, agents and employees for losses arising from the work performed by the Contractor for the City.

**19. GRATUITIES:**

- A. The right of the Contractor to proceed or otherwise perform this Contract, and this Contract may be terminated if the City Manager and/or the City Contracting Manager determine, in their sole discretion, that the Contractor or any officer, employee, agent, or other representative whatsoever, of the Contractor offered or gave a gift or hospitality to a City officer, employee, agent or contractor for the purpose of influencing any decision to grant a City Contract or to obtain favorable treatment under any City Contract.
- B. The terms "hospitality" and "gift" include, but are not limited to, any payment, subscription, advance, forbearance, acceptance, rendering or deposit of money, services, or any thing of value given or offered, including but not limited to food, lodging, transportation, recreation or entertainment, token or award.
- C. Contract termination under this provision shall constitute a breach of contract by the Contractor, and the Contractor shall be liable to the city for all costs of reletting the contract or completion of the contract.

Further, if the Contractor is terminated under this provision, or violates this provision but is not terminated, the Contractor shall be subject to debarment under the City's Procurement Regulations. The rights and remedies of the City provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract."

**20. PAYMENTS.** The City shall pay the Contractor, upon submission of proper invoices, the prices stipulated in the contract for services rendered and accepted, less any deductions provided in this contract within 30 days. Unless otherwise specified in this contract, payment shall be made on partial deliveries accepted by the City if

- A. The amount due on the deliveries warrants it; or
- B. The Contractor requests it and the amount due on the deliveries is at least \$1,000 or 50 percent of the total contract price.

**21. SUB-CONTRACTORS, OUT-SIDE ASSOCIATES, AND OTHER CONTRACTORS**

- A. Any Sub-Contractor, outside associates, or other Contractors used by the Contractor in connection with Contractor's work under this Contract shall be limited to individuals or firms that are specifically identified by the Contractor in the Contractor's proposal and agreed to by the City. The Contractor shall obtain the City delegated Project Manager or Representative's written consent before making any substitution of these sub-Contractors, associates, or other Contractors.
- B. The Contractor shall include a flow down clause in all of its sub-contracts, agreements with outside associates, and agreements with other Contractors. The flow down clause shall cause all of the terms and conditions of this Contract, including all of the applicable parts of this Contract document, to be incorporated in all subcontracts, agreements with outside associates, and agreements with other Contractors. The flow down clause shall provide clearly that there is no privity of contract between the City and the Contractor's Sub-Contractors, outside associates, and other Contractors.

**22. INSPECTION OF SERVICES.** The Contractor is responsible for performing or having performed all inspections and tests necessary to substantiate that the services furnished under this contract conform to contract requirements, including any applicable technical requirements for specified manufacturers' parts. This clause takes precedence over any City inspection and testing required in the contract's specifications, except for specialized inspections or tests specified to be performed solely by the City.

- A. Definition of "services", as used in this clause, includes services performed, workmanship, and material furnished or utilized in the performance of services.
- B. The Contractor shall provide and maintain an inspection system acceptable to the City covering the services under this contract. Complete records of all inspection work performed by the Contractor shall be maintained and made available to the City during contract performance and for as long afterwards as the contract requires.
- C. The City has the right to inspect and test all services called for by the contract, to the extent practicable at all times and places during the term of the contract. The City shall perform inspections and tests in a manner that will not unduly delay the work.
- D. If the City performs inspections or test on the premises of the Contractor or a subcontractor, the Contractor shall furnish, and shall require subcontractors to furnish, at no increase in contract price, all reasonable facilities and assistance for the safe and convenient performance of these duties.
- E. If any of the services do not conform to contract requirements, the City may require the Contractor to perform the services again in conformity with contract requirements, at no increase in contract amount. When defects in services cannot be correct by re-performance, the City may (1) require the Contractor to take necessary action to ensure that future performance conforms to contract requirements and (2) reduce the contract price to reflect and reduced value of the services performed.
- F. If the Contractor fails to promptly perform the services again or to take the necessary action to ensure future performance in conformity with contract requirements, the City may (1) by contract or otherwise, perform the services and charge to the Contractor any cost incurred by the City that is directly related to the performance of such service or (2) terminate the contract for default.

**23. ILLEGAL IMMIGRATION ACT**

Illegal Aliens - Public Contracts for Services - Compliance with Title 8, Article 17.5, Colorado Revised Statutes: The Contractor acknowledges, understands, agrees, and certifies that: In the performance of any work or the provision of any services by the Contractor under this Contract, the Contractor shall not knowingly employ or

contract with an illegal alien to perform work under this contract; or Enter into a contract with any subcontractor that fails to certify to the contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this Contract or under the subcontract to this contract. In The Contractor certifies in accord with Section 8-17.5-102(1) C.R.S. that, on the date the Contractor signs this contract, the Contractor does not knowingly employ or contract with an illegal alien who will perform work under this contract and that the Contractor shall participate in the e-verify program or Colorado Department of Labor and Employment program in order to confirm the employment eligibility of all employees who are newly hired for employment or to perform work under this contract. The contractor is expressly prohibited from using basic pilot program procedures to undertake pre-employment screening of job applicants while this Contract and any services under this Contract are being performed. If the contractor obtains actual knowledge that a subcontractor performing work under the public contract for services knowingly employs or contracts with an illegal alien, the Contractor shall notify the subcontractor and the City within three days that the contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien, and terminate the subcontract with the subcontractor if within three days of receiving the notice the subcontractor does not stop employing or contracting with the illegal alien; except that the contractor shall not terminate the contract with the subcontractor if during the three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien. The Contractor shall comply with any request by the City, federal government, or the Colorado Department of Labor and Employment made in the course of an investigation that the department, pursuant to the authority established in Section 8-17.5-102 C.R.S., or a City or federal investigation. If the contractor violates or fails to comply with any provision of C.R.S. 8-17-101 et seq, the City may terminate this Contract for breach of contract. If this contract is so terminated, the Contractor shall be liable for any actual and consequential damages to the City.

**EXHIBIT 3      EXCEPTIONS**

Print the words "no exceptions"(here)\_\_\_\_\_ if there are no exceptions taken to any of the terms, conditions, or specifications of these proposal documents or contract.

If there are exceptions taken to any of the terms, conditions, or specifications of the proposal document or contract, they must be clearly stated on a separate sheet of paper attached to this sheet and returned with your proposal.

**Note:** All potential Offerors are hereby advised that exceptions taken may be considered during the evaluation phase which may effect the final scoring of proposals. Offerors stipulating that the City must use their contract or agreement may be determined non-responsive and their Proposal determined unacceptable.

Company Name: \_\_\_\_\_

Address: \_\_\_\_\_  
(City, State and Zip Code)

Federal Tax ID#: \_\_\_\_\_

PHONE: \_\_\_\_\_

FAX: \_\_\_\_\_

E-MAIL ADDRESS: \_\_\_\_\_

Authorized Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Printed Name/Title: \_\_\_\_\_

Return this form with your Proposal.



## EXHIBIT 5

### SCOPE OF SERVICES FOR AERIAL INSECTICIDE APPLICATION, TUSSOCK MOTH

#### 5.1 GENERAL INFORMATION

##### 5.1.1 INTENT

5.1.1.1 The intent of this solicitation is for the City of Colorado Springs to enter into a fixed unit price contract on a per acre basis with a qualified contractor to provide aerial application of the insecticide, *Bacillus thuringiensis* var. *kurstaki* (Bt.k.) Foray 48B containing over forested and urban acres in Colorado Springs during the time frame specified herein. The aerial spraying will be against the Douglas-Fir Tussock Moth (*Orgyia pseudotsuga*) and Western Spruce Budworm (*Choristoneura occidentalis* Freeman) on behalf and in cooperation with the City of Colorado Springs.

5.1.1.2 As of September 15, 2015 there are approximately 6,000 acres of a Douglas-fir tussock moth and western spruce budworm infestation located on the south and west side of the City of Colorado Springs, centrally adjacent to Cheyenne Mountain. The City will act as the primary contact for a multiplicity of cross-boundary stakeholders/landowners for the entire contract. The exact locations for spray treatments will be determined by late fall to early winter, 2015. SHAPE files for each property will be available prior to RFP due date.

5.1.1.3 The total number of acres to be treated is dependent upon the cumulative acres of each cross boundary stakeholder that have signed the mutually beneficial MOU (Memorandum of Understanding). A second application MAY be necessary, depending on the aerial apparatus selected, to be made approximately 7-14 days after the first application.

##### 5.2 OBJECTIVE

5.2.1 The Contractor shall furnish all application aircraft and insecticide, spraying equipment, pilots, ground support equipment and personnel as specified herein and other operational requirements, as necessary, to effectively, accurately and uniformly apply insecticide to specified tree-covered areas.

Upon being given 24 hours' notice by the City Representative, the Contractor shall be able to take to the air, weather permitting, from one of the local airport facilities.

The treatment area design and regional conditions may require the use of helicopter and/or fixed wing aircraft given terrain, aspect and topographic features.

##### 5.3 CERTIFIED PESTICIDE APPLICATOR AND RESPONSIBLE PERSON REGISTRATION

The Colorado Department of Agriculture (CDA) requires that all applicators obtain the proper certification for the insecticidal material to be used.

It shall be incumbent upon a Contractor to satisfy all Colorado Department of Agriculture pesticide licensing and registration requirements within ten (10) calendar days of notification of the City's intent to award a contract for services requiring said licensing and registration. Failure to comply with this requirement within the stipulated time frame will be cause for the rejection of its proposal.

Offerors must own at least 70% of the aircraft required and guarantees that he/she will not lease or otherwise subcontract the remainder of the aircraft equipment or pilots needed for the performance requirements of program from any commercial pesticide operator or applicator business whose registration is suspended by any governmental agency.

#### 5.4 OPERATING PERFORMANCE STANDARDS FOR RESPONSIBLE CONTRACTORS:

##### Operating Standards:

- A. All equipment meeting RFP requirements.
- B. Pilots must possess the proper certification for agricultural flying.
- C. Obtain the necessary FAA and State clearance, for all pilots and aircraft.
- D. Must report on the start date as directed and provide all required equipment, personnel, and facilities.
- E. Personnel report to work on time daily and remain on the job until officially released.
- F. Cooperate in following instruction, based on contract specifications.
- G. Avoid repeated delays caused by malfunction of equipment or delays in loading between trips which affect total overall length of time to perform the contract.

#### 5.5 REQUIREMENTS:

Offerors shall provide various aerial spraying services for the control of Douglass-fir tussock moth and western spruce budworm infestation to the City of Colorado Springs in accordance with the following performance requirements as listed below. In accordance with these requirements the contractor shall provide the following:

- A. Aircraft
- B. Pilots
- C. Airport facilities as required
- D. Proper aircraft maintenance
- E. All required fuel
- F. Any and all personnel, equipment and services associated with providing the aerial spraying service described herein, including but not limited to the following:
  - 1. Insecticide
  - 2. Material Transportation
  - 3. Pesticide Storage Areas
  - 4. Mixing Equipment
  - 5. Loading Equipment
- G. Unicom radios for communication with aircraft, and to monitor aircraft communications with base airport, FAA flight service stations as well as weather stations within the treatment areas.
- H. National Oceanographic and Atmospheric Administration (NOAA) weather reporting equipment including, but not limited to; the parameters of rain fall, wind speed and direction; and temperature.

#### 5.6 PAYMENT OF LANDING AND OTHER ASSOCIATED FEES:

Offerors shall select the airport(s) and landing zone(s) he will use and make the necessary arrangements with the proper authority for the:

- A. Use of each required airport
- B. Payment of all landing and other associated fees for airport use.
- C. Payment for any and all repairs or damages that result from contractor's aircraft, equipment, contamination, or personnel.
- D. Immediate removal of all aircraft and equipment from the airport(s), unless other satisfactory arrangements are made with the airport authorities.
- E. Policing aircraft loading areas to restrict access by unauthorized persons.
- F. Maintaining the areas by the contractor in a clean and orderly fashion during their use and cleanup after use.

#### 5.7 ESTIMATED ACRES AND CITY'S RIGHT TO EXPANSION:

The number of acres indicated for this program requirement and description are estimated acres only and will be finalized prior to contract signing.

#### 5.8 FACILITIES SURVEYS AND INSPECTIONS:

The City reserves the right at any time during normal work hours to inspect Contractor's work location. This inspection may include, but is not limited to, pre-award or post contract award survey.

Should the result of any inspection made by City authorities indicate that the material/services supplied does not meet specifications; the Contractor shall immediately rectify the situation at no additional cost to meet those requirements.

#### 5.9 LICENSES AND PERMITS:

Offerors shall be required to secure, pay for and maintain, during the term of this contract, all licenses, permits, certifications, inspections, authorizations, or any documents required by federal government, state government, county and municipal governments to perform this contract. A Offeror shall also supply the City with written evidence that such licenses, permits, certifications, inspections, authorizations or other required documents have been obtained, prior to contract award and any time during the term of this contract.

#### 5.10 AIRCRAFT MAINTENANCE/PILOT PROFICIENCY AWARD CRITERIA:

Federal Aviation Administration (FAA) approved maintenance records are necessary for the safe operation of the aircraft. Maintenance shall be performed in accordance with all applicable requirements of the federal government including, but not limited to, maintenance programs and manuals approved by the FAA.

Offerors shall provide fully qualified and proficient pilots who have met all applicable requirements of the federal and state governments.

#### 5.11 INSPECTION AND APPROVAL OF EQUIPMENT:

All aircraft equipment and storage facilities are subject to inspection and approval by a designated Representative of The City of Colorado Springs. Contractors must specify where aircraft equipment and storage facilities are available for inspection within one (1) week after notification. Any costs for travel and expenses to inspect equipment and aircraft shall be borne by the contractor.

#### 5.12 PROOF OF AIRCRAFT OWNERSHIP:

Proof of aircraft ownership or evidence of a satisfactory lease agreement must be provided as requested at any time during the term of the contract.

#### 5.13 CERTIFICATION/LICENSE:

The Contractor must be certified under Federal Aviation Regulations parts 135, 137 and/or part 133 as appropriate. A Contractor must possess license(s), certificate(s) and registration(s) required by Colorado Department of Agriculture.

Contractors shall provide a copy of each required certificate, license, or registration as required by the City at any time during period of the contract.

5.14 COMPLIANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS:

A Contractor must comply with all applicable FAA, State and Local Regulations.

5.15 CURRENT AIRWORTHINESS CERTIFICATE:

A current FAA air worthiness certificate must be displayed in each aircraft being operated in conjunction with this contract

5.16 MECHANICAL FAILURE

It is understood that occasionally an aircraft or truck will develop a mechanical problem even with proper maintenance. No assessment will be charged to the Vendor for such a breakdown, providing the equipment can be made ready for work within forty-eight (48) hours. After the forty-eight (48) hour period, liquidated damages will be assessed at a rate specified in Section 2.13- Liquidated Damages for each hour of acceptable flying conditions not flown. If an aircraft suffers from frequent mechanical problems, the City Representative reserves the right to notify the Vendor that the aircraft must be replaced with one from same aircraft category within forty-eight (48) hours. Failure to provide a replacement within the allotted time will result in liquidated damages being assessed against the amount due the Vendor of one thousand five hundred (\$1,500) dollars per day.

The Offeror shall provide, in his proposal, a backup plan in case the assigned aircraft is not available in the 48 hour timeframe.

5.17 INSTALLATION OF SPECIAL EQUIPMENT ON AIRCRAFT:

The installation of any special equipment specified must be FAA approved. Aircraft used in the program must be equipped with a differential GPS receiver to accurately pinpoint spray blocks in the Tussock Moth and Western Spruce Budworm aerial application program. The spray aircraft pilot shall also be familiar with and have a working knowledge of the DGPS equipment installed on the aircraft.

5.18 PERSONNEL REQUIREMENTS:

PROVIDE THE FOLLOWING PERSONNEL:

- A. A Representative at each airport being utilized shall have full authority to make decisions for the Contractor and direct all operations. They shall be stationed at the airport for the duration of the contract and shall be available for consultation at all times as requested by the contract administrator.
- B. Pilots qualified, certificated in accordance with applicable FARS and capable of completing flight activities as scheduled. Pilots shall possess a currently valid FAA commercial or high pilot certificate and maintain currency in accordance with Federal Aviation Regulations (FARS). Pilots shall meet all requirements of the operator's certificate necessary for conducting operations specified in this RFP and possess an appropriate medical certificate as required by the FARS. Each pilot must also hold an instrument, multi-engine or rotor-craft-helicopter rating(s) where applicable.
- C. In addition to the above the pilot shall meet the following minimum experience requirements which shall be verified by a personal or company log book when requested by the City.

Experience	Hours
a. Total Pilot-Time	1,500
b. Total Pilot-in-Command (Airplane or helicopter)	1,200
c. Category and Class (to be flown)	200
d. Airplane or helicopter (preceding 12-months)	100
e. Cross Country	500
f. Aerial application Operations in Typical Terrain	200
g. Night	100
h. Make and Model	25
i. Make and Class (preceding 60-days or pass a proficiency flight check)	10
j. Experience in Aerial Application (application pilot)	100

Experience (Multi-engine) in addition to requirements above – When used in program	Hours
a. Pilot-in-Command	250
b. Pilot-in-Command in Type (within the past 5-years unrestricted Type	
c. Rating in the applicable airplane(s) to be flown)	25

*Note: Typical terrain means pilot-in-command experience on flights in areas with similar topography, density altitude, or hazards presented by the mission environment.*

Additional pilot requirements for aerial application aircraft- rotorcraft:

More than 350 hours aerial application experience, of which at least 100 certified hours was devoted to forest treatment. Each pilot shall certify the hours devoted to each program, the State it was conducted in and the year it was conducted.

The pilot in command is responsible for the safety of the aircraft, its occupants and cargo. He shall operate the aircraft in accordance with FAA requirements and safety regulations. He shall comply with the direction of the City Representative, except when in his judgment, such compliance will be in violation of applicable Federal or State regulations.

The pilot must make a reconnaissance flight over each spray block to identify and locate any such hazards or congregations of people prior to treating the block. The pilot is responsible for maintaining radio communication with the City's base-of operations. The pilot must contact, via radio, the base-of operations when the pilot begins spraying a block, when a block is finished, and when a spray load is finished.

The City reserves the right to reject the vendor's use of any pilot who, in the City's opinion, has performed unsatisfactorily in previous operations whether in State of Colorado or elsewhere. The City reserves the right to permanently ground any pilot who, in the City's opinion, violates these Contract Specifications, is unsafe, or otherwise performs unsatisfactorily.

D. Personnel to mix insecticide load and service the aircraft.

The vendor(s) shall furnish a sufficient quantity of trained and qualified personnel to drive, operate and to maintain all ground support equipment and aircraft plus the mixing and transfer of insecticides. Each aircraft under contract must be capable of working independently of any other aircraft thus requiring ground support personnel for each aircraft. All ground support personnel must be equipped and trained to take proper action in an emergency. The personnel must observe standard safety precautions in handling

the insecticide solutions and refueling the aircraft. Any personnel mixing and loading pesticides must certify as and obtain a Commercial Pesticide Operators License (at a minimum) with The Colorado Department of Agriculture. This license requires a passing grade on a General Standards exam and supervision by a licensed Commercial Applicator with a Forest Pest control Category. The Contractor(s) shall be required to replace any ground support personnel who does not demonstrate the knowledge and capability of performing their duties.

FAA licensed "Airframe and Power plant" mechanic on staff, certified in accordance with the applicable FARs, capable of repairing and maintaining spray and observation aircraft throughout the duration of the contract. A copy of the license shall be submitted upon request by the City Representative.

#### E. Other requirements

Contractor must comply with qualification and operation requirements as specified by the Colorado Department of Transportation, Div. of Aeronautics. The Contractor must contact the Dept. of Transportation, Div. of Aeronautics at 303-512-5254 for information regarding qualifications under FAR Part 137.

Offerors must have a certificate of waiver from FAA when in restricted category as described in FAR Part 91.3 and currently be certified for agriculture aircraft operations. Such copies of certifications shall be provided to Colorado Department of Agriculture prior to the commencement of any work under this contract.

#### 5.19 INSECTICIDE MIXING EQUIPMENT:

Offerors shall provide the following;

- A. Clean tank trucks for mixing insecticide in sufficient quantities to ensure uninterrupted aircraft operation. Each tank truck shall be equipped with a pump of at least 50 gallons per minute capacity arranged so that it can be used to load or unload the tank.
- B. Mixing equipment as required in the unit specifications. Each mixing unit shall have a cylindrical mixing tank that shall have a bottom inlet located near the outlet and be equipped with a sprayer tube or a similar device so installed that the insecticide swirl when circulated.
- C. Agitation paddles are not required. The tank will have a hole on the top side through which the insecticide and diluents can be emptied. Provisions are to be made to accurately measure each batch of insecticide formulation mixed, either by means of calibrated measuring sticks, sight gauge, or other acceptable means.
- D. An engine driven centrifugal pump shall be attached to each tank to mix and circulate the insecticide. This pump may be used to add diluents to the tank through fitting and valve combinations. It may also be used to load the aircraft.

#### 5.20 AIRCRAFT LOADING FACILITIES:

Offerors shall provide the following aircraft loading facilities:

- A. Pumps capable of loading each aircraft at a minimum rate of 50 gallons per minute, unless the mixing pump is used for this purpose. Also have one spare pump available for use in case of pump malfunction.
- B. Meters of adequate capacity to accurately measure the insecticide into each aircraft. The Contractor shall provide evidence that each meter has been inspected and calibrated by a licensed inspector within one month prior to beginning the application operations.
- C. Air eliminator.
- D. Loading nozzles or couplings and all plumbing necessary to complete the loading installation.
- E. The 25-mesh strainer should be inserted to the pressure end of the loading hose in order to strain the insecticide before loading into aircraft.

- F. Positive shut-off; quick disconnect couplings, valves, or attachments so installed as to reduce loss of insecticide during loading or uncoupling.

