Wildland Fire Management Aerial Application Study

Final Report
October 17, 2005

Prepared For:

USDA Forest Service
National Interagency Fire Center
3833 S. Development Way
Boise, Idaho 83705

Prepared By:

Fire Program Solutions LLC
17067 Hood Court
Sandy, Oregon 97055

Table of Contents

AVIATION MANAGEMENT TRIANGLE

The Aviation Management Triangle reflects the essential elements of sound, professional aviation management. Aviation management is a service function. Our objective is to provide safe, cost effective, and appropriate aviation services.

The foundation of aviation management is SAFETY. If the mission cannot he accomplished without compromising safety, say NO! Insure an acceptable level of risk through sound risk management.

Strive for COST EFFECTIVE aircraft use. Question requests that are not cost effective - explain why and recommend a better alternative.

Use the RIGHT tool (aircraft) for the job. Question requests to the contrary - explain why and recommend a better way. Do what's right!

Acknowledgements

To accomplish the analysis work necessary, several people graciously gave significant amounts of time and expertise. The committee would like to express special thanks to:

- Elna Black, Procurement Assistant, Acquisition Management, Operations, NIFC
- Glenn Johnston, Helicopter Operations Specialist, Fire and Aviation Management, NIFC
- Brad Harwood, Computer Specialist, Fire and Aviation Management, NIFC
- Charlie Leonard, Fire and and Aviation Management, NIFC
- James Silverstone, Dispatcher, Fire and Aviation Management, NIFC
- Chuck Taylor, National Helicopter Program Manager, Fire and Aviation Management, NIFC
- Jon Turner Procurement, Assistant in Contracting, Acquisition Management, NIFC
- Sheila Valentine, Program Assistant, NIFC
- Rick Willis, Branch Chief, Acquisition Management, NIFC

Wildland Fire Management Aerial Application Study

Executive Summary

Summary of Findings and Comments

Listed below is a summary of finding and comments based on lessons learned as this study was conducted.

1. Fixed-wing Type 1 and 2 airtankers are justified as an integral component of the initial attack resources for land management agencies.

2. Due to differences in speed, tank size, effectiveness of long term versus short term retardants and daily availability cost, Type 1 and 2 fixed-wing airtankers are significantly more efficient in fireline building capability than Type 1 Limited helitankers. Comparison of acres burned and cost plus net value change (C+NVC) results in a conclusion that the staffing of eight Type 1, Category C, Limited helitankers is equivalent to the staffing of one to two Type 1 generic airtankers.

3. The ability to locate helibases in close proximity to the large fire incidents and to provide long term retardant at these helibases favors the use of Type 1 and 2 helitankers over Type 1 and 2 fixed-wing airtankers for large fire support.

4. Future fixed-wing airtanker platforms can be procured in the private sector and developed into airtankers that provide service in a cost efficient manner. Use of excess military platforms is also an option but not a requirement.

5. Future fixed-wing airtanker platforms of 3,000 to 5,000 gallons continue to show significantly greater economic benefit over smaller capacity platforms.

6. Due to the proximity of fires to the currently staffed set of airtanker bases, there are few instances where it is more effective for fixed-wind airtankers to climb to above 10,000 feet MSL in transit to a fire. As such, speed capability when traveling above 10,000 feet MSL provides only a minor effect on economic efficiency.

7. Based on the collective results of analysis in example fixed-wing airtankers, desirable design specifications for a future fixed-wing airtanker platform are as follows:

    - Is turbine-powered
    - Speed traveling under 10,000 feet is 250 KIAS
    - Speed traveling above 10,000 feet 350-400 KTAS is desirable
    - Retardant carrying capacity 4,000 to 5,000 gallons
    - Ability to operate from 80-90% of the existing airtanker bases

    The analysis also shows a positive economic benefit given the costs that follow:

    - Has a flight rate of $6,000 per hour or less
    - Has daily availability of $9,500 per day or less based on a 100-day contract

8. The modified analytical methods used in this study appropriately address the issues raised by reports critical of past National Studies (e.g. NATS1, NATS2, etc.) and provide supportable and confident results.

9. Significant savings in suppression costs for large fires can be achieved by the use of exclusive-use contracts for both Type 1 and Type 2 helicopters. The staffing of these contracts at locations where they can also support initial attack, when available, provides an added benefit.

10. The agencies should consider changes to the report keeping process at the National level to support the rapid attainment of the data needed to update this and other studies.

11. The TriSim model can be applied to study tradeoffs of alternative methods of procuring other fire management resources such as 20-person crews.

12. In the early 1990s, the Forest Service developed a report, which provides a blueprint for the conducting of National studies, includes an oversight group to manage the process. Revisiting that report and oversight process would provide timely guidance.

Background

In June 2005, the Forest Service Washington Office Fire and Aviation management team chartered this study to address staffing questions for Type 1 airtankers and Type 1 helicopters. The study was divided into two phases.

Phase 1 - Initial Attack Support

In NATS1, 38 large airtankers were justified nationally for initial attack based on an airtanker base by airtanker base analysis. The recommendation from the "NATS2" committee was that: The future composition of the large airtanker fleet be diverse in structure, turbine engine powered, 3,000 to 5,000 gallon in size capacity and compatible with a high percentage of federal airtanker bases.

Phase 1 of this study has the following two objectives:

Objective 1-1

Re-examine staffing of Type 1 and 2 airtankers as well as Type 1 helicopters at the airtanker bases recommended for staffing in NATS1 and NATS2. By airtanker base, recommend the aircraft type and number that supports the most cost efficient staffing.

Findings for Objective 1-1

Analysis of Type Fixed-Wing Airtankers for Initial Attack Support

Table ES-1 contains the results of analysis by GACC.

Table ES-1 – Summary of Number of Fixed-Wing Airtankers Using a Current Generic Airtanker and AutoAT4 Modeling

Geographic Area	No. of Fixed-wing Airtankers	Suggested Locations	Comments
Basin – W & E	8 - 9	Battle Mt., Boise, Cedar City, Hill, McCall, Minden	None
Eastern	1	Northern Minnesota	Unable to analyze fully due to lack of NFMAS files
No. & So. California	5 - 7	Chico, Chester, Fox Field, Lancaster, Fresno, Montague, San Bernardino, Porterville, Redding	Further analysis in So. Ops. using recalibrated analyses with adjusted ground resource production rates is supported.
No. Rockies	3 - 4	Coeur d' Alene, Missoula, Helena, West Yellowstone	Multi-GACC analysis used for Coeur d' Alene and West Yellowstone
Northwest	6 - 7	Klamath Falls, LaGrande, Moses Lake, Redmond	None
Rocky Mt.	2 - 3	Jeffco, Grand Junction, Durango	Multi-GACC analysis used for Durango
Southern	3	Chattanooga, Fayetteville	None
Southwest	6 - 7	Alamogordo, Albuquerque,	None

Table ES-1 – Summary of Number of Fixed-Wing Airtankers Using a Current Generic Airtanker and AutoAT4 Modeling

Geographic Area	No. of Fixed-wing Airtankers	Suggested Locations	Comments
		Prescott, Silver City, Williams Gateway (Phx), Winslow	
Total	34 - 41		

Determining the actual number of airtanker platforms to staff annually is mainly based on the concurrent fire seasons in the California, East Basin, Northern, Northwest, Rocky Mountain and West Basin GACCs. For these geographic areas the range of airtanker platforms is 24-30. The fire occurrence in these GACCs shows an episodic pattern and applying a percent increase of 30% based on the Northwest GACC analysis using WIRAS and AutoAT4 modeling brings the staffing range to 31 – 39. Note that in the NATS1 study, three additional airtankers were recommended to provide an increased capability to support large fires.

The scope of this study is to determine the most cost efficient number of airtankers to support initial attack and large fire suppression. The use of the military (MAFFS) and aircraft from other sources when demand reaches a very high percentile of supply is still needed. It is recognized that other resources are needed when private vendor sources for large airtankers are fully committed. Use of the military is an integral part of the total airtanker support during these events.

Analysis of Type 1 Helicopters for Initial Attack Support

For all of the locations analyzed for staffing to support initial attack, the acres burned and C+NVC were less for the fixed-wing airtanker versus the Type 1 helitanker. The initial attack working circle radius of the Type 1 helitanker is about 90 miles. This limitation forces the fire business support for this platform to be restricted to, in general, one or two organizational units. The annual daily availability is based on days staffed. For a 100-day fire season, the total would be $1,480,821. This cost together with the unit mission cost, mainly flight time, needs to be recovered from reduced C+NVC that results from a reduced number of acres burned. The analysis showed that at all locations modeled, the savings in C+NVC could not be recovered within this limited working circle. For analysis and discussion of the use of Type 1 helicopters in extended attack and large fire support, refer to the Phase 2 analysis.

Objective 1-2

Re-examine aircraft performance attributes recommended in NATS2 for a future airtanker platform. Recommend performance attributes for future airtanker and helicopter platforms that support a national cost efficient fire protection program.

Findings for Objective 1-2

Both AutoAT4 (NFMAS) and WIRAS modeling were completed in the Northwest GACC. Only AutoAT4 (NFMAS) analysis was done elsewhere. Analysis of platforms with a retardant load capacity less than 5,000 gallons was completed at five airtanker bases defined in the NATS2 study. These airtanker bases were shown to be representative of the entire set of airtanker bases. Analysis

of the platforms with a retardant load capacity greater than 5,000 pounds will be discussed in a later section.

AutoAT4 Modeling – Platform Capacity Less Than 5,000 Gallons - All GACCs

The result of runs at the five airtanker bases follows. The values in Tables ES-2a and ES-2b for each base are the changes in performance in the candidate platform's C+NVC and the C+NVC for the generic airtanker platform. Positive values indicate an improvement in C+NVC and negative values a reduction in C+NVC.

Table ES-2a – C+NVC Changes Between Generic Airtanker and Specified Platform With Travel Above and/or Below 10,000 feet, Which Ever is the Most Effective

Base	Example Airtanker Platforms					
	C-130H (Acquire from Military)	C-130H (Acquire Commercially)	BAe-146	S-3	Q-400	Q-200
Albuquerque	$4,432,150	$2,912,950	$163,916	-$2,718,677	-$2,675,973	-$3,659,745
Boise	$1,445,267	-$73,933	$444,565	-$1,132,427	-$2,593,072	-$1,840,177
Klamath Falls	$15,385,627	$13,186,727	$1,189,758	-$2,515,558	-$2,616,948	-$4,290,709
Phoenix	$2,408,303	$899,103	-$198,652	-$4,061,674	-$2,665,819	-$7,504,611
Redding	$12,847,447	$11,328,247	-$105,894	-$1,785,976	-$2,521,701	-$3,115,234

Table ES-2b – Ordinate Ranking of Platforms

Albuquerque	1	2	3	5	4	6
Boise	1	3	2	4	6	5
Klamath Falls	1	2	3	4	5	6
Phoenix	1	2	3	5	4	6
Redding	1	2	3	4	5	6
Average	1.0	2.2	2.8	4.4	4.8	5.6

WIRAS Modeling – Platform Capacity Less Than 5,000 Gallons in the Northwest GACC

At this time, WIRAS is built to run only on the Northwest GACC. Results where several of the candidate future airtanker platforms staffed are shown in Table E-3. Staffing was as follows: 1-Klamath Falls, 1-LaGrande, 2-Redmond and 1-Moses Lake. The staffing for each candidate airtanker was the same replacing the generic future platform with the candidate platform.

Table ES-3 – C+NVC Difference Between Five Generic Airtankers and Five of Each Specified Platform

Base	Example Airtanker Platforms					
	C-130H (Acquire from Military)	C-130H (Acquire Commercially)	BAe-146	S-3	Q-400	Q-200
Difference	$3,877,965	$79,965	-$409,203	-$6,518,502	-$7,923,955	-$9,101,272
Ordination	1	2	3	4	5	6

Summary of Results - Platform Capacity Less Than 5,000 Gallons

The ordination of the example platforms analyzed is the same regardless of cruise speed. The platform ordination using WIRAS modeling is the same as the ordination using AutoAT4 (NFMAS) modeling.

Table ES-4

Ordination of Example Platforms Using AutoAT4 and WIRAS Modeling
1. C-130H (Acquire from Military) 2. C-130H (Commercial Purchase) 3. BAe-146 (Commercial Purchase) 4. S-3 (Acquire from Military) 5. Q-400 (Commercial Purchase) 6. Q-200 (Commercial Purchase)

In general, the C-130H (Acquire from Military), the C-130H (Commercial Purchase) and the BAe-146 are more economically efficient that the generic current fixed-wing airtanker. This indicates that staffing of these platforms would not decrease the suggested number of platforms documented earlier. However, the remaining three platforms are less economically efficient than the generic current fixed-wing airtanker and staffing of these would most likely result in a reduced number of platforms that can be justified using economic efficiency criteria. Two of the top three platforms do not assume the use of surplus military platforms and can be justified based on a positive benefit to cost ratio.

Platform Capacity Greater Than 5,000 Gallons - All GACCs

The two platforms proposed with capacity greater than 5,000 gallons of retardant or water were the DC-10 and the B-747-200B. Prototypes of both platforms have been developed and some testing has occurred. The design of the National Type 1 and 2 fixed-wing airtanker fleet is to support primarily initial attack using an interchangeable, interoperable combination of aircraft platforms and airtanker bases. The aircraft proposed can operate only from a very limited number of airtanker bases (12%).

Phase 2 – Large Fire Support

The following objectives are proposed for Phase 2 of this study.

Objective 2-1

Re-examine economic efficiency for exclusive-use Type 1 and 2 helicopters to support large fire suppression.

Objective 2-2

Examine economic efficiency for the use of Type 1 and Type 2 airtankers to support large fire suppression.

Findings for Objectives 2-1 and 2-2

The large helicopters have a wide range of payload capacity. This is particularly true for those traditionally classified as Type 1. For this study, helicopters were grouped into three categories as shown in Table ES-5. Table ES-6 contains a summary of the results of modeling for Type 1 helicopters. Savings are approximate as the modeling is stochastic and the exact savings is dependent on specific demand assumptions per run.

Table ES-5

Category	Payload (lbs)
A	< 5,000
B	5,001-15,000
C	> 15,000

Table ES-6 - Summary of the Results of Modeling for Type 1 Helicopters

Helicopter Specs	% Demand*	No. EU Contracts Based on Economically Efficiency	Approximate Net Savings Over 100% CWN Staffing
Limited, Category C	100%	27	$34,932,293
Limited, Category B	100%	17	$6,011,090
Limited, Category C	34%	9	$11,086,398
Limited, Category B	67%	11	$5,376,400
Standard, Category C	100%	26	$36,392,915
Standard, Category B	100%	29	$19,333,064
* - Average annual demand is 2450 helicopter days			

Table ES-7 displays the number of exclusive-use helicopters based on percent of total demand divided between Category B and C, Type 1 helicopters.

Table ES-7 – Summary of Optimum Number Type 1 Limited Exclusive-Use Contracts by Category Based on Economic Efficiency

Cat.	Demand Level										
C	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0	3	5	8	11	13	16	18	21	24	27
B	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
	17	15	14	12	10	8	7	5	3	2	0
All	17	18	19	20	21	21	23	23	24	26	27

Table ES-8 displays the number of exclusive-use helicopters based on percent of total demand divided between Category B and C, Standard Type 1 helicopters.

Table ES-8 – Summary of Optimum Number Type 1 Standard Exclusive-Use Contract by Category Based on Economic Efficiency

Cat.	Demand Level										
C	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0	2	5	8	10	13	16	18	21	22	26
B	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
	29	26	24	20	17	15	12	9	6	3	0
All	29	28	29	28	27	28	28	27	27	25	26

Table ES-9 contains a summary of the results of modeling for Type 2 helicopters. Savings are approximate as the modeling is stochastic and the exact savings is dependent on specific demand assumptions per run.

Table ES-9 - Summary of the Results of Modeling for Type 2 Helicopters

Helicopter Specs	% Demand*	No. EU Contracts Based on Economically Efficiency	Approximate Net Savings Over 100% CWN Staffing
Limited, Category A	100%	33	$9,077,228
Standard, Category A	100%	28	$8,347,416
* - Average annual demand is 3433 helicopter days			

Objective 2-3

Determine additional staffing requirements for Type 1 and 2 fixed-wing airtankers and Type 1 and 2 helicopters that were recommended for staffing in Phase 1 due to expected unavailability attributed to large fire suppression support needs.

Findings for Objective 2-3

Three additional Type 1 fixed-wing airtankers were added to the fleet in "NATS1" to support the draw down from large fire support. This conclusion remains reasonable for the foreseeable future. Phase I did not identify additional Type 1 and 2 helicopters to support large fires. Additionally, the Phase 2 analysis supports significant helicopter support to large fire. Hence, there are no further resources identified here.

Wildland Fire Management Aerial Application Study

Background

In 1992, the USDA Forest Service and USDI Department of Interior completed the National Study of Type 1 and 2 Helicopters to Support Large Fire Suppression (NHeli1). This study recommended exclusive-use staffing of two Type 1 and seven Type 2 helicopters to support large fire suppression. An update of this report (Kirsh 1998) (TFMHeli) recommended that six Type 1 helicopters be staffed to support large fire suppression to reflect the increase in demand since the 1992 study,

In 1995 and 1996, the USDA Forest Service and US Department of Interior completed two studies of the national large airtanker fleet and airtanker bases (USDA Forest Service 1995, 1996). The Phase 1 study completed in 1995 (NATS1) recommended a large airtanker (1000 gallons or greater) fleet of 41 fixed-wing, turbine powered aircraft. In the phase 2 study completed in November 1996 (NATS2), the study committee set the following goal after examination of all information presented:

- The future airtanker fleet should be diverse in structure, turbine engine powered, 3000 to 5000 gallon in size capacity and compatible with a high percentage of federal airtanker bases.

Given the range of aircraft examined, the 1996 study committee recommended:

- The procurement of excess military aircraft as this is the most cost effective way to acquire airtanker platforms.

- A future fleet composition of twenty P-3A aircraft, ten C-130B aircraft and 11 C-130E/K aircraft. This would provide a fleet that is essentially 75% 3000-gallon capacity and 25% 5000 capacity. From Phase 1, it was determined that a National fleet size of 41 large airtankers is needed. This is affirmed and is cost efficient considering the benefit/cost at the representative airtanker base studies. Maintaining a fleet size of 41 while the total gallonage capacity of the fleet is increasing provides for greater fireline construction "early on" in initial attack and provides adequate numbers to support multiple fire occurrence episodes. Estimated benefit/cost upon full implementation is 6.38.

The NATS2 study team proposed a transition schedule to a fleet of P-3A, C-130B and C-130E/K aircraft to occur by contract period as follows:

	1999	2002	2005	2008
P-3A/C-130B	4	4	6	4
C-130E/K	0	3	4	4

In the summer of 2002, two airtanker accidents prompted a review of the national airtanker program (USDA Forest Service and Department of Interior 2002) and the suspension of airtanker operations and testing of the airtanker fleet. In December, 2002, a report titled Federal Aerial Firefighting: Assessing Safety and Effectiveness, Blue Ribbon Panel Report to the Chief, USDA Forest Service and Director, USDI Bureau of Land Management stated:

- Although the recommendations of the comprehensive National Study of Air Tankers to Support Initial Attack and Large Fire Suppression were valid in the 1990s, events have shifted the basis upon which it was founded, rendering the conclusions moot. Its authors recommended that the Department of Defense provide newer ex-military aircraft, but the Pentagon is clearly not inclined to provide those aircraft, saying they are needed for national security purposes. The aircraft simply are not available for transfer, the Department of Defense maintains.

A further review of the NATS1 and NATS2 recommendations indicates that most of these recommendations are still valid, not moot as indicated by the Blue Ribbon Panel Report. The Blue Ribbon Panel's concerns were focused on how the aircraft procurement recommendations were implemented.

The Blue Ribbon Panel Report states:

- The panel believes obtaining and outfitting newer military aircraft, such as C-130s and P-3s, would only perpetuate a cycle that has proven to be unsustainable and dangerous. Unless the FAA and operator community change its methods, one could expect to see another cycle of structural failures and pilot fatalities within a decade or two. This strongly suggests that it is time to abandon what the panel considers a 50-year-old unsustainable strategy.

The recommendation from the NATS2 committee was that:

- The future composition of the large airtanker fleet be diverse in structure, turbine engine powered, 3000 to 5000 gallon in size capacity and compatible with a high percentage of federal airtanker bases.

To cover the alternative where excess military aircraft were not available, the committee analyzed civilian purchase of several aircraft including the Lockheed L-188 and the Lockheed C-130E/K and C-382G models. All of these alternative aircraft had a positive benefit-cost ratio under the assumptions the aircraft were purchased new. The recommendation for a future fleet composition of 20 P-3A aircraft, 10 C-130B aircraft and 11 C-130E/K aircraft was provided as an example for how the agencies could implement the study committee's proposal.

The NATS2 analysis of potential future aircraft was completed to support the aircraft recommendations from NATS1. In NATS1, 38 large airtankers were justified nationally for initial attack based on an airtanker base by airtanker base analysis. An additional three airtankers were justified to backfill anticipated draw down of initial attack airtanker support due to large fire demand for retardant.

- It is critical to note that the justification of the 41 large airtankers in NATS1 was based on initial attack firefighting demand. The grounding of the national large airtanker fleet following the 2002 fire season did not change this demand for retardant delivery.

The NATS2 recommendations were accepted by the agencies and the implementation plan was approved December 20, 1999.

For the 2003, 2004 and 2005 fire seasons, the USDA Forest Service has been staffing airtankers and helicopters to support the delivery of fire retardant for initial attack. A variety of Single Engine Airtankers, Type 1 helicopters and Type 1 and Type 2 airtankers have been used. The USDA Forest Service Washington Office proposed this study to provide recommendations on the value of aircraft providing fire retardant to support initial attack and large fire support.

Components and Phases for this Study

This study addresses the following components:

- The study shall analyze the past studies (NATS1 and 2, TARMS, Type 1 and 2 Helicopter, etc.) with regard to issues that may make them no longer valid. These issues shall be addressed and the modeling made to accommodate these issues.

- The study shall develop the aviation needs (both helicopter Type 1 and 2, and Type 1 airtankers). The needs shall be identified in terms of aircraft capacity, number and type (helicopter or fixed-wing). The study shall not identify specific aircraft, e.g. P-3 Orion. The study shall first consider the aviation needs without constraints. The study shall also consider the aviation constrains that exist today, e.g. current fixed-wing airtankers, etc.

- The study shall examine the basis of the data used in the study. The study shall consider more recent data and determine the impact to the needs analysis.

- The study shall examine other modeling products used in Forest Service studies (namely ADFF and WIRAS).

- The study shall define the approach used as the basis of the analysis. The study shall revalidate the representative location concept (if used).

- The study shall consider National Resources only.

- The study shall be proposed in phases at appropriate points to allow for potential changes in direction.

This study will be accomplished in two phases as described below.

Phase 1 - Initial Attack Support

In NATS1, 38 large airtankers were justified nationally for initial attack based on an airtanker base by airtanker base analysis. The recommendation from the NATS2 committee was that: "The future composition of the large airtanker fleet be diverse in structure, turbine engine powered, 3000 to 5000 gallon in size capacity and compatible with a high percentage of federal airtanker bases."

Phase 1 has the following two objectives:

Objective 1-1

Re-examine staffing of Type 1 and 2 airtankers as well as Type 1 helicopters at the airtanker bases recommended for staffing in NATS1 and NATS2. By airtanker base, recommend the aircraft type and number that supports the most cost efficient staffing.

Objective 1-2

Re-examine aircraft performance attributes recommended in NATS2 for a future airtanker platform. Recommend performance attributes for future airtanker and helicopter platforms that support a national cost efficient fire protection program.

Scope

Aircraft platforms to be examined are fixed and rotary-wing with a fire retardant carrying capacity of 1000 gallons or greater.

Phase 2 – Large Fire Support

The following objectives are proposed for Phase 2 of this study.

Objective 2-1

Re-examine staffing efficiency for exclusive-use Type 1 and 2 helicopters to support large fire suppression.

Objective 2-2

Examine economic efficiency for the use of Type 1 and Type 2 airtankers to support large fire suppression.

Objective 2-3

Determine additional staffing requirements for Type 1 and 2 fixed-wing airtankers and Type 1 and 2 helicopters that were recommended for staffing in Phase 1 due to expected unavailability attributed to large fire suppression support needs.

Scope

Aircraft platforms to be examined are fixed and rotary-wing with a fire retardant carrying capacity of 1000 gallons or greater.

Aircraft

Fire protection planning is performed at three levels: the local level, the regional level and the national level. When planning is done for a National (Shared) Resource such as large airtankers and helicopters, assumptions are made based on the local and regional analysis that has already been performed. It is critical to understand that initial attack resources are initially justified at the local level (Forest Service National Forest, BLM District, etc).

Some initial attack resources require an analysis covering more than a single local unit level. Examples of these types of resources may include Type 1 and 2 helicopters and Type 1 and 2 fixed-wing airtankers. This multi-unit analysis requirement is usually dictated by the cost of the resource and the fire business needed to provide a justification for the resource.

As designed in NATS1 and NATS2, the National Large Airtanker Fleet was designed to be interoperable, effective and efficient in initial attack fire suppression support on a national basis. There are several key words in this design statement.

The first is the word "national," next is the word "interoperable," and the last are the words "effective" and "efficient." National and interoperable mean that the fleet is mobile and can perform its mission throughout the United States. Effective means the mission of the resource accomplishes its fire suppression mission as defined. Fire suppression missions can be accomplished in many ways all of which are effective, but some may be more cost efficient than others.

Fixed-Wing Platforms

Up until 2003, the multi-engine large airtanker fleet was composed of reciprocating engine models such as the PB4Y2, DC-4, Super DC-4, SP-2H, P-2V, DC-6, DC-7 and KC-97. In addition, two turbine aircraft models were part of the fleet, the P-3A and the C-130A.

In 2005, 17 aircraft were placed under contract. This fleet is composed of seven P-3As, nine P2Vs and one DC-7. Two of the P2Vs are instrumented (Avenger Testing) and the DC-7 is instrumented (Genesis Testing) to gather data during fire retardant dropping missions.

Aircraft defined in the NATS2 study as potential future platforms for the fixed-wing airtanker fleet are as follows (NATS2 report, page 14):

Civil Aircraft	Military Excess Aircraft	Turbine Refit Aircraft
- CL-215T	- E-2C	- C-123T
- CL-415T	- S-3	- P-2T
- F-27	- A-6	- DC-4T
- CV-580	- A-10	- S-2T
- L-188	- P-3A	
- L-382G	- C-130A,B	
- C-130E/K	- C-130E/K	
- B-737-200		
- B-747-200B		

Initial analysis of costs and aircraft compatibility at airtanker bases resulted in the elimination of several potential future platforms. Aircraft analyzed in NATS2 for initial attack efficiency are follows:

Civil Aircraft	Military Excess Aircraft	Turbine Refit Aircraft
- CV-580	- E-2C	- P-2T
- L-188	- S-3	- S-2T
- L-382G	- A-10	
- C-130E/K	- P-3A	
- B-737-200	- C-130A,B,E,K	

Definition of Attributes of Example Airtanker Platforms Uses in this Study

S-3, Viking

This turbine-powered aircraft was a carrier based anti-submarine platform. Deliveries to the Navy began in 1974 and ended in 1978 with the 187th being manufactured. The aircraft has received electronic warfare system upgrades since then. The Viking is powered by two GE TF3-GE-2 high bypass turbofan engines, each rated at 9,275 static pounds thrust. The retardant capacity is estimated at 2,400 gallons, and the aircraft's cruise speed is 250 KTAS, below 10,000 MSL, and 269 KTAS at 15,000 feet.

Figure 1 – S3, Viking

Bombardier Aerospace Q-200

Introduced in1998, it has the increased speed and payload over the Q-100 version. The aircraft has Pratt and Whitney 123C/D engines. The PW 123D engine offers full power at higher ambient temperatures for improved hot-and-high airfield performance. The retardant capacity is estimated at 1,500 gallons. The aircraft's cruise speed is 237 KTAS, below 10,000 MSL, and 265 KTAS at 15,000 feet.

Figure 2 – Q-200

Bombardier Aerospace Q-400

The Q400 is an upgraded version of the Q200. It is longer and has a higher cruise speed and payload than the Q200. The aircraft has Pratt and Whitney 150A engines. While the Q400 is larger and faster than the other Q Series models, the same pool of pilots can fly this aircraft, resulting in reduced crew costs for airlines with a mixed Q Series fleet. The retardant capacity is estimated at 2,642 gallons. The aircraft's cruise speed is 250 KTAS, below 10,000 MSL, and 340 KTAS at 15,000 feet.

Figure 3 – Q-400

BAe-146

The BAe-146 (also known as the Avro RJ) is a medium-sized commercial aircraft manufactured by BAe Systems. It carries its four jet engines on a high wing above the fuselage. Production began in 1983 with the series 100, carrying 70 - 84 passengers, and ended during the 2001 world slump in the aviation market. Minden Air is in the process of converting a platform to an airtanker. The retardant capacity is estimated at 3,100 gallons. The BAe-146 has a cruise speed of 250 KTAS, below 10,000 MSL and 314 KTAS at 15,000 feet.

Figure 4 – BAe-146

C-130H (Acquisition from the Military)

The C-130H has upgraded performance over the C-130A model (3,000 gallon capacity) and is estimated to carry 4,200 gallons of retardant. The aircraft is powered by 4 Allison 501 Model turbo-prop engines, which generate over 4000 shaft horsepower. The C-130H has a cruise speed of 250 KTAS, below 10,000 MSL and 269 KTAS at 15,000 feet.

Figure 5 – C-130H (Military)

C-130H (Commercial Acquisition)

The C-130H Hercules (also known as L-382G and L-100-30) is a commercial version of the military C-130H model. The aircraft will have the same payload and speed as the C-130H (Acquisition from the Military) but the expected daily availability cost will be different as the purchase price will vary for the C-130H (Commercial Acquisition).

Figure 6 – C-130H (Private)

DC-10

The DC-10 was designed and built in Long Beach, California, by Douglas Aircraft Company, now the Long Beach Division of Boeing Commercial Airplanes. Production was started in January, 1968, and first deliveries were in 1971. In a production run extending to 1989, 386 commercial DC-10s were delivered, plus 60 KC-10 tanker/cargo models built for the U.S. Air Force. The retardant capacity is estimated at 12,000 gallons. A prototype platform has been converted into an airtanker. The DC-10 has a cruise speed of 250 KTAS, below 10,000 MSL and 442 KTAS at 15,000 feet.

Figure 7 – DC-10

Boeing 747-200B

This aircraft was selected for study because of its large lift capability, and represents other commercial aircraft in the heavy lift aircraft category. The 747-200B is a derivative of the original 747. One commercial vendor has developed a prototype aircraft as an airtanker. Production of the 200B model began in 1971 and was completed with 226 delivered by 1991. The aircraft is still in production but in other models. The aircraft is powered by four turbofan engines produced by either Pratt & Whitney, General Electric or Rolls-Royce. Evergreen Aviation is in the process of converting a platform to an airtanker. The estimated retardant capacity for the B-747 is 20,000 gallons. Its cruise speed below 10,000 MSL is 250 KTAS and 442 KTAS at 15,000 feet.

Figure 8 – B-747-200B

Fixed-Wing Airtanker Specifications, Daily Availability Cost and Flight Rate Cost

Table 1 displays the average daily availability and flight rates from the 2003 and 2005 Large Airtanker Contract in 2004 dollars. The rates for Type 1 and 2 airtankers in 2005 are believed to be in response to the lack of availability of aircraft to fulfill the agency's desires. It is felt that with competition in the future, these daily availability rates will be less.

Table 1 – Large Airtanker Contract Costs

2003 Contract			
Size (gallons)	Aircraft Number	Daily Availability	Flight Rate
2,000	12	$3,398	$2,076
2,450	15	$3,722	$2,613
3,000	12	$4,747	$3,438
All	39	$3,960	$2,702
2005 Contract			
Size (gallons)	Aircraft Number	Daily Availability	Flight Rate
2,450	9	$3,578	$3,186
3,000	8	$8,329	$5,383
All	17	$5,814	$4,220

Aircraft use rates were developed in similar fashion to that presented in NATS2. For the Daily Availability, the acquisition costs of aircraft were obtained from an aircraft industry analyst. These were compared to airline industry studies that are available through on-line searches. It is noted that some aircraft prices are volatile to market trends and changes. For example, some cargo aircraft have seen price changes due to the US conflict in Iraq. Estimates were made for aircraft conversion (tank system, striping, avionic changes, load monitoring equipment, engineering analysis for Operational Service Life, etc.) using NATS2 as a basis, modified through inflation, and professional judgment. These costs were totaled and amortized for 15 years as 6.5%. Then insurance, other fixed costs (salaries and overhead), and extraordinary maintenance were applied resulting in the figures above.

The flight rate was determined using a combination of several methods. NATS2 was used for aircraft that were common to this study, and also provided a parametric analysis using all of the aircraft provide in the NATS2 study. (The NATS2 data were adjusted for inflation.) The Airline Transport Association annual reports for 2003 and prior, provides operating costs by aircraft type for Part 135 operators. A parametric analysis of the US Forest Service Large Airtanker contracts from 1999 to the present was conducted. Also the general rule that fuel costs are between 10 and 20

percent of operating cost was used. And finally professional judgment was applied. In cases where one or more of the future fleet was not available in any of the above methods, interpolation or extrapolation available data was employed to obtain an estimate. The flight rate values that appear in the above table represent an average of the methods described.

Table 2 displays the assumptions made in the analysis for the daily availability and flight rates as well as other performance criteria.

Table 2 – Summary of Future Fixed-Wing Airtanker Platform Attributes

		Example Airtanker Platforms							
		S-3	Q-200	Q-400	BAe-146	C-130H Military Acquire	C-130H Private Acquire	DC-10	B747-200
Daily Avail.	Low	$4,434	$5,906	$17,670* $36,524#	$6,520	$5,729	$12,721	$43,109*	$56,812*
	Average	$5,052	$7,507	$18,226* $37,785#	$8,107	$6,797	$14,393	$51,058*	$66,617*
	High	$5,670	$9,107	$18,782* $39,046#	$9,695	$7,866	$16,065	$59,007*	$76,423*
Flight Rate	$/Hr	$3,530	$2,400	$4,280	$6,500	$5,700	$5,700	$10,500	$16,000
Retardant Load	Gallons	1,800	1,600	2,642	3,100	4,200	4,200	10,700	18,080
Water Load	Gallons							12,000	20,500
Climb Rate	Feet/minute	3,400	1,800	2,500	4,000	2,000	2,000	1,100	2,000
	Min/1000 ft	0.29	0.56	0.40	0.25	0.50	0.50	0.91	0.50
Speed below 10,000 feet	KIAS	250	237	250	250	250	250	250	250
Speed above 10,000 feet (Operated from FS bases)	KTAS	269	265	340	414	269	269	442	442
Speed above 10,000 feet (Operated from Large AC bases)	KTAS							528	490

* - Daily availability costs for the Q400, DC-10 and B747 are based on the aircraft having work outside of the airtanker contract (i.e. Costs are amortized by other customers outside of FS contract period).
\# - Airtanker FS contract bares the full annual cost.

The description and performance data for each aircraft were developed from a combination of vendor responses, flight manuals, the Airliners.net Internet site, parametric analysis, and professional judgment. Initially, vendors who are considering an individual aircraft for conversion were contacted to provide performance information. Unfortunately, either due to the short time frame for the response or being the middle of fire season, only one response was obtained. Flight manuals were acquired and information extracted. In cases where the flight manual did not provide the information in a suitable form and other sources were sought for the information. Parametric analysis was also utilized where information could not be obtained.

Rotary-Wing Platforms

Aircraft defined in the NATS2 study as potential future platforms for the rotary-wing airtanker fleet are as follows (NATS2 report, page 14):

Type 1 Helicopters
- BV-234
- S-64F
- BV-107

BV-234

Figure 10 – BV-234

The Boeing-Vertol Model 234, which is the commercial version of the military CH-47 Chinook, began deliveries in 1981. The military CH-47 was developed during the same time as the CH-46, except that the customer was the US Army who defined a different role and requirements from that of the US Navy and Marines. The CH-47 has greater capability than that of the CH-46 (Model 107). The CH-47 began development in 1956, and by 1984, 732 aircraft had been delivered in various model configurations. In 1980, a major upgrade of the existing fleet of helicopters was begun. The upgrade made improvements to 13 major systems in the helicopter and included engines, transmissions, flight deck and others. Of the commercial versions, fewer than 15 aircraft were delivered. The aircraft speed (KIAS) is 135.

S-64 Skycrane

Figure 11 – S-64 Skycrane

The Sikorsky S-64, also known as CH-54 or Skycrane, started deliveries in 1964 to the US Army. The helicopter was designed for universal military transport duties and was equipped with interchangeable cargo pods which could carry personnel or equipment. Variation in this universal pod, were intended to appeal to a wide variety of customers, and in 1969, Sikorsky received FAA certification for commercial sale of the helicopter. Customers were mainly oil companies who used the aircraft to support exploration drilling. However, by 1974 a total of fewer than 100 aircraft were built. This aircraft is in current production by Erickson Air Crane. The aircraft speed (KIAS) is 80.

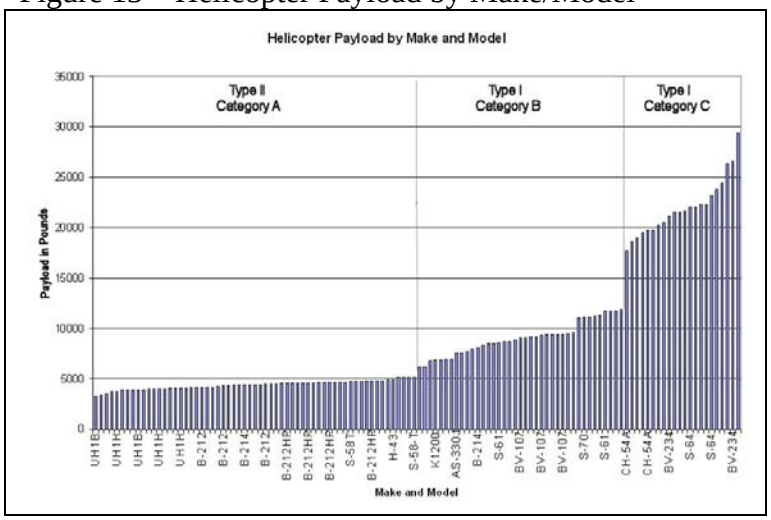
BV-107

Figure 12 – BV-107

The Boeing-Vertol Model 107 began design in 1956 and was to take advantage of the small, lightweight, yet powerful turbo-shaft engines that were becoming available. The prototype was built in 1957 and after extensive demonstration tours, orders for three variants were received, the CH-46A, CH-46C and the Model 107 2 (Commercial version). Production of these variations was started and deliveries began in 1958 to the US Navy, US Marines, and other countries. In total, nearly 100 of these were built by 1962 before additional modifications were made to provide greater capacity. The CH-46D and UH-46A (Sea Knights) began deliveries in 1966 and by 1968 over 1,000 twin rotor aircraft were delivered. The aircraft speed (KIAS) is 120.

Helicopter Size Categories

Figure 13 – Helicopter Payload by Make/Model



The large helicopters have a wide range of payload capacity. This is particularly true for those traditionally classified as Type 1. For this study, helicopters were grouped into three categories as follows:

Category	Payload (lbs)
A	< 5000
B	5001 – 15,000
C	> 15,000

Helicopter Daily Availability and Flight Rate Costs

Exclusive-Use (EU) and Call-When-Needed (CWN) contracts for 1999 through 2005 were used to determine an average daily availability and flight rate for each type of contract by helicopter category and contract length. For Exclusive-Use (EU) contracts, 2002 through 2005 was used and for Call-When-Needed (CWN) contracts, 1999 through 2005 was used.

Specifically, costs for Call-When-Needed (CWN) medium and heavy-lift helicopters were derived from the following contract:

- Interagency Call-When-Needed Helicopters, 1999, 2000 and 2001
- Interagency Call-When-Needed Helicopters, 2002, 2003 and 2004
- National Call-When-Needed Helicopters, 2005, 2006 and 2007

Costs for Exclusive-Use (EU) were gathered and provided by the acquisition management section at NIFC for the years 2002 through 2005. Flight rates for each contract period were defined in the contract for each period by make and model of aircraft. The same flight rates were used for both CWN and EU contracts. For EU contracts, the actual availability period was recorded.

The daily availability and flight rates were documented for each aircraft by tail number. Based on the make and model of the helicopter as well as the helicopter's tail number, each helicopter was assigned to a Category (A, B or C) and FAA Transport Category (Limited or Standard). Costs were changed to 2004 dollars based on the factors shown in Table 3. Average values were then developed for each category of aircraft by contract type (CWN vs. EU). The same process was used to determine average flight rates. The results are shown in Tables 4 and 5.

For EU contracts, the length of contract period was broken into three periods. These were generally those below 80 days, those between 80 and 100 days and those greater than 100 days. The purpose was to examine how costs are reflected by the length of the contract period. For the analysis, the costs associated with a 90- day contract period were used.

Appendix B contains a summary of the findings for EU and CWN contracts. Appendix C contains documentation on the development assumptions for management module costs. All dollar values are in 2004 dollars.

Table 3

Year	Factor	Multiplier
1990	1.041	1.45
1991	1.039	1.39
1992	1.027	1.36
1993	1.031	1.32
1994	1.032	1.28
1995	1.031	1.24
1996	1.031	1.20
1997	1.013	1.19
1998	1.029	1.15
1999	1.030	1.12
2000	1.030	1.09
2001	1.021	1.06
2002	1.021	1.04
2003	1.021	1.02
2004	**1.021**	**1.00**
2005	1.018	0.98

Table 4 – Exclusive-Use Helicopter Costs

		Limited			Standard		
		Cat A	Cat B	Cat C	Cat A	Cat B	Cat C
Daily Avail.*	$ / Day	$3,273	$12,666	$14,150	$3,273	$3,483	$13,873
Flight Rate	$ / Hr	$1,159	$2,564	$4,947	$1,159	$1,492	$5,018
Mgnt Module	$ / Year	$65,821			$258,587		
* - Daily availability is for a 90 day contract							

Table 5 – Call-When-Needed Helicopter Costs

		Limited			Standard		
		Cat A	Cat B	Cat C	Cat A	Cat B	Cat C
Daily Avail.*	$ / Day	$5,745	$16,292	$29,399	$5,745	$9,879	$30,261
Flight Rate	$ / Hr	$1,196	$2,311	$4,850	$1,196	$2,044	$4,913
Mgnt Module	$ / Day	$817			$2,977		
* - Daily availability is for a 90 day contract							

Airtanker Bases

Airtanker Base Compatibility

Compatibility of the potential future airtanker fleet with the existing base structure was examined.

Runway Load Bearing

The NOAA Airport Facilities Directory was used as the source for runway load bearing information. Airport load bearing data are reported in thousands of pounds based on the wheel configuration of the main landing gear (single, dual, dual tandem, and double dual tandem). The estimated operational weight developed for the study on each aircraft and its gear configuration were compared to the airport data. Additionally, the Forest Service has been granted over weight authority (allowances to operate airtankers in excess of the published capacity) at some bases, and has other restrictions. These agreements as they are reflected in the 2005 Interagency Airtanker Base Directory were used as well regarding base compatibility.

Wing and Tail Clearances

The 2005 Interagency Airtanker Base Directory was used as the source for clearances. The directory identifies aircraft excluded from a tanker base based on several criteria, which includes aircraft dimensional issues. Where current aircraft were excluded from a base due to size, their dimensions were compared to the future fleet and exclusions or inclusions were made.

Take off Performance

Takeoff performance was based on the capability of the aircraft on hot day conditions as published in flight manuals, from vendors known to be considering the aircraft as tankers, and/or parametric analysis. Hot day conditions are defined as ISA (International Standard Atmosphere) plus 30 degrees Fahrenheit at the altitude of the base with zero wind and zero slope. The ground roll required to either takeoff or accelerate and stop was compared to the longest available base runway. Based on the Interagency Airtanker Board Criteria, two engine aircraft are acceptable at a base as long as the distance required to accelerate and stop when one engine becomes inoperative (also know as critical field length) is less than the longest available runway. Three and four engine aircraft are acceptable so long as the ground roll required for takeoff is less than 80 percent of the longest available base runway. The runway lengths used in this study were obtained from the NOAA Airport Facilities Directory.

The results of the compatibility analysis are summarized in Table 6. As can be seen, several potential future airtankers have a low percentage of compatibility with the bases that are in consideration for the future. However, this alone would not be the reason for elimination from further consideration as future fleet candidates.

Table 6 - Airtanker Compatibility With Airtanker Bases (1=Yes, 0=No)

Base	Geo. Area	S-3	Q-200	Q-400	BAe-146	C-130H	DC-10	B-747
Fairbanks	AK	1	1	1	1	1	1	1
Ft. Yukon, Reload	AK	0	1	1	1	1	0	0
Galena, Reload	AK	1	1	1	1	1	0	0
Kenai	AK	1	1	1	1	1	0	0
McGrath	AK	1	1	1	0	0	0	0
Palmer	AK	1	1	1	1	1	0	0
Tanacross	AK	0	1	1	1	1	0	0
Bishop, Reload	CA	0	1	1	1	1	0	0
Chester	CA	0	1	0	1	0	0	0
Chico	CA	1	1	1	1	1	0	0
Columbia	CA	0	0	0	0	0	0	0
Fresno	CA	1	1	1	1	1	1	1
Hollister	CA	0	1	0	0	0	0	0
Fox Field/Lancaster	CA	1	1	1	0	1	0	0
Grass Valley	CA	0	0	0	0	0	0	0
Siskiyou/Montague, Reload	CA	1	1	1	1	1	0	0
San Bernardino Intl	CA	1	1	1	1	1	1	1
Paso Robles	CA	0	1	1	1	1	0	0
Porterville	CA	0	1	1	0	1	0	0
Ramona	CA	0	0	0	1	0	0	0
Redding	CA	1	1	1	1	1	0	0
Rohnerville	CA	0	0	0	0	0	0	0
Santa Barbara	CA	1	1	1	1	1	0	0
Santa Rosa/Sonoma	CA	0	0	0	1	1	0	0
Stockton, Reload	CA	1	1	1	1	1	1	1
Bemidji	East	0	1	1	1	1	0	0
Brainard	East	0	1	1	1	1	0	0
Ely	East	0	1	1	0	1	0	0
Hibbing	East	1	1	1	1	1	0	0
Battle Mountain	GB	0	1	1	1	1	0	
Boise	GB	1	1	1	1	1	1	1
Cedar City	GB	1	1	1	1	1	0	0
Hill	GB	1	1	1	1	1	0	0
McCall	GB	0	1	0	1	1	0	0
Minden	GB	0	1	1	1	1	0	0
Pocatello	GB	1	1	1	1	1	0	0
Reno/Stead	GB	1	1	1	1	1	0	0
Billings	NO	1	1	1	1	1	0	0
Coeur d'Alene	NO	1	1	1	1	1	0	0
Grangeville	NO	0	1	1	0	0	0	0
Helena	NO	1	1	1	1	1	0	0
Kalispell/Glacier	NO	1	1	1	1	1	0	0
Missoula	NO	1	1	1	1	1	0	0
West Yellowstone	NO	0	1	0	1	1	0	0
Kingsley/Klamath Falls	PNW	1	1	1	1	1	0	0
La Grande	PNW	0	1	1	1	1	0	0

Table 6 - Airtanker Compatibility With Airtanker Bases (1=Yes, 0=No)

Base	Geo. Area	S-3	Q-200	Q-400	BAe-146	C-130H	DC-10	B-747
Medford	PNW	1	1	1	1	1	0	0
Moses Lakes	PNW	1	1	1	1	1	1	1
Troutdale, Reload	PNW	0	0	0	1	1	0	0
Redmond	PNW	0	1	1	1	1	0	0
Durango, CO	RM	1	1	1	1	1	0	0
Greybull, WY	RM	0	1	1	1	1	0	0
Jeffco	RM	1	1	1	1	1	0	0
Grand Junction	RM	1	1	1	1	1	0	0
Rapid City, Reload	RM	1	1	1	1	1	0	0
Alexandria	SO	1	1	1	1	1	0	0
Chattanooga (Lovell Field)	SO	1	1	1	1	1	0	0
Fayetteville (Drake Field)	SO	0	1	1	1	1	0	0
Ft. Smith	SO	1	1	1	1	0	0	0
Kinston	SO	1	1	1	1	1	0	0
Knoxville	SO	1	1	1	1	1	0	0
Lake City	SO	1	1	1	1	1	0	0
London	SO	0	1	1	1	0	0	0
Tallahassee	SO	1	1	1	1	1	0	0
Weyers Cave/Staunton	SO	1	1	1	1	0	0	0
Alamogordo	SW	1	1	1	1	1	0	0
Albuquerque	SW	1	1	1	1	1	1	1
Libby/Ft Huachuca	SW	1	1	1	1	1	0	0
Phoenix/Williams Gateway	SW	1	1	1	1	1	1	1
Prescott	SW	1	1	1	1	1	0	0
Roswell	SW	1	1	1	1	1	1	1
Silver City	SW	0	1	1	1	1	0	0
Winslow	SW	0	1	1	1	1	0	0
Total Number of Bases	73							
Number of Compatible Bases		45	67	63	64	62	9	9
Percentage of Compatible Bases		62%	92%	86%	88%	85%	12%	12%

Aircraft Compatibility with Airtanker Bases

The Q-200 had the highest compatibility, 92%. Being an aircraft designed for the low volume commercial passenger market where airport facilities may have short runways, this finding is understandable. It was followed by the Q-400 designed for similar capabilities as the Q-200. In that NATS2 study, it was determined that the C-130 A,B models were compatible at 91% of the bases. The reduction of the percentage to 85% for the C-130H model is due to the increased tank capacity (4,300 gallons versus 3,000 gallons). This reduction was mainly due to the need for a longer runway to meet the takeoff performance criteria.

The S-3 was compatible with only 62% of the base locations. The major reason for this incompatibility was the requirement to meet accelerate-and-stop distances (critical field length) within the paved portion of the airport runway. The only exception to this was the B-747. The driving reason for these aircraft not being compatible with the studied bases is its load bearing. The take off performance of the B-747 proved to meet the 60 percent of available runway for ground roll

criteria, but most of the studied bases are municipal airports or smaller airports with the runway and taxiway bearing strength too low to withstand the weight of the aircraft.

In all of the cases where incompatibility exists, except for size fit at the tanker base, downloading of the aircraft could be considered. However, the effort in this study is to find aircraft, which will meet the needs of the studied future bases without compromising the capability of the aircraft.

The NATS2 report provided recommendations on the infrastructure for air tanker bases to support the National fixed-wing large airtanker fleet. To date, approximately $68,000,000 has been spent to upgrade existing airtanker bases and to construct new airtanker bases. For this study, the locations of large fixed-wing airtanker bases are noted in Table 7 as defined in the 2005 Interagency Airtanker Base Directory.

Table 7 – Large Airtanker Bases Used in This Study

GACC	Airtanker Bases
Alaska	Ft. Wainwright, Galena, Homer, Kenai, McGrath, Palmer, Tok (Tanacross)
Eastern	Bemidji, Brainerd, Ely, Hibbing (All MN state bases)
Eastern Basin	Boise, Cedar City, Hill, McCall, Pocatello
No. Ops.	Chester, Chico, Montague, Redding, Stockton
Northern Rockies	Billings, Coeur d' Alene, Grangeville, Kalispell (Glacier), Helena, Missoula, West Yellowstone
Northwest	Klamath Falls, LaGrande, Medford, Moses Lake, Troutdale, Redmond
Rocky Mts.	Jeffco, Durango, Grand Junction, Rapid City
So. Ops.	Bishop, Fresno, Hemet, Lancaster, Porterville, Ramona, San Bernardino, Santa Barbara
Southern	Chattanooga, Fayetteville, Lake City (Fl)
Southwest	Alamogrardo, Albuquerque, Ft. Huachuca, Prescott, Roswell, Silver City, Winslow, Williams
Western Basin	Battle Mountain, Minden, Stead

One of the potential future airtanker platforms is the B-747-200. The developer, Evergreen International, has suggested staffing as a “turn-key” operation where both the retardant mixing and loading would be contracted with the airtanker. Table 8 contains locations suggested by the vendor for this operation. However, this list is not exhaustive since the vendor is still negotiating with additional airports.

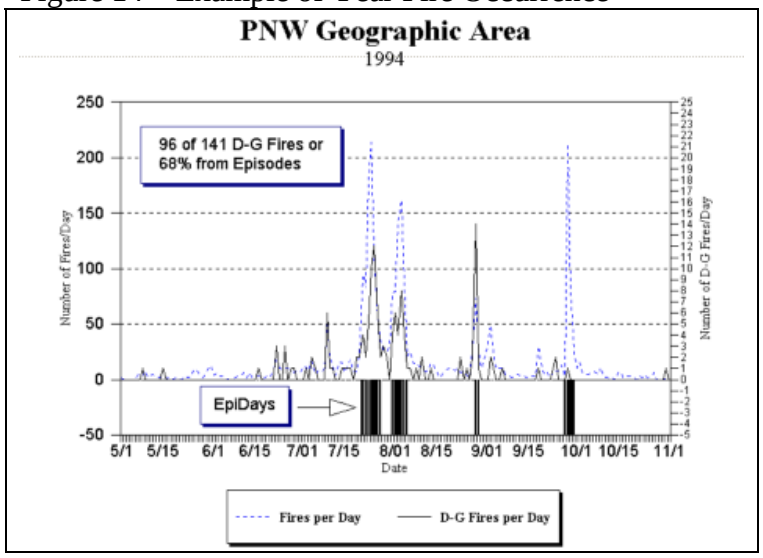
Table 8 – Locations Suggested for Use by B-747-200

Independent	Common with Agency Airtanker Bases
Castle, CA	Albuquerque, NM
Charleston AFB, SC	Boise, ID
Colorado Springs, Co (Peterson AFB)	Fresno, CA
March AFB, CA	Moses Lake, WA
Mather, CA	Rosewell, NM
McClellen, CA	Williams, AZ
Vandenberg, CA	
Victorville, CA	

Patterns of Fire Occurrence

The National Airtanker Study, Phase 1, (NATS1) displays on pages 44 and 45 graphs of fires per day for the year 1994 in the Great Basin, Northwest and Northern Geographic Areas. Superimposed on these graphs is the number of fires 100 acres (size class D) or greater in size by day. Figure 14 shows an example of daily fire occurrence. It is from the PNW GACC. Note in Figure 14, the relationship between the total number of 100-acre and larger fires per day and the days when a large number of fires happened on that day. These days are referred to as an "EpiDay" and a series of these EpiDays form a fire occurrence episode.

Figure 14 – Example of Year Fire Occurrence



Staffing of airtankers during episodes is critical. The data in Table 9 is from a recent 18-year period. Columns 1 - 2 provide the percent of all fires and of fires in the D size class (100-299 acres) or greater that occur during fire occurrence episodes. On EpiDays, the average daily fire occurrence is displayed in column 3 and increase to the level noted in column 4. This increase is frequently at a magnitude of three to four-fold. Column 5 provides the percent of the total fire season days that are within fire occurrence episodes.

Note than in most Geographic Areas, this percent is relatively low indicating a high percent of fires on a small percent of days. Under this dynamic of fire occurrence, mobility of aircraft is critical.

Table 9

Geographic Area	Percent of Fires From Episodes		Number of Fires		Days in Episodes
	All Fires	D+ Fires	Avg. / Day	Avg. / EpiDay	Percent
Column ID=>	1	2	3	4	5
Alaska	47%	60%	3	14	6%
Basin – W & E	60%	63%	14	33	39%
Eastern	41%	48%	7	14	27%
No. & So. Ops.	32%	22%	13	58	13%
Northern Rockies	44%	39%	11	38	21%
Northwest	42%	44%	13	67	12%
Rocky Mt.	40%	37%	8	23	26%
Southern	47%	49%	8	14	33%
Southwest	52%	54%	15	42	41%

Analysis of Phase 1 - Initial Attack Support

Phase 1 has the following two objectives:

Objective 1-1

Re-examine staffing of Type 1 and 2 airtankers as well as Type 1 helicopters at the airtanker bases recommended for staffing in NATS1 and NATS2. By airtanker base, recommend the aircraft type and number that supports the most cost efficient staffing.