#### 5.21 INSECTICIDE DISPERSAL SYSTEM

Offeror shall be certified under Federal Aviation Regulations part 137 and/or part 138 as appropriate. Additionally, must possess license(s), certificate(s) and registration(s) required by State of Colorado and Colorado Department of Agriculture. Each spraying aircraft shall have:

- A. An insecticide dispersal system that has been cleaned thoroughly inside. All hoses shall be in good condition and shall be a chemical resistant type such as neoprene.
- B. Leak-proof insecticide tank(s). Caution, insecticide may loosen some sealants and plug the spraying system.
  - The tanks(s) in each aircraft shall have a sump no larger than 6 gallons capacity, so attached that the tank(s) can be emptied completely in flight or on the ground.
  - An unloading valve in the bottom of each aircraft tank sump, and in the bottom of the spray tank in all other aircraft, so that the tank(s) can be drained completely while the aircraft is parked. This valve is needed to determine calibration, to drain insecticide following a breakdown and on completion of the program. When suspensions are used na there is a breakdown of shutdown due to weather, the valve in needed to transfer the load into another aircraft or into the insecticide mixing tank.
- C. A pump that will provide the required flow rate at not less than 35 P.S.I. during spraying operations to assure uniform flow and proper functioning of the nozzles. Gear, centrifugal, or other rotary types of pumps will be acceptable.
  - i. Each centrifugal pump shall be so mounted and designed that the pump will prime itself with no more than 25 gallons of insecticide for swath checking and calibration.
  - ii. Pumps with a pumping capacity greater than 25 percent above the required flow rate shall have a bypass system that connects that spraying pump outlet with the pump inlet. This bypass shall be equal in size to the pump outlet. The bypass commonly used to circulate materials in the tank will be used.
- D. A leak-proof spraying system capable of spraying the insecticide uniformly. Nozzles shall be spaced generally uniformly across a span approximately equal to  $\frac{3}{4}$  of the wingspan. If the total boom length equals the wingspan a nozzle shall be attached in each end of the boom.
- E. A positive shut-off system that will prevent dribble from the nozzles.
- F. Bleed lines in any point that may trap air on the pressure end of the spraying system.
- G. A spraying system pressure gauge with an operating range from 0 to 100 P.S.I.
- H. A 25-mesh screen in the spraying system.
- I. A dispersal system that has a sufficient number of stainless steel 80- degree flat fan nozzle tips required for the application rate specified in the unit needs as follows:
  - i. Orifice size for each nozzle tip for all other aircraft shall have a flow rate of 0.6 gallon per minute at 40 P.S.I. or as otherwise required by the City Representative.
  - ii. No nozzle screens are required.

- Provision shall be made on all aircraft so that nozzle direction can be changed when it is necessary to change droplet sizes.
- Should the contractor choose to use spinning nozzles he shall provide at least four spinners for each aircraft.

## 5.22 COMMUNICATIONS REQUIREMENT

Each spraying aircraft and each observation aircraft shall be equipped with a fully operative air to ground programmable radio capable of transmitting and receiving. The VHF transceiver must be capable of providing a quality level of output so as to easily made and easily understandable communication by both pilot and City Representative. Each observation aircraft must have an operational intercom unit to allow clear communication between the pilot and the City Representative.

## 5.23 FAA AND STATE OF COLORADO REGULATIONS:

Compliance with all applicable FAA and State of Colorado Regulations. This includes any current regulations issued by the FAA regarding aircraft and insecticide safe guarding and security as well as any rules and/or recommendations issued by the national association of aerial applicators or any other responsible agency.

All BT products purchased for use on the departments program shall be new material, manufactured within the last six months or the date of application. This shall be certified by Affidavit from the manufacturing company. An Offeror must provide chain of custody documentation of the insecticide from the point of manufacture to delivery.

All spray aircraft must be disabled when not in use (prop locks) to prevent unauthorized operation. All aircraft doors and hoppers also must be sealed after daily operations.

All insecticide holding containers, hoppers, mixing tanks, pumps, hoses and similar equipment must have all possible points of entry sealed and secured when not in use.

## 5.24 INSECTICIDE USAGE:

An estimate of the amount of insecticide that is jettisoned for any reason shall be made by the City Representative and the cost thereof deducted from any monies due.

If it becomes necessary to terminate the contract prior to completion of the specified operational hours because of biological or entomological reasons, the contractor shall not be entitled to any compensation as a result of termination if through his own fault he is behind in the projected work schedule. The work schedule and determination of liability will be based on progress reports.

An estimate of the amount of insecticide lost due to spillage, overflowing of tanks, leakage of tanks, or loading devices, due to the contractor's negligence, will be made by the City Representative and the cost thereof deducted from any monies due.

## 5.25 FLIGHT LIMITATIONS:

There will be no formation flying over residential areas unless otherwise designated by the City Representatives.

Swath Checks: Swath Checks will be conducted when there is reason to believe that the spraying system will not produce a uniform deposit pattern or the spraying system will not produce swath as wide as that shown for each aircraft type listed in the section entitled aircraft categories.

There may be areas within the program boundaries that will not be sprayed. Such areas will be designated by the City Representative. Each pilot will be briefed thoroughly and every effort must be exerted to avoid spraying such areas.

## 5.26 APPLICATION HEIGHT

Pilots shall apply B.T.K. within the range of 30-50 feet above the tree top.

## 5.27 PRODUCTION RATE

The City requires that the entire treatment area be treated within 6 spray days.

A spray day shall be defined as a 5 hour period including ferry time, loading and actual spraying.

To archive this rate more than one type of aircraft may be required.

## 5.28 WEATHER

The City's program coordinator shall determine when spraying operations will be prohibited. Information supplied by the field crews and the pilot is used in making these decisions.

The following spray area conditions are used as guidelines in halting spray operations:

- A. Wind velocity exceeding ten (10) miles per hour.
- B. During rain or foggy weather, or when the foliage is dripping wet, or when there is an imminent threat (greater than 50% chance) of rain, within four hours. After rain, applications will resume only after foliage is dry.
- C. When air turbulence (thermal updrafts, etc.) is so great as to seriously affect the normal spray patterns.
- D. When temperatures and relative humidity conditions are such that proper insecticide application may be hindered. Generally, applications will be halted when temperatures and relative humidity exceed manufacturer's recommendations described in Figure 5.9.2 "Forestry Technical Manual" (See Exhibit 7).

## 5.29 INSECTICIDE SPRAYING:

The Offeror(s) shall exercise extreme caution in spraying over residential areas that are located in terrain that is mountainous or irregular. In addition, the Offeror(s) shall not spray in any area(s) identified by representatives of the City.

Operations over Congested Areas (FARS 137.51): The vendor will comply with all pertinent FAA regulations. It is the responsibility of the Vendor to ensure that a plan for operating over each congested area is submitted to and approved by the FAA Flight Standards District Office having jurisdiction over that area. Plans for treating over congested areas must be approved by the FAA no later than 2 weeks before the start of spraying operations. Colorado has experienced rather stringent FAA requirements in past aerial applications.

Approved plans will be made available for inspection by the Colorado Department of Agriculture personnel upon request. Expect all sites to require congested area flight plans.

Permits: Vendor shall obtain and comply with any permits or approvals that may be required.

## 5.30 OPERATIONAL HOURS:

The program requirement and description will specify the number of operational hours a contractor will be allowed to complete a contract. Operational hours are defined as those hours during a day when satisfactory aerial spraying can be done. Operational hours will include all aircraft loading and ground time between trips, but will not include aircraft loading time prior to the approved starting time or after operations are shut down nor will it include the minutes beyond the last half hour of operations.

START TIME: The Vendor(s) shall have all aircraft, equipment, pilots and ground support personnel on the job site at least 30 minutes prior to the start of all scheduled operations.

**SPRAY DAYS:** It is the intention of the City to spray the entire project area in multiple days, over a three week period, whenever conditions are acceptable, depending on the insect life stages, elevation, aspect and other factors. In residential areas, school and school bus schedules will play a role in determining treatment application planning.

**EVENING SPRAYING:** The primary productive spray time is in the early morning. Evening spraying is available and permitted when weather report is favorable and where a few hours would be helpful in keeping on schedule. Evening spraying is the biggest single factor that leads to fatigue for everyone working on the program. For these reasons evening operations should not be automatically included in the daily spray schedule. Evening spraying will be used when it can be very productive, such as finishing up an area and moving to a new location for the next morning's operations. Pilots flying for more than 6 hours in the morning may be exempt, at the discretion of the City's Representative, from any evening spraying that day. Pilots may request cancellation of evening spraying following two consecutive evening operations if they believe they need to rest to ensure continued safe operations.

**ACCURACY:** The spray application may be monitored for accuracy by City personnel using ground deposit cards and aircraft DGPS flight records. They will look for uniform coverage, even lane separation, and spray deposition in the designated areas. In wind conditions approaching 10 mph, pilots may be asked to optimize spray pattern and droplet deposition.

**RECONNAISSANCE:** Reconnaissance of treatment areas, by application pilots, will be required before treatment of each area. This is usually done the day prior to treatment of each area. This will help familiarize the application pilot with the boundaries, hazards, and environmentally sensitive areas.

On a day when operations are conducted without interruption or suspension requested by the City Representative, the operational hours charged for that day will begin when the first aircraft is cleared for takeoff and will continue until the last aircraft lands. However, if during a day, the City Representative suspends operations due to wind or other reasons, and then clears the aircraft to continue operations later in the day, the operational hours charged for the day will be for the total hours used during those operating periods, less the minutes beyond the last hour of operations.

A contractor who fails to spray on an operational day will be charged for each operational hour he could have sprayed up to a maximum of 6 hours for each such day.

When the contract gallons are increased up to 25 percent, the number of operational hours allowed to complete the program will be increased proportionately.

On an operational day when all or any aircraft on the program cannot operate for reasons beyond the control of the contractor, a proportional adjustment will be made in the operational hours charged for that day. Such conditions would include: (1) when one or more aircraft are grounded for lack of guidance furnished by the City, (2) certain areas may not be ready for spraying, or (3) when one or more aircraft are grounded due to fog or poor visibility in their areas while others can operate. Example: if there are 4 aircraft on a program and 2 can spray the operational hours charged would be 1/2 of those used on that day.

Spraying shall be done, weather permitting, from 5:30 a.m. until 2:00 p.m. and evening spray time (5:30 p.m. - 8:00 p.m.) as determined by the City with agreement of the other agencies. There shall be a one hour shutdown each morning as determined by the City Representative to reduce exposure to school children.

The word "day", as used in this contract, means calendar day. Unless ordered otherwise by the City Representative during the program, operations may be conducted 7 days per week.

#### 5.31 OBSERVATION AIRCRAFT (OPTIONAL ALTERNATE):

The Offeror shall include in his proposal the cost to provide four-place observation aircraft(s) CESSNA 172 or approved equal) and pilots for the duration of the program, equipped as follows:

- A. Aircraft must be equipped with a full operative two-way radio capable of transmitting and receiving air to air and air to ground. The vhf transceiver must be capable of producing a quality level output so as to assure easily made and easily understandable communication by both pilot and City of Colorado Springs Representative. The aircraft must also have an operational intercom unit to allow clear understandable communication between the pilot and City Representative.
- B. Aircraft shall be equipped with airborne GPS navigational units to accurately pinpoint spray blocks in the tussock moth and western spruce budworm aerial application program. The observation aircraft pilot shall be capable of using the GPS navigational equipment.
- C. Aircraft shall be equipped with a device to record flight hours and be capable of safe operation from the airport(s) used by the spraying aircraft.
- D. Aircraft shall be in good mechanical condition with a current 100-hour inspection approval. The aircraft will not qualify for acceptance when its engine time has reached manufacturer's recommended overhaul time. New or overhauled engines shall have been flown a minimum of 5 hours before use on a program. Should a 100-hour inspection be performed on the aircraft during the course of the program, the contractor shall test fly the aircraft prior to carrying City personnel. Current logbooks shall be provided to verify aircraft and engine time inspections.
- E. The aircraft engine shall be equipped with a standard muffler. The maximum noise level in the cabin shall be such that the occupants can converse without using earphones.
- F. Each observation aircraft and its pilot shall be stationed at the airport, specified by the City Representative throughout the period of the contract to carry City personnel for the monitoring of spraying operations and other program related activities.

#### 5.32 POST PROGRAM COMPLETION AIRCRAFT REQUIREMENTS:

There shall be available for five (5) working days after the completion of the program, one application aircraft and pilot, one observation aircraft and pilot, and one mixing unit in the event that missed areas or skips are detected.

#### 5.33 PILOT FLIGHT SUIT:

All pilots shall be provided with a safety approved helmet and fire retardant (Nomex) flight suit and gloves.

#### 5.34 THE CITY'S RESPONSIBILITIES:

- A. Provide maps, briefing, information and guidance for pilot of the areas to be treated with insect ide.
- B. Provide and maintain an accurate daily flight record and furnish the contractor with a copy.
- C. Notify Severe Allergy contact list and media prior to the treatments.
- D. Conduct meeting(s) with local officials
- E. Notify NORAD, Air Force Academy, Peterson AFB, Fort Carson and the Colorado Springs Municipal Airport.
- F. Provide a list of potential helicopter landing zones.

#### 5.35 ROLE OF CITY'S REPRESENTATIVE:

- A. The City Representative may reject any aircraft deemed not suitable for this contract. Qualifying tests of aircraft may be conducted by the City's Representative to assure that operational standards are met. All

operational costs incurred in conducting these tests will be borne by the contractor. All aircraft and equipment proposed for use in this contract will be inspected prior to the award date of the contract.

- B. The City's Representative may reject, at any time, any pilot or other employee whom he finds unqualified or incompetent, violates contract provisions, or operates an aircraft or equipment in a negligent or unsafe manner.
- C. The City Representative shall determine the time, date and sequence, for spraying individual areas. The time to start and stop spraying each day shall also be determined by the City of Colorado Springs Representative.
- D. Should the contractor wish to provide additional aircraft and pilot(s) that meet all contract requirements, he may do so provided it is agreeable to the City Representative. No adjustments will be made in the contract price for providing additional aircraft.
- E. The starting date shown in the program description and specific requirements is an estimated date when all aircraft, personnel, and facilitating equipment must be ready to begin spraying. The official starting date, to be specified by the City Representative after award will be made, will be the latest date on which the contractor shall be fully prepared to begin spraying.
- F. The City Representative shall determine whether program progress is satisfactory. When contractor has not completed spraying 40 percent of the insecticide within 40 percent of the operational hours allowed, he will be required to furnish up to two additional aircrafts within 3 calendar days after request by the City Representative. Such aircraft shall be of the same category as those specified in the description; shall meet all contract requirements including qualified pilot(s) to operate the aircraft; and shall be fully operational within 1 day after reporting. No adjustment will be made in the contract price for furnishing such additional aircraft.
- G. Reconnaissance flights: the City Representative shall be authorized to accompany the pilot of the spray aircraft on reconnaissance flights when required, to orient the spray pilot and delineate the spray area boundaries

#### 5.36 THE INSECTICIDE REQUIRED

The insecticide to be used shall be Foray 48B, a biological insecticide containing Bt K (*Bacillus thuringiensis* var *kurstaki*). The application should be 0.75 gallons per acre neat (undiluted).

The manufacturer of this product is:

Valent Biosciences Corporation (Foray/Dipel)  
870 Technology Way Suite 100  
Canal Stream, IL 60132-2673

**EXHIBIT 6**  
**CITY OF COLORADO SPRINGS PERFORMANCE BOND**

1. KNOW ALL MEN BY THESE PRESENTS, THAT:

\_\_\_\_\_  
 (Name) \_\_\_\_\_ As Principal, hereinafter called Principal, and  
 (Address) \_\_\_\_\_

\_\_\_\_\_  
 (SURETY Name) \_\_\_\_\_ a corporation organized and existing under  
 the laws of the State of:

\_\_\_\_\_  
 (SURETY Address) \_\_\_\_\_  
 and AUTHORIZED TO DO BUSINESS IN THE STATE OF COLORADO, as Surety, hereinafter called Surety, are held firmly bound to the CITY OF COLORADO SPRINGS, COLORADO, as Obligee, hereinafter called the Obligee, in the sum of: (Insert bid amount in words)

\_\_\_\_\_  
 lawful money of the United States of America, for payment of which sum well and truly to be made, the Principal and the Surety bind themselves, their heirs, executors, successors and assigns, jointly and severally, firmly by these presents.

2. WHEREAS, the Principal and the Obligee have entered into,  
 a contract dated the \_\_\_\_\_ day of \_\_\_\_\_ For the following project:

\_\_\_\_\_  
 Contract # \_\_\_\_\_ which contract is by reference made a part hereof, and referred to as the Contract.

3. NOW THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH THAT if the Principal shall promptly and faithfully perform all terms, conditions and other obligations of the Contract, and any modifications or extensions thereof granted by the Obligee, then this obligation shall be null and void: otherwise this obligation shall remain in full force and effect.

4. The Surety for value received agrees that no extension of time, change in, addition to, or other alteration modification of the terms, conditions or obligations of the Contract or work to be performed thereunder, or any forbearance on the part of either the Obligee or the Principal to the other shall in any way release or affect the liability or obligation of this Bond, and the Surety hereby waives notice of any such extension of time, change, addition, modification, alteration or forbearance.

Signed and sealed on the dates set forth below:

\_\_\_\_\_  
 (Witness) FOR: \_\_\_\_\_  
 (Principals Name)

BY: \_\_\_\_\_

(Seal) ITS: \_\_\_\_\_  
 this \_\_\_\_\_ day of \_\_\_\_\_

\_\_\_\_\_  
 (Witness) FOR: \_\_\_\_\_  
 (Surety's Name)

BY: \_\_\_\_\_

(Seal) ITS: \_\_\_\_\_  
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Bond # \_\_\_\_\_ This Bond \_\_ (is) \_\_ (is not) a SBA Guaranteed Bond.

# Protecting Our Forests — Protecting Our Future

**Foray<sup>®</sup>  
DiPel<sup>®</sup>**

*Forestry Technical Manual*



## 1.0 INTRODUCTION

### 1.1 Message from The VBC Forestry Team

Commercial formulations of *Bacillus thuringiensis* subspecies *kurstaki* (Btk) have been used as a tool for the control of forest caterpillar pests since the mid-70's and over the past two decades both the product and the application technologies have evolved. Technical Bulletins and Manuals have been provided by Valent BioSciences to address these new developments. In our continued effort to support the appropriate and efficient use of Btk, and more specifically Foray and DiPel, we have produced this manual, which is in its ninth edition.

As in previous editions, we want to provide a comprehensive publication which addresses all aspects of Btk use. Therefore, as well as covering the purely operational aspects of its use, we have tried to address a number of peripheral issues pertaining to the use of Btk in the environment.

This edition sees a number of changes regarding units; because our products are used internationally, we have included metric units where relevant, avoiding the need for conversion from US units. As in the previous edition, the Technical Manual is published in a loose leaf, three-ring binder format. It is our intention to replace outdated information sheets and provide the latest technology available to our Btk customers on a timely basis. Please feel free to copy and distribute any information contained herein in support of your programs.

As always, we are receptive to feedback from our customers.

### 1.2 What's New?

Since their introduction over 25 years ago, Valent BioSciences has called its Btk formulations 'DiPel'. With the acquisition of the Plant Protection Division of Novo Nordisk, and their Foray formulations, we have decided to standardize upon 'Foray' as the main product identifier of our aqueous-based forest protection products. DiPel remains the brand name for our oil based formulation.

#### 1.2.1 The Forestry Toxin Unit

Inside the manual, you will also find that we are starting to make Btk formulations more specific for particular forest pests.

With continuous development of our products, we have been able to make our Btk formulations easier to handle. You will find that even the high activity 76B formulations have low viscosities and flow easily.

Consequently, we are introducing the Forestry Toxin Unit (FTU) as a replacement of the Billion International Units (BIU) commonly used as a measure of Btk activity.

Forestry Products Available		
<u>Product</u>	<u>Formulation</u>	<u>Activity</u>
Foray 48F	AF <sup>1</sup>	48 FTU/gal (12.7 FTU/L)
Foray 48B	AF	48 BIU/gal (12.7 BIU/L)
Foray 76B	AF	76 BIU/gal (20 BIU/L)
DiPel 8L	Oil <sup>2</sup>	64 BIU/gal (16.9 BIU/L)

<sup>1</sup> AF is an Aqueous Flowable formulation.

<sup>2</sup> Oil is a paraffinic oil-based formulation

#### 1.2.2 Accurate Deposit Assessment Methodology (ADAM) of Btk Delta-Endotoxin

Adequate spray deposition and coverage is a prerequisite for treatment success. One method to measure spray deposition is to incorporate dyes into the Btk formulation (see Section 5.7.1). However, the use of dyes is limited in that they can be used only in experimental trials and for relatively small application areas. Furthermore, spray cards used for measuring the deposit require significant effort in placement prior to application and in analysis following the application. More importantly, cards have been shown to be an unreliable measure of the spray deposit actually found on the foliage. Dye incorporation is therefore not a practical or reliable way for determining deposit.

An ELISA (Enzyme Linked Immuno Sorbent Assay), therefore, has been developed to measure Foray/DiPel Bt deposits on foliage. This technology, available in kit form for field and research use to VBC customers, very accurately measures the deposition of Foray/DiPel Btk delta-endotoxin on foliage. Consult your Valent BioSciences field representative for further information on the "ADAM" kit.

### 1.3 What are Foray and DiPel?

Foray and DiPel are biorational insecticides containing the spores and crystalline proteins produced by the gram-positive bacterium *Bacillus thuringiensis* subspecies *kurstaki*, commonly known as B.t. or Btk. The vegetative cells of B.t. form spores which enable it to reproduce and survive in an adverse environment. During spore formation, the bacterium also produces unique crystalline proteins called delta-endotoxins. Together, the endotoxins and spores are toxic to many lepidopteran larvae.

Btk is considered “friendly” to human beings as well as to other species of animals. Btk has specific activity only against susceptible caterpillars. Foray’s and DiPel’s inert ingredients, which include various carriers, suspension agents, and stabilizers are classified by the Environmental Protection Agency (EPA) as inert ingredients of minimal toxicological concern to non-target organisms and the environment (EPA’s List 4).

As Btk exhibits a unique insecticidal activity specific to caterpillars and because the inert ingredients are innocuous, Foray and DiPel do not exhibit any of the hazards often associated with chemical insecticides.

Several Foray and DiPel products are available for control of forest defoliators. They are Foray 48F, 48B, 76B and DiPel 8L. These products offer unique formulations to address the diversified requirements of individual pest control programs and aerial applications.

Foray and DiPel are very effective and are considered environmentally friendly and compatible.

### 1.4 How do Foray and DiPel work?

Btk is active only on the larval stages of Lepidoptera and must be eaten to be effective. Activation of the toxic proteins takes place in the insect’s mid-gut where the alkaline pH and enzymes found there are essential to the process. Proteolytic enzymes (which are similar to trypsin), from both the insect gut and possibly the crystal, break the crystal down into smaller active toxins.

These activated toxins bind to the cell membrane lining the gut, generating pores that disturb osmotic balance and lead to cellular swelling and lysis. The effect of this process on the insect host is cessation of feeding, usually within an hour, lysis of gut lining cells through the action of active toxins, perforation of the intestinal wall, septicemia and death of the organism.

Different subspecies of Btk have differently shaped crystals composed of specific toxin combinations. For example, Foray Btk contains at least four toxin subtypes - CryIA(a), CryIA(b), CryIA(c), and CryIIA. Each toxin needs a specific receptor site on the gut for binding (and subsequent gut wall disruption) to occur. An insect must have the receptor sites for the specific Bt toxins in order to be susceptible to the insecticide.

## 2.0 FORAY AQUEOUS FORMULATIONS: TECHNICAL INFORMATION

### 2.1 General Description

Foray 48F, 48B, 76B are water based (aqueous) suspensions of Btk insecticide designed specifically for forestry applications. These formulations can be sprayed undiluted or diluted with water. Foray disperses readily into water to form a free-flowing spray suitable for conventional or low volume aerial applications. Foray formulations do not contain formaldehyde, benzene, xylene or other solvents of toxicological concern. Government regulatory agencies worldwide have expressed no concerns of a toxicological nature about Foray. These products are not classified as hazardous materials and are not regulated under DOT (US Department of Transportation) hazardous materials regulations (49 CFR 100-199).

When applied undiluted or when tank-mixed with water, Foray suspensions are slightly acidic, but they are not seriously corrosive to fittings normally encountered on mixing and application equipment. Foray is mildly acidic to ensure product storage stability and to optimize its efficacy.

The different formulations of Foray exhibit the following characteristics:

#### 2.1.1 Physical Properties of Foray 48F

<i>Appearance</i>	Tan colored liquid
<i>Potency</i>	11,800 FTU/mg or 48 billion FTU <sup>1</sup> /gal
<i>Specific Gravity</i>	1.14 +/- 0.05
<i>Weight</i>	9.51 +/- 0.42 lbs/gal (1.14 +/- 0.05 kg/L)
<i>pH</i>	4.7 +/- 0.3
<i>Dispersibility</i>	Disperses readily into water
<i>Viscosity @ 25°C</i>	300-900 cP <sup>3</sup>
<i>Viscosity @ 5°C</i>	300-900 cP <sup>3</sup>

#### 2.1.2 Physical Properties of Foray 48B

<i>Appearance</i>	Tan to light colored liquid
<i>Potency</i>	10,600 IU/mg or 48 BIU <sup>2</sup> /gal
<i>Specific Gravity</i>	1.14 +/- 0.05
<i>Weight</i>	9.51 +/- 0.42 lbs/gal (1.14 +/- 0.05 kg/L)
<i>pH</i>	4.7 +/- 0.3
<i>Dispersibility</i>	Disperses readily into water
<i>Viscosity @ 25°C</i>	150 - 800 cP <sup>3</sup>
<i>Viscosity @ 5°C</i>	150- 1000 cP

#### 2.1.3 Physical Properties of Foray 76B

<i>Appearance</i>	Tan to brown colored liquid
<i>Potency</i>	16,700 IU/mg or 76 BIU <sup>2</sup> /gal
<i>Specific Gravity</i>	1.14 +/- 0.05
<i>Weight</i>	9.51 +/- 0.42 lbs/gal (1.14 +/- 0.05 kg/L)
<i>pH</i>	4.7 +/- 0.3
<i>Dispersibility</i>	Disperses readily into water
<i>Viscosity @ 25°C</i>	600-1800 cP <sup>3</sup>
<i>Viscosity @ 5°C</i>	600-2200 cP

<sup>1</sup> FTU = Forestry Toxin Unit

<sup>2</sup> BIU = Billion International Units

<sup>3</sup> cP = centipoise

### 2.2 Foray 48F and the FTU

In 1996, Valent BioSciences introduced the Forest Toxin Unit (FTU) as the standard measure of the activity of a forestry Btk product. The intention of the change was to use a reference standard which more accurately reflects the material's activity against the defoliator being controlled, rather than the cabbage looper, *Trichoplusia ni*, which is the standard insect used to assay Btk. The FTU should be used as the equivalent of the universally accepted International Unit (IU).

#### 2.2.1 Foray 48F and Optimization of Btk Activity

In development of this product, Valent BioSciences focused upon the optimization of Btk activity for control of the gypsy moth. The production (fermentation) process has been optimized by using a new analytical technique and an insect-specific bioassay to measure and validate these improvements.

High performance liquid chromatography (HPLC) is being used in a new patented technology (U.S. Patent 5,356,788). This technology is capable of analyzing Bt products to provide separation and quantification of the individual toxins that are biologically active. It is the first analytical tool whose use has demonstrated a high degree of correlation between the ratios of different endotoxins and the target insect bioassay.

### 2.3 Compatibility Statements

Foray is a fully formulated product which contains ample surfactants to insure wetting and adhesion to most foliage surfaces. If a sticker is used when applying a diluted Foray mixture, read and follow the manufacturer's label for correct use and rates. Always add the sticker to the water prior to addition of Foray. NEVER ADD SPRAY STICKER TO UNDILUTED FORAY.

Never mix undiluted Foray with molasses, or any thickening agents and/or evaporation retardants. An excessively viscous spray mix may result.

Do not tank mix Foray with other insecticides, miticides, fungicides, spray oils, foliar nutrients, or herbicides unless the physical compatibility and safety of the tank mixture to plants has been thoroughly evaluated by standard methods.

## 2.4 Handling Undiluted and Diluted Aqueous Foray

### 2.4.1 Undiluted Applications

Foray is formulated to be applied as undiluted ULV sprays, but it can be mixed with water for higher volume applications. Undiluted applications increase payload efficiency and lower application cost.

The only precaution recommended for handling undiluted Foray is to thoroughly flush all tanks, pumps, pump lines and aircraft systems with clean water, followed by complete draining, before the addition of undiluted Foray. Clean in-line strainers and inspect for holes or gaps. Use strainers between 16 and 50 size mesh. A 30 mesh strainer is a good general recommendation. For nozzle strainers, follow the equipment manufacturer's recommendations. See section 5 for a detailed description of spray system screens and nozzles.

Foray is formulated with the correct amount of suspending agents to provide minimal settling of solid portions during storage and transport. However, it is recommended that product be recirculated at least once prior to use. During a spray operation and ferrying, it is not necessary or even recommended to maintain continuous agitation of Foray with bypass flow.

### 2.4.2 Diluted Applications

Foray is completely miscible with water and can be mixed in any ratio with water to obtain desired spray volumes. The preferred mixing sequence is to add Foray to water; however, the reverse procedure can also be used. All mixing and transfer equipment should be clean prior to the mixing of Foray. Clean in-line strainers and inspect for holes or gaps. Drums should be stirred, agitated, or rolled prior to dispensing. Water to be used in mixing should be clean and filtered to remove any coarse suspended matter. Water hardness levels should not exceed 340 ppm, and the pH of final mixture should be below 7.

Clean in-line strainers and inspect for holes or gaps. Use strainers between 16 and 60 size mesh. A 30 mesh strainer is a good general recommendation. For nozzle strainers, follow the manufacturer's recommendations.

### 2.4.3 Mixing Procedure

- ◆ Fill the mix tank or aircraft hopper with the necessary volume of water. Start hydraulic or mechanical agitation.
- ◆ If a sticker is being used, add to the water at this time.
- ◆ Add Foray gradually to agitating water.
- ◆ Rinse empty drums and bulk tanks previously holding Foray and use rinse water for any subsequent mixing.

It is recommended that Foray tank mixes be used immediately. However, in the event of application delays, Foray tank mixtures are stable for 72 hours, depending upon storage temperatures and water quality. Recirculate tank mixes prior to loading aircraft.

### 2.4.4 Aircraft Loading

In cold weather, especially with the first load of each spray day, all product in the pumps and hoses, (including the loading hoses) should be recirculated back through the storage tank. This will assure that all pumps, meters, valves and filters are operating properly. In addition, the product in the first load will be of a temperature and viscosity consistent with normal operations.

## 2.5 Cleaning Transfer, Mixing and Spray Equipment

Periodically, during the spray operation, it is recommended to rinse off any Foray residues which may be on the atomizers or the aircraft.

At the conclusion of the spray program, equipment should be cleaned according to the following recommendations:

- ◆ Remove in-line screens, nozzle screens and nozzles, and clean these in a detergent/water solution. If so equipped, Micronair variable restrictor units (VRU) should be set at #13 or pulled out to the "full open" position.
- ◆ Filling the mix tank or plane hopper with clear water, followed by agitation and spraying out is usually sufficient to clean Foray residues from the system. Optionally, a detergent solution can be used, followed by a clear water rinse.

## 2.6 Pump Seals

Most centrifugal pumps used in aerial application programs are fitted with inexpensive carbon-ceramic mechanical seals. Aircraft and transfer pumps equipped with these seals may have a tendency to leak when using Foray. As Foray is composed of suspended particles in a liquid medium, as with any such material, some mechanical abrasion may occur. Inexpensive carbon seals should be replaced. This does not occur with all centrifugal pumps, but the problem is alleviated with the substitution of tungsten carbide-silicon seals.

There are several manufacturers and numerous distributors for original equipment and/or replacement seals. Two manufacturers of such seals are:

1. FLOWSERVE  
(Formerly PAC-SEAL Inc.)  
211 Frontage Road  
Burr Ridge, Illinois 60521  
(847) 325-7119
2. John Crane Inc.  
6400 W. Oakton Street  
Morton Grove, Illinois 60053  
(847) 967-2400

If you intend to use a Foray aqueous formulation, discuss the matter of pump seals with your VBC Field Representative to assist with ordering seals. Ordering new or replacement seals should be done well in advance of the operational program because tungsten seals are not generally an inventory item.

Use positive displacement pumps where feasible. An example for wind driven systems is the Sorensen Sprayers Model 4000 gear pump. Smaller electric pumps are available for helicopters.

REFER TO MANUFACTURER'S DIRECTIONS FOR MECHANICAL SHAFT SEAL REPLACEMENT.

DO NOT RUN PUMP DRY.

ALWAYS PRIME PUMP BEFORE STARTING.

IN THE CASE OF SELF-PRIMING MODELS, THE PUMP CASING MUST BE FILLED.

## 2.7 Storage and Disposal

Do not store Foray in the direct sun where product temperature will exceed 90°F (30°C) for prolonged periods of time. Within normal storage temperature ranges of 32° to 90°F (0°- 30°C), there will be no adverse effects on the formulation.

Re-close all unused containers. Foray is an EPA Category III pesticide; refer to CAUTION statement on Foray label for handling and storage.

### 3.0 DIPEL OIL-BASED FORMULATION: TECHNICAL INFORMATION

#### 3.1 General Description

DiPel 8L is an emulsifiable oil-based suspension of Btk designed especially for forestry applications. It can be sprayed undiluted for ultra low volume applications and it disperses readily into water or oil-based carriers to form a low viscosity spray suitable for conventional or low volume aerial applications.

The oil formulation uses a paraffinic mineral oil which is highly refined and hydro-treated to further purify and remove any potentially toxic substances which may be found in some mineral oils.

DiPel 8L does not contain formaldehyde, benzene, xylene, or other solvents of toxicological concern. Government regulatory agencies, worldwide, have expressed no concerns of a toxicological nature about DiPel. This product is not classified as a hazardous material and is not regulated under DOT (US Department of Transportation) hazardous materials regulations (49 CFR 100-199).

When applied undiluted or when tank-mixed with water, DiPel suspensions are slightly acidic, but they are not seriously corrosive to fittings normally encountered on mixing and application. DiPel 8L is mildly acidic to ensure product storage stability and to optimize its efficacy.

For calibration purposes DiPel 8L formulations exhibit the following physical characteristics:

##### 3.1.1 Physical Properties of DiPel 8L

<i>Appearance</i>	Brown colored liquid
<i>Potency</i>	17,600 IU/mg or 64 BIU <sup>1</sup> /gal
<i>Specific Gravity</i>	0.94 +/- 0.20
<i>Weight</i>	7.84 +/- 0.17 lbs/gal (0.94 +/- 0.20 kg/L)
<i>Dispersibility</i>	Miscible with water, diesel fuel, kerosene, agricultural spray oils
<i>Viscosity @ 25°C</i>	300-700 cP <sup>2</sup>
<i>Viscosity @ 5°C</i>	2500 cP max.

<sup>1</sup> BIU = Billion International Units

<sup>2</sup> cP = centipoise

#### 3.2 Compatibility Statements

DiPel 8L is a fully formulated product which contains ample emulsifiers to insure wettability of most foliage surfaces whether applied undiluted or diluted with water. If a sticker is used (dilute applications only), read

and follow the manufacturer's label for correct use and rates. Always add the sticker to the water prior to addition of DiPel 8L .

**NEVER ADD SPRAY STICKER TO UNDILUTED DIPEL 8L.**

Currently available spray stickers are not compatible with undiluted DiPel 8L.

Never mix undiluted DiPel 8L with molasses or other thickening agents and/or evaporation retardants. An excessively viscous spray mix will result. Do not mix DiPel 8L with a combination of fuel oil and water or excessive viscosity will occur.

Do not tank mix DiPel 8L with other insecticides, miticides, fungicides, foliar nutrients, or herbicides unless the physical compatibility and safety of the tank mixture to plants has been thoroughly evaluated by standard methods.

#### 3.3 Handling Undiluted and Diluted DiPel 8L

##### 3.3.1 Undiluted Applications

Combinations of undiluted DiPel 8L with water, even as little as 0.5% of the total product volume can cause thickening, especially if water is allowed to remain in pump lines, strainers, booms and atomizers. To avoid problems associated with incorrect water/product mixes, follow these recommendations:

##### **Recommendations for Bulk Storage and Transfer Equipment:**

- ◆ Tanks, transfer lines and pumps for bulk storage should be clean and free of water prior to addition of undiluted DiPel 8L.
- ◆ Flush lines, pumps, metering devices, and tanks with an oil-miscible organic solvent (diesel, kerosene, crop oil) to evacuate any remaining water. After flushing, drain solvent completely and retain for further use if not excessively contaminated with water.
- ◆ DiPel 8L can be pumped into bulk tanks following flushing and draining.
- ◆ On standing, undiluted DiPel 8L will undergo slight separation of oil and solid phase components. Periodic recirculation of the entire tank volume of product by pumping from bottom to top of bulk storage tanks every 3 days during spray operations will maintain uniform product consistency.

- ◆ Bulk storage tanks should be fitted with a vented, rain-proof hatch.
- ◆ In-line screens or filters should be at least 16 size mesh, but not finer than 50 mesh. A general recommendation is a 30 mesh strainer.

### **Recommendations For Aircraft Spray Systems:**

- ◆ Flush the spray system with clear water and drain completely. Make certain inside surfaces of booms and lines are clean and free of scale and sediment.
- ◆ Purge the spray system of any liquid using the most appropriate method for your aircraft.
- ◆ If you still need to eliminate all traces of moisture, perform the following: Fill the aircraft hopper with enough oil solvent (diesel, kerosene, crop oil) to insure that the pump can circulate material through the spray system. Clear the booms and atomizers by spraying solvent. Used solvent can be reused if not excessively contaminated with water.

In most cases trace amounts of water will not affect the flow of DiPel 8L through the spray system. The detergent action of the formulation will purge the last traces of water from the system.

- ◆ Between spray sessions cover hopper lids securely with a tarpaulin or equivalent to prevent water from rain or moisture condensation from entering the hopper because of inadequate seals.
- ◆ Avoid excessive agitation of the undiluted formulation. Constant mixing or “whipping” can alter emulsion properties resulting in high viscosity.
- ◆ Solids may accumulate on the atomizer screens after continued use. These can be removed by rinsing the screens with an oil solvent or water. The rinsate can be reused for several cleanings. Rinsing off the DiPel deposit at the end of each day is a good practice.

### **3.3.2 Diluted Applications**

Oil-based, emulsifiable suspensions of DiPel 8L are formulated with enough emulsifier to permit mixing with water at ratios greater than 50:50 water to undiluted product. Mixing of product with less than 50% water will result in an invert emulsion - a thick, viscous material that is difficult to pump and spray. A general recommendation is to use a 40:60 DiPel: water dilution as a minimum dilution ratio.

All mixing and transfer equipment should be clean prior to the mixing of DiPel. Clean the in-line strainers and inspect for holes or gaps. Drums should be stirred, agitated, or rolled prior to dispensing. Water to be used in mixing should be clean and filtered to remove any coarse suspended matter. Water hardness levels should not exceed 340 ppm, and the pH of the final mixture should be below 7.

Use strainers between 16 and 60 size mesh. A 30 mesh strainer is a good general recommendation. For nozzle strainers, follow the manufacturer’s recommendations.

### **3.3.3 Mixing Procedure**

- ◆ Fill the mix tank or plane hopper with the necessary volume of water. NEVER ADD UNDILUTED DIPEL TO TANK OR HOPPER BEFORE A SUFFICIENT VOLUME OF WATER IS ADDED.
- ◆ Start the mechanical and/or hydraulic agitation of water.
- ◆ If using a sticker, add sticker to agitating water prior to addition of DiPel.
- ◆ Steadily add DiPel to agitating water.
- ◆ Rinse empty drums and bulk tanks previously holding DiPel and use rinse water for any further mixing.

DiPel 8L, after it is diluted, will stay suspended during the normal course of application. Mild agitation via the by-pass flow in aircraft spray systems is adequate to maintain uniform suspension.

**CAUTION:** Avoid excessive agitation of the diluted formulation. Constant mixing or “whipping” can alter emulsion properties resulting in high viscosity.

It is recommended that DiPel tank mixes be used immediately. However, in the event of application delays, DiPel tank mixes are stable for 72 hours, depending on storage temperatures and water quality. Recirculate tank mixes prior to loading aircraft.

**MIXING RATIOS:** Do not mix DiPel 8L to a greater concentration than 1:1 (50:50) in water. Mixing a greater proportion of DiPel to water will result in an unworkable viscosity. If an error is made in mixing, resulting in a high viscosity mixture, add the appropriate amount of water to restore the correct mixture.

As a general recommendation, use mixtures having 40% or less DiPel 8L.

<b>Typical Viscosities of DiPel 8L Tank Mixes</b>	
<b>Ratio Product: Water</b>	<b>Approx. Viscosity (Centipoise)</b>
25:75	<20
40:60	<40
45:55	1,500
50:50	2,000
60:40	4,000

### 3.3.4 Aircraft Loading

In cold weather, especially with the first load of each spray day, all product in the pumps and hoses, (including the loading hoses) should be recirculated back through the tank. This will assure that all pumps, meters, valves and filters are operating properly. In addition, the product in the first load will be of a temperature and viscosity consistent with normal operations.

### 3.4 Cleaning Transfer, Mixing, and Spray Equipment

At the conclusion of the spray program, ground and aircraft equipment should be cleaned according to these recommendations:

Remove in-line screens, nozzle screens and nozzles, and clean these in either oil solvent (undiluted applications) or detergent water solution (diluted applications). Micronair variable restrictor units should be set at #13 or pulled out to the “full open” position.

For diluted applications, filling the mix tank or plane hopper with clear water, followed by agitation and spraying out, is usually sufficient to clean DiPel residues from the system. Optionally, a detergent solution can be used, followed by a clear water rinse.

For undiluted applications, (1) add a small quantity of an oil solvent (diesel, kerosene, crop oil) in a sufficient volume to dilute and remove undiluted DiPel residues from internal walls of the pump and transfer system. (2) Agitate and flush system. (3) Rinse equipment with clear water and drain. (4) Replace screens and nozzles if they were removed.

Use the above procedures for cleaning transfer pumps, lines, and meters.

### 3.5 Storage and Disposal

Oil-based formulations are more stable than aqueous formulations when stored for long periods of time. DiPel 8L properly stored, will remain stable for a minimum period of two years, as indicated by product stability testing at 77°F (25°C). DiPel is stable at low temperatures. Storage of DiPel below freezing temperatures has not resulted in any undesirable effects on the formulation or on product potency.

Do not store DiPel in the direct sun where product temperature will exceed 100° F (38°C) for prolonged periods of time. Within normal storage temperature ranges of 32° to 90°F (0°- 32°C), there will be no adverse effects on the mixing properties or potency of DiPel.

Re-close all unused containers. DiPel is an EPA Category III pesticide; refer to CAUTION statement on DiPel label for handling and storage.

## **4.0 HANDLING, MIXING AND LOADING**

### **4.1 Basic Principles**

All aqueous and oil-based Btk formulations are suspensions, not solutions. They consist of water (or oil in the case of DiPel 8L), plus Btk spores and crystals, fermentation solids, adjuvants, stabilizers and other minor inert ingredients. Therefore, some basic principles can be stated about how these liquids should be handled in order to avoid problems.

#### **4.1.1 Variable Viscosity**

Temperature affects the viscosity of the material. Typical temperature changes during the day will not be noticeable in spray system flow rates. However, wide temperature ranges such as could be experienced between the start and finish of a project may require the use of different calibration constants in flow meters.

#### **4.1.2 Suspensions**

The suspended solids are small particles; filters finer than 30 (i.e. 50 to 100) mesh may collect these particles and eventually become plugged.

#### **4.1.3 Detergent Action**

Foray and DiPel formulations act as mild detergents and may loosen up dried-on accumulations of foreign matter from previous spray operations on the walls of hoppers, lines, pumps, booms and nozzles.

#### **4.1.4 Stickers**

Aqueous formulations of Foray contain additives to enhance sticking. Therefore, regular rinsing, especially of system parts exposed to the air where drying can occur, should be performed before complete drying occurs.

The oil-based DiPel 8L formulation is less volatile than water; consequently, equipment can be left longer (up to half a day) without drying occurring under most conditions.

#### **4.1.5 Aeration**

Any heavy, viscous liquid can entrap air and hold it for some period of time. When recirculating or transferring these products, it is important to avoid the entrapment of air. Submerging both the inlet and the outlet of the hoses/tubes when recirculating these products will help prevent excessive aeration.