Objective 1-2

Re-examine aircraft performance attributes recommended in NATS2 for a future airtanker platform. Recommend performance attributes for future airtanker and helicopter platforms that support a national cost efficient fire protection program.

Objective for Fire Management Analysis and Planning

The Forest Service Handbook FSH 5109.19 - FIRE MANAGEMENT ANALYSIS AND PLANNING HANDBOOK, 1/83 WO AMENDMENT 1, provides the Objective for fire management planning.

10.2 - Objective. Fire management analysis and planning is accomplished through the use of the National Fire Management Analysis System (NFMAS). NFMAS was developed to:

1. Provide a formal process to integrate fire management planning with land management planning.

2. Provide input into the program development and budgeting processes at Forest, Regional, and National levels.

3. Establish a consistent budget analysis process for evaluating the efficiency and effectiveness of the fire program at the National and Regional levels.

4. Provide a means to determine fire suppression resource and program needs, which are considered National or Regional in scope.

Overview of the National Fire Management Analysis System (NFMAS)

Forces used for initial attack of wildland fires have been traditionally analyzed and justified using the National Fire Management Analysis System (NFMAS) by the USDA Forest Service and the USDI Bureau of Land Management and Bureau of Indian Affairs. A replacement system called Fire Program Analysis (FPA) is under construction and is not complete. Hence the legacy system, NFMAS, will be one analysis system used in this study.

NFMAS initial attack assessment (IAA) model analyzes initial attack effectiveness and was used to analyze the effectiveness and efficiency of the alternatives. The local initial attack forces remained constant as airtanker staffing and locations were changed. Where use of the IAA model was not current or was unavailable for the area, an equivalent process was allowed as long as consistency was maintained.

Several key assumptions do apply to airtankers. The amount of fireline produced by an aerial drop is based on the use of long term fire retardant and varies by the number of gallons in the drop as well as the National Fire Danger Rating System (NFDRS) fuel model. In the Phase 1 Report, the formula used was:

Chains of line = (Gallons in Drop)/100 * Production Factor

where the production factor is 1.0 for NFDRS fuel models A, L and S; 0.7 for NFDRS fuel models C, H, R, E, P and U; 0.6 for NFDRS fuel models T, N, F and K; 0.5 for NFDRS fuel model G; 0.3 for NFDRS fuel models D and Q; and 0.2 for NFDRS fuel models B, O, J, and I.

For drops of water or foam (short term retardants), it was assumed the number of chains of fireline built was 50% of the number of chains of fireline built using long term fire retardant.

In the IAA, the effectiveness of retardant drops as it relates to rate of fire spread, the amount of fireline produced is reduced linearly from its maximum value described by the formula above. Maximum fireline production is assumed when the rate of fire spread is equal to one chain/hour. The fireline production rate is decreased linearly so that the fireline production rate is zero when the rate of fire spread is equal to eighty chains per hour or greater in NFDRS fuel models A, L, S and T. These fuel models represent grass, Alaska tundra and sagebrush. For the rest of the NFDRS fuel models, there was no change from the forty chains per hour limit.

All dollar amounts displayed in this report are in 2004 dollars unless otherwise stated. The current OMB Price Adjustment Index was used to calculate factors as follows to move all dollars to 2004 dollars (Table 3).

The term Fire Suppression (FFF) Costs is used to describe the sum of the cost to suppress a wildfire. These costs are accounted for in two ways, unit mission costs and average acre (suppression) costs. Unit mission costs are "trip" costs for fire suppression resources. For airtankers, these costs would be the flight costs (flight rate times hours flown) and retardant cost. Retardant cost was assumed to be $0.72 per gallon. Average acre costs include all other fire suppression costs expressed on a per acre basis.

The term Net Value Change (NVC) Costs is used to describe the algebraic sum of the effects of a fire keeping in mind that some effect is negative and some positive. In general, the algebraic sum is a negative number.

The term Fire Program Costs is used to describe the staffing of the airtanker, and is generally the daily availability times the number of staffing days for an exclusive-use contract. It also includes the module staffing costs.

Overview of the Wildfire Initial Response Assessment System (WIRAS)

The Wildfire Initial Response Assessment System (WIRAS) is a simulation model designed to address the importance of wildfire occurrence and suppression response dynamics in planning initial attack organizations. A key feature that distinguishes it from other models is its ability to assess how the ebb and flow of fire occurrence intensity across the landscape and over time affects the economic and physical performance of an initial attack organization. This approach better addresses the value of resource mobility and the consequence of peak demand requirements that are so important in determining the size, location, and composition of an initial attack organization.

WIRAS models the dynamics of fire occurrence as it affects suppression activities by using historically recorded fire times and locations from multiple fire seasons. This approach preserves the spatial and temporal nature of fire occurrence with all its implications for defining initial attack program performance. Programs are tested against a set of historical fire seasons.

On the initial attack side of the equation, WIRAS models resource deployment with a system of rules intended to closely reflect how managers make resource allocation decisions in a multiple fire environment. This set of rules defines a hierarchy of preferred resource responses that recognizes the fire location, behavior, management objectives, and accessibility, among other things, but also takes into account the availability of different kinds of initial resources at any point in time. In general, the dispatch rules in WIRAS favor responding to a fire with local ground resources provided the response times are reasonable given a fire's behavior. When ground resource response times are not reasonable, the model seeks to dispatch helitack, and finding none, will request smokejumpers, if available. Airtanker support is determined by projected fire intensity. If no resources are available, fires just wait and grow until resources returning from earlier responses become available for dispatch. Fires that reach predefined sizes or perimeters either while waiting or during suppression are declared escaped. All resources have the ability to attack several fires on a given day depending on how quickly they can contain fires and prepare for another dispatch.

Projected fire behavior and fuel model determines the "might" of the initial attack response. During multiple fire episodes, new fires and those waiting for service are prioritized based on highest fire intensity level (FIL) with a somewhat diminished priority if located in wilderness or roadless areas.

WIRAS currently provides capabilities for evaluating regional and national resources, Type 1 and 2 helicopters, smokejumpers, helitankers, and airtankers. The software has some local program analysis capabilities, but these have not been fully developed.

Analysis to Determine Number of Fixed-Wing Airtankers

Due to the availability of data, the WIRAS model is only implemented in the northern part of California, Oregon, Washington and parts of Idaho and Montana. The WIRAS model was used in conjunction with the AutoAT4 (NFMAS) model to allow for understanding of each model's strengths and weaknesses. The AutoAT4 (NFMAS) software models initial attack on each representative fire assuming all firefighting resources are available. The WIRAS model is a time-based spatial model where fires receive "services," firefighting resources, only if the resource is available. Modeling using WIRAS should allow for a much better estimate of effects in a multiple fire occurrence area such as the Northwest GACC.

Generic Airtanker Defined

Review of the recommendations from the NATS2 report provided some insight to the characteristics of a generic current airtanker. In addition, a review was made of the schedule of items in the 2005 airtanker contract. Professional judgment was applied to estimate the daily availability and flight rate for the generic fixed-wing airtanker. Following assessment of future fixed-wing airtanker platforms, the number of fixed-wing airtankers to staff will be revisited. The attributes for a generic exclusive-use Type 1 fixed-wing airtanker based on a 100-day contract follow.

Size – 2,700 gallons
Speed below 10,000 feet = 250 knots
Speed above 10,000 feet = 323 knots
Climb Rate = 0.67 minutes/1000 feet
Daily Availability = $6,500 per day
Flight Rate = $4,000 per hour
Retardant Cost = $0.72 / gallon

Analysis Results – AutoAT4 (NFMAS) Modeling

Within each GACC, a run was made assuming staffing of no large fixed-wing or large helicopter aircraft. Next, runs were made with one airtanker staffed within a GACC at each airtanker base. This allowed for determination of the most efficient location to place one airtanker within a GACC. The most efficient airtanker location was then staffed with one generic airtanker and runs were made to determine the next best location within a GACC to staff a second airtanker. This process was iterated until an alternative with the lowest FFF + NVC + Program Costs (C+NVC) was determined.

Table 10 provides an example of how this analysis process was completed in the Northwest GACC using only fires that occurred on National Forest lands. Alternative F1 with a specific six airtanker staffing configuration has the lowest C+NVC. This configuration has one airtanker at Klamath Falls, two at LaGrande, two at Redmond and one at Moses Lake. The second most efficient alternative is G2, which has a specific staffing configuration of seven airtankers. This second configuration is the same as alternative F1 with a second airtanker added at Moses Lake. Even though alternative F1 has the lowest C+NVC, alternative G2 has a difference from F1 of only $95,989 or 0.14% of the totals C+NVC for alternative F1.

Table 10 – Example of Results from AutoAT4, Northwest GACC

ID	No of ATs	Acres Burned	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. from Low
A0	0	61,496	$58,814,963	-$62,072,265	$120,887,228	$0	$120,887,228	
A3	1	47,370	$42,639,981	-$50,512,621	$93,152,602	$650,000	$93,802,602	$25,913,204
A2	1	51,412	$46,141,776	-$52,115,170	$98,256,946	$650,000	$98,906,946	$31,017,548
A4	1	52,867	$46,994,193	-$52,158,683	$99,152,876	$650,000	$99,802,876	$31,913,478
A1	1	51,771	$45,254,997	-$51,017,138	$96,272,135	$650,000	$96,922,135	$29,032,737
B1	2	36,877	$34,029,645	-$43,931,611	$77,961,256	$1,300,000	$79,261,256	$11,371,858
B2	2	37,295	$34,446,108	-$43,776,965	$78,223,073	$1,300,000	$79,523,073	$11,633,675
B3	2	48,815	$41,833,381	-$47,641,377	$89,474,758	$1,300,000	$90,774,758	$22,885,360
B4	2	47,456	$40,594,941	-$48,259,613	$88,854,554	$1,300,000	$90,154,554	$22,265,156
B5	2	45,391	$39,481,180	-$46,566,636	$86,047,816	$1,300,000	$87,347,816	$19,458,418
B6	2	36,877	$34,029,645	-$43,931,611	$77,961,256	$1,300,000	$79,261,256	$11,371,858
C1	3	43,661	$36,303,971	-$43,336,673	$79,640,644	$1,950,000	$81,590,644	$13,701,246
C2	3	35,806	$31,722,407	-$41,011,595	$72,734,002	$1,950,000	$74,684,002	$6,794,604
C3	3	35,492	$31,045,889	-$40,798,387	$71,844,276	$1,950,000	$73,794,276	$5,904,878
C4	3	34,439	$30,645,816	-$40,609,228	$71,255,044	$1,950,000	$73,205,044	$5,315,646
D1	4	34,299	$30,086,367	-$40,423,955	$70,510,322	$2,600,000	$73,110,322	$5,220,924
E1	5	32,056	$29,181,767	-$38,681,491	$67,863,258	$3,250,000	$71,113,258	$3,223,860
E2	5	33,943	$29,404,100	-$38,359,337	$67,763,437	$3,250,000	$71,013,437	$3,124,039
E3	5	32,897	$28,774,574	-$36,297,109	$65,071,683	$3,250,000	$68,321,683	$432,285
E4	5	33,984	$29,544,595	-$40,235,163	$69,779,758	$3,250,000	$73,029,758	$5,140,360
F1	**6**	**31,554**	**$28,203,035**	**-$35,786,363**	**$63,989,398**	**$3,900,000**	**$67,889,398**	**$0**
F2	6	31,700	$28,499,500	-$36,616,873	$65,116,373	$3,900,000	$69,016,373	$1,126,975
F3	6	32,869	$28,735,945	-$36,185,889	$64,921,834	$3,900,000	$68,821,834	$932,436
F4	6	32,056	$29,181,767	-$38,681,491	$67,863,258	$3,900,000	$71,763,258	$3,873,860
F5	6	32,601	$28,276,128	-$36,189,292	$64,465,420	$3,900,000	$68,365,420	$476,022
F6	6	33,628	$28,862,328	-$38,170,545	$67,032,873	$3,900,000	$70,932,873	$3,043,475
G1	7	31,526	$28,164,406	-$35,675,143	$63,839,549	$4,550,000	$68,389,549	$500,151
G2	**7**	**31,287**	**$27,731,068**	**-$35,704,319**	**$63,435,387**	**$4,550,000**	**$67,985,387**	**$95,989**
G3	7	31,414	$27,984,207	-$36,453,854	$64,438,061	$4,550,000	$68,988,061	$1,098,663
G4	7	32,573	$28,237,499	-$36,078,072	$64,315,571	$4,550,000	$68,865,571	$976,173
H1	8	31,259	$27,692,439	-$35,593,099	$63,285,528	$5,200,000	$68,485,538	$596,140

Analysis Results – WIRAS Modeling

The same alternatives analyzed using AutoAT4 were analyzed using WIRAS. Additional alternatives where built for analysis also. Table 11 provides analysis results in the Northwest GACC. Alternative K2 with a specific ten airtanker staffing configuration has the lowest C+NVC. This configuration has two airtankers at Klamath Falls, three at LaGrande, three at Redmond and two at Moses Lake. The second most efficient alternative is K3, also having a specific staffing configuration of ten airtankers and the third most efficient option, J1, has a specific staffing of nine airtankers. Even though alternative K2 has the lowest C+NVC, alternative J1 has a difference from K2 of only $9,055 or 0.01% of the totals C+NVC for alternative K2, essentially equal given the variability inherent in the analysis.

Table 11 – Example of Results from WIRAS, Northwest GACC

ID	No of ATs	Acres Burned	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. from Low
A0	0	62,883	$83,128,100	$38,416,685	$121,544,785	$0	$121,544,785	$27,613,449
A3	1	57,996	$76,862,294	$35,499,836	$112,362,130	$650,000	$113,012,130	$19,080,795
A2	1	57,893	$76,844,843	$35,485,836	$112,330,680	$650,000	$112,980,680	$19,049,344
A4	1	57,741	$76,555,433	$35,381,137	$111,936,570	$650,000	$112,586,570	$18,655,235
A1	1	57,818	$76,610,597	$35,365,104	$111,975,701	$650,000	$112,625,701	$18,694,365
B1	2	55,511	$74,122,403	$33,561,648	$107,684,051	$1,300,000	$108,984,051	$15,052,716
B2	2	55,622	$74,280,257	$33,465,945	$107,746,201	$1,300,000	$109,046,201	$15,114,866
B3	2	55,612	$74,142,427	$33,446,607	$107,589,034	$1,300,000	$108,889,034	$14,957,698
B4	2	55,671	$74,413,241	$33,596,021	$108,009,262	$1,300,000	$109,309,262	$15,377,927
B5	2	55,480	$74,160,392	$33,596,138	$107,756,530	$1,300,000	$109,056,530	$15,125,195
B6	2	55,394	$74,300,190	$33,843,965	$108,144,155	$1,300,000	$109,444,155	$15,512,820
C1	3	52,881	$70,999,419	$32,056,833	$103,056,252	$1,950,000	$105,006,252	$11,074,917
C2	3	53,022	$70,974,272	$32,265,197	$103,239,469	$1,950,000	$105,189,469	$11,258,134
C3	3	52,530	$70,793,440	$31,647,925	$102,441,364	$1,950,000	$104,391,364	$10,460,029
C4	3	52,723	$70,973,635	$32,069,959	$103,043,593	$1,950,000	$104,993,593	$11,062,258
D1	4	51,641	$69,290,127	$31,442,165	$100,732,293	$2,600,000	$103,332,293	$9,400,958
E1	5	49,158	$66,529,705	$29,119,366	$95,649,072	$3,250,000	$98,899,072	$4,967,737
E2	5	49,234	$66,623,287	$28,437,503	$95,060,790	$3,250,000	$98,310,790	$4,379,454
E3	5	48,727	$66,089,541	$28,332,847	$94,422,388	$3,250,000	$97,672,388	$3,741,053
E4	5	49,283	$66,946,942	$28,823,161	$95,770,103	$3,250,000	$99,020,103	$5,088,768
F1	6	47,637	$64,946,466	$27,159,410	$92,105,876	$3,770,000	$95,875,876	$1,944,541
F2	6	47,789	$65,096,939	$27,237,896	$92,334,834	$3,900,000	$96,234,834	$2,303,499
F3	6	47,750	$64,994,219	$27,260,978	$92,255,198	$3,770,000	$96,025,198	$2,093,862
F4	6	47,915	$65,273,077	$27,367,811	$92,640,888	$3,900,000	$96,540,888	$2,609,553
F5	6	47,672	$64,993,235	$27,225,911	$92,219,147	$3,900,000	$96,119,147	$2,187,811
F6	6	47,831	$65,161,023	$27,305,029	$92,466,052	$3,900,000	$96,366,052	$2,434,717
G1	7	47,245	$64,542,451	$26,923,091	$91,465,542	$4,355,000	$95,820,542	$1,889,207
G2	7	47,215	$64,670,733	$26,854,252	$91,524,985	$4,550,000	$96,074,985	$2,143,650
G3	7	47,519	$64,952,822	$26,924,328	$91,877,150	$4,355,000	$96,232,150	$2,300,815
G4	7	47,351	$64,750,616	$26,820,747	$91,571,363	$4,550,000	$96,121,363	$2,190,028
H1	8	46,487	$63,833,417	$26,113,213	$89,946,629	$5,200,000	$95,146,629	$1,215,294
H2	8	46,106	$63,448,649	$25,812,333	$89,260,982	$5,200,000	$94,460,982	$529,647
J1	9	45,221	$62,608,774	$25,481,616	$88,090,390	$5,850,000	$93,940,390	$9,055
K1	10	45,033	$62,319,655	$25,299,038	$87,618,693	$6,500,000	$94,118,693	$187,358
K2	**10**	**44,859**	**$62,221,800**	**$25,209,535**	**$87,431,335**	**$6,500,000**	**$93,931,335**	**$0**
K3	10	44,933	$62,225,681	$25,209,578	$87,435,259	$6,500,000	$93,935,259	$3,924

Analysis Results – Differences Between AutoAT4 (NFMAS) and WIRAS Modeling

This comparison is only possible in the Northwest GACC using only fires that were on National Forest lands. The current fire occurrence database in the WIRAS model is based on National Forest lands. The WIRAS model dispatches airtankers to fires as they occur based on fire behavior and availability. As was noted in the section titled Patterns of Fire Occurrence, a high percentage of fires occur in episodes and frequently airtankers are already committed when a fire starts. These new starts only receive airtanker services when a platform becomes available. The AutoAT4 (NFMAS) modeling models initial attack with the assumption that all staffed firefighting resources are available when the fire starts. Comparison of the results from these two models provides insight into the effects of concurrent fire occurrence during episodes on airtanker availability. This can lead to an estimation of the number of additional airtanker platforms that can efficiently be staffed to support initial attack when fires occur in episodes versus one at a time.

The results from AutoAT4 and WIRAS show both similarities and differences. Using AutoAT4 (NFMAS) modeling, the most efficient number of airtankers to staff was 6-7 versus 9-10 using WIRAS. In general, the WIRAS model points to 30-60% increased staffing level to support a fire occurrence regime that is episodic in nature. The C+NVC curves flatten substantially in both models at this number of airtankers suggesting that investments in additional airtankers would not necessarily be economically detrimental given the inherent variability associated with the results. WIRAS does show a fair economic benefit to pushing the airtanker investment envelope beyond the 6 to 7 airtankers suggested by AutoAT4. This increase of additional airtankers indicated by WIRAS might be mollified to some degree by an analysis conducted in a wider geographic context that permits using and the sharing of airtankers from adjacent geographic areas. The correlation of fire workload and competing demand for airtankers between the PNW geographic area and adjacent geographic areas would determine the nature of this moderating effect.

When looking at airtanker location, for any specific number of airtankers, WIRAS tends to show less difference between location-based alternatives than AutoAT4. This is probably due to the ability of WIRAS to move airtankers among bases in response to fire activity. Despite this capability, as noted in the previous section, both models expressed similar preferences for the locating of 6-7 airtankers, generally favoring Redmond for two airtankers and the remaining airtankers spread among Klamath Falls, Moses Lake and LaGrande.

When looking at incremental investments in airtankers, AutoAT4 tends to show higher returns for each additional airtanker beyond the first airtanker, whereas WIRAS shows that diminishing returns to additional airtankers sets in much more quickly. This may be due to WIRAS's ability to move the first airtankers around the Pacific Northwest to bases near outbreaks of fires. This tends to shorten the average initial attack time for WIRAS and give relatively higher returns to the initial airtankers, leaving less benefit to be received by the addition of the later airtankers.

There remain some subtle differences between the databases driving the two models. This, of course, introduces some risk that the observed similarities and differences between the results of the two models are less a function of modeling approaches than input differences. Future investigation will eventually illuminate these questions more fully.

Analysis Results for All GACCs

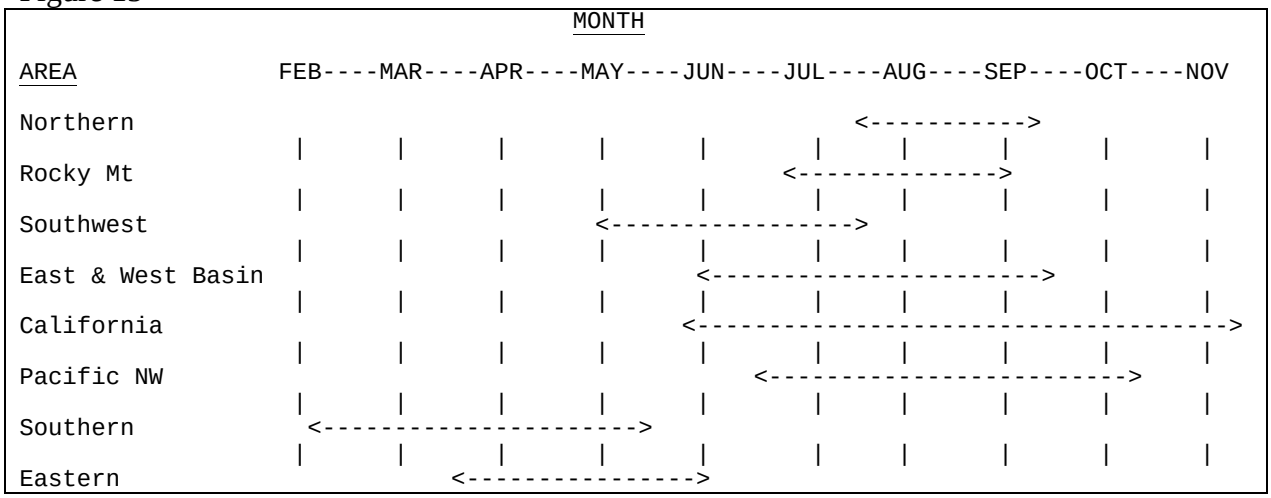
Table 12 contains the results of analysis by GACC using the same process described. Detailed tables for each GACC that are similar to Table 10 are provided in Appendix E.

Table 12 – Summary of Number of Fixed-Wing Airtankers Using a Current Generic Airtanker and AutoAT4 modeling

Geographic Area	No. of Fixed-wing Airtankers	Suggested Locations	Comments
Basin – W & E	8 - 9	Battle Mt., Boise, Cedar City, Hill, McCall, Minden	None
Eastern	1	Northern Minnesota	Unable to analyze fully due to lack of NFMAS files
No. & So. Ops.	5 - 7	Chico, Chester, Fox Field, Lancaster, Fresno, Montague, Norton, Porterville, Redding	Further analysis in So. Ops. using recalibrated analysis with adjusted ground resource production rates is supported.
No. Rockies	3 - 4	Coeur d' Alene, Missoula, Helena, West Yellowstone	Multi-GACC analysis used for Coeur d' Alene and West Yellowstone
Northwest	6 - 7	Klamath Falls, LaGrande, Moses Lake, Redmond	None
Rocky Mt.	2 - 3	Jeffco, Grand Junction, Durango	Multi-GACC analysis used for Durango
Southern	3	Chattanooga, Fayetteville, Shenandoah Valley	None
Southwest	6 - 7	Alamogordo, Albuquerque, Prescott, Silver City, Williams Gateway (Phx), Winslow	None
Total	34 - 41		

The geographic areas do not all have concurrent fire season dates (Figure 15) hence one airtanker platform can support more than one of the identified locations noted in Table 12.

Figure 15



Determining the actual number of airtanker platforms to staff annually is mainly based on the concurrent fire seasons in the California, East Basin, Northern, Northwest, Rocky Mountain and West Basin GACCs. For these geographic areas the range of airtanker platforms is 24-30. The fire occurrence in these GACCs shows an episodic pattern and applying a percent increase of 30% based on the Northwest GACC analysis using WIRAS and AutoAT4 modeling brings the staffing range to 31 – 39. Note that in the NATS1 study, three additional airtankers were recommended to provide an increased capability to support large fires.

The scope of this study is to determine the most cost efficient number of airtankers to support initial attack and large fire suppression. The use of the military (MAFFS) and aircraft from other sources when demand reaches a very high percentile of supply is still needed. It is recognized that other resources are needed when private vendor sources for large airtankers are fully committed. Use of the military is an integral part of the total airtanker support during these events.

Analysis to Determine Number of Rotary-Wing Helitankers

The attributes for a generic exclusive-use Type 1 Limited helitanker based on a 100-day contract and for a generic fixed-wing airtanker follow.

Figure 16

Type 1 Limited Helitanker	Fixed-Wing Airtanker
Size – 1,800 gallons	Size – 2,700 gallons
Speed below 10,000 feet = 105 knots	Speed below 10,000 feet = 250 knots
Speed above 10,000 feet = N/A	Speed above 10,000 feet = 323 knots
Climb Rate = 1 minutes/1000 feet	Climb Rate = 0.67 minutes/1000 feet
Daily Availability = $14,150 per day	Daily Availability = $6,500 per day
Flight Rate = $4,947 per hour	Flight Rate = $4,000 per hour
Flight Time to Refuel = 120 minutes	Flight Time to Refuel = 120 minutes

A general analysis of the speed capabilities of the two aircraft allow for some initial observations on the size of the working circle around a refuel location. Assuming refueling is done at the initial dispatch location, the working circle for the fixed-wing airtanker is 6 to 11 times larger than for the helitanker (Table 13). The maximum distance allows for the helitanker to make two water drops and the airtanker to make one retardant drop. The distance Nationally from an airtanker base to representative fire locations is 91 miles (NATS2).

Table 13

Knots	MPH	Max. Miles	Square Miles	Ratio to Heli
105	121	89	24,667	N/A
250	288	230	166,414	6.7
323	372	297	277,790	11.3

Analysis Results

As with fixed-wing platforms, analysis was completed in the Northwest GACC using both the AutoAT4 (NFMAS) model and the WIRAS model. These results will be summarized first followed by results for other geographic areas using AutoAT4 modeling only.

AutoAT4 Modeling in the Northwest GACC

Table 14 summarizes the runs in the Northwest area. Alternative 0 is the no staffing of aircraft alternative. Alternatives A1- A5, X1 – X4 and X7 were run to show the comparison of a generic future airtanker with a Type 1, Category C, Limited helitanker. The differences can be explained by noting the difference in cruise speed below 10,000 feet (250 KTAS vs. 105 KTAS), the tank size (2,700 vs. 1,800) and the fireline production difference between long term retardant and the short term retardant water. The helitanker was allowed to make drops each 8 minutes.