## **4.2 Equipment**

### **4.2.1 Pumps**

Pumps with a 3" (7.5 cm) suction inlet are

recommended. They should be powerful enough to transfer a minimum of 100 gpm (400 L/min). If 2" (5 cm) suction pumps are used with bulk tankers, it is better to use a 3" suction hose from the tanker to the pump and then reduce from 3" to 2" at the pump. Always have back-up pumps available in case of pump failure.

### **4.2.2 Hoses**

Maximum hose diameters should be used wherever possible to improve the rate of flow of product from tank to tank or aircraft. Suction hoses of less than 2" in diameter and loading hoses of less than 1" diameter should never be used. Hoses should be in good condition and suction hoses must be airtight and free of holes and leaks. All fittings on the suction side must be airtight. Use the shortest possible suction hoses. With centrifugal pumps it is much more efficient to extend the hose length required on the pressure (outlet) side of the pump than on the suction (inlet) side of the pump.

### **4.2.3 Screens/Filters in Transfer/Loading Systems**

Screens and filters in transfer and loading systems are designed to prevent damage to pumps and meters and to prevent larger particles from entering the aircraft spray system. Screens of 20-30 mesh size will accomplish this objective. A 20 mesh screen will allow improved flow rates, and will not plug as easily. If no in-line screens are being used in the aircraft system, then 30 mesh screens should be used in the loading system. See Section 5 for a detailed discussion on spray system screens.

### **4.2.4 Flow-Meters**

Meters are used to measure the liquid volume of product being handled. Meter accuracies will vary with the slippage of the liquid past the meter vanes, and by the amount of entrapped air in the product. Meters should be calibrated for (1) the product being pumped and (2) the system being used. If meters are calibrated with water, aqueous formulations produce meter readings which are typically 3-4% higher than the actual amount of non-aerated product delivered. For example, a meter calibrated with water reading 100 gallons (or liters) will have actually only delivered 96 or 97 gallons (or liters) of Foray. No standard conversion factor can be provided because of variables such as viscosity of product as it passes through the meter and the extent of aeration.

At the start of the season, the calibration of transfer pumps should be checked by pumping material into a previously calibrated container, such as an aircraft hopper, and comparing the pump flow meter readings to the actual volume transferred.

### 4.3 Spill Management and Disposal

#### 4.3.1 Spill Management of Aqueous Flowable Formulations (Foray F/B)

Always assure adherence to federal, state/provincial and local regulations subsequent to disposal. Foray formulations are Category III pesticides and are not classified as hazardous materials and are not regulated under DOT (US Department of Transportation) hazardous material regulations (49 CFR 100-199). Foray degrades naturally in the environment and does not accumulate in the soil. Therefore, spills on soil surfaces may be handled as follows:

Hose the area down with ample water to disperse into the soil and/or grass. The dilution effect will facilitate the biodegradation of Btk. Cover the spill with a layer of soil to enhance degradation. (This would be the most likely option in remote forested areas).

If a spill occurs on an impervious surface such as concrete or asphalt, rinse the area with clean water if the runoff is directed to a soil/grass surface.

**OR**

Use an absorbent material such as cat litter or commercially available absorbents (e.g. SorbAll) to soak up the spills. The material may be spread over soil surface or taken to an approved landfill.

While Btk has shown no adverse effects to aquatic organisms, do not rinse spills directly into streams, lakes or rivers.

Foray is listed with the Chemtrec Spill Notification Network (800) 424-9300.

#### 4.3.2 Spill Management of Oil formulations (DiPel 8L)

DiPel 8L is a Category III pesticide, is not classified as a hazardous material and is not regulated under DOT hazardous material regulations (49 CFR 100-199). DiPel degrades naturally in the environment and does not accumulate in the soil.

However, the oil carrier is a purified paraffinic oil with low volatility. Every effort should be made to clean up any spill, whether or not it occurs on a soil surface, using absorbent material such as cat litter or commercially available absorbents. The used material should be taken to an approved landfill. Assure adherence to federal, state/provincial and local regulations subsequent to disposal.

While Btk has shown no adverse effects to aquatic organisms, do not rinse spills directly into streams, lakes or rivers.

DiPel 8L is listed with the Chemtrec Spill Notification Network (800) 424-9300.

### 4.4 Disposal of Rinsate

Foray and DiPel must be disposed of in accordance with federal, state/provincial and local regulations. For product and container disposal procedures, see label directions.

Rinsates are best disposed of by adding them to the spray mixture during the operation and applying the material on the target area. Rinsate may be added to undiluted materials so long as it constitutes no more than 5% of the total volume at any time. Aqueous rinsate should NEVER be added to undiluted oil-based DiPel 8L formulations.

### 4.5 Product Container Size Availability & Handling Procedures

Foray and DiPel formulations are available in the U.S. in 55 gallon drums, 275 gallon mini bulk containers and in bulk quantities from 4,000 to 5,900 gallons shipped in tanker trucks. In the rest of the world (RoW) Foray and DiPel are available in 209L drums, 1,000L mini bulk containers, and in bulk quantities up to 25,000 liters in tanker trucks. Each form of packaging requires somewhat different handling procedures.

#### 4.5.1 Drum Handling

(SEE APPENDIX III for drum photo and dimensions.)

**Delivery:** Drums are normally delivered by truck on pallets (4 drums/pallet). If no fork-lift is available, drums may be rolled off the truck tailgate onto 2 or 3 old tires (without rims) stacked where the drum impacts the ground behind the tailgate.

**Storage:** Store drums upright in a dry location. Storage temperatures should be between 32° and 90°F (0° and 32°C). Keep out of direct sunlight at higher temperatures. During shipping and storage, some normal settling of the formulation will occur. To re-suspend, roll or shake drums prior to dispensing.

**Loading:** The drums may be configured with two 2" NPT threaded openings (North America) or a combination of a 2" NPT and a 5 cm metric threaded opening. Product can be dispensed either by pouring or use of a transfer pump having a minimum flow capacity of 100 gal/min (400 L/min), e.g. 5 HP gasoline engine - centrifugal pump with a standpipe (at least 42" [110 cm] in length, not more than 2" [5cm] in diameter) and non-collapsible hose. All pump and transfer lines should be flushed with plenty of clear water prior to pumping Foray and DiPel.

Diluted or undiluted Foray and DiPel left in the lines and pumps will not cause damage or plugging.

**PILOT TIP:** If a meter is unavailable and a partial drum quantity is required, a measuring stick may be used to determine the volume.

The liquid height in a standard drum containing 55 gals is approximately 33". Therefore, 1" is equivalent to 1.67 US gals; in metric terms, 1.0 cm on the dipstick is approximately equivalent to 2.5L.

#### 4.5.2 Mini Bulk Handling

(SEE APPENDIX III for photo and dimensions)

**Storage:** Store in a dry, preferably enclosed, location. The contents should be recirculated prior to use.

**Handling:** Mini-bulk containers (when full) weigh around 1 ton (1000 kg), and require a forklift to handle. The mini-bulk containers are mounted on a 4-way pallet. Do not stack more than 2 high. When empty, the containers can be handled manually (empty weight = 175 lbs or 80 kg).

**Loading:** There is a 5 cm male metric threaded outlet at the base of the container which is fitted with a valve. Each container is provided with a 5 cm male metric to 2" female NPT adapter. The top of the container has a large 8" (20 cm) opening, fitted with a screw-on lid, through which a 42" (110cm) standpipe may be inserted.

The transfer pump should be equipped with a 2" non-collapsible suction line and a 5 hp (minimum) motor capable of pumping 100 gpm (400 L/min).

Prior to use, the contents should be recirculated once by pumping the product from the outlet valve back through the top opening. The hose end should be submerged below the surface of the product. The lid to this opening must always be open or removed when unloading product to facilitate flow and prevent the collapse of the container. Replace the lid once the unloading operation is complete to prevent airborne contamination by dust, debris, rainfall or other moisture.

#### 4.5.3 Bulk (Tanker) Handling

(SEE APPENDIX III for photo and dimensions)

**Delivery:** Bulk shipments are made in standard U.S./Canadian tank trucks. They may be off-loaded into the customer's bulk facility or "spotted" / "dropped" for direct use by the customer. If the entire contents are off-loaded, no recirculation of the contents is required. Standard tank trucks are equipped with 3" male camlock outlet fittings.

Most bulk tankers are equipped with 2 valves to avoid accidental discharge. Both valves (internal and external) must be open to allow discharge of contents. External valve controls should be secured during non-use periods to prohibit unauthorized operation.

The product should be recirculated at least once prior to use if it has been sitting for 2 days or more. During recirculation the return hose should be submerged under the product surface to avoid entrapment of air and foaming of the product.

**Loading:** Off-loading and/or recirculating equipment recommended for bulk tankers include a 3" (7.5 cm) non-collapsible suction, 3" hose, transfer pump capable of pumping 250 gpm (1,000 L/min) and one or two 2" (5 cm) loading hoses of sufficient length to reach the top manhole and/or one or more aircraft for direct loading. If 2" suction pumps are used with bulk tankers, it is better to use a 3" suction hose from the tanker to the pump and then reduce from 3" to 2" at the pump. A 2" loading hose will provide a significantly slower flow rate than a 3". (In the latter case a 3" to 2" camlock reducer will be required to connect the 3" suction to the 2" pump.) Always have back-up pumps available in case of pump failure.

The contents of the tanker should be completely recirculated once before partial unloading or usage. This can be done by pumping the product from the outlet valve through the open manhole. The hose end at the manhole should be submerged below the surface of the product. Precautions should be taken to prevent the hose end from coming out of the manhole and causing a spill or injury; usually the hose is tied into place at the manhole.

The lid of the tanker manhole must always be open when pumping to prevent the collapse of the tanker walls. The lid should be vented prior to opening the tanker to release any pressure that has built up. If the tanker has not been completely emptied, be sure to close the lid in order to prevent rain from contaminating undiluted product.

If the tanker is being dropped, it must be placed on solid ground with the front support dollies on solid planks or timbers (4-6" thick). The ground should be solid and level (or slightly inclined towards outlet) and the trailer wheels should be locked and chocked.

If the tanker unloads from the tail, the rear of the tanker should be lower than the front. If it unloads from the center, it should be level. If loading into a compartmentalized tanker that has been spotted on its dolly legs, load into the middle compartment first, the wheel end, and then the dolly end. Reverse the

procedure when unloading from a compartmentalized tanker. No specific unloading procedure is necessary for compartmentalized tankers that are connected to a tractor. Whether unloading a tanker into another tanker or holding tank, the storage tanker or tank must be flushed and cleaned with clear water and completely drained prior to transferring undiluted product.

**Aqueous formulations:** When the container is almost empty (less than 200 gallons), rinse down the sides of the container with small amounts of water. This will assure that all delivered product is removed as the water will reduce the viscosity of the remaining contents which will then flow readily from the tanker. Small amounts (up to 5% by volume) of water in the undiluted product will not adversely affect the handling or efficacy of the product.

**Oil based formulations:** When the tanker is almost empty (less than 200 gal - 800L), rinse the sides with a small quantity of oil diluent (diesel, kerosene, crop oil) to ensure that most of the Btk is removed from the tanker. The small amount of diluent will not adversely affect any calibration rates. If preferred, this rinsate can be saved and dropped off with the rest of the rinsate from the aircraft and loading equipment.

#### **4.6 Recirculation Protocol for Foray and DiPel Formulations**

Undiluted oil and aqueous formulations of DiPel and Foray are stable suspensions. There is no need to recirculate the contents except prior to their use.

## 5.0 AIRCRAFT OPERATIONS WITH FORAY & DIPEL PRODUCTS

### 5.1 Aircraft Calibration

Proper calibration and spray atomization are paramount to achieving optimal efficacy. Several methods exist for calibrating flow rates, based on the kind of equipment that is fitted to the aircraft. In all cases, some basic calculations first have to be performed to establish the flow rate required by the spray system, and the flow rate through each atomizer or nozzle.

#### 1) Determine the spray system flow rate

The formula for determining the *system flow rates* for US units and metric units are:

#### US Units

$$\text{Flow rate (gal/min)} = \frac{\text{Airspeed (MPH)} \times \text{Swath (ft)} \times \text{Application Rate (gal/acre)}}{495}$$

#### Metric Units

$$\text{Flow rate (l/min)} = \frac{\text{Airspeed (km/h)} \times \text{Swath (m)} \times \text{Application Rate (L/Ha)}}{600}$$

#### 2) Choose the atomizer type and number

The droplet spectrum you require will determine the type of atomizer or hydraulic nozzle that you will use. Using nozzle or atomizer flow charts supplied by the manufacturer, determine the most accurate combination of number, pressure and flow setting (or nozzle orifice size) to deliver the desired flow per minute through each atomizer/nozzle.

Hydraulic nozzles have a narrow pressure (and flow rate) range for any particular droplet size. Rotary atomizers can be adjusted for different droplet sizes independent of their flow rates.

To obtain the *flow rate per atomizer* for either US or metric units, just divide the flow rate by the number of atomizers that will be fitted to the aircraft.

$$\text{Flow/Atomizer/Minute} = \frac{\text{System Flow Rate}}{\text{No. of atomizers}}$$

*Example:* (US units) If airspeed is 110 mph, and the expected swath width is 200 feet, what is the calibrated flow rate through each rotary atomizer if 6 Micronair AU5000 units will be used and the applied volume is 64 fluid oz/acre? (Don't forget to convert ounces to gallons!)

$$\text{Flow rate (gal/min)} = \frac{\text{Airspeed (110)} \times \text{Swath (200)} \times \text{Application Rate (0.5)}}{495}$$

$$= 22.2 \text{ gal/min}$$

$$\text{Gal/Min/Atomizer} = \frac{22.2}{6} = 3.7$$

The next step in the calibration process will depend upon the type of equipment fitted in the aircraft. If the spray system is powered by an engine driven pump (hydraulic or electric), and rotary atomizers are fitted, the aircraft can be statically calibrated on the ground, by catching and measuring the output of the atomizers. If there are many nozzles, or if the system pump is wind-driven, then ground calibration becomes impractical, and an airborne method is required.

Most aircraft are equipped with flow meters which are used to accurately calibrate the system and monitor flow rate during operations. At the start of a project, it may be a good idea to monitor the flow meter carefully to insure that the "displayed" totals match the actual "spray total" volumes. Although it is not necessary to calibrate such-equipped aircraft on the ground, if there are any doubts about the accuracy of the meters, such a calibration can be performed as a cross-check.

It is always essential to monitor the calibration during operational spraying, by comparing volume of product applied with the spray area treated.

#### 5.1.1 Ground Calibration for Aircraft With Hydraulic or Electrical Pumps

1) Load sufficient product into the aircraft hopper to prime the entire spray system, and allow enough product for the required number of tests.

2) Place collectors under each atomizer/nozzle and operate spray system for one or more minutes, so that a measurable volume is produced. Measure volume output per minute from each atomizer/nozzle and compare to calculated rate. Check total output.

3) Adjust system pressure and/or atomizer setting, or change nozzle orifice size, to raise or lower output as needed. Re-test system as per step 2.

#### 5.1.2 Airborne Calibration for Aircraft With Wind Driven Pumps

*Note: It is often possible to get sufficient wind pump pressure by applying power while stationary. Consult the pilot for the standard operating procedure. In such case follow the calibration procedure in 5.1*

1) Load product into the hopper as described in step 1 above, with the exception that the system must be primed in flight.

2) After the system is primed, position aircraft on a level surface and mark the spot. Add a measured volume of product to the spray tank and note the level either through the sight window or by measuring the distance from the top or bottom of the tank to the fluid surface of the product with a measuring stick.

3) Fly the aircraft as in a normal application and operate the spray system for a set amount of time, e.g., 1 minute, using a stopwatch.

4) Return aircraft to the exact spot on the ground as marked in step 3 above, and measure the volume of product needed to refill to the original level. This volume can then be used to calculate output per minute.

5) Make adjustments to the spray system, if necessary, to change output.

6) Alternatively, a known quantity of spray mix can be pumped into the aircraft which has had its spray system primed. Ground equipment, fitted with a previously calibrated and correct flowmeter, may be used for loading. Alternatively, the hopper site gauge may be used if the aircraft is parked on level ground.

The time taken to pump the measured volume is recorded with a stop watch, and the spray system settings adjusted accordingly and re-tested as necessary.

### 5.1.3 Aircraft with Electronic Flow Meters

Electronic flow monitors such as those manufactured by Onboard Systems (Crophawk) and Micronair greatly facilitate aircraft calibration and enable in-flight adjustments if conditions demand it. However, flow monitors and application computers should be calibrated with the product or spray mixture prior to operational use. Refer to equipment manufacturers' directions for volumetrically calibrating flow meters with fluids other than water.

Also, flow monitors that have interchangeable cartridges of different flow range sensitivities should have the correct cartridge or flow turbine installed. For example, for general ULV use, the Onboard Systems "Crophawk Series 4100" uses cartridge #2, which has a listed range of accuracy between 1.5 and 30 gal/min (5 - 100 L/min). Consult the appropriate manufacturers' directions for other flow monitors.

Additionally, some DGPS suppliers now offer a flow monitoring system interlinked with the DGPS system. Please consult with the technical representatives of DGPS manufacturers for more details. (See Appendix II: Sources & Resources.)

#### **General Calibration Procedure**

All Foray and DiPel formulations have been optimized so that their viscosity is as low as possible. Please note that the viscosity of current formulations is considerably lower than earlier Btk formulations.

1) Assume that the Foray and DiPel formulation of choice will behave like water, and use the appropriate calibration factor in the flow meter.

2) Add a known quantity of the spray material to the aircraft hopper. Ground equipment, fitted with a previously calibrated and correct flowmeter, may be used for loading. Alternatively, the hopper site gauge may be used if the aircraft is parked on level ground.

You may want to spray this first load as part of the operation, if you are confident that the application rate will be within +/-10 percent of the target rate.

3) Make an adjustment to your flow meter calibration constant if the total volume sprayed (as indicated by your flow meter) is different from the amount that was pumped into the hopper. Typically this adjustment is:

$$\text{New Calib. Constant} = \text{Old Calib. Constant} \times \frac{\text{Volume Applied}}{\text{Volume Indicated}}$$

*Pilot Tip: Use the aircraft flow meter as your primary instrument for monitoring flow rate.*

With the new calibration constant, adjust the pressure of the spray system until the desired flow rate appears. This step may have to be repeated once or twice to determine the correct flow rate constant.

### 5.2 Spray System Filters/Screens

Filters in aircraft spray systems are designed and installed to prohibit foreign particles which could block vital components from entering the system. Except for in-line screens, the smallest orifices are found in the nozzles fitted to the aircraft. Mesh size is defined by the number of openings there are per inch (e.g. a 30 mesh screen has 30 openings per linear inch of screen). But because of the thickness of the wire, the size of the orifice is not the inverse of the mesh size in inches.

The most common screen size found in aircraft in-line screens is 50 mesh (holes in 50 mesh screens are 0.011" across). Although undiluted Foray/DiPel will pass through a 50 mesh screen, the product solids will eventually build up the screen. When foreign matter is additionally collected on the screens, the buildup will occur more rapidly and will cause plugging of the screen. The same principle applies to 50 mesh nozzle screens. The pore sizes of various screen meshes, slotted strainer slots and nozzle openings are shown below in Figures 5.2 (a) and (b), in order of size increments.

It is clear from an evaluation of the sizes of various screen and nozzle openings shown above that the most commonly used nozzle openings (D-3, 8003 and VRU # 3

Figure 5.2(a): Filter and screen mesh sizes, in order of size (US)

In-Line Screens	Nozzle Screens	Nozzle* Slotted Strainers	Hollow Cone	Nozzles Flat Fan 80 Series	Micronair VRU	L A R G E R  S I Z E S  ↓
50 mesh = 0.011" 30 mesh = 0.021"  16 mesh = 0.045"	50 = 0.011"  24 = 0.030"	50 = 0.010" 25 = 0.020" 16 = 0.032"	D2 = 0.041" D3 = 0.047"  D4 = .0631" D5 = .078"	02 = 0.036" 03 = 0.043"  04 = 0.052" 05 = 0.057" 06 = 0.063"	1 = 0.030" 3 = 0.046"  5 = 0.063"  7 = 0.094"	

\*Slotted strainers are recommended (required) for suspended solids where nozzle straining is required.

Figure 5.2(b): Filter and screen mesh sizes, in order of size (metric)

In-Line Screens	Nozzle Screens	Nozzle* Slotted Strainers	Hollow Cone	Nozzles Flat Fan 80 Series	Micronair VRU	L A R G E R  S I Z E S  ↓
50 mesh = 0.28mm 30 mesh = 0.53mm  16 mesh = 1.14mm	50 = 0.28mm  24 = 0.76mm	50 = 0.25mm 25 = 0.51mm 16 = 0.81mm	D2 = 1.04mm D3 = 1.19mm  D4 = 1.60mm D5 = 1.98mm	02 = 0.91mm 03 = 1.09mm  04 = 1.32mm 05 = 1.45mm 06 = 1.60mm	1 = 0.76mm 3 = 1.17mm  5 = 1.60mm  7 = 2.39mm	

\*Slotted strainers are recommended (required) for suspended solids where nozzle straining is required.

or 5) are significantly larger than a 30 mesh in-line screen pore size.

Therefore the use of a 30 mesh in-line screen or a 25 mesh slotted strainer installed in the nozzle body will enable the free flow of material to the atomizer orifices.

The minimum pore size recommended is 0.02" or 0.50 mm in cross section. No strainer or screen is necessary at the nozzle when using rotary atomizers.

### 5.3 Droplet Spectrum Size, Atomizer Selection & Spray Atomization

The manner in which the Btk insecticide is atomized can markedly influence the effectiveness with which it controls the target insect. The impingement of droplets in a forest canopy, their distribution on foliage, and the

likelihood of the target insect obtaining a lethal dose are all strongly determined by the droplet size.

Not surprisingly, because of differing foliage shapes and densities, broad-leaf forests have slightly different droplet size parameters than coniferous forests. Additionally, target species can affect droplet size selection. Thus a free-roaming insect like the gypsy moth may require a different droplet spectrum than sequestered insects like the spruce budworm.

The choice of atomizer will be largely determined by the required droplet spectrum. At air speeds below 120 mph (190 km/h), rotary atomizers such as the Micronair can deliver smaller droplets than conventional hydraulic nozzles. Their great advantage is the ability to alter

droplet size independently of aircraft boom pressure or airspeed, and to do this as spray conditions change.

At higher airspeeds, small drop diameter ranges are possible with standard hydraulic nozzles through the action of high pressure and wind shear. Such airspeeds are typically obtained with single engine turbine agricultural airplanes and multi-engine converted passenger/transport airplanes. Use of hydraulic nozzles (e.g. Teejet flat fan or hollow cone) is not recommended for application of undiluted Foray and DiPel at air speeds of less than 100 mph (160 km/h).

One factor which should be considered when selecting an atomizer is the range of meteorological conditions you will be encountering during the spray project. For example, as conditions become hotter and drier during the day, rotary atomizers can be adjusted to produce bigger droplets, which evaporate less quickly than smaller droplets, and are more likely to reach their desired target.

#### 5.4 Droplet Size Considerations

Any particular droplet can produce eight droplets of half its diameter. For example, a 200  $\mu\text{m}$  droplet will produce eight 100  $\mu\text{m}$  droplets, which in turn produce eight 50  $\mu\text{m}$  droplets. Thus the original 200  $\mu\text{m}$  droplet can produce sixty-four 50  $\mu\text{m}$  droplets. It can be seen that given the same volume of spray material, when effectively distributed throughout the forest canopy, numerous small droplets would increase the likelihood of encounter by a larva than a single large droplet.

However, there are physical and biological limits to the useful size of the droplets. Does the droplet contain a lethal dose? Will it survive the evaporation stresses during descent? Will it drift off-target?

The next two sub-sections deal in general with droplet sizes in needle and broad leaf forests. The recommendations provided are based on the two most researched insects in the respective forest types, the Eastern Spruce Budworm (*Choristoneura fumiferana*) and the Gypsy Moth (*Lymantria dispar*). However, many defoliators show similar susceptibility ranges, and foliage deposition considerations remain the same for the forest types. Consequently, many of the broad recommendations are directly applicable to other species of defoliators such as the Pine Processionary moth (*Thaumetopoea pityocampa*) or the Nun moth (*Lymantria monacha*) in Europe.

#### 5.4.1 Optimum Droplet Sizes in Needle Coniferous Forests

Some Eastern Spruce Budworm control programs are technically advised to maximize the number of small droplets produced by the atomizers to ensure effective distribution throughout the targeted forest canopy. In contrast, other program managers prefer to set up aircraft atomizers to produce fewer, larger droplets which maximize the toxic dose when ingested by larvae. The concern is that the dose contained in a very small droplet (<75  $\mu\text{m}$  diameter) will be sub-lethal, and will inhibit feeding of the larvae for a time, thus preventing them from acquiring a lethal dose.

Field studies with the Eastern Spruce Budworm to date (spring 1997) have not conclusively demonstrated a clear advantage of larger droplets but they indicate that some degree of latitude exists regarding droplet size. Droplet sizes in the range of DV0.5 of 110-160  $\mu\text{m}$ , DN0.5 40-80  $\mu\text{m}$ , obtained with Micronair AU4000 atomizers set to turn at 4,500 rpm gave comparable biological results when compared with AU4000s spinning at 9,900 rpm producing a spectrum with a DV0.5 of 60-80  $\mu\text{m}$ , DN0.5 of 25-30  $\mu\text{m}$ .\*

DV0.5 and DN0.5 (Volume median diameter and number median diameter also abbreviated as VMD and NMD) represent median droplet sizes which divide the volume of the spray droplet spectrum and the number of spray droplets into two parts containing the same volume of droplets and the same number of droplets respectively. DV0.5 is the most common term used when people describe a spray with one droplet size.

We recommend that the extremely low size regime be avoided, and that AU5000 atomizer speeds of 6,000 rpm and AU4000 speeds of 5,000 rpm, producing droplets with DV0.5 of around 80-120  $\mu\text{m}$ , should be the goal for coniferous forest defoliators.

\*K. van Frankenhuyzen and others. "Effect of droplet size spectrum and application rate on field efficacy of *Bacillus thuringiensis*" 1996 Spray Efficacy Research Group publication.

#### 5.4.2 Optimum Droplet Sizes in Broad Leaf Forests

As in coniferous forests, there are advantages and disadvantages to finely atomizing an application of Btk. Although small droplets give a good distribution in the forest canopy, this has to be balanced by the possibility of larvae obtaining sub-lethal doses from small droplets. Such doses may protect the larvae by inhibiting feeding and preventing them from ingesting further Btk deposits

for a few days until recovery. Studies show that the size of the droplet required for effective mortality of gypsy moth larvae increases with larval instar, so that although droplets in the 100 µm DV 0.5 range are optimally effective against second instars, their size should be increased to 200 µm DV 0.5 range if the population is in the third and fourth instar stage. Droplets larger than 200 µm should not be applied because the resulting low droplet densities reduce the chance of effective dose acquisition by larvae.

Field studies on gypsy moth performed by the NEFAAT (Northeast Forest Aerial Application Technology) Group in the early 1990's with undiluted Foray 48B sprayed with different atomizers showed that a range of droplet sizes will provide a similar level of control on second and third instar larval populations. Small orifice hydraulic nozzles (Flat Fan 8004 and 8004 Twin-jets), as well as Micronair rotary atomizers, all produced droplets in size classes shown to be effective.

We recommend that for the control of gypsy moth and other broad leaf defoliators, the atomizers which deliver droplets in the 120-170 µm DV 0.5 range should be selected and adjusted. Micronair AU5000 atomizers should therefore be set to rotate at approximately 5,000 rpm. Use the smallest orifice flat fan nozzles which can deliver a sufficient volume with medium-speed agricultural aircraft (100-120 mph). We recommend the use of rotary atomizers, especially in slower aircraft, as the shear atomization which aids the production of small droplets by hydraulic nozzles is not adequate at low airspeeds.

If you are operating at the flow capacity limits of your nozzles/atomizers, it would be wise to modify the numbers and/or types of atomizers fitted to your aircraft. For example, if you are having to increase the VRU setting of the Micronairs to their highest setting, consider adding more atomizers. If you are working considerably below 40 psi (275 kPa) for hydraulic nozzles and cannot reduce their number, consider changing the orifice size, so that the adequate atomization, which is obtained at higher boom pressure, is assured.

The following measures will serve to decrease droplet size:

*Hydraulic nozzles:* Smaller orifice size, increase boom pressure, orientation to 45° forward.

*Wind-driven rotary atomizers:* Increase unit rpm - decrease blade angle; in slow helicopters use a longer blade.

*Electrically or hydraulically powered rotary atomizers:* increase rpm or change sleeve size.

## 5.5 Undiluted and Diluted Applications

Foray and DiPel may be applied as undiluted or diluted sprays to control gypsy moth larvae. In field and operational trials against gypsy moth, applications of undiluted product have been proven to give results equal to higher volume diluted sprays, provided the product is properly applied.

Traditionally, Btk formulations were diluted with water to provide a spray volume in the range of 96-128 oz/ac (3.5-4.7 l/ha). Currently, significant improvements in the non-evaporative properties of Btk formulations and application technology have meant that diluted Btk applications provide no significant advantages over undiluted ones.

The effectiveness of undiluted ULV applications of Foray and DiPel on other lepidopteran pests such as elm spanworm, cankerworms, and other native species has also been successfully demonstrated.

Program managers should consider maximizing the use of undiluted Foray and DiPel applications as comparable results can be achieved with diluted applications. Undiluted applications also provide significant improvements in aircraft payload efficiency and help to reduce application costs.

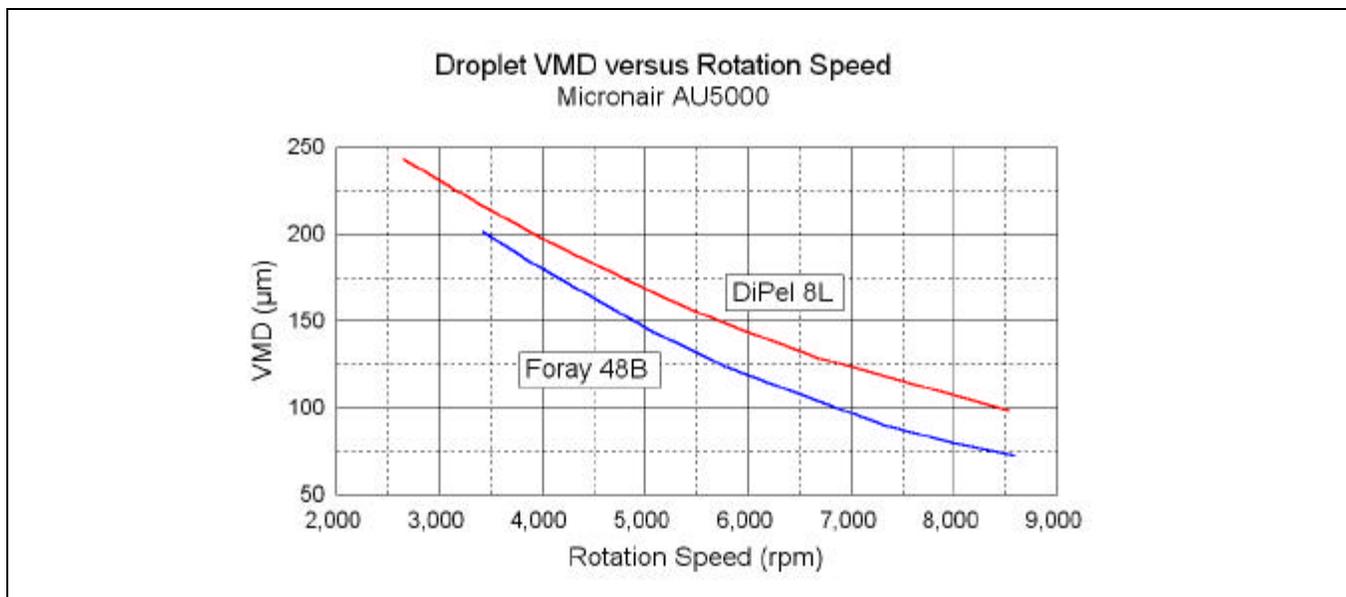
### 5.5.1 Micronair AU5000 Droplet Size Parameter Selection

Figure 5.5 shows wind tunnel data for droplet sizes (DV 0.5) for undiluted Foray 48B and DiPel 8L formulations applied using a Micronair AU5000 atomizer. The charts and figures provided in the Micronair AU5000 operator's handbook are based upon the atomization of water, and they encompass all possible applications in agriculture, vector and forestry spraying.

## 5.6 Lane Separations

Lane separation (or the effective swath width) is the offset distance between parallel tracks flown by a spray aircraft. It represents the span under the aircraft and parallel to the flight path which receives an effective deposit of the pesticide. When accurately flown under most weather conditions, there will be no significant over or under-application if this lane separation spacing is maintained. Note though that the effective swath is not the total swath; rather it is

Figure 5.5.1 Droplet Sizes (DV 0.5) obtained at different Micronair AU5000 rotation speeds



that cross section portion of the spray deposited that is considered as adequate to provide a lethal dose to the larvae and to ensure uniform and homogenous coverage of the forest canopy.

Btk has to be ingested by the larvae to be efficacious so an accurate application is essential to ensure that an adequate dose is deposited across the forest canopy to ensure larval mortality.

The lane separation of aircraft varies depending upon the aircraft/spray system parameters (release height, atomizer setting, aircraft speed), the pesticide formulation, as well as factors such as meteorology and forest canopy architecture.

Pattern testing of aircraft over flat ground as well as in forests has shown that droplet size is one of the major factors which can affect the lane separation distance. Smaller droplets are affected more by the aircraft wake and can travel greater distances. Wind direction has little effect on increasing the effective swath width. Although fine droplets may drift long distances, they do not form part of the effective swath as there is very little biological activity in this portion of the droplet spectrum. For convenience, lane separation determinations are normally performed by flying the aircraft into wind, so that the lateral drift of deposit is a function of the aircraft's wake, rather than wind-borne distribution.

The technique most used to measure the swath width is to assess deposit of dyed droplets on collectors, usually flat cards. White coated card stock (commercially known as Kromekote) has been the most popular collector.

Historically, a droplet density of between 5 and 20 spots per square centimeter (range dependent on product potency) has been commonly held as an effective deposit for Btk products for field use. This standard is rarely used now as the number of fine droplets which are caught by flat cards is greatly influenced by the wind speed, and can give skewed readings under still conditions. With the increased use of image analysis pattern testing, it is more common to measure swath patterns in application rate units of gal/ac or L/ha.

Although measuring spray deposit on the target foliage would provide a more meaningful representation of swath width, this requires more sophisticated measurement techniques and is generally not practical for most operational programs.

Figure 5.6 presents various swath width ranges for a variety of aircraft and atomizers that have been used effectively in forestry programs with Btk formulations. USDA APHIS produced some guidelines in the 1980s, but most states have found these figures somewhat too conservative and have established their own lane separation guidelines, usually based on pattern testing of the aircraft. Increasingly, many states in the US require the use of rotary atomizers for forestry work, but some allow hydraulic nozzles, although typically a shorter lane separation is then assigned. The USDA Forest Service and several states and provinces which have performed extensive swath pattern testing using Swath Kit spray pattern analysis equipment provided the single-engine aircraft data. Multi-engine aircraft data were provided by

Figure 5.6: Suggested ranges of lane separations for Btk applications.

<b>Aircraft</b>	<b>Lane Separation Range</b>		<b>Aircraft</b>	<b>Lane Separation Range</b>	
	<b>ft</b>	<b>m</b>		<b>ft</b>	<b>m</b>
<b>Single Engine Fixed Wing Aircraft</b>			<b>Multi Engine Fixed Wing Aircraft</b>		
Piper Pawnee	65 - 100	20 - 30	DC-3	225	75
Piper Brave	75	23	DC-4, DC-6, DC-7	400	120
Cessna Ag Truck, Ag Wagon, Ag Husky	75 - 100	23 - 30	C-130	400	120
Ag Cat Model B	100 - 130	30 - 40	Beech 18	150	45
Antonov An-2	130 - 165	40- 50	<b>Helicopters</b>		
Ayres Thrush SR2 - Turbine	150	45	Bell 47G	75	23
Ayres Thrush SR2 - Piston	150	45	Hiller 12E	75	23
PZL M-18 Dromader	150 - 175	45 - 53	Hughes/MD 500	75 - 90	23 - 27
Air Tractor 400 Piston	150	45	Kamov Ka-26	80 - 90	24 - 27
Air Tractor 502 Turbine	175	53	Bell 47G Soloy	100	30
Air Tractor 802 Turbine	200	60	Hiller 12E Soloy	100	30
			Bell 206 Jetranger, Long Ranger	100 - 120	30 - 36
			Mil Mi-2	98 - 131	30 - 40
			Bell 204/205/212/412/UH-1	150	45

the Forest Service and the US Air Force, also based on studies with the Swath Kit™.

Where a range of lane separations is shown in the table, the greater figure was obtained with aircraft equipped with Micronair rotary atomizers.

### 5.7 Aircraft Guidance

Over the last decade, traditional aircraft navigation techniques (balloons, spotter aircraft etc.) have given way to the advent of satellite-based technology. Commonly referred to as GPS (Global Positioning System), the location of any feature, natural or man-made, can be confirmed through the use of intersecting signals from a series of orbiting satellites. Not only can locations be identified on the earth's surface, (by latitude and longitude), but aircraft may use the satellite transmissions to plan and follow a specific flight path above the earth's surface. Although accurate for waypoint navigation, the GPS system doesn't offer the accuracies required for proper spray aircraft guidance. An extra signal, called differential correction is required to achieve such precision. When the satellite signals are differentially corrected (DGPS), an aerial application aircraft can follow a swath width (lane interval) to accuracies within two meters.

DGPS systems calculate the aircraft's position (latitude, longitude and elevation) several times per second and use these calculations to provide the aerial applicator with a very accurate and sophisticated guidance system.

DGPS navigation has proven itself in the forest protection industry. Ground-based survey and assessment crews now use inexpensive portable "hand-held" GPS systems to establish treatment boundaries or to locate assessment plots in the forest; 'No Spray' zones are also easily marked.

Aerial applicators, using the same basic technology as the portable hand-held units, rely upon sophisticated instrumentation and cockpit displays to guide their aircraft across the sprayblock. Guidance lights, and small computer style screens provide continuous navigational assistance to the pilots by marking every swath and displaying the position of the aircraft in or near the treatment area. The most recent development in this technology is the interlinking of the aircraft's spray system (flow control) to the DGPS, ensuring that an accurate application rate is maintained across the spray block regardless of the aircraft's groundspeed.

The proven accuracy of DGPS technology has resulted in the rapid adoption of DGPS navigation by program managers and applicators alike. For example, in the USA, all forest protection contracts funded by the US government require the use of DGPS equipment that has USDA Forest Service approval. For the latest specifications, contact the Missoula Technology Development Center of the USDA Forest Service. As the DGPS software is continuously upgraded, the USFS maintains a set of technical specifications describing the features required for forestry spraying.

A list of DGPS manufacturers is included in Appendix II: Sources & Resources

### 5.7.1 Spray Pattern Modeling

In the 1980s and 90s the USDA Forest Service invested a considerable amount of resources in creating a computer program which could accurately predict aircraft spray patterns and deposition within a forest canopy when given inputs on the aircraft, atomizers, spray mixture properties, weather details and spray canopy structure.

they can be used to model aerial spraying situations. Although they can be made to run with minimum effort, the maxim that a little knowledge is a dangerous thing should be taken to heart when running these powerful programs for the first time.

### 5.8 Swath Pattern Analysis

In many forestry projects, it is common practice to examine the spray pattern of contracted spray aircraft before spraying, to ensure that the aircraft has been optimally configured to apply the spray.

Figure 5.8.3: Dye tracers for use with Kromekote Cards

Formulation/Dilution	Dye	Concentration (% w/w)	Manufacturer <sup>1</sup>
<i>Dye Tracers for coated (Kromekote) cards</i>			
L formulations (undiluted)	Base Oil Red	0.4%	Becker-Underwood
L formulations (diluted) & AF formulations (diluted & undiluted)	Black Shade <sup>2</sup> FD&C Blue 1, Rhodamine WT Erio Acid Red	0.1 - 0.5% 0.1 - 0.5% 0.5% 0.3 - 0.5%	Warner-Jenkinson Warner-Jenkinson Various Various
<i>Dye Tracers for Foliage and UV light studies</i>			
L formulations (diluted) & AF formulations (diluted & undiluted)	CSF	0.5%	Carolina Color & Chemical Co.

<sup>1</sup> See Appendix II

<sup>2</sup> Recommended: Black Shade is a mixture of FD&C Blue, Red and Yellow

The program which emerged from those efforts exists either as AGDISP, which models the 'near wake' deposit (the spray pattern close to the aircraft) but does not model drift or canopy deposition, or FSCBG, which adds a Gaussian plume model to AGDISP to simulate the latter effects.

A third derivative of AGDISP is Ag-Drift, which was created by the Spray Drift Task Force to model drift away from the site of application.

At time of writing (Summer 1997) the Forest Service announced intentions to make the models available on the Internet. Please contact Dr. Harold Thistle (406-329-3981) at the Forest Service's Missoula Technology Development Center for more information. The Spray Drift Task Force also announced that their Ag-Drift program will be made available to the public.

All three programs require some instruction before

Although established methods using microscopes to analyze cards exist, the 1990s have seen the development of rapid and powerful methods of measuring the deposition obtained on a line of cards laid out on the ground perpendicular to aircraft flight.

The Swath Kit™ was developed for the USDA Forest Service and is in wide use by state and provincial forestry bureaus conducting forestry projects in the northeastern US and Canada. Information on the Swath Kit can be obtained from Droplet Technologies, Inc. (see Appendix II: Sources & Resources).

Another method uses a suspended string to capture droplets for deposit analysis, but is mainly used in agricultural projects by state aerial applicator associations in the US.

Figure 5.9.1 Weather-affected spray plume movement characteristics under a range of meteorological conditions found throughout a typical spray day.

**Stable Atmosphere (early morning)**

Low Wind	Low wake translation. Maximum vortex lifetime to carry material into canopy. High canopy top deposition. Warning: Highest chance of long range drift impact due to high concentrations of material downwind.
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**Transition Period - Growing Boundary Layer (mid-morning) & cloudy days. Neutral Stability**

Low Wind	Low wake translation, good penetration into the canopy. Little drift.
High Wind	High wake translation. Good penetration and coverage of canopy. High potential for wide spread drift, but downwind concentrations of material are low.

**Boundary Layer Fully Developed (sunny: late morning and afternoon). Instability**

Moderate Winds	Some wake translation. Moderate drift will occur with much drifting material dispersing upwards in the air out of the surface layer.
Low winds	Low wake translation. High drift potential due to free convection. Alternating penetration/drift. Highly variable coverage of target forest.

It is recommended that you contact your local USDA Forest Service, state forestry bureau or state agricultural aviation association representatives for further information.

**5.8.1 Droplet Spread Factors**

Image analysis of spray deposits uses a spread factor to convert droplet stain sizes obtained on target cards to diameters of droplets which created the stains. The spread factor is a ratio of droplet diameter to stain diameter. Thus a 100 µm droplet giving a stain diameter of 200 µm is said to have a spread factor of 0.5. Multiply the stain by the spread factor to come up with droplet size. Some references use the inverse of 0.5 (2.0) to refer to the spread factor. If the spread factor is greater than 1.0, the inverse notation is used. In making quick and simple assessments in the field, a spread factor of 0.5 (2.0) may be used for diluted and undiluted Btk sprays.

**5.8.2 Oil and Aqueous Flowable Formulations**

The spread factor on Kromekote cards varies greatly according to the formulation. It is also affected by droplet size, and to a lesser extent by temperature and relative humidity. Oil formulations will spread rapidly into the card, leaving a central dyed deposit and an oily ring which increases in diameter up to several hours after spray. Although the cards can be read at different times after spraying the oil formulation, it is important that all runs be read at the same time after spray so that they can

be directly comparable. Diluted oil formulations do not show the 'oily ring' effect.

Deposits of undiluted aqueous formulations and water dilutions for both aqueous and oil-based formulations dry shortly after impact on the cards and remain stable.