Table 14 – Comparison of Airtanker and Helicopter Staffing in Northwest GACC Using AutoAT4

ID	Description	Acres	FFF	NVC	FFF+NVC	Program Costs	C+NVC	Difference Between AT & Heli
A0	No A/C	61,496	$58,814,963	-$62,072,265	$120,887,228	$0	$120,887,228	
A1	1 AT @ RD	51,771	$45,254,997	-$51,017,138	$96,272,135	$650,000	$96,922,135	$11,413,936
X1	1 Heli @ RD	56,426	$51,063,391	-$55,791,859	$106,855,250	$1,480,821	$108,336,071	
A2	1 AT @ ML	51,412	$46,141,776	-$52,115,170	$98,256,946	$650,000	$98,906,946	$13,851,670
X2	1 Heli @ LC	56,581	$53,703,086	-$57,574,709	$111,277,795	$1,480,821	$112,758,616	
A3	1 AT @ LG	47,370	$42,639,981	-$50,512,621	$93,152,602	$650,000	$93,802,602	$15,017,105
X3	1 Heli @ LG	54,078	$51,723,785	-$55,615,101	$107,338,886	$1,480,821	$108,819,707	
A4	1 AT @ KF	52,867	$46,994,193	-$52,158,683	$99,152,876	$650,000	$99,802,876	$13,150,899
X4	1 Heli @ KF	58,514	$53,051,305	-$58,421,649	$111,472,954	$1,480,821	$112,953,775	
A5	1 AT @ MD	53,270	$47,522,152	-$52,421,563	$99,943,715	$650,000	$100,593,715	$12,893,254
X7	1 Heli @ MD	58,826	$53,434,950	-$58,571,198	$112,006,148	$1,480,821	$113,486,969	
						Average ATs =	$98,005,655	
						Average T-1s =	$111,271,028	
							Average Difference =	$13,265,373
X5	1 Heli @ JD	55,188	$51,833,275	-$55,421,050	$107,254,325	$1,480,821	$108,735,146	
X6	1 Heli @ OA	57,715	$52,130,364	-$56,674,822	$108,805,186	$1,480,821	$110,286,007	
X8	1 Heli @ RB	60,670	$56,925,320	-$61,455,914	$118,381,234	$1,480,821	$119,862,055	
						Average =	$112,538,559	
H1	AK2L2R2W2	31,259	$27,692,439	-$35,593,099	$63,285,538	$5,200,000	$68,485,538	$25,208,127
X9	8 Type 1 Helis	45,921	$38,294,482	-$43,552,615	$81,847,097	$11,846,568	$93,693,665	

- Option X9 has eight Type 1 Category C Limited helitankers simultaneously staffed at the bases in alternatives X1 – X 8.
- Alternative H1 has two generic future airtankers each staffed at Klamath Falls, LaGrande, Redmond and Moses Lake.

Staffing of one or eight Type 1, Category C, Limited helitankers yields a C+NVC that is less than no aircraft staffing (Table 12). Comparison of acres burned results in a conclusion that the staffing of eight Type 1, Category C, Limited helitankers is equivalent to the staffing of two Type 1 generic future airtankers (Table 9). Comparison of C+NVC values results in a conclusion that the staffing of eight Type 1, Category C, Limited helitankers is equivalent to the staffing of one Type 1 generic future airtanker (Table 10).

WIRAS Modeling in the Northwest GACC

Table 15 summarizes the runs in the Northwest GACC. Alternative 0 is the no staffing of aircraft alternative. The table also shows eight alternatives where a single Type 1, Category C, Limited helitanker was staffed. At the end of the table, two alternatives are shown where eight Type 1, Category C, Limited helitankers are staffed or eight Type 1 future generic airtankers are staffed. The helitanker was allowed to make drops each 8 minutes.

Table 15 – Comparison of Airtanker and Helicopter Staffing in Northwest GACC Using WIRAS

Alternative	Acres Burned	FFF	NVC	FFF+NVC	Program Cost	C+NVC
Alt 0 - No Aircraft	62,883	$83,128,100	$38,416,685	$121,544,785	$0	$121,544,785
Single Helicopter Scenarios						
John Day	61,874	$82,144,540	$38,116,552	$120,261,092	$1,415,000	$121,676,092
Klamath Falls	62,058	$81,268,273	$37,992,608	$119,260,881	$1,415,000	$120,675,881
LaGrande	61,821	$82,220,059	$38,155,420	$120,375,479	$1,415,000	$121,790,479
Lake Chelan	62,138	$82,580,470	$38,561,551	$121,142,021	$1,415,000	$122,557,021
Medford	62,059	$81,252,830	$37,993,383	$119,246,213	$1,415,000	$120,661,213
Oakridge	59,721	$78,089,185	$35,557,787	$113,646,972	$1,415,000	$115,061,972
Redmond	59,724	$78,218,552	$35,562,716	$113,781,268	$1,415,000	$115,196,268
Roseburg	62,061	$81,307,329	$37,996,024	$119,303,353	$1,415,000	$120,718,353
Average	61,432	$80,885,155	$37,492,005	$118,377,160	$1,415,000	$119,792,160
Average for Staffing of 1 airtanker	57,862	$76,718,292	$35,432,978	$112,151,270	$650,000	$112,801,270
Eight Aircraft Scenarios						
8 - Type 1 Helis	54,353	$72,296,671	$32,753,025	$105,049,696	$11,320,000	$116,369,696
8 - Type 1 AT	46,297	$63,641,033	$25,962,773	$89,603,806	$5,200,000	$94,803,806

As with modeling with AutoAT4 (NFMAS), staffing of one or eight Type 1, Category C, Limited helitankers yields a C+NVC that is less than no aircraft staffing. This indicates that staffing with the Type 1, Category C, Limited helitankers as noted is better than doing no staffing of helitankers. But the staffing of one fixed-wing Type 1 airtanker versus one Type 1, Category C, Limited helitanker showed a significant benefit to the staffing of the fixed-wing airtanker.

Comparison of acres burned or C+NVC results in a conclusion that the staffing of eight Type 1, Category C, Limited helitankers is equivalent to the staffing of one to two Type 1 generic fixed-wing airtankers.

Analysis Results for Other GACCs

Table 16 contains the results of analysis by GACC using the same process described. Detailed tables for each GACC are provided in Appendix F. The C+NVC values in the table are stated as provided by the model. Though written to the nearest dollar, there is no intent for these values to be accurate to the level of resolution.

Table 16 – Comparison of Airtanker and Helicopter Staffing Using AutoAT4

	GACC					
	California	Great Basin	Northern	Rocky Mt.	Southern	Southwest
No AT or T-1 Heli						
Ac. Burned	114,815	358,966	44,828	31,327	31,683	120,433
C+NVC	$237,070,338	$157,683,482	$22,108,025	$16,882,739	$14,665,423	$73,358,160
Staffing 1 AT or 1 T-1 Heli at Airtanker Base						
Number of Sites	6	6	4	4	4	3
Avg. C+NVC for AT	$147,163,142	$131,935,787	$13,631,112	$14,798,490	$12,327,348	$55,774,233
Avg. C+NVC for T-1 Heli	$178,762,779	$147,280,266	$14,495,564	$16,201,482	$15,639,774	$65,565,953
Difference	$31,599,637	$15,344,476	$864,453	$1,402,992	$3,312,425	$9,791,719
Staffing 1 T-1 Heli Not at an Airtanker Base						
Number of Sites	6	1	3	5	0	0
Avg. C+NVC for T-1 Heli	$193,207,445	$148,419,331	$14,452,015	$16,553,350	---	---
Staffing ATs versus T-1 Helis at the Number of Airtanker Bases Noted						
Number Staffed	6	6	3	3	3	6
Avg. C+NVC for AT	$125,053,292	$114,311,003	$13,136,099	$15,360,930	$10,074,800	$41,422,675
Avg. C+NVC for T-1 Heli	$139,000,484	$137,389,929	$16,063,601	$17,840,499	$16,287,382	$53,462,337
Difference	$13,947,192	$23,078,926	$2,927,502	$2,479,569	$6,212,582	$12,039,662

California

The Region suggested locations for analysis of a Type 1 helitanker rather than a Type 1 or 2 fixed-wing airtanker were: Bighill, Chester, Chico, Montague, Quincy, Redding, San Bernardino (Norton) and Santa Barbara. The staffing of the Type 1 helitanker had an average annual C+NVC of $31,599,637 more than the C+NVC for the fixed-wing airtanker.

The Region suggested locations for analysis of a Type 1 helitanker solely were: Bighill, Casitas, Hemet, Mariposa, Quincy and Van Nuys. The staffing of the Type 1 helitanker had an average annual C+NVC of $193,207,445. This is $14,444,666 more than the average from current fixed-wing airtanker base locations with a staffing of one fixed-wing airtanker.

A comparison was done with staffing of six fixed-wing airtankers and six Type 1 helitankers using the following locations: Chico, Chester, Fresno, Monteague, Redding and San Bernardino. The staffing of the Type 1 helitankers had an average annual C+NVC of $13,947,192 more than the C+NVC for the fixed-wing airtankers.

The staffing of a Type 1 helicopter at all locations had a C+NVC that was less than not having any staffing of Type 1 helitankers but in all cases was significantly higher than the staffing of a Type 1 or 2 fixed-wing airtanker. The two locations where the staffing of a Type 1 helitanker had significantly lower C+NVC values than the other locations modeled were Bighill and Quincy.

Comparison of acres burned results in a conclusion that the staffing of six Type 1, Category C, Limited helitankers is equivalent to the staffing of two Type 1 generic fixed-wing airtankers. Comparison of C+NVC results in a conclusion that the staffing of six Type 1, Category C, Limited helitankers is equivalent to the staffing of one Type 1 generic fixed-wing airtanker.

Great Basin

The Region suggested locations for analysis of a Type 1 helitanker rather than a Type 1 or 2 fixed-wing airtanker were: Boise, Cedar City, Minden and Hill (Ogden). The staffing of the Type 1 helitanker had an average annual C+NVC of $15,344,476 more than the C+NVC for the fixed-wing airtanker.

The Region suggested analysis of a Type 1 helitanker only staffed at Salmon, Idaho. The staffing of the Type 1 helitanker there had an average annual C+NVC of $148,419,331 which is $16,483,544 more than the average for fixed-wing airtankers staffed at fixed-wing airtanker bases. It is also $1,139,065 more than the average for Type 1 helitankers staffed at fixed-wing airtanker bases with a staffing of one fixed-wing airtanker.

The staffing of a Type 1 helicopter at all locations had a C+NVC that was less than not having any staffing of Type 1 helitankers but in all cases was significantly higher than the staffing of a Type 1 or 2 fixed-wing airtanker.

Comparison of acres burned or C+NVC results in a conclusion that the staffing of six Type 1, Category C, Limited helitankers is equivalent to the staffing of one Type 1 generic fixed-wing airtanker.

Northern

The Region suggested locations for analysis of a Type 1 helitanker rather than a Type 1 or 2 fixed-wing airtanker were: Coeur d' Alene, Helena, Kalispell and Missoula. The staffing of the Type 1 helitanker had an average annual C+NVC of $864,453 more than the C+NVC for the fixed-wing airtanker.

The Region suggested locations for analysis of a Type 1 helitanker solely were: Hamilton and Dillon. Grangeville was also included in this group since the generic airtanker could not operate from Grangeville. The staffing of the Type 1 helitanker had an average annual C+NVC of $14,452,015. This is $820,904 more than the average from current fixed-wing airtanker base locations with a staffing of one fixed-wing airtanker.

The staffing of a Type 1 helicopter at all locations had a C+NVC that was less than not having any staffing of Type 1 helitankers but in all cases was significantly higher than the staffing of a Type 1 or 2 fixed-wing airtanker.

Comparison of acres burned results in a conclusion that the staffing of three Type 1, Category C, Limited helitankers is equivalent to the staffing of one Type 1 generic fixed-wing airtanker. Comparison of C+NVC results in a conclusion that the staffing of three Type 1, Category C, Limited helitankers is equivalent to the staffing of one-half to one Type 1 generic fixed-wing airtanker.

Rocky Mountain

The Region suggested locations for analysis of a Type 1 helitanker rather than a Type 1 or 2 fixed-wing airtanker were: Durango, Grand Junction, Jeffco and Rapid City. The staffing of the Type 1 helitanker had an average annual C+NVC of $1,402,992 more than the C+NVC for the fixed-wing airtanker.

The Region suggested locations for analysis of a Type 1 helitanker solely were: Casper, Cody, Craig, Lake George, Pueblo and Rifle (Garfield Co. Airport). The staffing of the Type 1 helitanker had an average annual C+NVC of $16,553,350. This is $ $1,754,860 more than the average from current fixed-wing airtanker base locations with a staffing of one fixed-wing airtanker.

The staffing of a Type 1 helicopter at all locations had a C+NVC that was less than not having any staffing of Type 1 helitankers but in all cases was significantly higher than the staffing of a Type 1 or 2 fixed-wing airtanker.

Comparison of acres burned results in a conclusion that the staffing of three Type 1, Category C, Limited helitankers is equivalent to the staffing of one Type 1 generic fixed-wing airtanker. Comparison of C+NVC results in a conclusion that the staffing of three Type 1, Category C, Limited helitankers results in a C+NVC that is about $1,000,000 more than the no airtanker or helitankers staffing alternative.

Southern

The Region did not provide suggested locations for analysis of a Type 1 helitanker rather than a Type 1 or 2 fixed-wing airtanker. Analysis was done though at the following locations: Fayetteville, Chattanooga, Shenandoah Valley and Lake City. The staffing of the Type 1 helitanker had an average annual C+NVC of $3,312,425 more than the C+NVC for the fixed-wing airtanker.

Analysis of a Type 1 helitanker staffed at a location where there is not a current fixed-wing airtaker base did not occur.

The staffing of a Type 1 helicopter at all locations had a C+NVC that was less than not having any staffing of Type 1 helitankers but in all cases was significantly higher than the staffing of a Type 1 or 2 fixed-wing airtanker.

Comparison of acres burned results in a conclusion that the staffing of three Type 1, Category C, Limited helitankers is equivalent to the staffing of one to two Type 1 generic fixed-wing airtankers. Comparison of C+NVC results in a conclusion that the staffing of three Type 1, Category C, Limited helitankers results in a C+NVC that is about $1,600,000 more than the no airtanker or helitankers staffing alternative. Given the distance between areas of National Forest land used in this modeling effort, this last finding is understandable.

Southwest

The Region suggested locations for analysis of a Type 1 helitanker rather than a Type 1 or 2 fixed-wing airtanker were: Albuquerque and Prescott. Also suggested was Tucson which is not currently a fixed-wing airtanker base facility. For comparison purposes though, an alternative with a generic fixed-wing airtanker was analyzed. The staffing of the Type 1 helitanker had an average annual C+NVC of $9,791,719 more than the C+NVC for the fixed-wing airtanker.

Analysis of a Type 1 helitanker staffed at a location where there is not a current fixed-wing airtaker base did not occur.

The staffing of a Type 1 helicopter at all locations had a C+NVC that was less than not having any staffing of Type 1 helitankers but in all cases was significantly higher than the staffing of a Type 1 or 2 fixed-wing airtanker.

Comparison of acres burned results in a conclusion that the staffing of six Type 1, Category C, Limited helitankers is equivalent to the staffing of one to two Type 1 generic fixed-wing airtankers. Comparison of C+NVC results in a conclusion that the staffing of six Type 1, Category C, Limited helitankers is equivalent to the staffing of one Type 1 generic fixed-wing airtanker.

Summary – Use of Type 1 Helicopters for Initial Attack

Given all of the locations analyzed for staffing to support initial attack, the acres burned and C+NVC were less for the fixed-wing airtanker versus the Type 1 helitanker. As noted, the initial attack working circle radius of the Type 1 helitanker is about 90 miles. This limitation forces the fire business support for this platform to be restricted to, in general, one or two organizational units. The annual daily availability is based on days staffed. For a 100-day fire season, the total would be $1,480,821. This cost together with the unit mission cost, mainly flight time, needs to be recovered from reduced C+NVC that results from a reduced number of acres burned. The analysis showed that at all locations modeled, the savings in C+NVC could not be recovered within this limited working circle.

Use of Type 1 Helicopters for Extended Attack and Large Fire Support

For analysis and discussion of the use of Type 1 helicopters in extended attack and large fire support, refer to the Phase 2 analysis later in this report.

Analysis of Example Fixed-Wing Airtanker Platforms for Initial Attack

The purpose of this analysis is to define the attributes for future fixed-wing airtanker platforms which best serve the initial attack fire demand. Example platforms have been defined earlier in this document with required attributes for costs and performance.

Example Platforms

Table 17 is the same as Table 2 and summarizes the attributes of the example fixed-wing airtanker platforms provided to the study team.

Table 17 – Summary of Example Fixed-Wing Airtanker Platform Attributes

		Example Airtanker Platforms							
		S-3	Q-200	Q-400	BAe-146	C-130H Military	C-130H Private	DC-10	B747-200
Daily Avail.	Low	$4,434	$5,906	$17,670* $36,524#	$6,520	$5,729	$12,721	$43,109*	$56,812*
	Average	$5,052	$7,507	$18,226* $37,785#	$8,107	$6,797	$14,393	$51,058*	$66,617*
	High	$5,670	$9,107	$18,782* $39,046#	$9,695	$7,866	$16,065	$59,007*	$76,423*
Flight Rate	$/Hr	$3,530	$2,400	$4,280	$6,500	$5,700	$5,700	$10,500	$16,000
Retardant Load	Gallons	1,800	1,600	2,642	3,100	4,200	4,200	10,700	18,080
Water Load	Gallons							12,000	20,500
Climb Rate	Feet/minute	3,400	1,800	2,500	4,000	2,000	2,000	1,100	2,000
	Min/1000 ft	0.29	0.56	0.40	0.25	0.50	0.50	0.91	0.50
Speed below 10,000 feet	KIAS	250	237	250	250	250	250	250	250
Speed above 10,000 feet (Operated from FS bases)	KTAS	269	265	340	414	269	269	442	442
Speed above 10,000 feet (Operated from Large AC bases)	KTAS							528	490

* - Daily availability costs for the Q400, DC-10 and B747 are based on the aircraft having work outside of the airtanker contract (i.e. Costs are amortized by other customers outside of FS contract period).
\# - Airtanker FS contract bares the full annual cost.

Generic Airtanker Defined

The attributes for a generic exclusive-use Type 1 fixed-wing airtanker are based on a 100-day contract that were defined earlier and are repeated below.

- Size – 2,700 gallons
- Speed below 10,000 feet = 250 knots
- Speed above 10,000 feet = 323 knots
- Climb Rate = 0.67 minutes/1000 feet
- Daily Availability = $6500 per day
- Flight Rate = $4000 per hour
- Retardant Cost = $0.72 / gallon

Analysis Results

Analysis of platforms with a retardant load capacity less than 5,000 gallons was completed at five airtanker bases defined in the NATS2 study as being representative of the entire set of airtanker bases. Analysis of the platforms with a retardant load capacity greater than 5,000 pounds will be discussed in a later section. A narrative of results is provided in Appendix H.

AutoAT4 Modeling – Platform Capacity Less Than 5,000 Gallons - All GACCs

The results of runs at the five airtanker bases follows. The values in Tables 18a and 18c for each base are the difference between the candidate platform's C+NVC and the C+NVC for the generic future airtanker platform. Positive values indicate an improvement in C+NVC and negative values a reduction in C+NVC.

Table 18a – C+NVC Changes Between Generic Airtanker and Specified Platform With Travel Above and/or Below 10,000 feet, Which Ever is the Most Effective

Base	Example Airtanker Platforms					
	C-130H (Acquire from Military)	C-130H (Acquire Commercially)	BAe-146	S-3	Q-400	Q-200
Albuquerque	$4,432,150	$2,912,950	$163,916	-$2,718,677	-$2,675,973	-$3,659,745
Boise	$1,445,267	-$73,933	$444,565	-$1,132,427	-$2,593,072	-$1,840,177
Klamath Falls	$15,385,627	$13,186,727	$1,189,758	-$2,515,558	-$2,616,948	-$4,290,709
Phoenix	$2,408,303	$899,103	-$198,652	-$4,061,674	-$2,665,819	-$7,504,611
Redding	$12,847,447	$11,328,247	-$105,894	-$1,785,976	-$2,521,701	-$3,115,234

Table 18b – Ordinate Ranking of Platforms

Albuquerque	1	2	3	5	4	6
Boise	1	3	2	4	6	5
Klamath Falls	1	2	3	4	5	6
Phoenix	1	2	3	5	4	6
Redding	1	2	3	4	5	6
Average	1.0	2.2	2.8	4.4	4.8	5.6

WIRAS Modeling– Platform Capacity Less Than 5,000 Gallons in the Northwest GACC

At this time, WIRAS is built to run only on the Northwest GACC. Results where several of the candidate future airtanker platforms are staffed are shown in Table 19. Alternative K1L1R2M1 staffs future generic airtankers as follows: 1-Klamath Falls, 1-LaGrande, 2-Redmond and 1-Moses Lake. The staffing for each candidate airtanker was the same as for alternative K1L1R2M1 replacing the generic future platform with the candidate platform.

Table 19 – C+NVC Difference Between Five Generic Airtankers and Five of Each Specified Platform

Base	Example Airtanker Platforms					
	C-130H (Acquire from Military)	C-130H (Acquire Commercially)	BAe-146	S-3	Q-400	Q-200
Difference	$3,877,965	$79,965	-$409,203	-$6,518,502	-$7,923,955	-$9,101,272
Ordination	1	2	3	4	5	6

Summary of Results - Platform Capacity Less Than 5,000 Gallons

The ordination of the example platforms analyzed is the same regardless of cruise speed. The platform ordination using WIRAS modeling is the same as the ordination using AutoAT4 (NFMAS) modeling.

Table 20

Ordination of Example Platforms Using AutoAT4 and WIRAS Modeling
1. C-130H (Acquire from Military) 2. C-130H (Commercial Purchase) 3. BAe-146 (Commercial Purchase) 4. S-3 (Acquire from Military) 5. Q-400 (Commercial Purchase) 6. Q-200 (Commercial Purchase)

In general, the C-130H (Acquire from Military), the C-130H (Commercial Purchase) and the BAe-146 are more economically efficient than the generic current fixed-wing airtanker. This indicates that staffing of these platforms would not decrease the suggested number of platforms documented earlier. However, the remaining three platforms are less economically efficient than the generic current fixed-wing airtanker and staffing of these would most likely result in a reduced number of platforms that can be justified using economic efficiency criteria. Two of the top three platforms do not assume the use of surplus military platforms and can be justified based on a positive benefit to cost ratio.

Summary of Results - Platform Capacity Greater Than 5000 Gallons - All GACCs

The two platforms proposed with capacity greater than 5,000 gallons of retardant or water was the DC-10 and the B-747-200B. Prototypes of both platforms have been developed and some testing has occurred (Figures 17 and 18).

Figure 17 – DC-10

Figure 18 – B-747-200B

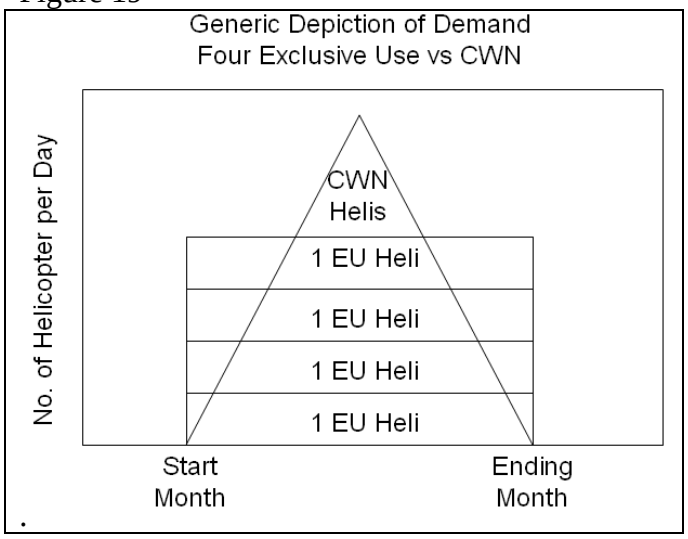
The design of the National Type 1 and 2 fixed-wing airtanker fleet is to support primarily initial attack using an interchangeable, interoperable combination of aircraft platforms and airtanker bases. These the aircraft proposed can operate only from a very limited number of airtanker bases (12%) (Table 6). The developer of the B-747-200B has specifically developed a "turn-key" operation for the loading and deployment of the aircraft with retardant for defined airports (Table 8).

Operational guidelines for the use of this size of aircraft over incidents have not been explored or defined. Further study and analysis needs to occur beyond this report to define the operating conditions under which these aircraft might be used in a cost efficient setting.

Analysis of Phase 2 – Large Fire Support

The model for Phase 2 is the National Study of Type 1 and 2 Helicopters to Support Large Fire Suppression (1992) (NHeli1) (Figures 19). Initial staffing from the early 1990's through 2002 was for only Type 2 helicopters. Starting in 2003, additional Type 2 helicopters and some Type 1 helicopters were staffed when the large fixed-wing airtanker fleet was not fully operational. Some of this additional staffing was for initial attack purposes, but this additional staffing of exclusive-use helicopters satisfied large fire suppression support requirements.

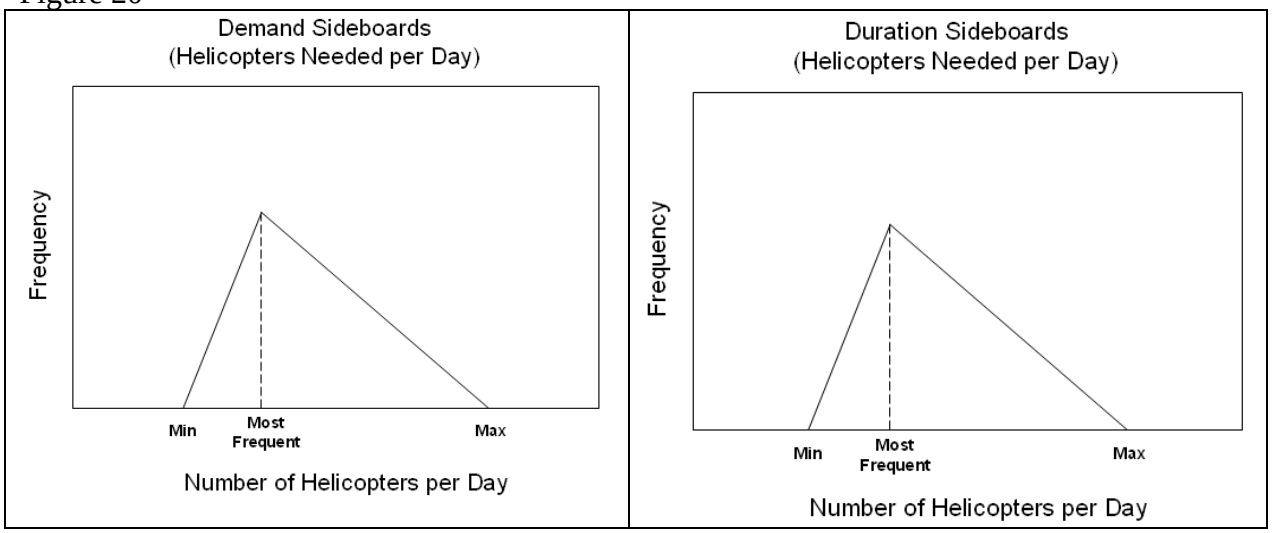
Figure 19



TriSim Analysis Model

Some innovative operations research and statistical analysis techniques where developed and used to examine the most efficient combination of CWN and exclusive-use helicopters. Two techniques were needed (Figure 20). One technique was used to perform statistical analysis on the demand profile produced for the past year's reports. Reference will be made to this "demand simulation model." A second technique was then used to examine the tradeoff in costs to fill this demand with CWN and exclusive-use contracts. Reference will be made to this "cost efficiency model."

Figure 20



Demand

Demand for Type 1 helicopters to support large fire suppression has significantly increased since the first study (NHeli1) (Table 21). Table 22 documented the recent demand for Type 2 helicopters.

Table 21 – Helicopters Days per Year for Type 1 Helicopters

1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
245	360	180	N/A	1530	2350	176	946	248	N/A	1060	2464	2059	3536	3130
Average = 262				Average = 775						Average = 2,450				

Demand for Type 1 or 2 helicopters to support large fire suppression can be described with two parameters, daily number of helicopters in use and number of days in duration. Each of these parameters can vary. To simulate this variance, the demand simulation model was built utilizing Triangular Probability Distributions and random simulation theory.

Table 22 - Helicopters Days per Year for Type 2 Helicopters

1999	2000	2001	2002	2003
2,698	4,334	3,070	3,932	3,503
Average = 3,507				

The study committee documented demand for 1999 - 2003 and used their experience to determine the minimum, most frequent and maximum values for these two demand parameters. Graphs (Figures 22-31) shown in the report were used to estimate an aggregate demand for all GACCs in the lower 48 states. The white lines in the graphs are plotting anomalies from the plotting program.