**5.8.3 Tracer Dyes**

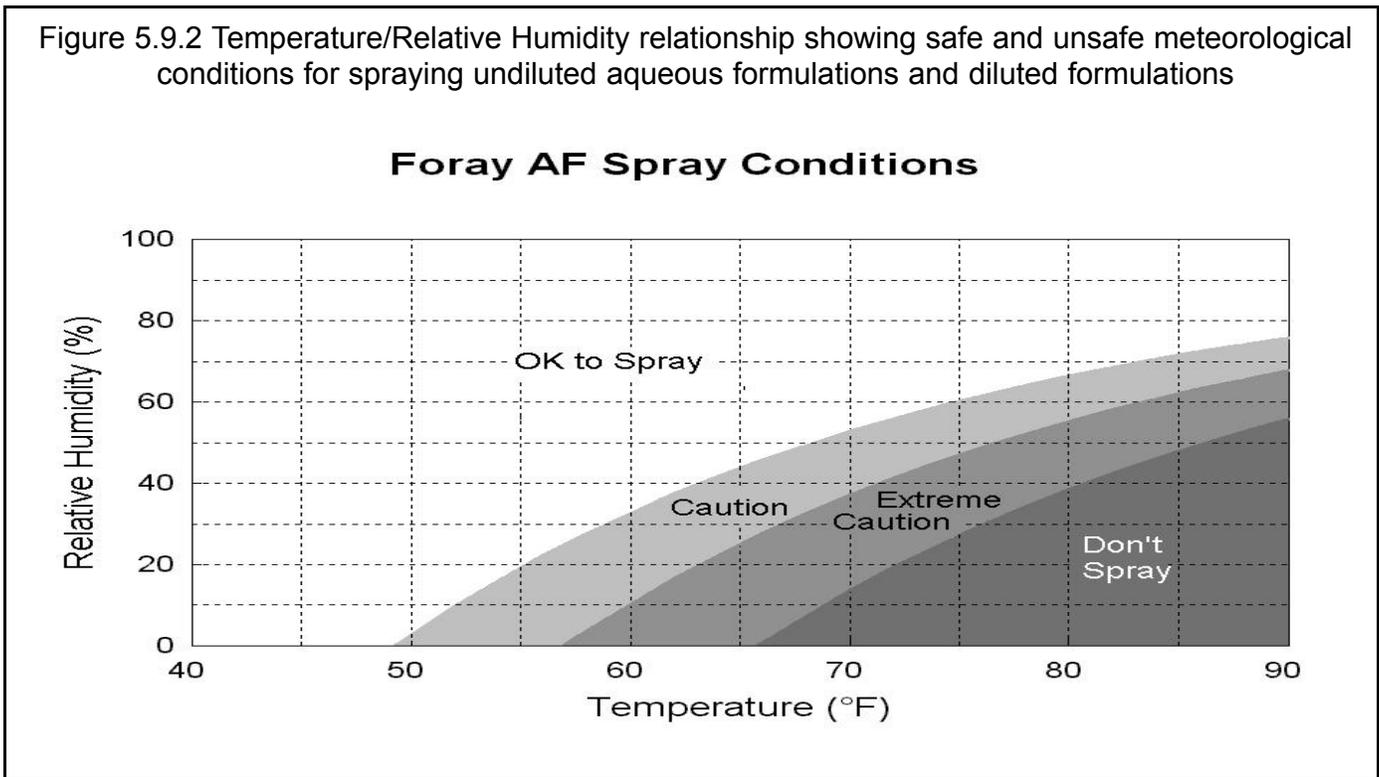
In order for droplet deposit analysis to be performed with white cards, a dye has to be added to the formulation in order to be visible on the target cards. Aqueous formulations can use a range of soluble food dyes, whereas undiluted oil formulations require dyes which can dissolve in oil solvents. Figure 5.8.3 is a limited list of dyes which have been shown to work effectively for their respective formulations.

**5.8.4 Water and Oil-Sensitive Cards**

A major alternative to using white target cards with added tracer is the use of water-sensitive or oil-sensitive cards. These cards have been specially developed to react to aqueous and oil-based formulations. Water sensitive cards work well with undiluted aqueous formulations, and all diluted formulations.

Droplets of the undiluted oil-based DiPel 8L formulation do not leave clear marks on oil sensitive cards, and small droplets leave no marks at all. It is, therefore, recommended to use oil sensitive cards.

Figure 5.9.2 Temperature/Relative Humidity relationship showing safe and unsafe meteorological conditions for spraying undiluted aqueous formulations and diluted formulations



Water and oil-sensitive cards are available from Spraying Systems Company. (see Appendix II: Sources & Resources).

### 5.9 Weather Conditions For Spraying

The weather has a tremendous impact on the aerial application process. Wind, temperature and humidity affect how the spray is deposited on the forest canopy; temperature affects the feeding activity of the caterpillars, and sun and rain both serve to reduce the active ingredient of Btk.

#### 5.9.1 Wind

Two considerations are essential when spraying forests — maximizing spray deposit in the forest canopy while minimizing spray drift outside the target area. Wind plays an important role in both of these situations.

Figure 5.9.1 summarizes the effects of different wind speeds at different times of the day<sup>1</sup>. The best spraying conditions are during light to moderate wind with neutral stability, such as occurs during cloudy days. Stable atmospheric conditions result in good foliage coverage in partly expanded broad leaf canopies, but carry the risk of drift of fine droplets, with little dispersal as the spray cloud drifts downwind.

The atmosphere shows a stable condition when air movements are dampened by the temperature gradient in the air. A temperature inversion, where a layer of cold

air lies below a layer of warmer air after a cold clear night is a typical case of stable air. An unstable atmospheric condition occurs when any air movement is strengthened by the temperature gradient. A wind gust may start an upward movement which will then continue as a thermal. Neutral conditions imply that any air movement will not be dampened or magnified by the state of the atmosphere.

<sup>1</sup>Further reference: *An Atmospheric Primer for Aerial Spraying of Forests* D. R. Miller et al. USDA Forest Service Publication FHM-NC-07-95 December 1995.

#### 5.9.2 Temperature & Humidity

Undiluted DiPel 8L oil formulation is not affected by high temperatures and/or low humidities, and can be sprayed under quite dry conditions. Undiluted Foray aqueous formulations are formulated to be highly resistant to evaporation under dry conditions, but should not be sprayed under extreme conditions. Such extreme conditions are determined by a combination of temperature and humidity.

Relative humidity by itself is not a valid parameter for determining whether you can spray or not. Cool air can be very dry, but because of its low temperature, it is not able to hold much moisture and does not substantially affect the evaporation of the water content of droplets. Figure 5.9.2 shows the risks of spraying undiluted aqueous Foray under different temperature/relative humidity. **The figure is advisory in**

**nature, and assumes that the correct droplet size is selected for the spray operation.**

**CAUTION:** If you are in the 'safe' part of the graph on a morning when it is cool and the air is dry, monitor the temperature and humidity constantly, and be ready to shut down operations at short notice. As the dry air warms up, its ability to hold moisture (known as the *vapor pressure deficit*) will increase dramatically, and spraying of aqueous formulations will be compromised.

Because all Foray/DiPel formulations are manufactured to be resistant to evaporation, the most common reason for shutting down spray operations during the day is vertical movement of air in thermal convection cells, which form after the air close to the ground has been heated by the sun. Applications made under such conditions result in a highly variable coverage in the forest canopy, and significant (but highly dispersed) drift.

### 5.9.3 Rain & Dew

Formulation components of Foray/DiPel provide good weatherability of spray deposits, particularly with undiluted applications. However, rainfall (1/10" or more) within several hours after spray application can reduce the biological activity of the spray deposit. It is recommended that a 6 hour period free of precipitation be allowed for the spray deposit to dry and adhere to the foliage. Foray/DiPel should not be applied when rain is forecast within six hours. However, once Foray/DiPel deposits are dry, it is difficult to dislodge the droplets from the foliage surface.

If early morning dew (or previous night's rainfall) is sufficient to wet the foliage to the point of run-off, it is advisable to wait for a mild breeze or for warmer temperatures to dry the surface of the foliage before starting to spray. A small amount of foliage wetness (which does not produce run-off) will not affect the quality of the spray. However, if rainfall is forecast, ensure that the spray deposit has adequate time to dry before any precipitation. In general, 6 hours drying/feeding time is considered as adequate.

### 5.9.4 Cold Weather Operations

Aerial applications over forests are usually conducted when ambient temperatures are such that larvae are feeding in a forest canopy in which the new foliage has at least partially expanded. At higher latitudes, such conditions may still provide considerable diurnal temperature variations, with the possibility of near freezing temperatures at night.

A few common sense procedures minimize possible flow problems when applying Btk in cool weather conditions:

- ◆ Do not leave product in the aircraft hopper overnight.
- ◆ If possible, store product in bulk, as it is less likely to experience temperature changes.
- ◆ Before loading aircraft, recirculate any product that may be in loading hoses back into the bulk storage containers.

## **6.0 MANUFACTURER'S SUGGESTION**

Careful consideration of these application recommendations will improve control of target insects. However, these recommendations are based on limited evaluations of Foray and DiPel and they are not intended to limit the application of Foray and DiPel through all known types of application equipment. The mention and description of a particular application and related equipment is not to be considered as a corporate endorsement of this equipment, rather it is a reflection of current industry standards and practices.

## 7.0 COMMONLY ASKED QUESTIONS CONCERNING FORAY & DIPEL, THE ENVIRONMENT AND THE SAFETY OF BTK

### 7.1 What are Foray and DiPel?

Foray and DiPel are microbial or biorational insecticides produced by Valent BioSciences. They contain the spores and unique crystalline proteins produced by a naturally occurring bacterium, *Bacillus thuringiensis* subspecies *kurstaki* (Btk). These biological components are combined with approved ingredients and water to make the final product.

### 7.2 What is *Bacillus thuringiensis* or Bt?

*Bacillus thuringiensis* or Bt is a naturally occurring rod-shaped, spore-forming, aerobic, gram-positive micro-organism (bacterium) that is found throughout most areas of the world. It can be found in soils and on leaves/needles and in other common environmental situations. When the bacteria produces spores, it also produces unique crystalline proteins. When eaten, these natural proteins are toxic to certain insects, but not to human beings, birds, or other animals.

### 7.3 How many other Bt's are There?

There are many varieties or subspecies of B.t., and they do not all share the same properties. *Bacillus thuringiensis* subspecies *kurstaki* (Btk) is the B.t. most widely used commercially to protect agricultural crops, fruit trees and rural and urban forests from defoliating lepidopteran larvae. This particular type of B.t. has been used for over 30 years. Other subspecies of B.t. developed commercially by Valent BioSciences are subspecies *aizawai*, active against lepidopteran pests; *israelensis*, active against mosquito and blackfly larvae; *sphaericus*, active against mosquito larvae, and *tenebrionis*, which is active against some beetle larvae.

### 7.4 How Does Btk Work?

Btk must be eaten by the target pest larvae in order to cause mortality. The ingested bacterium is not what kills the larvae, but rather a protein crystal produced by the bacterium. The crystal carries a toxin that is lethal to some lepidopteran larvae. To release the toxin, the crystals require the alkaline environment found in the gut of lepidopteran larvae. When Btk is eaten by a susceptible larva, the toxin is released, the midgut wall is destroyed, the gut becomes paralyzed, and the larva stops feeding within a few minutes. Destruction of the

midgut wall allows the bacteria to enter the blood of the target insect, causing full-scale infection and death of the insect. This process may take 3-5 days so, unlike the situation with some chemical insecticides, there is not an immediate knockdown of insects following treatment.

### 7.5 Does Btk Occur Naturally?

Soil is the natural environment for Btk. Varieties of Bt were isolated from urban, forest, and agricultural soils long before the material was used in insect control programs. Bt has been detected in soils and other substrates around the world including Canada, the United States, Japan, Germany, France, and Israel. Bt can also be found on the leaves of deciduous and coniferous trees. Varieties of Bt have also been found in grain elevators and grain dust.

### 7.6 How are Foray and DiPel Made?

Foray and DiPel are produced from Btk grown in large quantities in enclosed fermentation tanks, in ways very similar to those used for the production of antibiotics and alcoholic beverages. The fermentation broth containing spores and the crystalline proteins is formulated with approved ingredients and water to make the final formulation.

### 7.7 How are Foray and DiPel Different From Chemical Insecticides?

Btk is not a chemical. Chemical pesticides kill a wider range of insects, including many beneficial ones. The active ingredient of Foray and DiPel is a natural bacterium, *Bacillus thuringiensis*. It has been shown to kill certain caterpillars such as the destructive gypsy moth. Additionally, Foray and DiPel are quickly biodegraded in nature, unlike a number of chemical pesticides that form by-products and residues of environmental concern.

### 7.8 Why is Btk used for Forest Spraying?

Btk was developed in response to the growing concern among the scientific community and the public in the 1960's and 1970's over the use of chemical pesticides in the forest environment. At that time, forest managers realized that an alternative to broad spectrum chemical insecticides would be needed if forest protection was to remain a component of future forest management efforts. The new insecticide would have to be: effective when applied in small amounts, more host-specific than chemicals, more quickly broken down in the environment than chemicals, and harmless to non-target organisms such as bees, birds, fish and mammals. As well, the cost

of the new insecticide would have to be comparable to the cost of chemicals.

Btk was not an immediate success in terms of effectiveness and cost, but intensive research and development produced a product that now meets all of these criteria. Btk is now the material of choice in the majority of forest protection programs in North America. This product has gained a level of public acceptance that was unheard of even 10 years ago and, as a result, Btk is widely used to protect trees from insect infestations in both rural and urban settings. The major reasons that Btk is used today is because it is considered ecologically friendly and effective.

### **7.9 How Effective is Btk?**

Btk effectiveness is comparable to chemical applications in controlling many pest insects when pest population densities are low to moderate. Btk is less likely to be as effective as chemicals when pest populations are extremely high unless multiple applications are conducted. However, a control strategy does not have to kill all the target insects in order to be successful. In fact, studies indicate that there are benefits to maintaining some pest insects in an area to support the population of natural enemies.

Because it can take several days for Btk to kill larvae, there is not an immediate reduction in the pest population as is the case when some chemical insecticides are used. This has created the erroneous perception that Btk does not work. Btk does work but it takes a little longer to see the results.

Appropriate conditions are essential for Btk to be effective. Btk is sensitive to sunlight and heat and will only persist on foliage for 3-7 days. Since Btk has to be eaten to kill target insects, sprays are most successful when medium-sized caterpillars are actively feeding.

Depending on the life cycle of the pest and climatic conditions, more than one application of Btk may be necessary to achieve the desired level of control. When eradication is the goal of a control program, a single application of Btk may be somewhat less effective than some chemical insecticides in reducing the population to zero. However, because of its low impact on non-target organisms, Btk is the product of choice for most forest pest control programs (including eradications) conducted in North America and around the world.

### **7.10 Are Foray and DiPel Harmful to Humans and Animals?**

As required by the United States Environmental Protection Agency and Health and Welfare Canada, extensive, oral and intravenous animal studies have been conducted with Foray and DiPel. No evidence of any poisonous, infectious or disease-causing effects were found. In inhalation tests with Btk, there were no mortalities and the Btk was shown to have a low pathogenic potential.

Feeding, skin, breathing, and eye irritation animal studies were also carried out with Foray and DiPel. No toxic effects were seen when significant quantities of Foray and DiPel were fed or inhaled. Very mild, temporary skin irritation and moderate, temporary eye irritation was observed in the tests when Foray and DiPel were applied directly to the skin and into the eyes. These effects were totally reversible.

In addition, the Environmental Protection Agency and Agriculture Canada have determined that Foray and DiPel are exempt from the requirement of tolerance on all labeled crops. Due to this exemption, there is no required interval before re-entering a sprayed area. This exemption is based on extensive testing of Btk to determine both short-term and long-term effects on humans and warm-blooded animals.

Finally, Btk has been used extensively in commercial urban and rural forest pest management for over 30 years. A solid record of safety and health has been amassed over this time.

### **7.11 What Effect Will Bt Have On People, Especially Those with Immunodeficiency, Asthma or Allergies?**

Bt is a common bacterium found in soils throughout the world. People are exposed to Bt and many other microbes everyday. Many of the microbes we encounter, including Btk, do not produce any toxins which affect humans.

Btk and other common microbes are frequently found in blood, urine and other samples from healthy people. It has been shown that the presence of Btk in patient specimen samples is not indicative of pathological or toxic effects. As with many other microbes naturally present in the environment, it can be detected as an insignificant contaminating organism among infection-causing organisms isolated from patient samples.

Individuals with an immuno-deficient condition are somewhat more likely to be affected by microbes that are normally controlled by a healthy immune system. Such

microbes are referred to as opportunistic pathogens. Bt is not considered an opportunistic pathogen.

Exposure to a Btk spray program is not likely to result in the development of new allergies, asthma or other hypersensitive reactions.

Individuals with pre-existing allergies, asthma or hypersensitive individuals, especially those sensitive to normal exposure to soil or smoke and pollutants, could feel some temporary effect.

The exposure level to Btk from an aerial spray program is very low in comparison to the levels applied in safety and health related testing. Even at higher levels used in tests, Btk has been shown to be safe. That safety has been confirmed in over 30 years of use in urban and rural applications.

Individuals with any of the particular medical conditions described above should consider seeking the advice of their physician.

### **7.12 Will Foray or DiPel injure plants?**

Foray and DiPel have been sprayed on millions of acres of trees and other plants. There have been no reports of any plant damage. Foray and DiPel and other Bt products produced by VBC are commonly used on market gardens and in greenhouses.

### **7.13 Are Foray and DiPel harmful to non-target animals, birds and beneficial insects?**

The Btk in Foray and DiPel has been tested against mammals, birds and other insects. In all cases, when Foray and DiPel were tested at doses far in excess of the levels to which these organisms would be exposed during a routine forestry or urban tree spray program, no harmful effects were observed.

### **7.14 Are Foray and DiPel Harmful to Aquatic Organisms?**

Foray and DiPel have shown no adverse effects in aquatic environments. Btk has been tested against freshwater fish and aquatic invertebrate. After extended exposure tests, there were no adverse effects observed.

### **7.15 Can Btk Grow and Replicate in the Environment?**

Btk is a naturally occurring bacterium but it requires alkaline conditions to complete its life cycle. The vegetative form of Btk is generally not well adapted to soil, and it requires the specialized habitat of vulnerable insects to persist. However, Btk endospores can survive

in some soils for at least four months. Foliage, water, and acidic soils are not suitable environments for Btk growth and replication. In these environments, Btk will degrade quite rapidly.

### **7.16 Won't Target Insects Build Up a Resistance to Btk?**

It is very unlikely that forest pests will build up a resistance to Btk. It appears that in order for an insect species to develop resistance to a pesticide, it must have several generations per year, and it must be exposed to multiple applications of the pesticide over a relatively short period of time. In forestry, only a very small area of the total forest is sprayed, and that area will likely not receive more than 2 or 3 treatments over the entire lifespan of the trees. The pest population exposure to Btk is, therefore, extremely low. The chances of a pest developing resistance to Btk in the forest is almost zero.

More intensive spray programs are used against agricultural pests. After repetitive applications of Btk to control the diamondback moth in watercress fields in Hawaii, the insect developed a resistance to Btk. Over 5 years, the watercress fields had been treated an average of 10-20 times/year. This is a very high level of exposure. New techniques of implanting Btk genes into cotton and food crops may lead to the development of resistance in the species that feed on the plants. However, these insects never cause infestations on tree species.

Resistance to Btk has been documented for the Indian meal moth and the almond moth, both stored-product insect pests. Storage-product insects are found in confined environments where a Btk treatment would not be subjected to the conditions that would inactivate it in the forest, such as rain or sunlight. In this closed environment, the probability of developing resistance to Btk is significantly greater than in the field.

### **7.17 What else is in Foray and DiPel besides Btk? Will These Other Ingredients Harm the Environment?**

Foray and DiPel are biological insecticides which contain spores and crystal-shaped proteins produced by the naturally occurring bacterium *Bacillus thuringiensis* variety *kurstaki*, or Btk. Foray and DiPel are very selective insecticides and are not designed to control a wide variety of insect species.

All Bt products, including Foray and DiPel, are produced in a similar fashion. The Btk is grown in large enclosed fermentation tanks. Foray and DiPel are produced using ingredients and a technology which are

similar to those used to make beer or spirits. During fermentation, the bacteria (Btk) reproduce in a pre-sterilized growth medium containing basic food sources, such as corn, potatoes, grains, etc. After the fermentation is complete and the bacteria are grown, the fermentation material, including the Btk, is collected. This material becomes the basic ingredient of Foray and DiPel.

This basic ingredient is composed of the Btk, which is the active ingredient, and the residual fermentation growth material and water. The water and residual fermentation growth material are referred to as “inerts” or inactive, because they are not “active” against insects. Several other inerts are added to this fermentation material, Btk and water, to make up the final formulations of Foray and DiPel. These other ingredients comprise a small proportion of the total formulation. In fact, nearly 90% of Foray 48B for example is composed of water, the residual fermentation growth material, and the Btk, (and one other inert which is a food-approved carbohydrate).

The other inactive or inert ingredients are added to maintain the quality of the Btk formulation, to make it easier to handle, and to protect the activity of the Btk. Some of these ingredients help ensure the microbial quality of Foray and DiPel by acting to control the level of possible contaminating natural microorganisms. These ingredients, added in very minor amounts to control contaminating bacteria and molds, are also used in many foods in Canada and the U.S. for the same purpose.

All inert ingredients in Foray and DiPel formulations are included in 40 CFR 180.1001. This list has been designated by the EPA as “exempt from the requirements of a residue tolerance on raw agricultural commodities”. VBC verifies that none of its Btk formulations contain toxic inert ingredients, such as benzene, xylene, or formaldehyde. The Foray and DiPel toxicology profiles are outlined in Appendix VI.

Additionally, and of considerable importance, not just the Btk powder itself, but our final end-use formulations are tested toxicologically. In this process the safety of both the active ingredient and inerts are assessed and quantified.

### **7.18 How Can We Prove That Btk is Not a Harmful Product?**

We can never prove that a product is absolutely safe. We can only demonstrate that when Btk is applied following the label instructions, that the risk to non-target

organisms, whether they are birds or humans, is acceptably low. There are many drugs on the market today that, when properly taken, will effectively relieve pain or even save lives. Those same drugs come with the warning that if used improperly, they can be harmful or even cause death. As a society we must set standards and we do not permit the sale of commercial products until they have met those standards. Btk does meet the safety standards set in the USA, Canada and in all other countries. It is also acknowledged that Canada has some of the toughest regulatory standards in the world.

In the United States and Canada, commercially available products are reviewed and certified for use by federal agencies including the Environmental Protection Agency in the United States, and in Canada, several agencies including the Pesticide Management Regulatory Agency (Health Canada), Agriculture Canada, Natural Resource Canada, and Environment Canada. All pesticide applications must comply with local, state/provincial, and federal regulations. In addition, researchers continue to monitor programs for potential impacts.