The demand parameter "sideboards" were then used to do 2,000 random simulations of this demand. The result of the demand simulation model was a probability distribution of demand including the mean. The mean was examined by the committee and the experts comparing the results to the 1999-2003 demand. Adjustments were made in the minimum, most frequent and maximum values until the committee was satisfied that these values were valid. Demand simulation model results modified by committee consensus resulted in agreement to use the following annual helicopter days in the study.

Analysis Results – Type 1 Helicopters

To explain the modeling process, the Type 1, Category, Limited platform will be used. Table 23 defines the demand and duration parameters that were developed to simulate the five-year average of 2,405 helicopter days per year. Table 24 defines the cost assumptions assuming the exclusive-use contract was for 90 days. The daily use hours is based on data from the agency's AMIS database for 1998 through 2003.

Table 23 – Demand and Duration Parameters – Type 1

	Demand Profile*	
	Duration (days)	Peak (number/day)
Minimum	75	10
Mode	120	50
Maximum	155	60
Average Helicopter days = 2,464		

Table 24 – Cost Assumptions, Type 1, Category C. Limited. EU has a 90-day contract

	Hourly Flight Rate	Daily Availability	Ave Daily Use (hrs)	Module Cost	Contract Cost	Daily Cost
Call-When-Needed	$4,850	$29,399	4.0	$817	N/A	$54,578
Exclusive-Use	$4,947	$14,150	4.0	$65,821	$1,339,321	$19,788

Figure 21 displays the results of the tradeoff analysis. The optimum number of exclusive-use contracts is 27, which would result in an annual saving over the 100% staffing with CWN helicopters by $34,932,793. A summary of the costs and benefits is documented in Table 25. Savings are approximate as the modeling is stochastic and the exact savings is dependent on specific demand assumptions per run.

Figure 21 - Annual Expected Type 1 Limited Helicopter Costs for Alternative Levels of Contract Helicopters

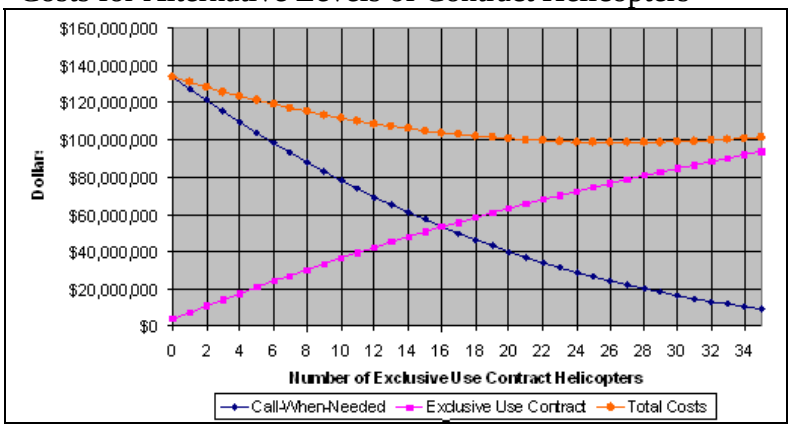


Table 25 – Summary of Cost & Savings -Type 1, Cat. C, Limited, EU 90 day contract.

No EU Helis Staffed	CWN Cost	EU Cost	Total	Marginal Benefit	Approximate Cumulative Savings
0	$133,518,600	$0	$133,518,600		
1	$127,226,342	$3,620,682	$130,847,023	$2,671,576	$2,671,576
2	$121,104,134	$7,179,709	$128,283,843	$2,563,180	$5,234,757
3	$115,151,977	$10,677,082	$125,829,059	$2,454,784	$7,689,541
4	$109,369,870	$14,112,800	$123,482,670	$2,346,389	$10,035,930
5	$103,757,814	$17,486,864	$121,244,678	$2,237,993	$12,273,922
6	$98,315,808	$20,799,273	$119,115,081	$2,129,597	$14,403,519
7	$93,043,852	$24,050,027	$117,093,880	$2,021,201	$16,424,720
8	$87,941,948	$27,239,127	$115,181,075	$1,912,805	$18,337,525
9	$83,010,093	$30,366,573	$113,376,666	$1,804,409	$20,141,934
10	$78,248,289	$33,432,363	$111,680,653	$1,696,013	$21,837,947
11	$73,656,536	$36,436,500	$110,093,036	$1,587,617	$23,425,564
12	$69,234,408	$39,379,135	$108,613,543	$1,479,493	$24,905,057
13	$64,980,928	$42,260,625	$107,241,553	$1,371,990	$26,277,047
14	$60,895,017	$45,081,360	$105,976,377	$1,265,176	$27,542,223
15	$56,975,065	$47,841,923	$104,816,988	$1,159,389	$28,701,612
16	$53,219,198	$50,542,995	$103,762,193	$1,054,795	$29,756,407
17	$49,625,156	$53,185,395	$102,810,551	$951,642	$30,708,049
18	$46,189,950	$55,770,206	$101,960,156	$850,395	$31,558,444
19	$42,910,982	$58,298,370	$101,209,352	$750,804	$32,309,247
20	$39,785,965	$60,770,717	$100,556,682	$652,670	$32,961,918
21	$36,812,490	$63,188,120	$100,000,610	$556,072	$33,517,990
22	$33,987,854	$65,551,559	$99,539,413	$461,197	$33,979,186
23	$31,309,258	$67,862,049	$99,171,307	$368,107	$34,347,293
24	$28,773,389	$70,120,790	$98,894,180	$277,127	$34,624,420
25	$26,376,749	$72,329,052	$98,705,801	$188,378	$34,812,798
26	$24,115,750	$74,488,135	$98,603,885	$101,916	$34,914,714
27	**$21,986,275**	**$76,599,533**	**$98,585,807**	**$18,078**	**$34,932,793**
28	$19,984,366	$78,664,678	$98,649,044	-$63,237	