### **7.19 Will Foray or DiPel Cause Damage To Car Finishes?**

There is nothing in Foray or DiPel that will cause damage to automobile finishes. These products are formulated to stick to the surface of leaves when they dry. Therefore, it is easiest to remove from any surface while it is still wet. To remove dried Foray and DiPel from any surface, simply soak the dried droplets with water and then sponge or wipe with a soft cloth. A cleaning product normally labeled for car washing may be needed if the dried spray has been on the surface for awhile. The sooner the surface is cleaned, the easier it will be to remove the spray droplets.

If the automobile’s paint is old, oxidized, and/or severely weathered, Foray and DiPel will adhere to this porous surface; it will be more difficult to remove. A large bath towel may be soaked and placed upon the painted surfaces for several minutes to allow the Foray and DiPel deposits to become rehydrated. This will make the spray deposit easier to remove. In extreme cases, several soakings with a wet towel may be required.

DiPel 8L will form oily rings on the car finish - these are especially apparent on weathered paint. Regular car cleaning detergents will completely remove these temporary blemishes.

## APPENDIX I: FORAY AND DIPEL FIELD SUMMARIES

### Foray 48F United States Field Trial Data Summaries

Location/year Researcher	Rate/Treatments BIU/ha	Dilution/ application rate	Aircraft and Spray Equipment	Result Summary
<b>Gypsy Moth</b> <i>(Lymantria dispar)</i>				
Pennsylvania, 1995 Ticehurst	60	4.7 L/ha undiluted	Bell 206 AU5000 Micronair	less 5% defoliation 68% egg mass reduction
Michigan, 1995 Davis, Smitley	40 & 60	3.2 & 4.7 L/ha undiluted	Bell 47 AU5000 Micronair	98-99% EM Reduction 7-15% defoliation
Pennsylvania, 1996 Ticehurst	60	4.7 L/ha undiluted	Bell 206 AU5000 Micronair	99% EM Reduction 3% defoliation

### Foray 48F (ABG-6387) Canadian Field Trial Data Summaries

Location/year Researcher	Rate/Treatments BIU/ha	Dilution/ application rate	Aircraft and Spray Equipment	Result Summary
<b>Eastern Hemlock Looper</b> <i>(Lambdina fuscicollis fuscicollis)</i>				
Newfoundland, 1995 West	2 x 20 BIU/ha	1.6 L/ha undiluted	Cessna 188 AU4000 Micronairs	73-99% larval mortality 90-100% pupal mortality
<b>Western Spruce budworm</b> <i>(Choristoneura occidentalis)</i>				
British Columbia, 1995 Otvos	45 BIU/ha	3.9 L/ha undiluted	Hiller 12E/T Beecomist	73% larval population reduction

## Foray 48B Canadian Field Trial Data Summaries

Location/year Researcher	Rate/Treatments BIU/ha	Dilution/ application rate	Aircraft and Spray Equipment	Result Summary
<b>Eastern Spruce Budworm (<i>Choristoneura fumiferana</i>)</b>				
Manitoba, 1996 Cadogan	30	2.4 L/ha undiluted	Cessna 188 AU4000 Micronairs	69-80% population reduction 13-14% defoliation
Quebec, 1996 Dugal (SOPFIM)	2 x 30 BIU	2.4 L/ha undiluted	Piper Pawnee AU5000 Micronairs	91% population reduction 19-26% defoliation
<b>Western Spruce Budworm (<i>Choristoneura occidentalis</i>)</b>				
British Columbia, 1994 Otvos	60	4.8 L/ha	Hiller 12E/T	73% population reduction
	30	2.4 L/ha undiluted		32% population reduction
British Columbia, 1995 Otvos	60	4.8 L/ha undiluted	Hiller 12E/T Beecomist	94.4% population reduction

## Foray 76B Canadian Field Trial Data Summaries

Location/year Researcher	Rate/Treatments BIU/ha	Dilution/ application rate	Aircraft and Spray Equipment	Result Summary
<b>Eastern Hemlock Looper (<i>Lambdina fiscellaria fiscellaria</i>)</b>				
Newfoundland, 1996 West	2 x 40	2.0 L/ha undiluted	Cessna 188	70-90% mortality 0-14% defoliation
<b>Eastern Spruce Budworm (<i>Choristoneura fumiferana</i>)</b>				
Alberta, 1995 Tomm	2 x 25	1.25 L/ha undiluted	AT401 AU4000 Micronairs	64-92% larval mortality 89% defoliation
New Brunswick, 1996 Kettela	30	1.5 L/ha undiluted	Cessna 188 AU4000 Micronairs	99% population reduction 1-2% defoliation
Quebec, 1996	1 x 50	2.4 L/ha undiluted	Piper Pawnee AU5000 Micronairs	73-91% popluation reduction
Dugal (SOPFIM)	2 x 50			28-35% defoliation

## DiPel 8L European & Russian Field Trial Data Summary

Location/year Researcher	Rate/Treatments BIU/ha	Dilution/ application rate	Aircraft and Spray Equipment	Result Summary
<b>Pine Processionary Moth</b> <i>(Thaumetopoea pityocampa)</i>				
Savoie, France Demolin	40 & 50	2.3 & 3.0 L/ha undiluted	Bell 47G 6 Airbi rotary atomizers	80-97% mortality
<b>Nun Moth</b> <i>(Lymantria monacha)</i>				
Eberswalde, Germany, 1994	50 & 67 against L1 & L2 larvae	3.0 & 4.0 L/ha diluted, 35 L/ha		84% control after 14 days for both dose rates
Eberswald, Germany, 1995	40 & 50 against L1 & L2 larvae	2.5 & 3.0 L/ha diluted, 35 L/ha		97% control after 14 days for both dose rates
Poland, 1994 Glowacka	47 & 57 against L1 & L2 larvae	2.8 & 3.4 L/ha undiluted	An-2 10 Micronair AU5000	79% and 88% control after 16 days for 2.8L and 3.4L rates
Czech Republic, 1995 Strnady	40 & 50 against L1 & L2 larvae	2.5 & 3.0 L/ha undiluted	Zlin 37T Micronair AU4000	80 and 90% control
Chechersk, Belarus, 1995 Krushev	50	3.0 L/ha undiluted	Kamov KA-26	34%, 74%, and 82% control after 5, 10, and 15 days
<b>Pine Moth</b> <i>(Bupalis piniarius)</i>				
Russia, 1995 Pushkino	25 & 30 against L1 & L2 larvae	1.5 & 3.0 L/ha diluted, 35 L/ha	An-2 Hydraulic nozzles	98% mortality for both dose rates
<b>Gypsy Moth</b> <i>(Lymantria dispar)</i>				
Germany, 1994 Bogenshutz	33 & 50 1 & 2 applications	2 and 3 L/ha diluted 12 L/ha	12L: Bell 47/Alouette 2 6 Airbi rotary atomizers	3L x 1 70% control after 9 days  2L x 2 87% control after 9 days
B. Stiavnica, Slovakia, 1995 Novotny	3 L/ha	undiluted	Zlin 37T Miconair AU4000	6% control
<b>Siberian Silk Moth</b> <i>(Dendrolimus sibiricus)</i>				
Krasnoyarsk, Russia, 1996 Soldatov	50 BIU 1st yr. and 2nd yr. generations	3 L/ha undiluted	An-2 Micronair AU5000	

## Foray 48B European & Russian Field Trial Data Summary

Location/year Researcher	Rate/Treatments BIU/ha	Dilution/ application rate	Aircraft and Spray Equipment	Result Summary
<b>Pine Moth (or Pine Lapet Moth)</b> <i>(Dendrolimus pini)</i>				
Eberswalde, Germany, 1994 (Autumn treatment)	50 BIU against L3 & L4 larvae	4.0 L/ha diluted wt. water to 35L/ha		99% control after 14 days
Miedzzychod, Poland, 1993 (Spring, overwintering pops)	50	4.0 L/ha undiluted	An-2 10 Micronair AU5000	68-93% control
Gomel, Belarus, 1995 Fall, Some L5-6 from previous year	25 & 30	2.0 & 2.5 L/ha undiluted	An-2 8 Micronair AU5000	97% control after 10 days for both rates
Germany, 1996 Spring, L4-L6 larvae	38	3.0 L/ha undiluted	Helicopter 'ULV atomizers'	83% control after 30 days
Lithuania, 1995 Spring, L3 (30%) & L4 (60%)	38	3.0 L/ha undiluted	An-2 Micronair AU5000	92-97% control after 1 month
Lithuania, 1996 Spring, mostly L4	50 & 58	4.0 & 4.5 L/ha undiluted	Kamov Ka-26 8 Micronair AU5000	92% control after 1 month
Belarus, 1996 Fall, L1-2	50	4.0 L/ha undiluted	An-2/Ka-26 Micronair AU5000	9-99% control 10-15% defoliation
<b>Pine Processionary Moth</b> <i>(Thaumetopoea pityocampa)</i>				
Taragona, Spain, 1993 L3 (20%) L4 (75%) L5 (5%)	21 BIU/ha	3.0 liters diluted (water)	Bell 206 Jetranger 6 Airbi	66% control after 16 days 80% control after 27 days
Cordoba, Spain, 1994 L3 (10%) L4 (55%) L5 (37%)	38	3 L/ha undiluted	Piper Brave Micronair AU5000	57% control after 22 days 90% control after 47 days
<b>Nun Moth</b> <i>(Lymantria monacha)</i>				
Poland, 1994 150,000 ha	38 & 50	3.0 & 4.0 L/ha undiluted	An-2 10 Micronair AU5000	72-99% control after 2 weeks 93-100% control after 4 weeks
Belarus, 1995 27,000 ha, L1-L3 larvae	38 & 50	3.0 & 4.0 L/ha undiluted	An-2/Ka-26 both with Micronair AU5000	90-100% control
Belarus, 1996 L1- L3 larvae	38 & 50	3.0 & 5.0 L/ha undiluted	An-2/Mi-2 both with Micronair AU5000	90-98% control 10-30% defoliation
<b>Green Oak Tortix</b> <i>(Tortix viridana)</i>				
Romania, Spring, 1993 L2-L3 larvae	19	3.0 L/ha diluted (water)	An-2 Micronair AU5000	93-99% control

## APPENDIX II: SOURCES & RESOURCES

This section lists manufacturers of equipment and products and sources of information which can facilitate your operations. We have tried to make this manual as comprehensive as possible, but invariably will have left out some key contacts. Please contact us with any omissions; in future versions we will try to correct this situation. References used in the production of this manual are listed in Appendix IV.

As always, if a name of a supplier appears in our list, it should not be considered as an endorsement by Valent BioSciences; rather it is an industry-recognized supplier of the product or service.

Businesses move, mail and electronic addresses change, new area codes appear and the World Wide Web Internet sites may change. At time of writing, every effort has been made to have up-to-date information. If you find that some of the information is outdated, please contact Valent BioSciences so we can update the information for the next release of the manual.

### ATOMIZERS

#### Hydraulic:

Spraying Systems Company  
P.O. Box 7900, Wheaton, IL 60189 USA  
Tel: 630-665-5000

Web site: [www.spray.com](http://www.spray.com) (Does not have any agricultural content at time of writing)

CP Nozzles  
C&E Enterprises  
604 West McKellips Drive  
Mesa, AZ 85201 USA  
Tel: 602-834-5593  
Fax: 602-969-6671

#### Rotary:

Micronair (Head Office)  
Bembridge Fort  
Sandown, Isle of Wight, PO36 8QS  
England  
Tel: (UK) 1983 406111  
Fax: (UK) 1983 404461

(US Office)

Micronair Sales & Service  
7792 N.W. 54th Street  
Miami, FL 33166 USA  
Tel: 800-368-6125  
305-592-9250  
Fax: 305-592-5432  
Web site: [www.charline.be/micronai/uk/welcmic1.htm](http://www.charline.be/micronai/uk/welcmic1.htm)

Beecomist Systems Inc.  
31 Meetinghouse Road  
Telford, PA 18969 USA  
Tel: 215-721-9424  
Fax: 215-721-0751

### FLOW METERS

CROPHAWK flow monitors and data recording systems  
ONBOARD SYSTEMS  
1212 NW St. Helen's Road, Portland, OR 97231 USA  
Tel: 503-286-4956  
Fax: 503-286-0370

MICRONAIR flow monitoring turbines and recording systems: See Micronair under Rotary Atomizers in this section.

### DIFFERENTIAL GPS EQUIPMENT MANUFACTURERS

AG-NAV  
Picodas Group, Inc.  
100 West Beaver Creek Road, Unit #6  
Richmond Hill, Ontario, Canada L4B 1H4  
Tel: 905-764-3744  
Fax: 905-764-3792

Trimble Navigation Limited  
1440 Lake Front Circle, Suite 110  
The Woodlands, TX 77380 USA  
Tel: 713-363-4700  
Fax: 713-292-8876

Del Norte Technology, Inc.  
1100 Pamela Drive  
Euless, TX 76039 USA  
Tel: 817-267-3541  
Fax: 817-354-5762

SATLOC  
15990 N. Greenbay Hayden Loop, Suite 800  
Scottsdale, AZ 85260 USA  
Tel: 602-348-9919  
800-4SATLOC  
Fax: 602-348-6368

WAG Corporation  
386 Highway 6 West  
Tupelo, MS 38801 USA  
Tel: 601-844-8478  
Fax: 601-844-7247  
Website: [www.wagcorp.com](http://www.wagcorp.com)

## SWATH KIT

The Swath Kit is a laptop computer-based aircraft spray pattern analysis system. It uses an image analyzer to read cards sprayed by the aircraft and includes a weather station which helps in the interpretation of the spray pattern. The swath pattern analysis program runs in the Windows operating system.

### **For further information contact:**

Droplet Technologies, Inc.  
937-1 West Whitehall Road  
State College, PA 16801 USA  
Tel: 814-238-6857  
Fax: 814-238-1366  
Web site: [www.mindspring.com/~droptech](http://www.mindspring.com/~droptech)

## COLOR TRACERS & DYES

The following dyes are suggestions only. It is the users' responsibility to carefully read all safety information about a candidate dye to ensure standards of human and environmental safety are maintained.

FD&C means that the dye is approved for use in food, cosmetics and drugs, and it can be assumed to be acceptable to spray on your site. However, in these litigious times it is best to check with the appropriate ruling body that they have no objections.

### **Tracer Dye**

FD & C Blue #1  
FD & C Blue #1

### **Supplier**

Chemcentral  
13395 Huron River Dr  
Romulus, MI 48174 USA  
Tel: (313) 941-4800

Black Shade R  
FD & C Blue #1  
FD & C Blue #1

Warner-Jenkinson  
2520 Baldwin Street  
St. Louis, MO 63106 USA  
Tel: (800) 325-8110

Rhodamine WT

Keystone Aniline Corp.  
2501 West Fulton Street  
Chicago, IL 60612 USA  
Tel: (312) 666-2015  
Web site: [www.dyes.com](http://www.dyes.com)

Bas Oil Red

Becker-Underwood  
801 Dayton Avenue  
Ames, IA 50010 USA  
Tel: (515) 232-5907  
Web site: [www.bucolor.com](http://www.bucolor.com)

CSF

Carolina Color &  
Chemical Company  
3400 Silas Ave  
Charlotte, NC 28206 USA  
Tel: (704) 333-5101  
Fax: (704) 342-3023

## SPRAY CARDS

### **Kromekote Cards**

Kromekote® paper has been used for many years by printers. Ask for Mead Mark 1, 10 point cover stock or equivalent. It is advisable to use papers that are glossy on both sides to prevent card warping in moist environments. Since spread factors will vary depending on quality of Kromekote paper, it is necessary to use only one supplier for spray cards.

Many print shops will carry such card stock, and will be able to cut it to size. For typical Btk deposit analysis, 2" x 3" Kromekote cards are an ideal size.

An example in the northeastern US is:

Glove Printing  
1437 Buffalo Run Road  
Bellefonte, PA 16823 USA  
Tel: (814) 355-2197  
Fax: (814) 355-0188

### **Water & Oil Sensitive Cards**

Supplied by 'Spraying Systems Company' see reference under "Hydraulic" in this section.

## PUMP SEALS

The following companies are two major manufacturers of pump seals. These suppliers can direct you to their distributors for local service.

FLOWSERVE (Formerly PAC-SEAL, INC.)  
211 Frontage Road  
Burr Ridge, Illinois 60521 USA  
Tel: (847) 325-7119  
Web site: [www.pacseal.com](http://www.pacseal.com)

John Crane Inc.  
6400 W. Oakton Street  
Morton Grove, Illinois 60053 USA  
(847) 967-2400

## **SPILL NOTIFICATION**

### ***Chemtrec Spill Notification Network (800) 424-9300***

Chemtrec (Chemical Transportation Emergency Center) is a public service of the Manufacturing Chemist Association to deal with chemical transportation emergencies.

In the event of chemical transportation emergency, Chemtrec provides immediate advice for those at the scene of emergencies, then promptly contacts the shipper of the chemicals for more detailed assistance and appropriate follow-up.

## APPENDIX IV: PARTIAL LIST OF INSECTS CONTROLLED WITH FORAY AND DIPEL

Table 1 and Table 2 show a list of forest Lepidoptera against which Foray/DiPel has been successfully used.

Common name	Scientific name	Suggested dose	
		BIU/ha	L/ha
<b>Coniferous Forests</b>			
Pine Processionary	<i>T. pityocampa</i>	12-40	1-3
Nun moth	<i>L. monacha</i>	50	4
Pine moth	<i>Dendrolimus pini</i>	25-50	2-4
Pine beauty moth	<i>Panolis flammea</i>	25-50	2-4
Pine Looper moth	<i>Bupalis pinarius</i>	25-50	2-4
Fir & Larch tortricids	<i>Zeiraphera spp</i>	25	2
<b>Deciduous Forests</b>			
Gypsy moth	<i>L. dispar</i>	25-60	2-5
Green Oak tortrix	<i>T. viridana</i>	25	2
Oak Processionary	<i>T. processionaria</i>	25-50	2-4
Fall Webworm	<i>H. cunea</i>	12	1
Brown tailmoth	<i>E. chrysorrhoea</i>	12-25	1-2
Tent caterpillars	<i>Malacasoma spp</i>	12-25	1-2
Ermine moths	<i>Yponomeuta spp</i>	12-25	1-2
Vapourer moth	<i>O. antiqua</i>	12-25	1-2
Winter moth	<i>O. bumata</i>	12-25	1-2

<i>Leucoma salicis</i> on poplars
<i>Dasychira pudibunda</i> on beech
<i>Drymonia ruficornis</i> on Oak stands
<i>Diocrytria</i> spp in pine seed orchards
<i>Epinolia</i> spp in Christmas tree plantations, etc.
<i>Orthesia cruda</i>

The following two sections deal with species on which extensive research exists on the effect of Foray 48B.

### **Pine Moth** **(*Dendrolimus pini*)**

#### **Dose**

Both trial data from Germany and operational experience in Poland during the 1994 season, have shown exceptionally good results have been obtained against late instar larvae (L3-L4) of *Dendrolimus pini* at dose rates of 4L/ha.

The experimental and operational results indicate

that the optimum dose rates for the various larval stages are:

L1-L2: 2 - 2.5 L/ha  
L3-L4: 3 - 4 L/ha

#### **Timing**

The optimum period for treatments is when the larvae are actively feeding. This means that there are two periods during which *Dendrolimus pini* larvae may be treated:

In autumn to catch the L1 and L2 larvae, and  
In spring for the over-wintering L3 and L4 larvae.

The "operational window" for *Dendrolimus pini*, depends more upon climatic conditions than the development of the larvae. Experience in Poland indicates that the larvae can be treated over an extended period in both the autumn and spring seasons, giving great operational flexibility.

The long susceptible phase of the larvae means that adverse weather need not be a limiting factor to successful control, and operations can be stopped until better conditions occur in order to get the optimal results.

## **Application**

### **Rotary atomizers**

Foray and DiPel should be applied undiluted whenever possible through rotary atomizers (e.g. Micronair or Beecomist) set to produce droplets in the range 75-125 µm.

### **Hydraulic nozzle systems**

If rotary atomizers are not available, then standard hydraulic boom and nozzle systems can be used successfully. Application volumes are higher (ca 10-15 L/ha), so Foray and DiPel require dilution with water.

### **Pine Processionary Moth (*Thaumetopoea pityocampa*)**

Foray and DiPel are very effective products for the control of Pine Processionary Moth across the whole geographical range of the insect. They give excellent control of all the larval stages -1st & 2nd, 3rd, 4th and even 5th instar larvae, under a wide range of operational conditions. They also stop feeding soon after application, and limits the damage that the larvae can do.

### **Dose Rate**

The rates vary according to a number of factors; such as the influence of:

- geography
- development of the larval population
- weather conditions

### **Timing**

The "operational window" for Foray and DiPel is very long. Depending upon the geographical area it is usually 2-3 months. This means that periods of adverse weather should not affect the overall timing of treatments.

The optimum period for treatments is during the

early season. Low dose rates can be used, which give corresponding reductions in application costs and increased aircraft utilization.

Mid to late season applications with Foray and DiPel, using the appropriately higher dose rates, are equally successful.

Winter applications against L4 & L5 larvae have been made as late as early February, and under cold conditions using 3 and 4L/ha, with equal success.

### **Aerial Application**

Foray and DiPel should be applied whenever possible, undiluted, through rotary atomizers (e.g. Micronair, or Beecomist) set to produce droplets below 100 microns, preferably in the 60-80 micron range.

If rotary atomizers are not available, then the standard hydraulic systems may be used successfully.

### **Green Oak Tortrix (*Tortrix viridana*)**

#### **& Winter Moth (*Operopthera brumata*)**

Foray and DiPel have been shown to be effective against the larvae of *T. viridana* when applied early in the spring, at bud burst on deciduous oaks (*Q. robur*, *Q. cerris* etc), and in early summer on both the evergreen oaks, *Q. ilex* and *Q. subor*.

### **Deciduous Oaks**

#### **Dose**

Operational experience shows that a dose rate of 2-3 L/ha will give excellent results.

#### **Timing**

Both experimental and operational experience shows that early treatments, when the oak leaves are still in bud, are more effective in terms of larval mortality, and therefore foliar protection, than later ones.