Figure 22 – 1999 Lower 48 States Type 1 Helicopter Use

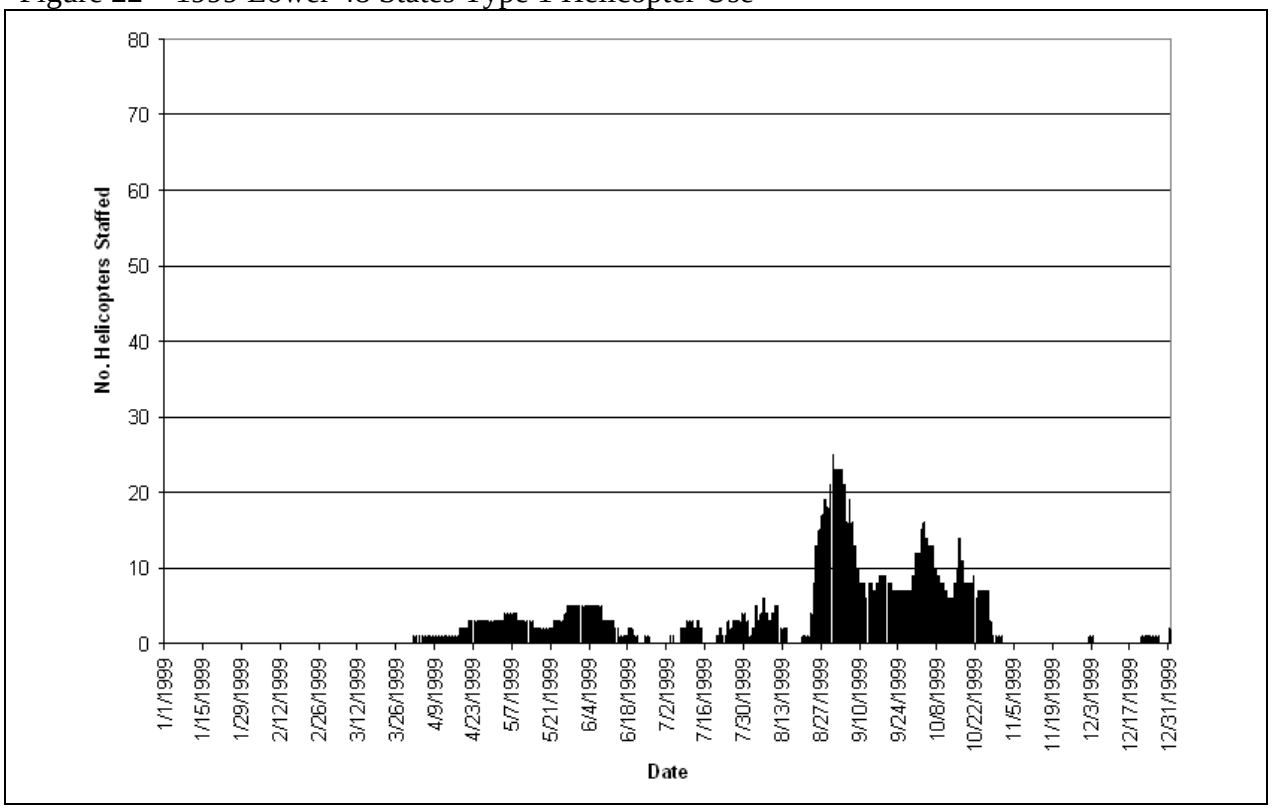


Figure 23 - 1999 Lower 48 States Type 2 Helicopter Use

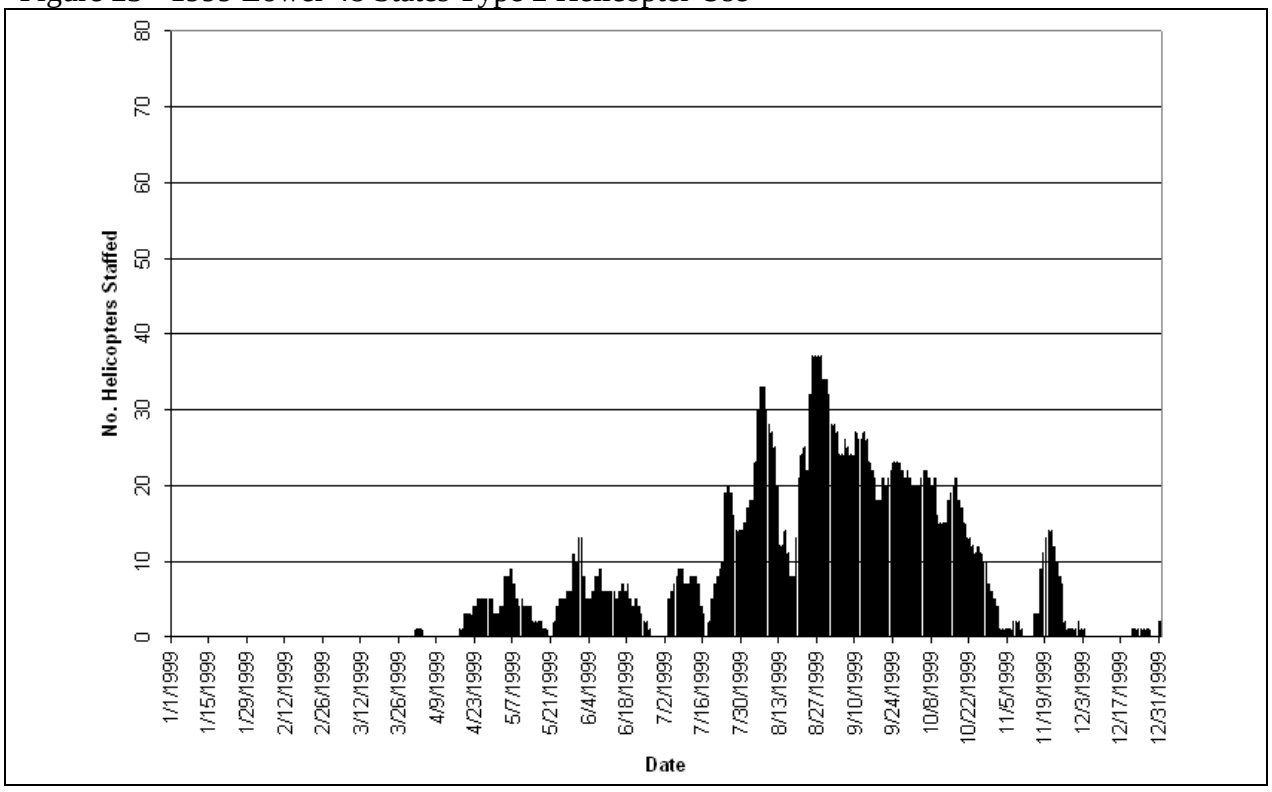


Figure 24 – 2000 Lower 48 States Type 1 Helicopter Use

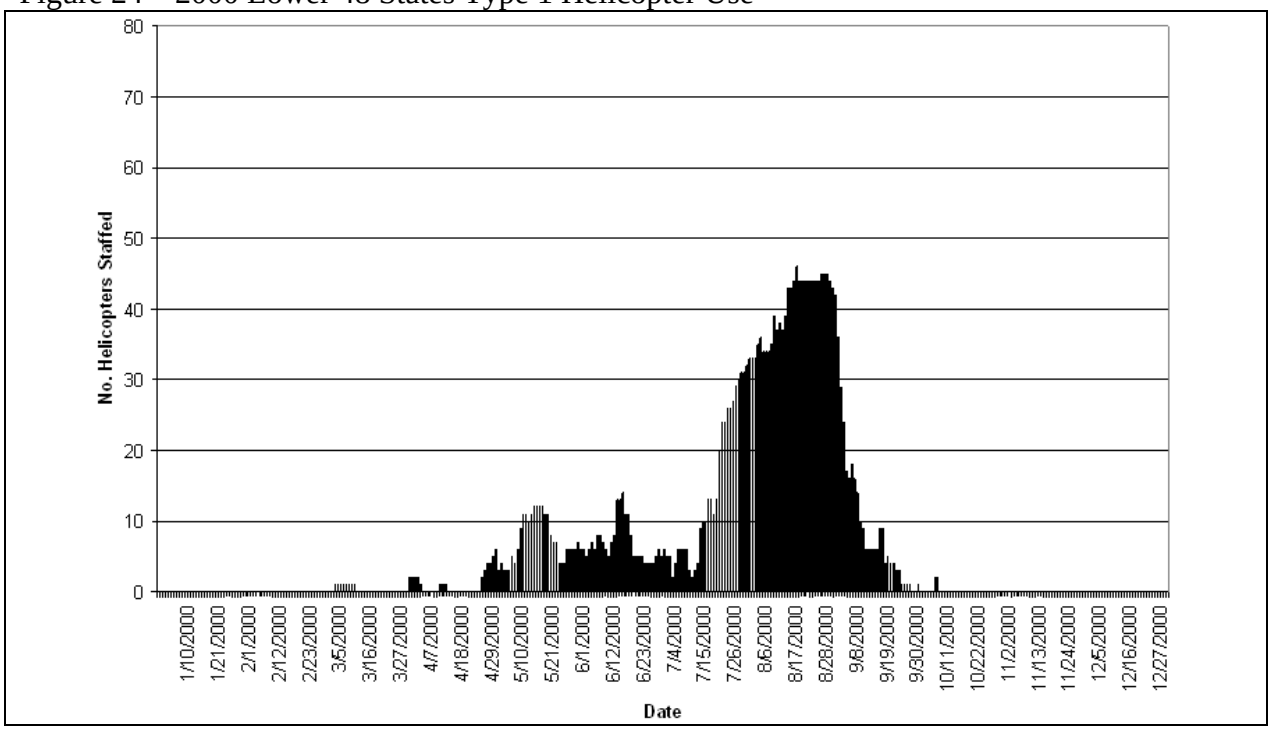


Figure 25 - 2000 Lower 48 States Type 2 Helicopter Use

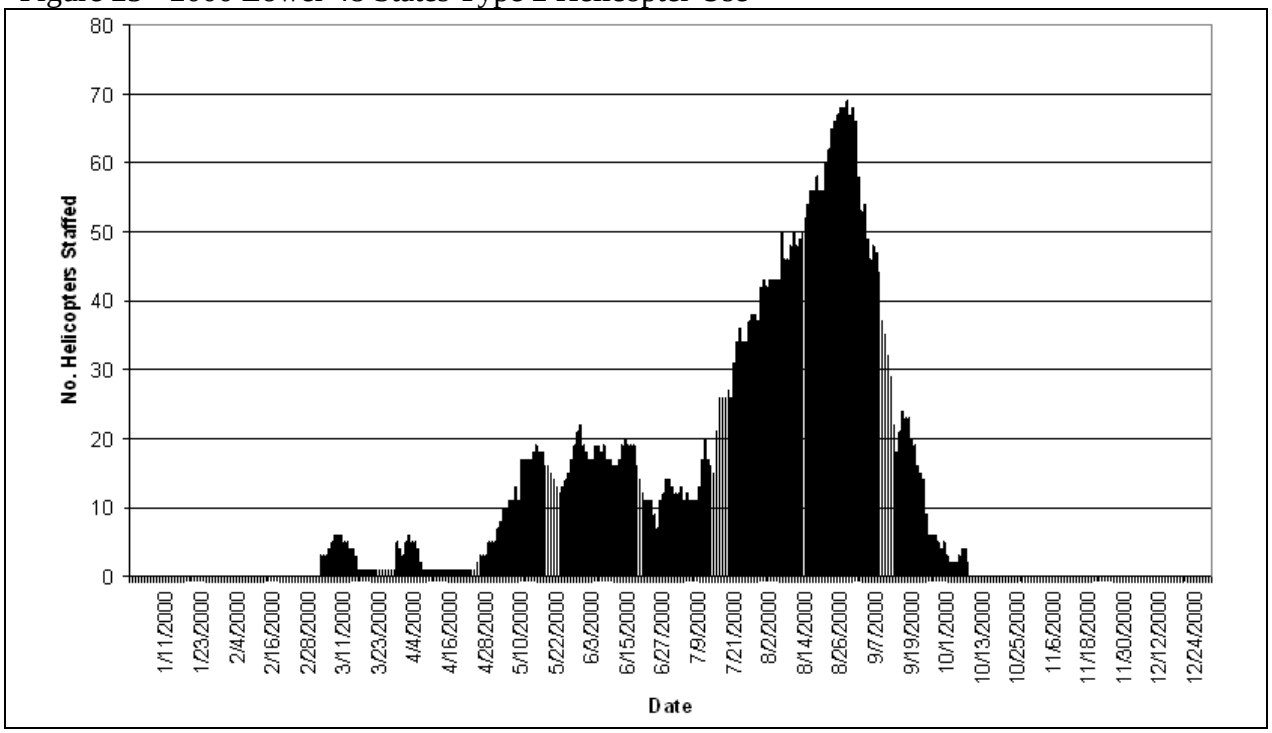


Figure 26 – 2001 Lower 48 States Type 1 Helicopter Use

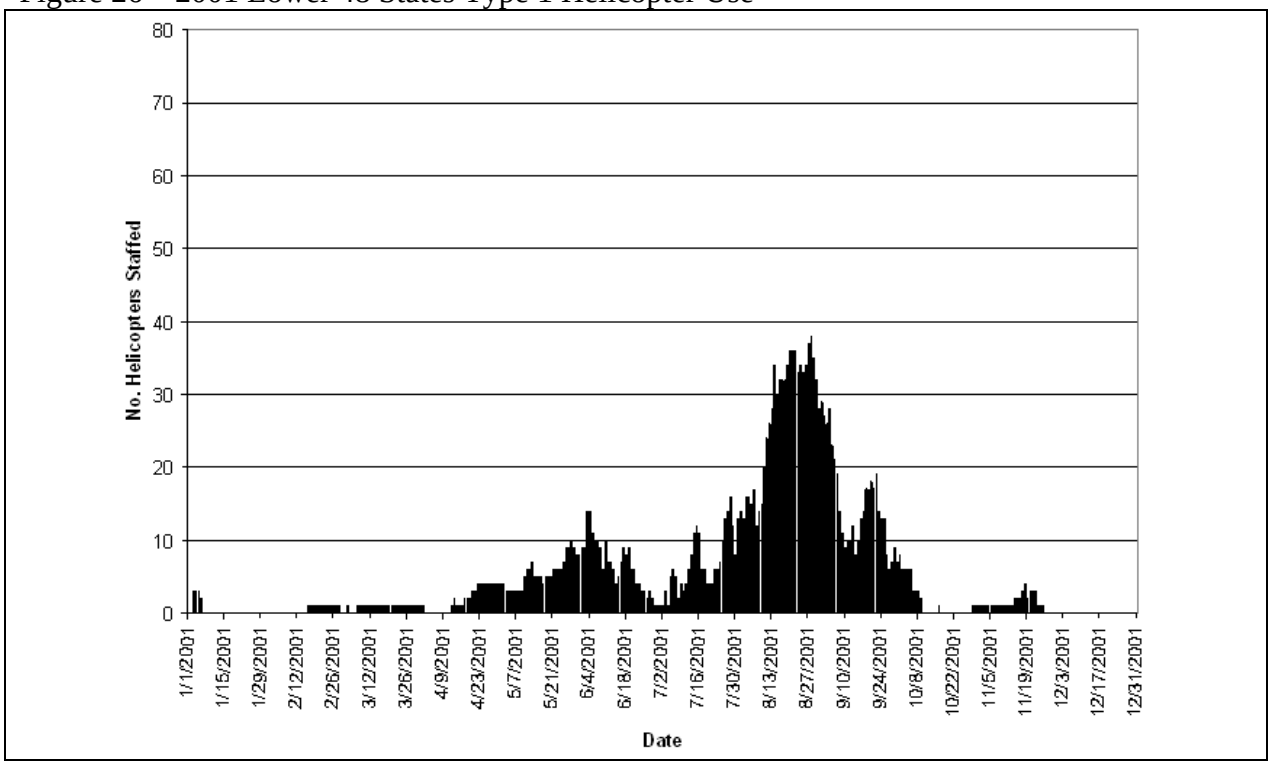


Figure 27 – 2001 Lower 48 States Type 2 Helicopter Use

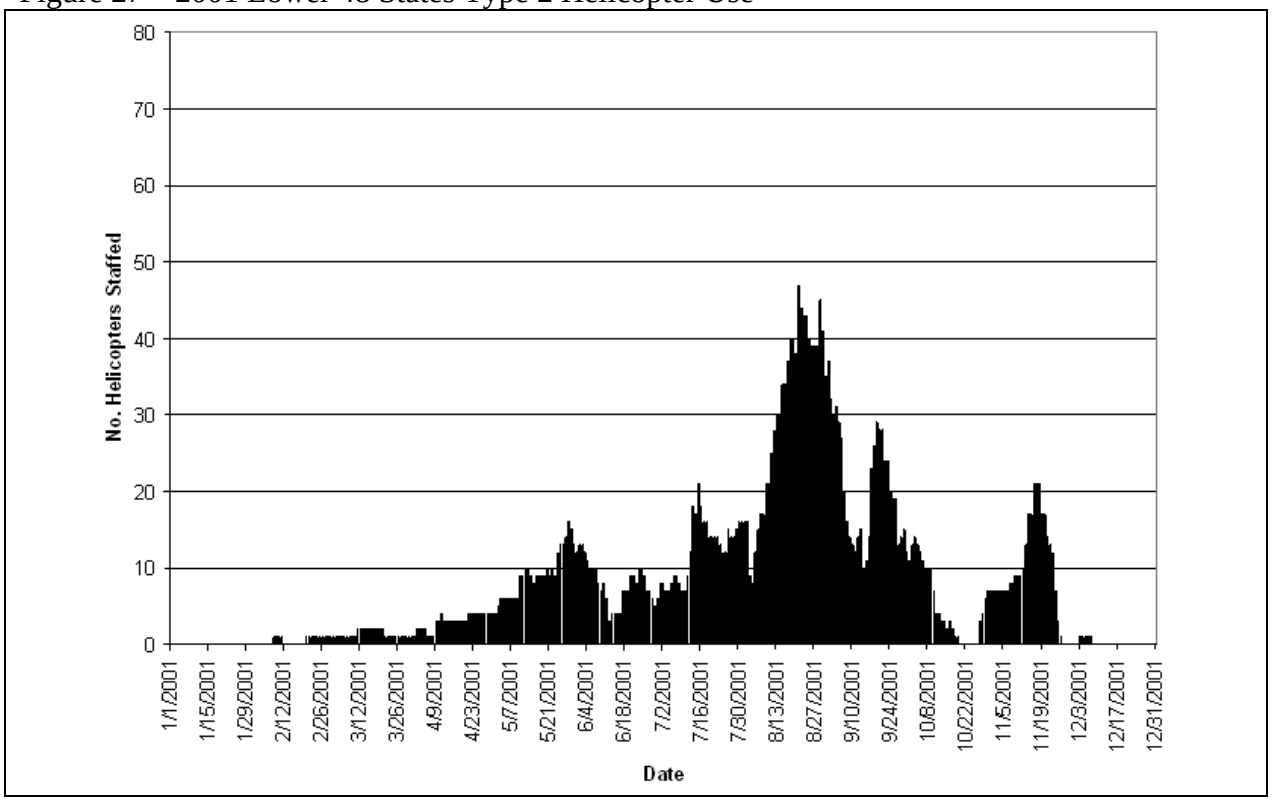


Figure 28 – 2002 Lower 48 States Type 1 Helicopter Use

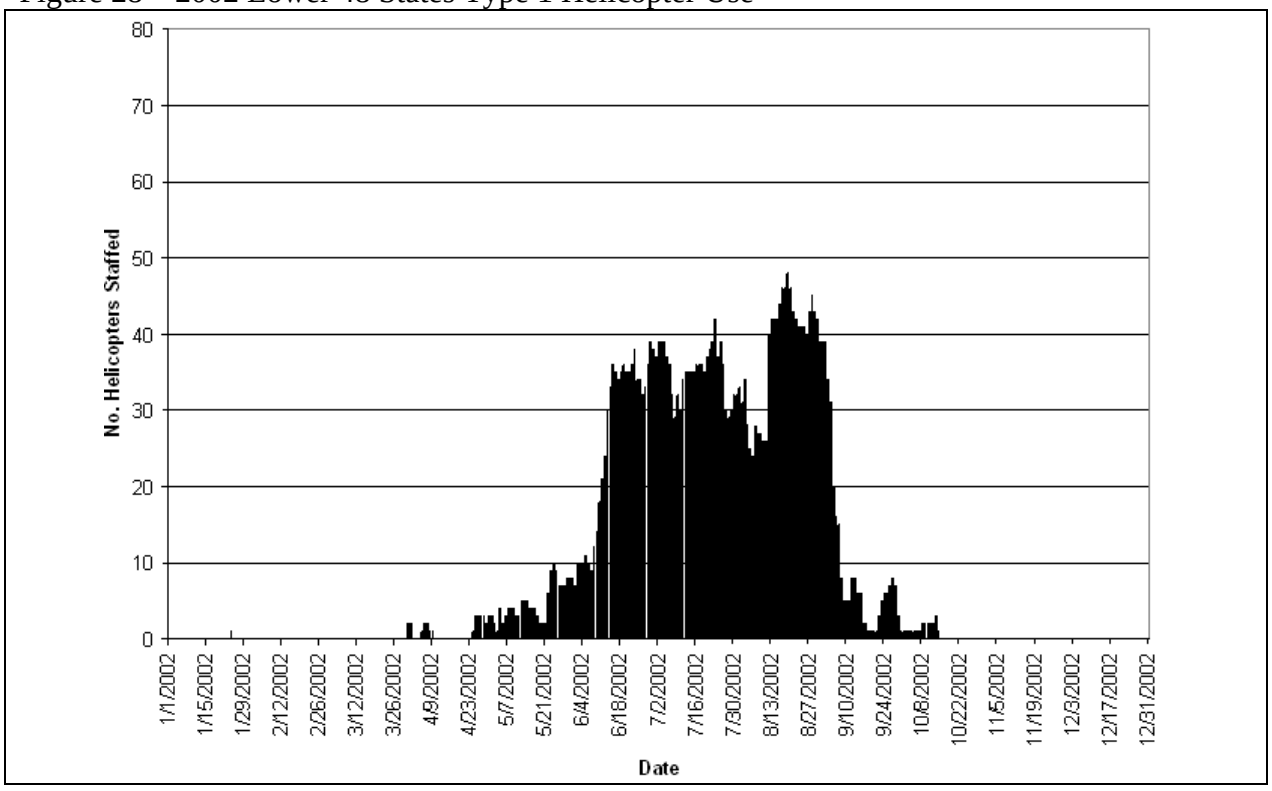


Figure 29 - 2002 Lower 48 States Type 2 Helicopter Use

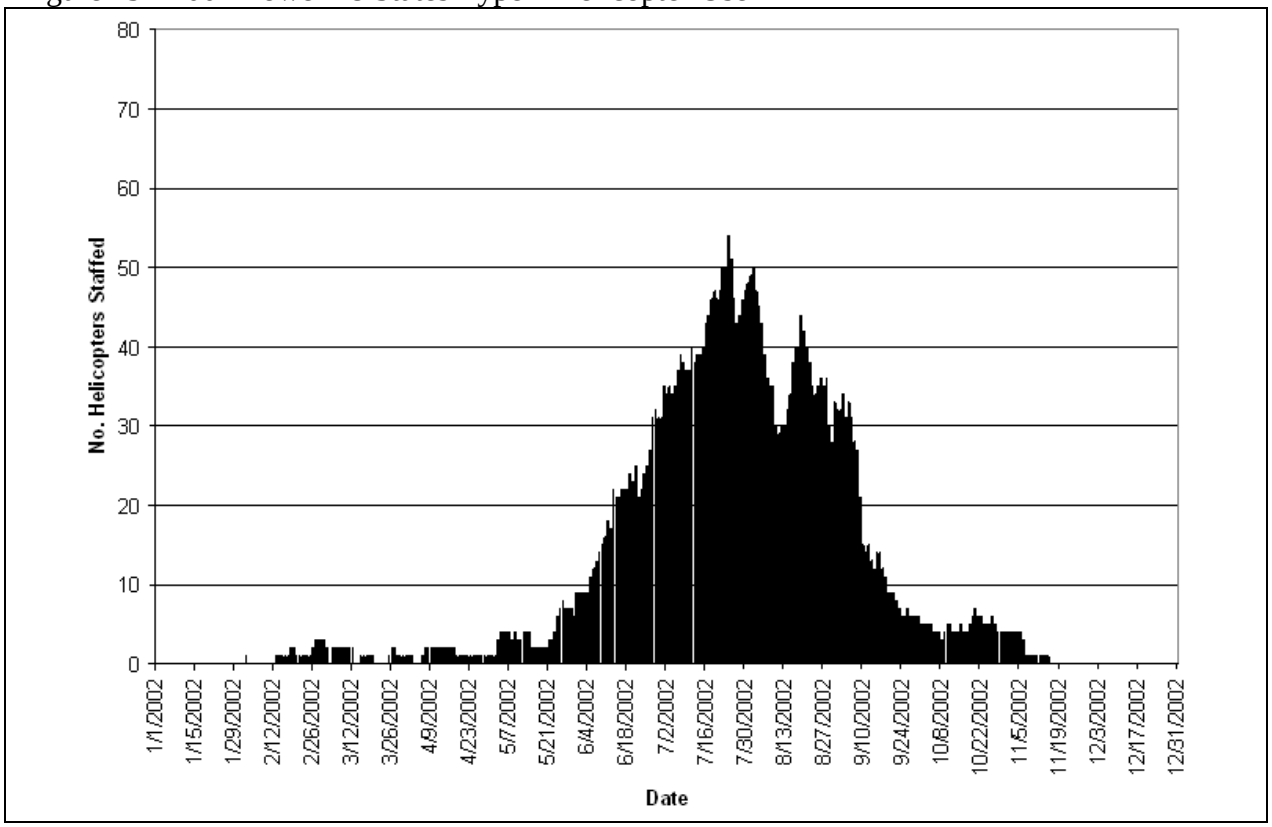


Figure 30 – 2003 Lower 48 States Type 1 Helicopter Use

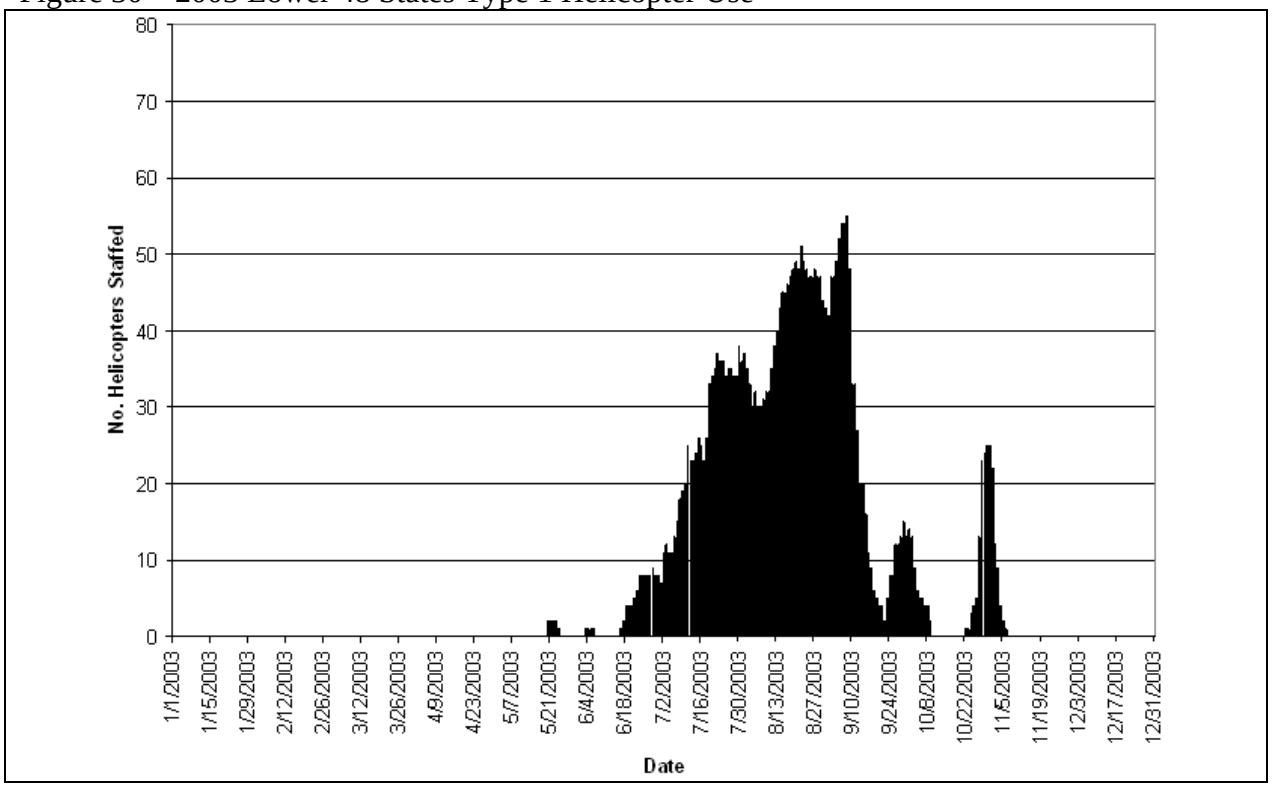


Figure 31 – 2003 Lower 48 States Type 2 Helicopter Use

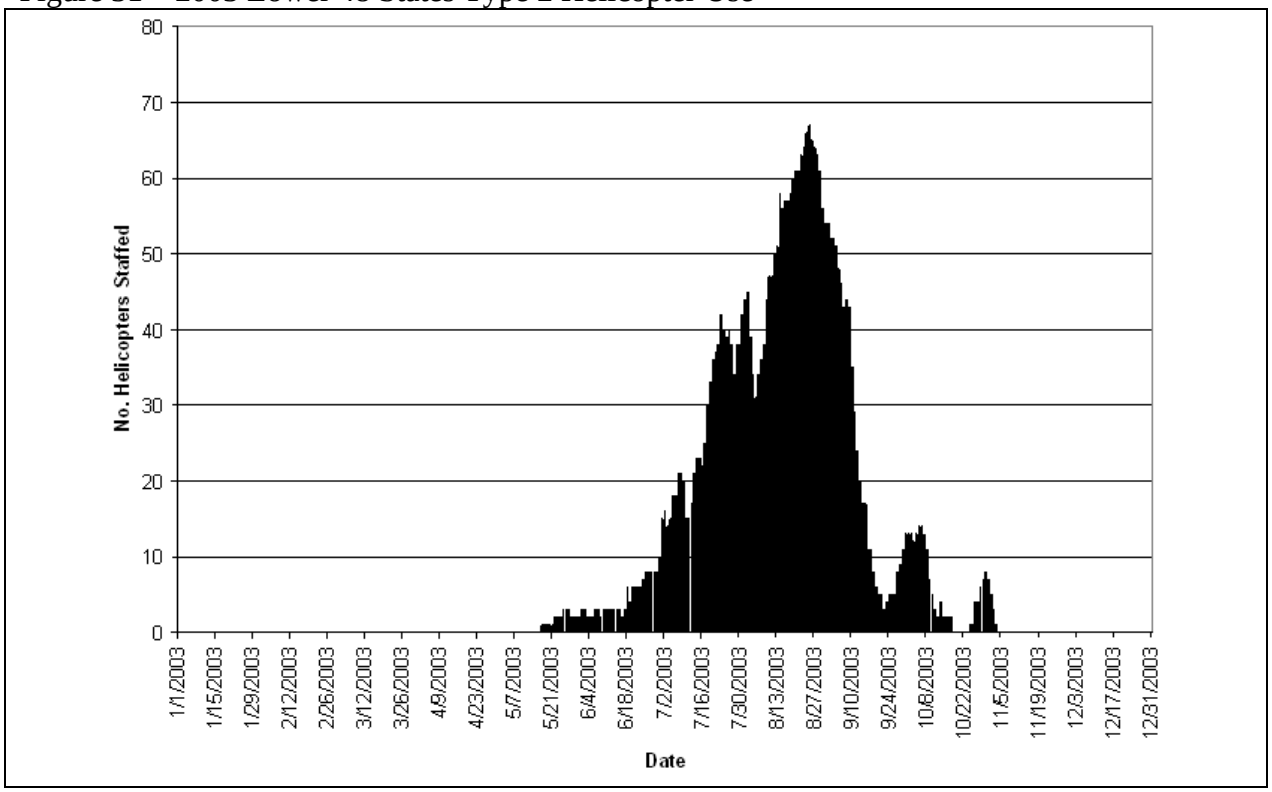


Table 26 contains a summary of the results of modeling for Type 1 helicopters. Savings are approximate as the modeling is stochastic and the exact savings is dependent on specific demand assumptions per run.

Table 26 - Summary of the Results of Modeling for Type 1 Helicopters

Helicopter Specs	% Demand*	No. EU Contracts Based on Economically Efficiency	Approximate Net Savings Over 100% CWN Staffing
Limited, Category C	100%	27	$34,932,293
Limited, Category B	100%	17	$6,011,090
Limited, Category C	**34%**	**9**	**$11,086,398**
Limited, Category B	**67%**	**11**	**$5,376,400**
Standard, Category C	100%	26	$36,392,915
Standard, Category B	100%	29	$19,333,064
* - Average annual demand is 2450 helicopter days			

Table 27 displays the number of exclusive-use helicopters based on percent of total demand divided between Category B and C, Limited, Type 1 helicopters.

Table 27 – Summary of Optimum Number of Limited, Type 1 Exclusive-Use Contracts by Category Based on Economic Efficiency

Cat.	Demand Level										
C	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0	3	5	8	11	13	16	18	21	24	27
B	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
	17	15	14	12	10	8	7	5	3	2	0
All	17	18	19	20	21	21	23	23	24	26	27

Table 28 displays the number of exclusive-use helicopters based on percent of total demand divided between Category B and C, Standard, Type 1 helicopters.

Table 28 – Summary of Optimum Number Standard Type 1 Exclusive-Use Contract by Category Based on Economic Efficiency

Cat.	Demand Level										
C	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	0	2	5	8	10	13	16	18	21	22	26
B	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
	29	26	24	20	17	15	12	9	6	3	0
All	29	28	19	28	27	28	28	27	27	25	26

Analysis Results – Type 2 Helicopters

To explain the modeling process, the Type 2, Category A, Limited platform will be used. Table 29 defines the demand and duration parameters that were developed to simulate the five-year average of 3,433 helicopter days per year. Table 30 defines the cost assumptions assuming the exclusive-use contract was for 90 days. The daily use hours is based on data from the agency's AMIS database for 1998 through 2003.

Table 29 – Demand and Duration Parameters – Type 2

	Demand Profile*	
	Duration (days)	Peak (number/day)
Minimum	75	10
Mode	130	68
Maximum	160	95
Average Helicopter days = 3,468		

Table 30 – Cost Assumptions, Type 2, Category A. Limited. EU has a 90 Day Contract

	Hourly Flight Rate	Daily Availability	Ave Daily Use (hrs)	Module Cost	Contract Cost	Daily Cost
Call-When-Needed	$1,196	$5,745	3.4	$817	N/A	$11,691
Exclusive Use	$1,159	$3,273	3.4	$65,821	$360,391	$3,941

Figure 32 displays the results of the tradeoff analysis. The optimum number of exclusive-use contracts is 33, which would result in an annual saving over the 100% staffing with CWN helicopters by $9,033,228. A summary of the costs and benefits is documented in Table 31. Savings are approximate as the modeling is stochastic and the exact savings is dependent on specific demand assumptions per run.

Figure 32 - Annual Expected Type 2, Category A, Limited Helicopter Costs for Alternative Levels of Contract Helicopters

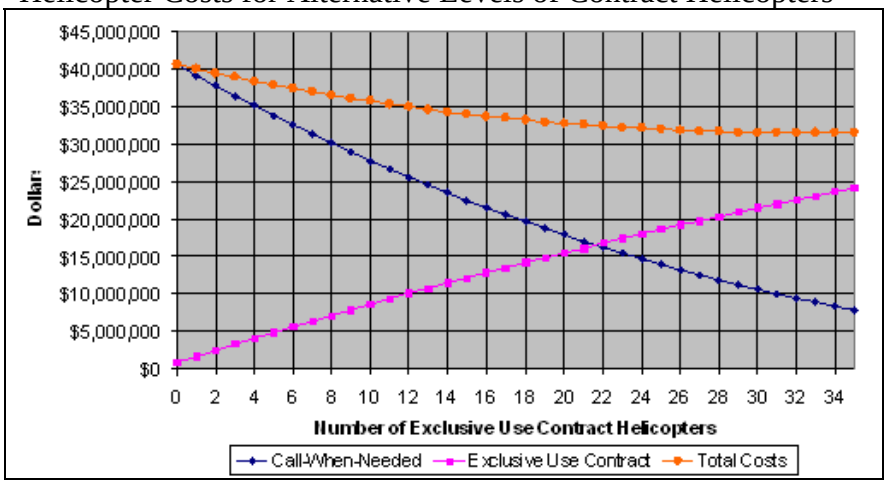


Table 31 – Summary of Cost and Savings for Type 2, Category A, Limited with EU 90 Day Contract.

No EU Helis Staffed	CWN Cost	EU Cost	Total	Marginal Benefit	Approximate Cumulative Savings
0	$40,545,498	$0	$40,545,498		
1	$39,139,383	$834,330	$39,973,713	$571,785	$571,785
2	$37,762,103	$1,658,941	$39,421,045	$552,669	$1,124,453
3	$36,413,658	$2,473,833	$38,887,492	$533,553	$1,658,006
4	$35,094,049	$3,279,006	$38,373,055	$514,437	$2,172,443
5	$33,803,274	$4,074,461	$37,877,735	$495,321	$2,667,763
6	$32,541,334	$4,860,196	$37,401,530	$476,205	$3,143,968

Table 31 – Summary of Cost and Savings for Type 2, Category A, Limited with EU 90 Day Contract.

No EU Helis Staffed	CWN Cost	EU Cost	Total	Marginal Benefit	Approximate Cumulative Savings
7	$31,308,230	$5,636,212	$36,944,441	$457,089	$3,601,057
8	$30,103,960	$6,402,509	$36,506,469	$437,973	$4,039,029
9	$28,928,526	$7,159,087	$36,087,612	$418,856	$4,457,885
10	$27,781,927	$7,905,946	$35,687,872	$399,740	$4,857,626
11	$26,664,162	$8,643,085	$35,307,248	$380,624	$5,238,250
12	$25,575,204	$9,370,516	$34,945,720	$361,527	$5,599,778
13	$24,514,949	$10,088,272	$34,603,221	$342,499	$5,942,277
14	$23,483,266	$10,796,398	$34,279,664	$323,557	$6,265,834
15	$22,479,960	$11,494,959	$33,974,919	$304,745	$6,570,579
16	$21,504,787	$12,184,038	$33,688,825	$286,094	$6,856,673
17	$20,557,468	$12,863,728	$33,421,196	$267,629	$7,124,302
18	$19,637,727	$13,534,123	$33,171,850	$249,346	$7,373,648
19	$18,745,203	$14,195,344	$32,940,547	$231,303	$7,604,951
20	$17,879,553	$14,847,508	$32,727,061	$213,487	$7,818,437
21	$17,040,544	$15,490,692	$32,531,236	$195,825	$8,014,262
22	$16,227,864	$16,125,001	$32,352,865	$178,370	$8,192,633
23	$15,441,134	$16,750,564	$32,191,698	$161,167	$8,353,800
24	$14,679,923	$17,367,526	$32,047,449	$144,249	$8,498,049
25	$13,943,904	$17,975,996	$31,919,900	$127,548	$8,625,598
26	$13,232,658	$18,576,117	$31,808,775	$111,126	$8,736,723
27	$12,545,713	$19,168,046	$31,713,759	$95,015	$8,831,739
28	$11,882,744	$19,751,895	$31,634,639	$79,121	$8,910,859
29	$11,243,351	$20,327,797	$31,571,148	$63,491	$8,974,350
30	$10,627,108	$20,895,896	$31,523,004	$48,143	$9,022,493
31	$10,033,665	$21,456,311	$31,489,975	$33,029	$9,055,523
32	$9,462,646	$22,009,167	$31,471,813	$18,163	$9,073,685
33	**$8,913,680**	**$22,554,590**	**$31,468,270**	**$3,543**	**$9,077,228**
34	$8,386,421	$23,092,697	$31,479,117	-$10,848	

Table 32 contains a summary of the results of modeling for Type 2 helicopters. Savings are approximate as the modeling is stochastic and the exact savings is dependent on specific demand assumptions per run.

Table 32 - Summary of the Results of Modeling for Type 2 Helicopters

Helicopter Specs	% Demand*	No. EU Contracts Based on Economically Efficiency	Approximate Net Savings Over 100% CWN Staffing
Limited, Category A	100%	33	$9,077,228
Standard, Category A	100%	28	$8,347,416
* - Average annual demand is 3,433 helicopter days			

Objective 2-3

Determine additional staffing requirements for Type 1 and 2 fixed-wing airtankers and Type 1 and 2 helicopters that were recommended for staffing in Phase 1 due to expected unavailability attributed to large fire suppression support needs.

Findings for Objective 2-3

Three additional Type 1 fixed-wing airtankers were added to the fleet in "NATS1" to support the draw down from large fire support. This conclusion remains reasonable for the foreseeable future. Phase 1 did not identify additional Type 1 and 2 helicopters to support large fires. Additionally, the Phase 2 analysis supports significant helicopter support for large fires. Hence, there are no further resources identified here.

Summary of Findings and Comments

Listed below is a summary of finding and comments based on lessons learned as this study was conducted.

1. Fixed-wing Type 1 and 2 airtankers are justified as an integral component of the initial attack resources for land management agencies.

2. Due to differences in speed, tank size, effectiveness of long term versus short term retardants and daily availability cost, Type 1 and 2 fixed-wing airtankers are significantly more efficient in fireline building capability than Type 1 Limited helitankers. Comparison of acres burned and cost plus net value change (C+NVC) results in a conclusion that the staffing of eight Type 1, Category C, Limited helitankers is equivalent to the staffing of one to two Type 1 generic airtankers.

3. The ability to locate helibases in close proximity to the large fire incidents and to provide long term retardant at these helibases favors the use of Type 1 and 2 helitankers over Type 1 and 2 fixed-wing airtankers for large fire support.

4. Future fixed-wing airtanker platforms can be procured in the private sector and developed into airtankers that provide service in a cost efficient manner. Use of excess military platforms is also an option but not a requirement.

5. Future fixed-wing airtanker platforms of 3,000 to 5,000 gallons continue to show significantly greater economic benefit over smaller capacity platforms.

6. Due to the proximity of fires to the currently staffed set of airtanker bases, there are few instances where it is more effective for fixed-wind airtankers to climb to above 10,000 feet MSL in transit to a fire. As such, speed capability when traveling above 10,000 feet MSL provides only a minor effect on economic efficiency.

7. Based on the collective results of analysis in example fixed-wing airtankers, desirable design specifications for a future fixed-wing airtanker platform are as follows:

    - Is turbine-powered
    - Speed traveling under 10,000 feet is 250 KIAS
    - Speed traveling above 10,000 feet 350-400 KTAS is desirable
    - Retardant carrying capacity 4,000 to 5,000 gallons
    - Ability to operate from 80-90% of the existing airtanker bases

    The analysis also shows a positive economic benefit given the costs that follow:

    - Has a flight rate of $6,000 per hour or less
    - Has daily availability of $9,500 per day or less based on a 100-day contract

8. The modified analytical methods used in this study appropriately address the issues raised by reports critical of past National Studies (e.g. NATS1, NATS2, etc.) and provide supportable and confident results.

9. Significant savings in suppression costs for large fires can be achieved by the use of exclusive-use contracts for both Type 1 and Type 2 helicopters. The staffing of these contracts at locations where they can also support initial attack, when available, provides an added benefit.

10. The agencies should consider changes to the report keeping process at the National level to support the rapid attainment of the data needed to update this and other studies.

11. The TriSim model can be applied to study tradeoffs of alternative methods of procuring other fire management resources such as 20-person crews.

12. In the early 1990s, the Forest Service developed a report, which provides a blueprint for the conducting of National studies, includes an oversight group to manage the process. Revisiting that report and oversight process would provide timely guidance.

References

Kirsh, Joe. 1998. 1997 National Type 1 Helicopter Study. Technical Fire Management Final Paper. Washington Institute, Duvall, WA.

USDA Forest Service. NFES 1878. January 2002. Interagency Helicopter Operations Guide.

USDA Forest Service. NFES 2168. 1999-2000-2001, Interagency Call-When-Needed Helicopters.

USDA Forest Service. NFES 2168. 2002-2003-2004, Interagency Call-When-Needed Helicopters.

USDA Forest Service. NFES 2168. 2005-2006-2007 National Call-When-Needed Helicopters.

USDA Forest Service and Department of Interior. 1992. National Study of Type 1 and 2 Helicopters to Support Large Fire Suppression.

USDA Forest Service and Department of Interior. 1995. Phase 1, National Study of Air Tankers to Support Initial Attack and Large Fire Suppression.

USDA Forest Service and Department of Interior. 1996. Phase 2, National Study of Air Tankers to Support Initial Attack and Large Fire Suppression.

USDA Forest Service and Department of Interior. 1998. National Study of Tactical Aerial Resource Management to Support Initial Attack and Large Fire Suppression.

USDA Forest Service and Department of Interior. 1998. National Aerial Delivered Firefighter Study.

USDA Forest Service and Department of Interior. 2002. Federal Aerial Firefighting: Assessing Safety and Effectiveness. Blue Ribbon Panel Report to the Chief, USDA Forest Service and Director, USDI Bureau of Land Management.

This page intentionally left blank.

Appendix A

Study Committee and Steering Committee Membership

This page intentionally left blank.

Study Group Members

Brian Booher
Bighorn Information Systems, Inc.
1503 S. Coast Drive
Suite 317
Costa Mesa, California 92626
Phone: 714-557-5961
Email: bbooher@bighorn.info

Donald Carlton
Fire Program Solutions, LLC
17067 Hood Court
Sandy, Oregon 97055
Phone: 503-668-1390
Email: dcarlton1@aol.com

Pat Kelly
PJ Kelly Consulting, LLC
4305 NE Davis Street
Portland, Oregon 97213
Phone: 503-235-9999
Email: pjkjgk@earthlink.net

John Robertson
Ridgeline Fire Consulting, LLC
45217 Best Road
Pendleton, Oregon 97801
Phone: 541-278-1433
Email: johnrobertson@wtechlink.net

Darrell Schulte
Seize & Squeeze LLC
PO Box 172
Virginia City, Montana 59755
Phone: 406-843-5443
Email: firewood@3rivers.net

Marc Wiitala
Wiitala Consulting
10235 SW Hawthorne Lane
Portland, Oregon 97225
Phone: 503-296-1396
Email: mrwiitala@aol.com

Steering Committee Members

Carl Bambarger
USDA Forest Service
San Dimas Technology Development Center
444 E. Bonita
San Dimas, California 91773-3103
Phone: 909-599-1267, ext. 253
Email: cbambarger@fs.fed.us

Bill Breedlove
USDA Forest Service
National Office
Branch Chief Fire Planning and Budget
1400 Independence Ave., SW
Washington, DC 20250-0003
Phone: 202-205-0996
Email: bbreedlove@fs.fed.us

Neal Hitchcock
USDA Forest Service
National Interagency Fire Center
Deputy Director for Fire Operations
3833 S. Development Way
Boise, Idaho 83705
Phone: 208-387-5949
Email: nhitchcock@fs.fed.us

Pat Norbury
USDA Forest Service
National Interagency Fire Center
National Aviation Operations Officer
3833 S. Development Way
Boise, Idaho 83705
Phone: 208-387-5646
Email: pnorbury@fs.fed.us

This page intentionally left blank.

Appendix B

Daily Availability and Flight Rate for Exclusive-Use and Call-When-Needed Contract Helicopters

This page intentionally left blank.

Table B-1 – Exclusive-Use, Type 2, Category A

Contract Length	Cat.	# A/C Cont.		2002	2003	2004	2005	Avg.
Average	S	48	Daily Avail	$3,218	$3,218	$3,205	$2911	$3,239
			Flight Rate	$1,119	$1,119	$1,119	$1404	$1,165
58 to 85 Days	S	7	Daily Avail	$3,536	$3,536	$3,536	$2,677*	$3,555
			Flight Rate	$1,043	$1,043	$1,043	$1,480*	$1,084
89 to 118 Days	S	30	Daily Avail	$3,246	$3,246	$3,246	$3,032	$3,273
			Flight Rate	$1,111	$1,111	$1,111	$1,392	$1,159
120 to 170 Days	S	11	Daily Avail	$2,888	$2,888	$2,861**	$2,585	$2,900
			Flight Rate	$1,201	$1,201	$1,199**	$1,421	$1,243

- There was no data provided on any Limited Use Category A/Type 2 helicopter Contracts.
- Category S = Standard
* Indicates that only one contract was used to calculate that field.
** Data was provided on one additional aircraft not included in 2002-2003.

Table B-2 – Exclusive-Use, Type 1, Categories B and C

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
All Contracts	All	31	Daily Avail	$11,696	$11,471	$11,246	$12,502	$11,638
			Flight Rate	$3,454	$3,388	$3,321	$5,387	$3,630
	L	27	Daily Avail	$12,545	$12,545	$12,545	$13,005	$12,605
			Flight Rate	$3,424	$3,424	$3,424	$4,951	$3,832
	S	4	Daily Avail	$6,271	$6,271	$6,271	$9,285	$6,979
			Flight Rate	$2,295	$2,295	$2,295	$5,497	$2,657

Table B-3 – Exclusive-Use, Type 1, Category B

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
All Contracts	All	14	Daily Avail	$10,325	$10,325	$10,325	$12,645	$10,006
			Flight Rate	$2,024	$2,024	$2,024	$2,984	$2,004
	L	11	Daily Avail	$12,430	$12,430	$12,430	$12,645	$12,645
			Flight Rate	$2,193	$2,193	$2,193	$2,984	$2,317
	S	3	Daily Avail	$3,308	$3,308	$3,303	None	$2,530
			Flight Rate	$1,461	$1,461	$1,461	None	$2,004

Table B-4 – Exclusive-Use, Type 1, Category B by Contract Length and Limited or Standard

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
90 Days	L	8	Daily Avail	$12300	$12300	$12300	$13907	$12666
			Flight Rate	$2469	$2469	$2469	$2995	$2564
108 to 140 Days	L	3	Daily Avail	$12950	$12950	$12950	$8858*	$12562
			Flight Rate	$1088	$1088	$1088	$2950*	$1364
90 Days	S	2	Daily Avail	$3415	$3415	$3415	$None	$3483
			Flight Rate	$1463	$1463	$1463	None	$1492
108 to 140 Days	S	2	Daily Avail	$3094*	$3094*	$3094*	None	$3156
			Flight Rate	$1456*	$1456*	$1456*	None	$1485
* Only one aircraft meet the definition and was used in the calculation.								

Exclusive Use Category C (Type 1 Helicopters with a usable payload over 15,000 pounds.) These helicopters are not generally used for transporting passengers but they could be.

Table B-5 – Exclusive-Use, Type 1, Category C

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
All Contracts	L & S	17	Daily Avail	$12,887	$12,887	$12,887	$12,798	$12,879
			Flight Rate	$4,669	$4,669	$4,669	$5,716	$4,987
Note: Only 1 Helicopter is Standard and capable of transporting passengers								

The next table displays the contract rates subdivided by contract length.

Table B-6 – Exclusive-Use, Type 1, Category C by Contract Length

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
42 – 80 Days	L	3	Daily Avail	$11,633	$11,633	$11,633	None	$11,866
			Flight Rate	$4,352	$4,352	$4,352	None	$4,972
81 to 93 Days	L	10	Daily Avail	$14,350	$14,350	$14,350	$13,777	$14,150
			Flight Rate	$4,874	$4,874	$4,874	$5,738	$4,947
93 to 180 Days	L	3	Daily Avail	$11,433	$11,433	$11,433	$7,500*	$10,941
			Flight Rate	$4,843	$4,843	$4,843	$5,738*	$5,064
90 Days	S	1	Daily Avail	$15,161	$15,161	$15,161	$9,285	$13,873
			Flight Rate	$4,799	$4,799	$4,799	$5,497	$5,018
* Only one aircraft met the definition and was used in the calculation.								

Tables B-7 through B-10 documents the findings for CWN contracts.

Table B-7 – Call-When-Needed, Type 2, Category A

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
All	S	200	Daily Avail	$5,732	$5,663	$5,803	$5,663	$5,745
			Flight Rate	$1,150	$1,128	$1,106	$1,411	$1,196

Table B-8 – Call-When- Needed, Type 1, Categories B and C

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
All	All	152	Daily Avail	$20,973	$21,117	$21,391	$21,683	$21,321
			Flight Rate	$3,270	$3,207	$3,143	$3,984	$3,422
	L	127	Daily Avail	$22,348	$22,539	$22,738	$23,324	$22,763
			Flight Rate	$3,404	$3,338	$3,278	$4,137	$3,564
	S	25	Daily Avail	$11,585	$11,856	$12,144	$10,277	$11,477
			Flight Rate	$2,198	$2,155	$2,113	$2,604	$2,268

Table B-9 – Call-When-Needed, Type 1, Category B

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
All	All	91	Daily Avail	$14,497	$14,747	$15,027	$13,945	$14,551
			Flight Rate	$2,210	$2,167	$2,125	$2,454	$2,239
	L	68	Daily Avail	$16,066	$16,311	$16,589	$16,204	$16,292
			Flight Rate	$2,277	$2,233	$2,189	$2,538	$2,311
	S	23	Daily Avail	$10,309	$10,577	$10,863	$7,769	$9,879
			Flight Rate	$2,032	$1,993	$1,954	$2,207	$2,044

Table B-10 – Call-When-Needed, Type 1, Category C

Contract Length	Use	# A/C Cont.	Rate	2002	2003	2004	2005	Avg.
All	All	60	Daily Avail	$30,985	$31,112	$31,219	$30,411	$30,887
			Flight Rate	$4,914	$4,817	$4,721	$5,685	$5,090
	L	58	Daily Avail	$29,329	$29,460	$29,571	$29,281	$29,399
			Flight Rate	$4,656	$4,566	$4,477	$5,387	$4,850
	S	2	Daily Avail	$30,734	$31,048	$31,352	$29,086	$30,261
			Flight Rate	$4,687	$4,597	$4,507	$5,387	$4,913

This page intentionally left blank.

Appendix C

Documentation of Helicopter Module Costs

This page intentionally left blank.

MODULE COSTS

Assumptions

The Interagency Helicopter Operations Guide (IHOG) provides the following direction for the staffing of helicopters based on FAA Standard Transport Categories.

☞ Chart 2-4: Minimum Daily Staffing Requirements For Fire Helicopters

TYPE HELICOPTER	FAA STANDARD / TRANSPORT CATEGORY	FAA Standard Category Temporarily Designated for Limited Use	FAA Standard Category Permanently Designated for Limited Use* or FAA Restricted Category
1	Manager plus Four (4) Helicopter Crewmembers	Manager only	Manager only
2	Manager plus Three (3) Helicopter Crewmembers	Manager only	Manager only
3	Manager plus Two (2) Helicopter Crewmembers		
CWN Helicopter and Module must mate up away from Incident(s) or Fire Operations			

Costs were derived from the 2004 GSA Pay Schedule based on a Step 5 for each grade used. An additional 45% is added to the wages to cover benefits and other costs to generate a Cost to Government (CTG) for each grade. Salary reflects the CTG.

Regular days are based on an 8-hour work day. Overtime is based on a 13-hour work day.

Two pay periods are added to CWN modules to allow for training and travel, check- out/check-in of equipment, pay roll and other reporting in addition to fire assignments.

Analysis assumes that initial investments in bases and equipment have previously occurred. Estimates for miscellaneous items and reoccurring costs are included in the estimates.

Length of assignment for each FAA Transport Category was determined by averaging the length of assignment based on resource orders from NIFC.

	1999	2000	2001	2002	2003	Average
CWN 1 L	9	17	8	14	15	13
CWN 1 S	14	21	8	10	14	14
EU 1 L		34	19	8	15	19
EU 1 S	No Data					
CWN 2 L	4	14	9	13	14	11
CWN 2 S	10	17	12	16	17	13
EU 2 L	No Data					
EU 2 S	20	21	12	21	21	19

Two days are added for fire assignments to account for travel.

These estimates are used in determination of daily costs for each module.

Call-When-Needed Modules (CWN)

CWN Type 2 Standard Module 15 day assignment:

Regular Time (Pay Period)
GS 7 for 10 regular days @ $1,878
GS 6 for 10 regular days @ $1,690
GS 5 for 10 regular days @ $1,516
GS 4 for 10 regular days @ $1,355
Total = $6,439 (This represents 10 days of regular time for 4 persons).

$6,439 divided by 10 days = $644 per day
$644 per day x 11 days = $7,084 per 15 day assignment.

Overtime Days
$644 per day x 1.5 (OT Rate) = $966 per day
$966 per day x 4 days = $3,864 per 15 day assignment

Overtime Hours
Based on a 13 hour day for each day worked (5 hours per day).

Daily overtime daily rate of $966 divided by 8 hours per day = $121 per hour
$121 per hour x 5 hours x 15 days = $9,075 per 15 day assignment

Pre and post season costs associated with training, travel, equipment check-out/check-in, payroll and other reporting:

$6,439 per pay period x 2 pay periods = $12,878
$12,878 plus $4975 (Per Diem, tuition and other miscellaneous costs) = $17,878

Total Daily Cost CWN Type 2 Standard Module

Regular time =	$7,084
Overtime days =	$3,864
Overtime hours =	$9,075
Pre/post season =	$17,878
Total =	$37,876

15 day assignment $37,876divided 15 days = $2,525 per day

CWN Type 1 Standard Module 15 Day assignment

Regular Time (Pay Period)

GS 7 for 10 regular days @	$1,878
GS 6 for 10 regular days @	$1,690
GS 5 for 10 regular days @	$1,516
GS 4 for 10 regular days @	$1,354
GS 4 for 10 regular days @	$1,354
Total =	$7,794

(This represents 10 days of regular time for 5 persons).

$7,794 divided by 10 days =	$779 per day
$779 per day x 11 days =	$8,569 per 15 day assignment.

Overtime Days

$779 per day x 1.5 (OT Rate) =	$1,168 per day
$1,168 per day x 4 days =	$4,672 per 15 day assignment

Overtime Hours

Based on a 13 hour day for each day worked (5 hours per day).

Daily overtime daily rate of $1,168 divided by 8 hours per day = $146 per hour

$146 per hour x 5 hours x 15 days =	$10,950 per 15 day assignment

Pre and post season costs associated with training, travel, equipment check-out/check-in, payroll and other reporting:

$7,794 per pay period x 2 pay periods =	$15,588

$15,580 plus $4,880 (Per Diem, tuition and other miscellaneous costs) = $20,460

Total Daily Cost CWN Type 2 Standard Module

Regular time =	$8,570
Overtime days =	$4,670
Overtime hours =	$10,950
Pre/post season =	$20,460
Total =	$44,650

15 day assignment $44,650 divided 15 days = $2,977 per day

CWN Type 1 and 2 Limited Module 15 Day Assignment

Regular Time (Pay Period)

GS 9 for 10 regular days @ $2,220

Total = $2,220 (This represents 10 days of regular time for 1 persons).

$2,220 divided by 10 days = $222 per day
$222 per day x 11 days = $2,440 per 15 day assignment.

Overtime Days
$222 per day x 1.5 (OT Rate) = $333 per day
$333 per day x 4 days = $1,330 per 15 day assignment

Overtime Hours
Based on a 13 hour day for each day worked (5 hours per day).

Daily overtime daily rate of $333 divided by 8 hours per day = $41 per hour
$41 per hour x 5 hours x 15 days = $3,070 per 15 day assignment

Pre and post season costs associated with training, travel, equipment check-out/check-in, payroll and other reporting:

$2,220 per pay period x 2 pay periods = $4,440
$4,440 plus $970 (Per Diem, tuition and other miscellaneous costs) = $5,410

Total Daily Cost CWN Type 2 Standard Module

Regular time	= $ 2,440
Overtime days	= $ 1,330
Overtime hours	= $ 3,070
Pre/post season	= $ 5,410
Total	= $12,250

15 day assignment $12,250 divided 15 days = $817 per day

Exclusive-Use Modules

Exclusive-Use Type 1 and 2 Limited Module 16 Day Assignment (Category B and C)

GS 9 PFT Annual Salary $57,937

Overtime Days

$42 per x 8 hours x 4 days = $1,344 assignment

Overtime Hours

Based on a 13 hour day for each day worked (5 hours per day).

Hourly OT rate of $42 x 5 hours x 16 days = $3,360 per assignment

Pre and post season costs associated with training, travel, equipment check-out/check-in, payroll and other reporting:

Per Diem, tuition, equipment, space and other miscellaneous costs = $3,190

Annual Module Cost EU Limited Use Helicopter Module

Regular time	= $57,937
Overtime days	= $ 1344
Overtime hours	= $ 3360
Pre/post season	= $ 3,190
Total	= $65,821

Annual Costs with a 16 day assignment = $65,821 per season

Exclusive-Use Type 1 and 2 Standard Module*
(21-Day Assignment 90 Day Contract)

Base Salary

GS-9 PFT Annual Salary =	$ 57,937
GS-8 PFT Annual Salary =	$ 54,077
GS-6 PSE 13/13 =	$ 21,972
GS-5 PSE 13/13 =	$ 19,710
GS-4 Temp 11 pay periods =	$ 14,903
GS-4 Temp 11 pay periods =	$ 14,903

Total Salary= $183,502

Overtime Days (6)

GS-9 $42/hour x 8 hours x 6 days =	$ 2,010
GS-8 $39/hour x 8 hours x 6 days =	$ 1,872
GS-6 $32/hour x 8 hours x 6 days =	$ 1,521
GS-5 $28/hour x 8 hours x 6 days =	$ 1,365
GS-4 $ 25/hour x 8 hours x 6 days =	$ 1,220
GS-4 $ 25/hour x 8 hours x 6 days =	$ 1,220

Total OT Days = $ 9,207

Overtime Hours (5 hours per day, 21 day assignment)

GS-9 $42/hour x 5 hours x 16 days =	$ 3,140
GS-8 $39/hour x 5 hours x 16 days =	$ 2,925
GS-6 $32/hour x 5 hours x 16 days =	$ 2,377
GS-5 $28/hour x 5 hours x 16 days =	$ 2,132
GS-4 $25/hour x 5 hours x 16 days =	$ 1,905
GS-4 $25/hour x 5 hours x 16 days =	$ 1,905

Total OT Hours (5) = $ 9,207

Misc. Cost, Vehicles and Equipment	=	$ 8,300
Travel, Training, Per Diem	=	$ 7,500
Supplies, Cell phones, Radios	=	$ 10,590
Rents/Leases	=	$ 25,100

Annual Cost with a 21 day assignment = $258,587 per season

* - Incorporates information on module configuration contained in the April 25, 1995 Washington Office letter on National Type 2 Helicopters.

Appendix D

Initial Attack Analysis Assumptions and Rules

This page intentionally left blank.

Initial Attack Analysis Assumptions and Rules

1. All units will use MNIAAPC Version 4.88 as the Initial Attack model.

2. Use the Most Efficient budget level (MEL) from the unit's currently approved preferred NFMAS alternative. In the OST, label this budget level MEL. Alternative Cost for this study will not include the pre-suppression cost to staff the MEL organization as this is constant.

3. All representative fire locations will have a legal description (lat/long or T/R/S) and latitude/longitude. If this has not been done yet, use the airtanker attack times in the MRT to determine an appropriate legal description. This is needed to allow for calculation of attack times from alternative airtanker bases locations serving a representative fire.

4. All airtanker attack times and UMC costs will be calculated using the AutoAT4 program.

5. All money is expressed in 2004 dollars.

6. Retardant cost per gallon is assumed to be $0.72.

7. Existing dispatch philosophy from preferred IAA alternative. Maintain this dispatch philosophy unless historic use does not depict the current situation.

8. When using airtanker loads from another geographic area in an alternative, assume these loads are available based on the staffing of the 1996 airtanker contract.

9. Fireline production using water or foam was calculated at 50% of the fireline production produced using long term retardant.

This page intentionally left blank.

Appendix E

Documentation of Initial Attack Analysis by GACC

This page intentionally left blank.

Table E-1 Northern GACC

Alt.	Airtanker Bases *						No. AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	WYS	BIL	COE	HLN	MSO	FCA						
A0							0	44,828	$19,239,265	-$2,868,760	$0	$22,108,025
AA	1						1	32,738	$11,808,582	-$1,733,288	$650,000	$14,191,870
AB		1					1	32,239	$11,868,144	-$1,518,238	$650,000	$14,036,382
AC			1				1	33,686	$11,148,326	-$1,702,650	$650,000	$13,500,976
AE				1			1	33,176	$11,406,353	-$1,695,432	$650,000	$13,751,785
AF					1		1	33,483	$10,943,500	-$1,726,734	$650,000	$13,320,234
AG						1	1	34,104	$11,550,967	-$1,750,484	$650,000	$13,951,451
BA	1				1		2	30,936	$10,554,123	-$1,344,849	$1,300,000	$13,198,972
BB		1			1		2	30,988	$10,596,536	-$1,346,201	$1,300,000	$13,242,737
BC			1		1		2	32,359	$10,379,228	-$1,449,707	$1,300,000	$13,128,935
BE				1	1		2	31,595	$10,470,716	-$1,362,535	$1,300,000	$13,133,251
BF					2		2	32,183	$10,419,545	-$1,385,229	$1,300,000	$13,104,774
BG					1	1	2	32,359	$10,528,745	-$1,384,878	$1,300,000	$13,213,623
CA	1				2		3	30,738	$10,355,794	-$1,332,766	$1,950,000	$13,638,560
CB		1			2		3	30,721	$10,340,703	-$1,331,556	$1,950,000	$13,622,259
CC			1		2		3	32,168	$10,307,985	-$1,372,355	$1,950,000	$13,630,340
CE				1	2		3	31,403	$10,298,810	-$1,353,150	$1,950,000	$13,601,960
CF					3		3	32,177	$10,403,378	-$1,380,355	$1,950,000	$13,733,733
CG					2	1	3	32,173	$10,382,602	-$1,379,271	$1,950,000	$13,711,873
CK		`	1	1	1		3	31,396	$9,892,868	-$1,293,231	$1,950,000	$13,136,099
DA	1			1	2		4	30,725	$10,279,964	-$1,330,615	$2,600,000	$14,210,579
DB		1		1	2		4	30,716	$10,266,448	-$1,330,057	$2,600,000	$14,196,505
DD			1	1	2		4	31,394	$10,201,124	-$1,344,757	$2,600,000	$14,145,881
DE				2	2		4	31,401	$10,291,180	-$1,352,727	$2,600,000	$14,243,907
DF				1	2	1	4	31,401	$10,275,426	-$1,351,915	$2,600,000	$14,227,341
EA	1		1	1	2		5	30,716	$10,182,900	-$1,322,455	$3,250,000	$14,755,355
EB		1	1	1	2		5	30,707	$10,168,664	-$1,321,700	$3,250,000	$14,740,364
ED			2	1	2		5	31,394	$10,195,316	-$1,344,659	$3,250,000	$14,789,975
EE			1	2	2		5	31,392	$10,194,234	-$1,344,596	$3,250,000	$14,788,830
EF			1	1	2	1	5	31,393	$10,191,812	-$1,345,060	$3,250,000	$14,786,872

* - WYS, West Yellowstone; BIL, Billings; COE, Coeur d' Alene; HLN , Helena; MSO, Missoula; FCA, Kalispell;

** - Annual number of fires is 1,239.

*** - Airtanker staffing is for 100 days.

Table E-2 Rocky Mountain GACC

Alt.	Airtanker Bases *					No. AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	WYS	JC	DU	GJ	RC						
A0						0	31,327	$9,303,568	-$7,579,171	$0	$16,882,739
A1	1					1	19,027	$9,470,123	-$5,233,439	$552,500	$15,256,062
A2		1				1	19,640	$8,718,615	-$5,023,430	$552,500	$14,294,545
A3			1			1	18,261	$8,961,818	-$5,021,212	$552,500	$14,535,530
A4				1		1	22,924	$8,523,325	-$5,563,020	$552,500	$14,638,845
A5					1	1	19,997	$9,610,645	-$5,261,894	$552,500	$15,425,039
BA	1	1				2	22,595	$8,739,476	-$5,461,576	$1,105,000	$15,306,052
BB		2				2	20,452	$8,495,934	-$5,196,255	$1,105,000	$14,797,189
BC		1	1			2	20,758	$8,515,925	-$5,305,023	$1,105,000	$14,925,948
BD		1		1		2	21,100	$8,193,013	-$5,240,275	$1,105,000	$14,538,288
BE		1			1	2	21,984	$8,790,580	-$5,449,359	$1,105,000	$15,344,939
CA	1	1		1		3	21,073	$8,168,567	-$5,234,685	$1,657,500	$15,060,752
CB		2		1		3	20,976	$8,149,864	-$5,198,290	$1,657,500	$15,005,654
CC		1	1	1		3	21,051	$8,168,383	-$5,235,047	$1,657,500	$15,060,930
CD		1		2		3	16,106	$8,066,892	-$4,422,347	$1,657,500	$14,146,739
CE			1	1	1	3	20,962	$8,147,016	-$5,177,477	$1,657,500	$14,981,993
DA	1	1		2		4	16,084	$8,043,044	-$4,417,309	$2,210,000	$14,670,353
DB		2		2		4	15,982	$8,023,743	-$4,380,362	$2,210,000	$14,614,105
DC		1	1	2		4	16,104	$8,051,631	-$4,421,953	$2,210,000	$14,683,584
DD		1		2	1	4	15,968	$8,020,895	-$4,359,549	$2,210,000	$14,590,444
EA	1	1		2	1	5	15,952	$7,993,085	-$4,357,238	$2,762,500	$15,112,823
EB		2		2	1	5	15,938	$7,989,271	-$4,353,164	$2,762,500	$15,104,935
EC		1	1	2	1	5	15,966	$8,005,671	-$4,359,155	$2,762,500	$15,127,326
ED		1		2	2	5	15,936	$7,988,163	-$4,344,961	$2,762,500	$15,095,624

* - WYS, West Yellowstone; JC, Jeffco; DU, Durango; GJ, Grand Junction; RC, Rapid City;
** - Annual number of fires is 1,009.
*** - Airtanker staffing is for 85 days.

Table E-3 – Southwest GACC

Alt.	Airtanker Bases *								No AT	Acres Burned	FFF	NVC	AT Program Cost***	C+NVC**
	ALB	ALM	FH	PHX	PRE	ROS	SC	WI						
A0									0	120,433	$64,421,041	-$8,937,119	$0	$73,358,160
A1	1								1	82,963	$48,283,391	-$7,621,600	$455,000	$56,359,991
A2		1							1	82,700	$48,527,122	-$7,652,142	$455,000	$56,634,264
A2			1						1	82,184	$48,329,938	-$7,559,592	$455,000	$56,344,530
A4				1					1	79,226	$46,855,933	-$7,374,591	$455,000	$54,685,524
A4					1				1	80,290	$47,148,510	-$7,484,240	$455,000	$55,087,750
A6						1			1	85,396	$49,196,052	-$7,777,420	$455,000	$57,428,472
A7							1		1	80,704	$47,183,614	-$7,487,921	$455,000	$55,126,535
A8								1	1	80,866	$47,214,993	-$7,432,046	$455,000	$55,102,039
BA	1			1					2	65,991	$40,296,486	-$4,851,841	$910,000	$46,058,327
BB		1		1					2	66,550	$41,307,607	-$5,275,670	$910,000	$47,493,277
BC			1	1					2	66,705	$40,766,938	-$5,037,187	$910,000	$46,714,125
BD				2					2	64,390	$39,601,183	-$5,035,975	$910,000	$45,547,158
BE				1	1				2	64,120	$39,287,658	-$5,051,181	$910,000	$45,248,839
BF				1		1			2	68,127	$41,652,270	-$5,316,308	$910,000	$47,878,578
BG				1			1		2	65,693	$40,205,982	-$4,838,983	$910,000	$45,954,965
BH				1				1	2	64,266	$39,170,114	-$4,996,290	$910,000	$45,076,404
CA	1			1				1	3	61,247	$36,758,213	-$4,787,797	$1,365,000	$42,911,010
CB		1		1				1	3	59,780	$36,664,567	-$4,757,038	$1,365,000	$42,786,605
CC			1	1				1	3	61,550	$37,602,669	-$4,737,155	$1,365,000	$43,704,824
CD				2				1	3	61,640	$37,554,511	-$4,800,069	$1,365,000	$43,719,580
CE				1	1			1	3	61,228	$37,330,467	-$4,816,819	$1,365,000	$43,512,286
CF				1		1		1	3	62,283	$37,728,336	-$4,812,811	$1,365,000	$43,906,147
CG				1			1	1	3	59,252	$35,316,853	-$4,740,822	$1,365,000	$41,422,675
CH				1				2	3	61,449	$37,188,893	-$4,791,484	$1,365,000	$43,345,377
DA	1			1			1	1	4	54,571	$30,382,930	-$4,603,357	$1,820,000	$36,806,287
DB		1		1			1	1	4	53,158	$30,384,538	-$4,573,625	$1,820,000	$36,778,163
DC			1	1			1	1	4	56,062	$32,768,536	-$4,606,169	$1,820,000	$39,194,705
DD				2			1	1	4	58,890	$34,909,134	-$4,730,747	$1,820,000	$41,459,881
DE				1	1		1	1	4	58,259	$34,399,384	-$4,743,428	$1,820,000	$40,962,812
DF				1		1	1	1	4	57,262	$32,688,098	-$4,663,585	$1,820,000	$39,171,683
DG				1			2	1	4	54,330	$31,030,788	-$4,630,249	$1,820,000	$37,481,037
DH				1			1	2	4	58,582	$34,420,556	-$4,721,752	$1,820,000	$40,962,308

Table E-3 – Southwest GACC

Alt.	Airtanker Bases *								No AT	Acres Burned	FFF	NVC	AT Program Cost***	C+NVC**
	ALB	ALM	FH	PHX	PRE	ROS	SC	WI						
EA	1	1		1			1	1	5	50,683	$28,223,655	-$4,515,066	$2,275,000	$35,013,721
EB		2		1			1	1	5	51,988	$29,423,981	-$4,548,358	$2,275,000	$36,247,339
EC		1	1	1			1	1	5	51,373	$29,006,356	-$4,470,622	$2,275,000	$35,751,978
ED		1		2			1	1	5	52,797	$29,979,882	-$4,563,622	$2,275,000	$36,818,504
EE		1		1	1		1	1	5	52,392	$29,756,966	-$4,581,034	$2,275,000	$36,613,000
EF		1		1		1	1	1	5	52,900	$30,101,622	-$4,566,103	$2,275,000	$36,942,725
EG		1		1			2	1	5	50,700	$28,431,583	-$4,518,178	$2,275,000	$35,224,761
EH		1		1			1	2	5	53,107	$30,301,043	-$4,567,554	$2,275,000	$37,143,597
FA	2	1		1			1	1	6	50,503	$27,942,726	-$4,507,170	$2,730,000	$35,179,896
FB	1	2		1			1	1	6	50,536	$28,095,164	-$4,512,908	$2,730,000	$35,338,072
FC	1	1	1	1			1	1	6	50,242	$27,913,550	-$4,442,272	$2,730,000	$35,085,822
FD	1	1		2			1	1	6	50,322	$27,818,999	-$4,505,063	$2,730,000	$35,054,062
FE	1	1		1	1		1	1	6	49,917	$27,596,083	-$4,522,475	$2,730,000	$34,848,558
FF	1	1		1		1	1	1	6	50,535	$28,096,793	-$4,512,900	$2,730,000	$35,339,693
FG	1	1		1			2	1	6	50,588	$28,159,712	-$4,512,786	$2,730,000	$35,402,498
FH	1	1		1			1	2	6	50,632	$28,141,120	-$4,508,995	$2,730,000	$35,380,115
GA	2	1		1	1		1	1	7	49,737	$27,315,154	-$4,514,579	$3,185,000	$35,014,733
GB	1	2		1	1		1	1	7	49,770	$27,467,592	-$4,520,317	$3,185,000	$35,172,909
GC	1	1	1	1	1		1	1	7	49,482	$27,289,958	-$4,450,166	$3,185,000	$34,925,124
GD	1	1		2	1		1	1	7	49,888	$27,536,764	-$4,520,075	$3,185,000	$35,241,839
GE	1	1		1	2		1	1	7	49,913	$27,591,224	-$4,522,535	$3,185,000	$35,298,759
GF	1	1		1	1	1	1	1	7	49,769	$27,469,221	-$4,520,309	$3,185,000	$35,174,530
GG	1	1		1	1		2	1	7	49,822	$27,532,170	-$4,520,195	$3,185,000	$35,237,365
GH	1	1		1	1		1	2	7	49,917	$27,592,222	-$4,522,462	$3,185,000	$35,299,684

* - ALB, Albuquerque; ALM, Alalamogordo; FH, Fort Huachuca; PHX, Phoenix area; PRE, Prescott; ROS, Roswell; SC, Silver City; WI, Winslow;

** - Annual number of fires is 2,370.

*** - Airtanker staffing is for 70 days.

Table E-4 – Great Basin (EGB and WGB GACCs)

Alts	Airtanker Bases *								No AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	WYS	BM	BO	CC	HI	MC	MI	SD						
A0									0	358,966	$106,912,194	-$50,771,288	$0	$157,683,482
AA	1								1	318,039	$84,820,288	-$45,916,572	$650,000	$131,386,860
AB		1							1	323,192	$84,725,586	-$46,335,531	$650,000	$131,711,117
AC			1						1	317,339	$82,969,757	-$45,867,264	$650,000	$129,487,021
AD				1					1	324,747	$87,743,713	-$46,846,972	$650,000	$135,240,685
AE					1				1	321,345	$85,635,722	-$45,868,747	$650,000	$132,154,469
AF						1			1	315,800	$82,048,853	-$45,608,159	$650,000	$128,307,012
AG							1		1	324,671	$87,061,663	-$47,002,757	$650,000	$134,714,420
AH								1	1	324,633	$87,195,385	-$46,672,934	$650,000	$134,518,319
BA	1					1			2	307,896	$77,501,895	-$44,814,097	$1,300,000	$123,615,992
BB		1				1			2	308,679	$75,634,238	-$44,819,907	$1,300,000	$121,754,145
BC			1			1			2	304,571	$75,383,879	-$44,696,102	$1,300,000	$121,379,981
BD				1		1			2	309,754	$77,795,936	-$44,856,928	$1,300,000	$123,952,864
BE					1	1			2	309,491	$76,753,008	-$44,715,450	$1,300,000	$122,768,458
BF						2			2	303,071	$75,250,496	-$44,684,975	$1,300,000	$121,235,471
BG						1	1		2	309,699	$78,777,934	-$44,992,632	$1,300,000	$125,070,566
BH						1		1	2	309,844	$77,390,696	-$44,983,971	$1,300,000	$123,674,667
CA	1		1			1			3	304,292	$75,179,546	-$44,671,224	$1,950,000	$121,800,770
CB		1	1			1			3	303,437	$68,815,259	-$44,630,495	$1,950,000	$115,395,754
CC			2			1			3	304,137	$73,892,423	-$44,689,291	$1,950,000	$120,531,714
CD			1	1		1			3	303,467	$71,519,624	-$44,564,262	$1,950,000	$118,033,886
CE			1		1	1			3	303,280	$71,112,365	-$44,464,089	$1,950,000	$117,526,454
CF			1			2			3	302,206	$74,428,249	-$44,652,036	$1,950,000	$121,030,285
CG			1			1	1		3	303,367	$71,062,616	-$44,694,165	$1,950,000	$117,706,781
CH			1			1		1	3	303,581	$71,238,742	-$44,694,420	$1,950,000	$117,883,162
DA	1	1	1			1			4	303,273	$68,643,716	-$44,614,600	$2,600,000	$115,858,316
DB		2	1			1			4	302,584	$67,892,209	-$44,624,480	$2,600,000	$115,116,689
DC		1	2			1			4	303,309	$68,784,918	-$44,629,925	$2,600,000	$116,014,843
DD		1	1	1		1			4	301,641	$67,685,632	-$44,524,533	$2,600,000	$114,810,165
DE		1	1		1	1			4	302,299	$67,718,911	-$44,426,765	$2,600,000	$114,745,676
DF		1	1			2			4	301,122	$67,880,398	-$44,581,132	$2,600,000	$115,061,530
DG		1	1			1	1		4	301,938	$67,703,774	-$44,622,376	$2,600,000	$114,926,150
DH		1	1			1		1	4	302,133	$68,093,980	-$44,623,802	$2,600,000	$115,317,782

Table E-4 – Great Basin (EGB and WGB GACCs)

Alts	Airtanker Bases *								No AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	WYS	BM	BO	CC	HI	MC	MI	SD						
EA	1	1	1	1		1			5	301,522	$67,527,010	-$44,528,355	$3,250,000	$115,305,365
EB		2	1	1		1			5	301,602	$67,200,069	-$44,523,417	$3,250,000	$114,973,486
EC		1	2	1		1			5	301,550	$67,655,518	-$44,524,303	$3,250,000	$115,429,821
ED		1	1	2		1			5	299,706	$67,011,773	-$44,001,162	$3,250,000	$114,262,935
EE		1	1	1	1	1			5	300,753	$66,784,314	-$44,366,782	$3,250,000	$114,401,096
EF		1	1	1		2			5	299,326	$66,750,771	-$44,475,170	$3,250,000	$114,475,941
EG		1	1	1		1	1		5	300,876	$66,950,489	-$44,519,583	$3,250,000	$114,720,072
EH		1	1	1		1		1	5	301,064	$67,322,077	-$44,518,925	$3,250,000	$115,091,002
FA	1	1	1	1	1	1			6	299,134	$66,510,623	-$44,305,015	$3,900,000	$114,715,638
FB		2	1	1	1	1			6	300,714	$66,298,751	-$44,365,666	$3,900,000	$114,564,417
FC		1	2	1	1	1			6	300,675	$66,766,770	-$44,364,919	$3,900,000	$115,031,689
FD		1	1	2	1	1			6	299,116	$66,378,270	-$43,878,621	$3,900,000	$114,156,891
FE		1	1	1	2	1			6	298,283	$66,044,742	-$43,311,352	$3,900,000	$113,256,094
FF		1	1	1	1	2			6	298,451	$65,850,724	-$44,315,604	$3,900,000	$114,066,328
FG		1	1	1	1	1	1		6	299,988	$66,049,171	-$44,361,832	$3,900,000	$114,311,003
FH		1	1	1	1	1		1	6	300,176	$66,420,759	-$44,361,174	$3,900,000	$114,681,933
GA	1	1	1	1	2	1			7	297,412	$65,882,235	-$43,288,532	$4,550,000	$113,720,767
GB		2	1	1	2	1			7	298,244	$65,559,179	-$43,310,236	$4,550,000	$113,419,415
GC		1	2	1	2	1			7	298,205	$66,027,198	-$43,309,489	$4,550,000	$113,886,687
GD		1	1	2	2	1			7	296,646	$65,638,698	-$42,823,191	$4,550,000	$113,011,889
GF		1	1	1	2	2			7	295,981	$65,111,152	-$43,260,174	$4,550,000	$112,921,326
GG		1	1	1	2	1	1		7	297,518	$65,309,599	-$43,306,402	$4,550,000	$113,166,001
GH		1	1	1	2	1		1	7	297,706	$65,681,187	-$43,305,744	$4,550,000	$113,536,931
HA	1	1	1	1	2	2			8	295,182	$64,959,076	-$43,227,310	$5,200,000	$113,386,386
HB		2	1	1	2	2			8	295,942	$64,625,589	-$43,259,058	$5,200,000	$113,084,647
HC		1	2	1	2	2			8	295,947	$65,098,428	-$43,252,290	$5,200,000	$113,550,718
HD		1	1	2	2	2			8	294,344	$64,705,108	-$42,772,013	$5,200,000	$112,677,121
HG		1	1	1	2	2	1		8	295,216	$64,376,009	-$43,255,224	$5,200,000	$112,831,233
HH		1	1	1	2	2		1	8	295,404	$64,747,597	-$43,254,566	$5,200,000	$113,202,163
IA	1	1	1	2	2	2			9	293,545	$64,553,032	-$42,739,149	$5,850,000	$113,142,181
IB		2	1	2	2	2			9	294,305	$64,219,545	-$42,770,897	$5,850,000	$112,840,442
IC		1	2	2	2	2			9	294,310	$64,692,384	-$42,764,129	$5,850,000	$113,306,513
IG		1	1	2	2	2	1		9	293,579	$63,969,965	-$42,767,063	$5,850,000	$112,587,028
IH		1	1	2	2	2		1	9	293,767	$64,341,553	-$42,766,405	$5,850,000	$112,957,958

Table E-4 – Great Basin (EGB and WGB GACCs)

Alts	Airtanker Bases *								No AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	WYS	BM	BO	CC	HI	MC	MI	SD						
JA	1	1	1	2	2	2	1		10	292,780	$63,817,889	-$42,734,199	$6,500,000	$113,052,088
JB		2	1	2	2	2	1		10	293,557	$63,527,470	-$42,766,314	$6,500,000	$112,793,784
JC		1	2	2	2	2	1		10	293,545	$63,957,491	-$42,759,179	$6,500,000	$113,216,670
JG		1	1	2	2	2	2		10	293,541	$63,879,683	-$42,766,604	$6,500,000	$113,146,287
JH		1	1	2	2	2	1	1	10	293,548	$63,929,067	-$42,766,264	$6,500,000	$113,195,331

* - WYS, West Yellowstone; BM, Battle Mountain; BO, Boise; CC, Cedar City; HI, Hill; MC, McCall; MI, Minden; SD, Stead;
** - Annual number of fires is 2,730.
*** - Airtanker staffing is for 100 days.

Table E-5 – California (No. and So. Ops)

Alt	Airtanker Bases *											No. AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	C1	CH	FF	FR	MO	NO	PV	RE	RM	SB	SK						
A0												0	114,815	$129,543,498	-$107,526,840	$0	$237,070,338
AA	1											1	60,476	$70,611,859	-$66,614,103	$650,000	$137,875,962
AB		1										1	60,441	$70,416,127	-$66,572,187	$650,000	$137,638,314
AC			1									1	63,295	$75,002,444	-$75,274,882	$650,000	$150,927,326
AD				1								1	60,715	$71,420,255	-$68,744,070	$650,000	$140,814,325
AE						1						1	70,963	$81,278,945	-$81,708,368	$650,000	$163,637,313
AF							1					1	61,231	$72,839,390	-$70,025,584	$650,000	$143,514,974
AG								1				1	60,525	$70,688,264	-$66,718,690	$650,000	$138,056,954
AH									1			1	74,699	$85,692,855	-$92,654,963	$650,000	$178,997,818
AI										1		1	63,688	$75,760,615	-$75,122,805	$650,000	$151,533,420
AJ											1	1	61,229	$71,739,661	-$68,685,632	$650,000	$141,075,293
AK					1								64,834	$76,793,444	-$76,793,444	$650,000	$154,236,888
BA	1	1										2	57,553	$66,972,618	-$65,709,825	$1,300,000	$133,982,443
BB		1	1									2	57,344	$66,706,300	-$65,264,853	$1,300,000	$133,271,153
BC		1		1								2	56,442	$66,221,202	-$65,028,366	$1,300,000	$132,549,568
BD		1				1						2	57,621	$66,950,339	-$65,416,337	$1,300,000	$133,666,676
BE		1					1					2	57,467	$66,729,765	-$65,153,062	$1,300,000	$133,182,827
BF		1						1				2	57,767	$67,108,534	-$65,494,176	$1,300,000	$133,902,710
BG		1							1			2	58,196	$67,870,936	-$65,768,888	$1,300,000	$134,939,824
BH		1								1		2	57,815	$67,293,093	-$65,373,188	$1,300,000	$133,966,281
BI		1									1	2	56,804	$66,587,934	-$65,230,452	$1,300,000	$133,118,386
CA	1	1		1								3	56,351	$65,445,711	-$65,265,264	$1,950,000	$132,660,975
CB		1	1	1								3	56,620	$65,971,355	-$64,979,396	$1,950,000	$132,900,751
CC		1		1		1						3	55,781	$65,374,839	-$64,856,259	$1,950,000	$132,181,098
CD		1		1			1					3	55,783	$65,524,483	-$64,812,042	$1,950,000	$132,286,525
CE		1		1				1				3	56,102	$65,028,862	-$65,023,326	$1,950,000	$132,002,188
CF		1		1					1			3	55,933	$65,602,216	-$64,880,443	$1,950,000	$132,432,659
CG		1		1						1		3	55,902	$65,654,214	-$64,893,504	$1,950,000	$132,497,718
CH		1		1							1	3	56,276	$65,894,859	-$65,010,667	$1,950,000	$132,855,526
DA	1	1		1				1				4	53,103	$62,032,080	-$60,590,255	$2,600,000	$125,222,335
DB		1	1	1				1				4	55,429	$64,185,421	-$64,836,913	$2,600,000	$131,622,334
DC		1		1		1		1				4	55,442	$64,179,711	-$64,851,442	$2,600,000	$131,631,153
DD		1		1			1	1				4	55,444	$64,329,355	-$64,807,225	$2,600,000	$131,736,580
DE		1		1				1	1			4	55,594	$64,407,088	-$64,875,626	$2,600,000	$131,882,714
DF		1		1				1		1		4	55,563	$64,459,086	-$64,888,687	$2,600,000	$131,947,773
DG		1		1				1			1	4	55,942	$64,780,789	-$64,901,778	$2,600,000	$132,282,567
DH		1				1	1	1				4	55,421	$64,338,954	-$64,856,659	$2,600,000	$131,795,613

Table E-5 – California (No. and So. Ops)

Alt	Airtanker Bases *											No. AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	C1	CH	FF	FR	MO	NO	PV	RE	RM	SB	SK						
EA	1	1	1	1				1				5	52,432	$61,187,021	-$60,404,575	$3,250,000	$124,841,596
EB	1	1		1		1		1				5	52,445	$61,178,014	-$60,418,737	$3,250,000	$124,846,751
EC	1	1		1			1	1				5	52,447	$61,332,163	-$60,375,458	$3,250,000	$124,957,621
ED	1	1		1				1	1			5	52,596	$61,405,317	-$60,442,886	$3,250,000	$125,098,203
EE	1	1		1				1		1		5	52,566	$61,460,610	-$60,456,339	$3,250,000	$125,166,949
EG	1	1		1				1			1	5	52,948	$61,804,985	-$60,470,908	$3,250,000	$125,525,893
FA	1	1		1	1	1		1				6	52,382	$60,870,987	-$60,282,305	$3,900,000	$125,053,292
FB	1	1		2		1		1				6	52,309	$60,987,972	-$60,316,906	$3,900,000	$125,204,878
FC	1	1		1		2		1				6	52,380	$61,022,129	-$60,385,707	$3,900,000	$125,307,836
FD	1	1		1		1	1	1				6	52,287	$60,929,250	-$60,322,290	$3,900,000	$125,151,540
FE	1	1		1		1		2				6	52,441	$61,103,533	-$60,412,863	$3,900,000	$125,416,396
FF	1	1		1		1		1		1		6	52,397	$60,994,087	-$60,401,932	$3,900,000	$125,296,019
GA	1	1		1	1	1	1	1				7	52,224	$60,622,223	-$60,185,858	$4,550,000	$125,358,081
GB	2	1		1	1	1		1				7	52,382	$60,870,913	-$60,282,305	$4,550,000	$125,703,218
GC	1	2		1	1	1		1				7	52,381	$60,863,343	-$60,281,954	$4,550,000	$125,695,297
GD	1	1		2	1	1		1				7	52,246	$60,680,945	-$60,180,474	$4,550,000	$125,411,419
GE	1	1		1	2	1		1				7	52,375	$60,843,697	-$60,279,787	$4,550,000	$125,673,484
GF	1	1		1	1	2		1				7	52,317	$60,715,102	-$60,249,275	$4,550,000	$125,514,377
GG	1	1		1	1	1		2				7	52,380	$60,810,851	-$60,279,978	$4,550,000	$125,640,829
GH	1	1		1	1	1		1		1		7	52,334	$60,687,060	-$60,265,500	$4,550,000	$125,502,560
HA	2	1		1	1	1	1	1				8	52,224	$60,622,149	-$60,185,858	$5,200,000	$126,008,007
HB	1	2		1	1	1	1	1				8	52,223	$60,614,579	-$60,185,507	$5,200,000	$126,000,086
HC	1	1		2	1	1	1	1				8	52,224	$60,622,223	-$60,185,858	$5,200,000	$126,008,081
HD	1	1		1	2	1	1	1				8	52,217	$60,594,933	-$60,183,340	$5,200,000	$125,978,273
HE	1	1		1	1	2	1	1				8	52,173	$60,463,110	-$60,159,602	$5,200,000	$125,822,712
HF	1	1		1	1	1	2	1				8	52,181	$60,606,273	-$60,185,168	$5,200,000	$125,991,441
HG	1	1		1	1	1	1	2				8	52,222	$60,562,087	-$60,183,531	$5,200,000	$125,945,618
HI	1	1		1	1	1	1	1		1		8	52,207	$60,489,804	-$60,180,952	$5,200,000	$125,870,756

* - C1, Chico; CH, Chester; FF, Fox Field (Lancaster); MO, Monteague; NO, Norton (San Bernardino; PV, Porterville; RE, Redding; RM, Ramona; SB, Santa Barbara; SK, Stockton;

** - Annual number of fires is 2,363.

*** - Airtanker staffing is for 100 days.

Table E-6 Southern GACC

Alt.	Airtanker Bases *				No. AT	Acres Burned	FFF	NVC	AT Program Cost ***	C+NVC **
	FV	CH	SH	LC						
A0					0	31,683	$10,132,460	-$4,532,963	$0	$14,665,423
AA	1				1	9,062	$8,183,281	-$1,385,513	$455,000	$10,023,794
AB		1			1	8,796	$9,092,708	-$2,658,712	$455,000	$12,206,420
AC			1		1	10,347	$10,434,430	-$3,014,304	$455,000	$13,903,734
AD				1	1	11,499	$9,693,946	-$3,026,499	$455,000	$13,175,445
BA	2				2	7,496	$8,730,361	-$1,270,629	$910,000	$10,910,990
BB	1	1			2	6,361	$8,381,881	-$1,125,026	$910,000	$10,416,907
BC	1		1		2	6,812	$9,258,680	-$1,226,374	$910,000	$11,395,054
BD	1			1	2	7,185	$8,813,847	-$1,246,285	$910,000	$10,970,132
CA	2	1			3	6,323	$8,374,035	-$1,099,885	$1,365,000	$10,838,920
CB	1	2			3	5,595	$7,735,577	-$998,345	$1,365,000	$10,098,922
CC	1	1	1		3	5,399	$7,741,974	-$967,826	$1,365,000	$10,074,800
CD	1	1		1	3	6,070	$8,256,526	-$1,092,078	$1,365,000	$10,713,604
DA	2	1	1		4	6,046	$8,246,722	-$1,078,031	$1,820,000	$11,144,753
DB	1	2	1		4	5,295	$7,716,395	-$933,489	$1,820,000	$10,469,884
DC	1	1	2		4	5,232	$7,723,832	-$938,962	$1,820,000	$10,482,794
DD	1	1	1	1	4	5,282	$7,754,895	-$945,482	$1,820,000	$10,520,377

* - FV, Fayetteville; CH, Chattanooga; SH, Shenandoah Valley; LC, Lake City;
** - Annual number of fires is 1,060.
*** - Airtanker staffing is for 70 days.

Appendix F

Documentation of Helitanker Alternatives to Support Initial Attack by GACC

This page intentionally left blank.

Table F-1 – Northern GACC

Description	Acres	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. Between AT & Heli
No. AT or Helis	44,828	$19,239,265	-$2,868,760	$22,108,025	$0	$22,108,025	
1 AT @ Coeur d' Alene	33,686	$11,148,326	-$1,702,650	$12,850,976	$650,000	$13,500,976	$1,445,505
1-TI Heli @ Coeur d' Alene	34,924	$11,458,219	-$2,007,441	$13,465,660	$1,480,821	$14,946,481	
1 AT @ Helena	33,176	$11,406,353	-$1,695,432	$13,101,785	$650,000	$13,751,785	$1,036,565
1-TI Heli @ Helena	34,673	$11,496,359	-$1,811,170	$13,307,529	$1,480,821	$14,788,350	
1 AT @ Missoula	33,483	$10,943,500	-$1,726,734	$12,670,234	$650,000	$13,320,234	$416,015
1-TI Heli @ Missoula	34,285	$10,500,691	-$1,754,737	$12,255,428	$1,480,821	$13,736,249	
1 AT @ Kalispell	34,104	$11,550,967	-$1,750,484	$13,301,451	$650,000	$13,951,451	$559,726
1-TI Heli @ Kalispell	35,006	$11,208,007	-$1,822,349	$13,030,356	$1,480,821	$14,511,177	
					Average ATs =	$13,631,112	
					Average T-1s =	$14,495,564	
						Average Difference =	$864,453
1-TI Heli @ Hamilton	34,261	$10,380,983	-$1,782,898	$12,163,881	$1,480,821	$13,644,702	
1-TI Heli @ Dillon	35,006	$11,896,753	-$2,004,431	$13,901,184	$1,480,821	$15,382,005	
1-TI Heli @ Grangeville	34,647	$11,026,553	-$1,821,964	$12,848,517	$1,480,821	$14,329,338	
1 AT @ CDL, MSO, Hel	31,396	$9,892,868	-$1,293,231	$11,186,099	$1,950,000	$13,136,099	$2,927,502
1 T-1 Heli @ CDL, MSO, Hel	33,390	$10,036,394	-$1,584,744	$11,621,138	$4,442,463	$16,063,601	

Table F-2 – Rocky Mountain GACC

Description	Acres	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. Between AT & Heli
No. AT or Helis	31,327	$9,303,568	-$7,579,171	$16,882,739	$0	$16,882,739	
1 AT @ Jeffco	19,640	$8,718,615	-$5,023,430	$13,742,045	$652,500	$14,394,545	$1,539,179
1-TI Heli @ Jeffco	20,167	$9,395,428	-$5,279,598	$14,675,026	$1,258,698	$15,933,724	
1 AT @ Durango	18,261	$8,961,818	-$5,021,212	$13,983,030	$552,500	$14,535,530	$2,096,928
1-TI Heli @ Durango	21,399	$9,847,399	-$5,526,361	$15,373,760	$1,258,698	$16,632,458	
1 AT @ Grand Junction	22,924	$8,523,325	-$5,563,020	$14,086,345	$652,500	$14,738,845	$144,200
1-TI Heli @ Grand Junction	19,239	$9,186,808	-$5,143,737	$14,330,545	$552,500	$14,883,045	
1 AT @ Rapid City	19,997	$9,610,645	-$5,261,894	$14,872,539	$652,500	$15,525,039	$1,831,662
1-TI Heli @ Rapid City	29,529	$9,779,324	-$7,024,877	$16,804,201	$552,500	$17,356,701	
					Average ATs =	$14,798,490	
					Average T-1s =	$16,201,482	
						Average Difference =	$1,402,992
1-TI Heli @ Lake George	20,689	$9,410,913	-$5,318,603	$14,729,516	$1,258,698	$15,988,214	
1-TI Heli @ Pueblo	31,327	$9,303,568	-$7,579,171	$16,882,739	$1,258,698	$18,141,437	
1-TI Heli @ Rifle	19,119	$9,103,136	-$5,137,508	$14,240,644	$1,258,698	$15,499,342	
1-TI Heli @ Craig	18,320	$9,054,647	-$5,095,226	$14,149,873	$1,258,698	$15,408,571	
1-TI Heli @ Casper	27,384	$9,978,464	-$6,492,025	$16,470,489	$1,258,698	$17,729,187	
					Average =	$16,553,350	
1 AT @ JC, GJ, DU	21,051	$8,168,383	-$5,235,047	$13,403,430	$1,957,500	$15,360,930	$2,479,569
1-TI Heli @ JC, GJ, DU	18,238	$9,037,025	-$5,027,380	$14,064,405	$3,776,094	$17,840,499	

Table F-3 – Southwest GACC

Description	Acres	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. Between AT & Heli
No. AT or Helis	120,433	$64,421,041	-$8,937,119	$73,358,160	$0	$73,358,160	
1 AT @ Albuquerque	82,963	$48,283,391	-$7,621,600	$55,904,991	$455,000	$56,359,991	$14,321,116
1 T1 Heli @ Albuquerque	112,432	$61,144,762	-$8,499,770	$69,644,532	$1,036,575	$70,681,107	
1 AT @ Prescott	80,290	$47,148,510	-$7,484,240	$54,632,750	$455,000	$55,087,750	$9,722,259
1 T1 Heli @ Prescott	97,069	$55,336,546	-$8,436,888	$63,773,434	$1,036,575	$64,810,009	
1 AT @ Tucson	81,485	$47,994,214	-$7,425,745	$55,419,959	$455,000	$55,874,959	$5,331,784
1 T1- Heli @ Tucson	92,635	$51,785,394	-$8,384,774	$60,170,168	$1,036,575	$61,206,743	
					Average ATs =	$55,774,233	
					Average T-1s =	$65,565,953	
						Average Difference =	$9,791,719
1 AT @ AB AL PH PR SC WI	59,252	$35,316,853	-$4,740,822	$40,057,675	$1,365,000	$41,422,675	$12,039,662
1 T1 Heli @ AB AL PH PR SC WI	69,205	$42,250,950	-$4,991,937	$47,242,887	$6,219,450	$53,462,337	
1 AT @ AB, PR, and TU	62,182	$37,710,104	-$4,784,078	$42,494,182	$1,365,000	$43,859,182	$9,721,499
1 T1 Heli @ AB, PR and TU	75,125	$44,640,487	-$5,830,469	$50,470,956	$3,109,725	$53,580,681	

Table F-4 – Great Basin (East and West Basin GACCs)

Description	Acres	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. Between AT & Heli
No. AT or Helis	358,966	$106,912,194	-$50,771,288	$157,683,482	$0	$157,683,482	
1 AT @ Battle Mountain	323,192	$84,725,586	-$46,335,531	$131,061,117	$650,000	$131,711,117	$12,365,596
1 T1 Heli @ Battle Mountain	333,849	$94,099,895	-$48,495,997	$142,595,892	$1,480,821	$144,076,713	
1 AT @ Boise	317,339	$82,969,757	-$45,867,264	$128,837,021	$650,000	$129,487,021	$17,758,690
1 T1 Heli @ Boise	335,560	$98,368,635	-$47,396,255	$145,764,890	$1,480,821	$147,245,711	
1 AT @ Cedar City	324,747	$87,743,713	-$46,846,972	$134,590,685	$650,000	$135,240,685	$12,915,229
1 T1 Heli @ Cedar City	336,857	$97,644,290	-$49,030,803	$146,675,093	$1,480,821	$148,155,914	
1 AT @ Hill	321,345	$85,635,722	-$45,868,747	$131,504,469	$650,000	$132,154,469	$14,046,903
1 T1 Heli @ Hill	332,137	$97,229,208	-$47,491,343	$144,720,551	$1,480,821	$146,201,372	
1 AT @ McCall	315,800	$82,048,853	-$45,608,159	$127,657,012	$650,000	$128,307,012	$20,693,930
1 T1 Heli @ McCall	346,361	$99,404,867	-$48,115,254	$147,520,121	$1,480,821	$149,000,942	
1 AT @ Minden	324,671	$87,061,663	-$47,002,757	$134,064,420	$650,000	$134,714,420	$14,286,522
1 T1 Heli @ Minden	346,361	$99,404,867	-$48,115,254	$147,520,121	$1,480,821	$149,000,942	
					Average ATs =	$131,935,787	
					Average T-1s =	$147,280,266	
						Average Difference =	$15,344,478
1 T1 Heli @ Salmon	341,341	$99,249,867	-$47,688,643	$146,938,510	$1,480,821	$148,419,331	
1 AT @ BM, BO, CC, HI, MC, MI	299,988	$66,049,171	-$44,361,832	$110,411,003	$3,900,000	$114,311,003	$23,078,926
1 T1 Heli @ BM, BO, CC, HI, MC, MI	316,814	$82,853,770	-$45,651,233	$128,505,003	$8,884,926	$137,389,929	

Table F-5 – California (No. and So. Ops GACCs)

Description	Acres	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. Between AT & Heli
No. AT or Helis	114,815	$129,543,498	-$107,526,840	$237,070,338	$0	$237,070,338	
1 AT @ Chico	60,476	$70,611,859	-$66,614,103	$137,225,962	$650,000	$137,875,962	$19,005,852
1 T1 Heli @ Chico	67,635	$82,610,292	-$72,790,701	$155,400,993	$1,480,821	$156,881,814	
1 AT @ Chester	60,441	$70,416,127	-$66,572,187	$136,988,314	$650,000	$137,638,314	$19,630,936
1 T1 Heli @ Chester	68,493	$82,953,470	-$72,834,959	$155,788,429	$1,480,821	$157,269,250	
1 AT @ Montague	64,834	$76,793,444	-$76,793,444	$153,586,888	$650,000	$154,236,888	$9,118,484
1 T1- Heli @ Montique	69,673	$86,606,370	-$75,268,181	$161,874,551	$1,480,821	$163,355,372	
1 AT @ Norton	70,963	$81,278,945	-$81,708,368	$162,987,313	$650,000	$163,637,313	$57,201,234
1 T1- Heli @ Norton	95,721	$117,352,663	-$102,005,063	$219,357,726	$1,480,821	$220,838,547	
1 AT @ Redding	60,525	$70,688,264	-$66,718,690	$137,406,954	$650,000	$138,056,954	$17,711,058
1 T-1 Heli @ Redding	67,737	$82,515,469	-$71,771,722	$154,287,191	$1,480,821	$155,768,012	
1 AT @ Santa Barbara	63,688	$75,760,615	-$75,122,805	$150,883,420	$650,000	$151,533,420	$66,930,259
1 T1 Heli @ Santa Barbara	94,176	$115,650,616	-$101,332,242	$216,982,858	$1,480,821	$218,463,679	
					Average ATs =	$147,163,142	
					Average T-1s =	$178,762,779	
						Average