Mixed infestations of:

- ◆ *viridana* and *O. brumata* should be treated simultaneously, while
- ◆ *viridana* and *L. dispar* should be treated separately, (if both populations need to be controlled) although it has been observed that late applications for *T. viridana* made when there are significant numbers of *L. dispar* present on the tree are equally effective against both species.

## **Application**

Operational experience backed up by some experimental work in the USA indicates that equipment should be set to produce Foray/DiPel droplets in the range 125-150 microns to get the best results.

Rotary atomizers and conventional hydraulic systems are capable of producing droplets within this range.

### **Nun Moth (*Lymantria monacha*)**

Nun moth is a relatively rare pest. When it occurs, it infests firs and pine trees, particularly those growing on the poorest soil. Its effects can be catastrophic. Foray 48B has been shown to be effective against the larvae of the nun moth (*L. monacha*), under both experimental and operational conditions at dose rates between 3.5 and 4L/ha.

### **Dose**

#### *Pines*

Operational experience in Poland during the 1994 season, has shown that exceptionally good results have been obtained against early stage larvae (L1-L3) of *L. monacha* at dose rates of 3-4 L/ha.

The experimental and operational results indicate that the optimum dose rates for the various larval stages are:

L1-L2:	2 - 2.5 L/ha
L3-L4:	3 - 4 L/ha

### **Timing**

#### *Pines*

The optimum period for treatments is when the larvae are actively feeding.

Applications were made in Poland to late 1st instar larvae in mid May through to early 3rd instar larvae in mid June, with equally good effect.

While there are no efficacy reports available at the time of writing of applications against late 3rd and 4th instar larvae, the higher dose rates should be used until further clarification is made.

## **Weather**

The "operational window" for *L. Monacha*, depends more upon climatic conditions and the development of the new growth rather than the susceptibility of the larvae to Foray.

Experience in Poland indicates that the larvae can be treated over an extended period from L1 to L4, which in 1994 was 4-5 weeks. This would indicate that adverse weather need not be a critical factor, and operations can stop until better conditions occur in order to get the best results.

## **Application**

### *Pines*

Experience gained in 1994 shows that the best results are obtained with equipment set to produce undiluted Foray and DiPel droplets in the range of 40-80 microns.

This means that Micronair AU5000 (and AU4000) atomizers should be run at between 8,500 and 9,500 rpm, and flow rates per atomizer should be maintained at less than 3L/minute, even if it means fitting an extra pair of atomizers per aircraft.

### *Spruce*

Experience gained in 1994 and 1995 shows that it is important to obtain the finest droplets (40-60  $\mu\text{m}$ ) that the equipment is capable of producing in order to get the coverage required for good performance.

This means that Micronair AU4000 atomizers should be run at 10-12,000 rpm, and that AU5000 atomizers should be set to run at the maximum rotation possible, by setting the fan blade angles at 35° (or finer). Flow rates per atomizer should be maintained at less than 3 l/minute, even if it means fitting an extra pair of atomizer per aircraft.

## APPENDIX V: REFERENCES

A frequent comment of individuals concerned over Btk spray programs is that information provided by industry is suspect. Often the very opposite is true and the general public tends to be misinformed by other sources. The Btk field is very well researched, and a great many peer-reviewed publications are available for reference. The use of Btk in forestry has been extensively reviewed in 1994 by the USDA Forest Service (Reardon et al, 1994) and in 1993 by Forestry Canada (Otvos et al, 1993). In addition, Btk received wide coverage from the USDA Forest Service in 1995 with the publication of the new Environmental Impact Statement for gypsy moth.

The Canadian publication is the most comprehensive review of Btk use available, looking at every aspect of the use of this product by society. It has a very complete list of publications on the subject. We strongly recommend any interested persons to order the publication from the Canadian Forest Service, Natural Resources Canada (previously Forestry Canada) for further study.

In order not to overwhelm readers with a library stack of references, we present a limited list of key publications, with a few recent ones that did not make it into the above key references, as well as the sources used for the preparation of this technical manual.

### Comprehensive Reviews of B.t. use

Otvos, I.S. and S. Vanderveen. 1993. Environmental report and current status of *Bacillus thuringiensis* var. *kurstaki* use for control of forest and agricultural insect pests. Forestry Canada and Province of British Columbia, Ministry of Forests; Victoria, B.C. 81 pp.

Reardon, R., N. Dubois, and W. McLane. 1994. *Bacillus thuringiensis* for managing gypsy moth: A review. USDA Forest Service, National Center of Forest Health Management, Morgantown, W.V. 32 pp.

Gypsy Moth Management in the United States: a cooperative approach. Environmental Impact Statement, Vols I-V, USDA, Forest Service and APHIS.

### Recent publications not listed in Otvos and Vanderveen

Kreutzweiser, D.P., S.S. Capell, and D.R. Thomas. 1994. Canadian Journal of Forest Research 24: 2041-2049 Aquatic insect responses to *Bacillus thuringiensis* var. *kurstaki* in a forest stream.

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**Internal research reports performed by and for Valent BioSciences**

**Manufacturers' literature**

**Foray**<sup>®</sup>

# Toxicology Profile

**FOR USE IN FORESTS**

Foray is a selective, microbial insecticide that effectively protects forests throughout the world from defoliating lepidoptera larvae, including gypsy moths, spruce budworms, and other leaf-eating caterpillars.

The active ingredient in Foray, *Bacillus thuringiensis kurstaki*, or Btk, is a naturally occurring bacterium commonly found on foliage and in soil. Unlike chemicals, Foray works by quickly paralyzing the digestive system of the pest after the active ingredient, Btk, is eaten, causing the insects to stop feeding immediately and die within a few days. Foray formulations are used to economically and effectively control a wide variety of damaging forest pests.

## Toxicity Studies

### Oral Toxicity Studies

No oral toxicity has been demonstrated in rats given Foray at 5000 milligrams per kilogram of animal body weight. In a separate study, a dose of  $10^8$  Btk Colony Forming Units (CFU: a measure of viable spore concentration) did not cause any toxic or pathogenic effects.

### Inhalation Toxicity Studies

No toxic effects were observed in rats exposed to approximately 7 milligrams of Foray per liter of air for 4 hours.

The low pathogenic potential of Btk was demonstrated when rats were exposed to a concentration of approximately  $10^8$  CFU of Btk per liter of air for 4 hours. No overt symptoms of toxicity have been reported by individuals during the use of this or other Btk containing products.

### Dermal Toxicity Studies

No toxic effects were observed when Foray at 2.5 gram per kilogram of body weight was applied as a single dose exposure to the skin of rats.

### Dermal Irritation Studies

Very mild, temporary dermal irritation was seen when Foray was applied to the skin of rabbits for 4 hours. All signs of irritation cleared in all animals within 2 days after application.

### Eye Irritation Studies

Foray was moderately irritating in a rabbit eye irritation test. No apparent redness or other ocular finding remained 7 days after the application of  $10^9$  CFU of Btk to the eye.

### I.V. Injection Studies

A single I.V. dose of  $10^8$  CFU of Btk was not toxic to rats. Btk was not able to multiply in the tissue as examined periodically during the 167 days of the study.

### Freshwater Fish Toxicity Studies

No toxicity or pathogenicity was shown in rainbow trout exposed to Btk for 31 days at a dose of  $10^{10}$  CFU per liter of water and in the diet at  $10^{10}$  CFU per gram of feed.

### Freshwater Aquatic Invertebrate Toxicity Studies

Btk had no observed effect on *Daphnia magna* exposed to over  $10^8$  CFU of Btk per liter of water for 21 days.

---

### **Bird Toxicity Studies**

No toxicity or pathogenicity was seen in bobwhite quail after they were orally dosed with Btk at  $10^{11}$  CFU per kilogram body weight each day for 5 consecutive days.

No toxicity or pathogenicity was seen in mallard ducks orally dosed with Btk at  $10^{11}$  CFU per kilogram body weight each day for 5 consecutive days.

### **Honey Bee Toxicity Studies**

The LC<sub>50</sub> for Btk on honey bees was determined to be  $10^8$  CFU per gram of feed and the no-observed-effect-concentration was determined to be  $10^6$  CFU per gram of feed.

### **Non-Target Insect Toxicity Studies**

The LC<sub>50</sub> of Btk on green lacewing larvae was greater than  $10^8$  CFU per gram of feed and the no-observed-effect-concentration was  $10^8$  CFU per gram of feed.

The LC<sub>50</sub> of Btk on ladybird beetles was greater than  $10^8$  CFU per gram of feed and the no-observed-effect-concentration level for pathogenicity was  $10^6$  CFU per gram of feed.

The LC<sub>50</sub> of Btk on a species of parasitic wasps was greater than  $10^8$  CFU per gram of feed and the no-observed-effect-concentration was  $10^8$  CFU per gram of feed.

---

## **Residues**

As Foray has been shown to be non-toxic to non-target organisms, residues and spray drift are not considered hazardous.



**APPENDIX VII: LIST OF VBC SALES AND RESEARCH CONTACT PERSONS**

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<b>1.0 INTRODUCTION</b>	
1.1 Message from The VBC Forestry Team . . . . .	2
1.2 What's New? . . . . .	2
1.2.1 The Forestry Toxin Unit . . . . .	2
1.2.2 Accurate Deposit Assessment Methodology (ADAM) of Btk Delta-Endotoxin . . . . .	2
1.3 What are Foray and DiPel? . . . . .	3
1.4 How does Foray and DiPel work? . . . . .	3
<b>2.0 FORAY and DIPEL AQUEOUS FORMULATIONS: TECHNICAL INFORMATION</b> . . . . .	<b>4</b>
2.1 General Description . . . . .	4
2.1.1 Physical Properties: Foray 48F . . . . .	4
2.1.2 Physical Properties: Foray 48B . . . . .	4
2.1.3 Physical Properties: Foray 76B . . . . .	4
2.2 Foray and DiPel and the FTU	
2.2.1 Foray 48F and Optimization of Btk Activity . . . . .	4
2.3 Compatibility Statements . . . . .	4
2.4 Handling Undiluted and Diluted Aqueous Foray . . . . .	5
2.4.1 Undiluted Applications . . . . .	5
2.4.2 Diluted Applications . . . . .	5
2.4.3 Mixing Procedure . . . . .	5
2.4.4 Aircraft Loading . . . . .	5
2.5 Cleaning Transfer, Mixing and Spray Equipment . . . . .	5
2.6 Pump Seals . . . . .	6
2.7 Storage and Disposal . . . . .	6
<b>3.0 DIPEL OIL-BASED FORMULATION: TECHNICAL INFORMATION</b> . . . . .	<b>7</b>
3.1 General Description . . . . .	7
3.1.1 Physical Properties: DiPel 8L . . . . .	7
3.2 Compatibility Statements . . . . .	7
3.3 Handling Undiluted and Diluted DiPel 8L . . . . .	7
3.3.1 Undiluted Applications . . . . .	7
3.3.2 Diluted Applications . . . . .	8
3.3.3 Mixing Procedure . . . . .	8
3.3.4 Aircraft Loading . . . . .	9
3.4 Cleaning Transfer, Mixing, and Spray Equipment . . . . .	9
3.5 Storage and Disposal . . . . .	9
<b>4.0 HANDLING, MIXING AND LOADING</b> . . . . .	<b>10</b>
4.1 Basic Principles . . . . .	10
4.1.1 Variable Viscosity . . . . .	10
4.1.2 Suspensions . . . . .	10
4.1.3 Detergent Action . . . . .	10
4.1.4 Stickers . . . . .	10
4.1.5 Aeration . . . . .	10
4.2 Equipment . . . . .	10
4.2.1 Pumps . . . . .	10
4.2.2 Hoses . . . . .	10
4.2.3 Screens/Filters in Transfer/Loading Systems . . . . .	10
4.2.4 Flow-Meters . . . . .	10
4.3 Spill Management and Disposal . . . . .	11
4.3.1 Spill Management of Aqueous Flowable Formulations (Foray F/B) . . . . .	11
4.3.2 Spill Management of Oil Formulations (DiPel 8L) . . . . .	11
4.4 Disposal of Rinsate . . . . .	11
4.5 Product Container Size Availability & Handling Procedures . . . . .	11
4.5.1 Drum Handling . . . . .	11
4.5.2 Mini Bulk Handling . . . . .	12
4.5.3 Bulk (Tanker) Handling . . . . .	12
4.6 Recirculation Protocol for Foray/DiPel Formulations . . . . .	13
<b>5.0 AIRCRAFT OPERATIONS WITH FORAY AND DIPEL PRODUCTS</b> . . . . .	<b>14</b>
5.1 Aircraft Calibration . . . . .	14
5.1.1 Ground Calibration for Aircraft With Hydraulic or Electrical Pumps . . . . .	14
5.1.2 Airborne Calibration for Aircraft With Wind Driven Pumps . . . . .	14
5.1.3 Aircraft with Electronic Flow Meters . . . . .	15
5.2 Spray System Filters/Screens . . . . .	15
5.3 Droplet Spectrum Size, Atomizer & Spray Atomization . . . . .	16
5.4 Droplet Size Considerations . . . . .	17
5.4.1 Optimum Droplet Sizes in Needle Coniferous Forests . . . . .	17

5.4.2 Optimum Droplet Sizes in Broad Leaf Forests . . . . .	17	7.9 How Effective is Btk? . . . . .	27
5.5 Undiluted and Diluted Applications . . . . .	18	7.10 Are Foray/DiPel Harmful to Humans and Animals? . . . . .	27
5.5.1 Micronair AU5000 Droplet Size Parameter Selection . . . . .	18	7.11 What Effect will Bt have on People, Especially Those with Immunodeficiency, Asthma, or Allergies? . . . . .	27
5.6 Lane Separations . . . . .	18	7.12 Will Foray/DiPel Injure Plants? . . . . .	28
5.7 Aircraft Guidance . . . . .	20	7.13 Are Foray/DiPel Harmful to Non-Target Animals, Birds, and Beneficial Insects? . . . . .	28
5.7.1 Spray Pattern Modeling . . . . .	21	7.14 Are Foray/DiPel Harmful to Aquatic Organisms? . . . . .	28
5.8 Swath Pattern Analysis . . . . .	21	7.15 Can Btk Grow and Replicate in the Environment? . . . . .	28
5.8.1 Droplet Spread Factors . . . . .	22	7.16 Won't Target Insects Build Up Resistance to Btk? . . . . .	28
5.8.2 Oil and Aqueous Flowable Formulations . . . . .	22	7.17 What Else is in Foray/DiPel Besides Btk? Will These Other Ingredients Harm the Environment? . . . . .	28
5.8.3 Tracer Dyes . . . . .	22	7.18 How Can We Prove that Btk is Not a Harmful Product? . . . . .	29
5.8.4 Water and Oil-Sensitive Cards . . . . .	22	7.19 Will Foray/DiPel Cause Damage to Car Finishes? . . . . .	29
5.9 Weather Conditions For Spraying . . . . .	23	<b>APPENDIX I: FORAY/DIPEL FIELD DATA SUMMARIES . . . . .</b>	<b>30-33</b>
5.9.1 Wind . . . . .	23	<b>APPENDIX II: SOURCES &amp; RESOURCES . . . . .</b>	<b>34-36</b>
5.9.2 Temperature & Humidity . . . . .	23	<b>APPENDIX III: PRODUCT CONTAINERS AND DIMENSIONS . . . . .</b>	<b>37</b>
5.9.3 Rain & Dew . . . . .	24	<b>APPENDIX IV: PARTIAL LIST OF INSECTS CONTROLLED WITH FORAY AND DIPEL . . . . .</b>	<b>38-40</b>
5.9.4 Cold Weather Operations . . . . .	24	<b>APPENDIX V: REFERENCES . . . . .</b>	<b>41</b>
<b>6.0 MANUFACTURER'S SUGGESTION . . . . .</b>	<b>25</b>	<b>APPENDIX VI: FORAY TOXICOLOGY PROFILE and MSDS . . . . .</b>	<b>43</b>
<b>7.0 COMMONLY ASKED QUESTIONS CONCERNING FORAY AND DIPEL, THE ENVIRONMENT AND THE SAFETY OF B.T.K. . . . .</b>	<b>26</b>	<b>APPENDIX VII: LIST OF ABBOTT SALES AND RESEARCH CONTACT PERSONS . . . . .</b>	<b>45</b>
7.1 What are Foray and DiPel? . . . . .	26		
7.2 What is <i>Bacillus thuringiensis</i> or Bt.? . . . .	26		
7.3 How Many Other Bt's are There? . . . . .	26		
7.4 How Does Btk Work? . . . . .	26		
7.5 Does Btk Occur Naturally? . . . . .	26		
7.6 How are Foray and DiPel Made? . . . . .	26		
7.7 How are Foray and DiPel Different from Chemical Pesticides? . . . . .	26		
7.8 Why is Btk used for Forest Spraying? . . . . .	26		

## APPENDIX III - PRODUCT CONTAINERS & DIMENSIONS



### DRUM

<i>Capacity:</i>	55 gallons 200 litres
<i>Outside Diameter:</i>	23 1/4"
<i>Outside Height:</i>	34 3/4"
<i>Color:</i>	Blue
<i>Body:</i>	High molecular weight polyethylene with ultraviolet light protection.
<i>Closure:</i>	(2) 2" bungs



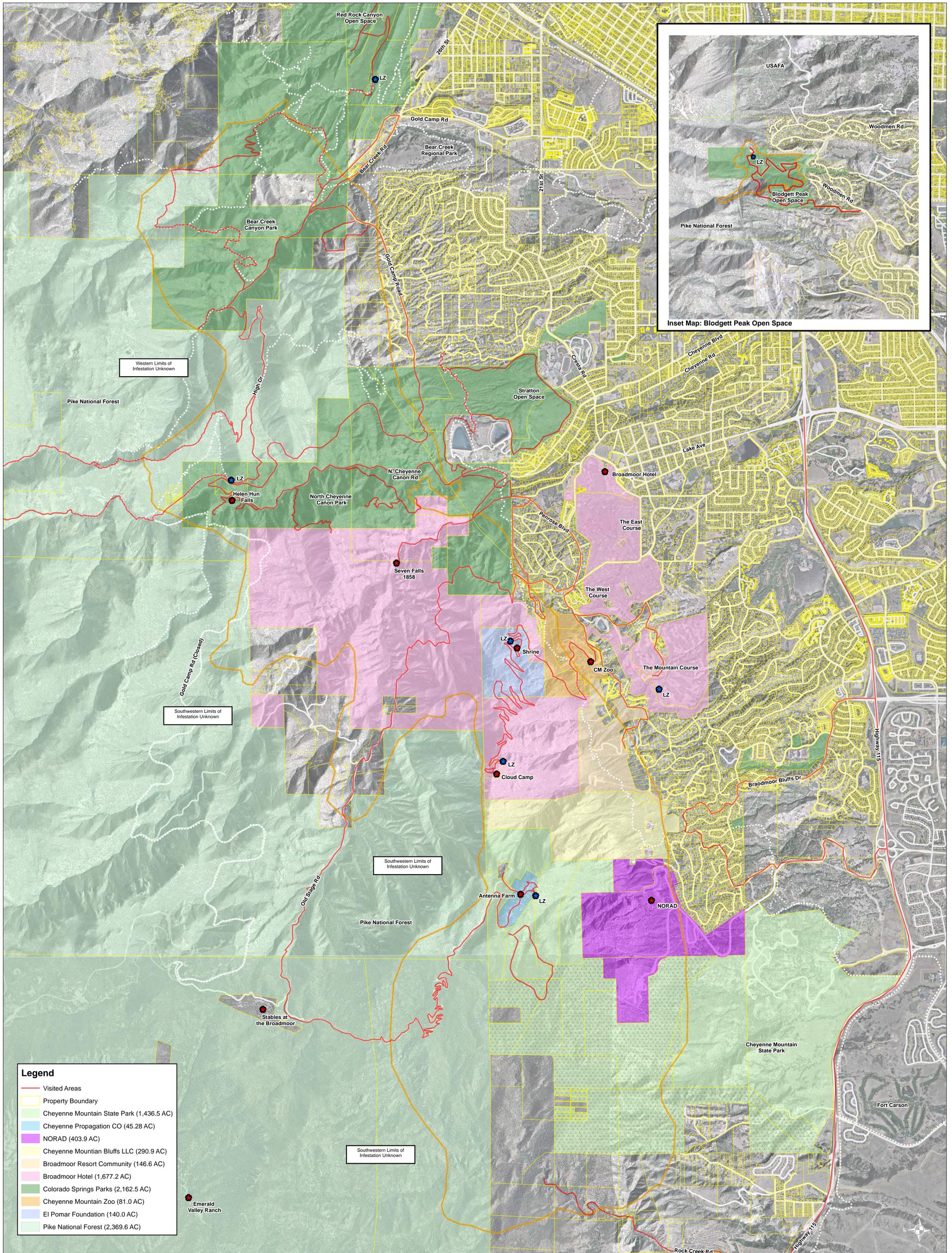
### MINI BULK

<i>Capacity:</i>	275 gallons 1000 litres
<i>Length:</i>	47 1/4"
<i>Width:</i>	40"
<i>Height:</i>	45 3/4"
<i>Color:</i>	White
<i>Body:</i>	Blow molded high density polyethylene
<i>Cage:</i>	1/4" solid rod steel
<i>Filling port:</i>	6"
<i>Discharge Valve:</i>	2" ball style valve. NPT threading
<i>Stacking:</i>	2 high



### BULK TANKER

<i>Capacity:</i>	Up to 7,000 gallons
<i>Tank Length:</i>	43'
<i>Tank Height:</i>	12'
<i>Unloading:</i>	Center or rear



Western Limits of Infestation Unknown

Southwestern Limits of Infestation Unknown

Southwestern Limits of Infestation Unknown

Southwestern Limits of Infestation Unknown

- Legend**
- Visited Areas
  - Property Boundary
  - Cheyenne Mountain State Park (1,436.5 AC)
  - Cheyenne Propagation CO (45.28 AC)
  - NORAD (403.9 AC)
  - Cheyenne Mountain Bluffs LLC (290.9 AC)
  - Broadmoor Resort Community (146.6 AC)
  - Broadmoor Hotel (1,677.2 AC)
  - Colorado Springs Parks (2,162.5 AC)
  - Cheyenne Mountain Zoo (81.0 AC)
  - El Pomar Foundation (140.0 AC)
  - Pike National Forest (2,369.6 AC)

Emerald Valley Ranch

# Tussock Moth & Western Spruce Budworm 2015 Outbreak

## DRAFT Infestation Mapping - Sept 30, 2015

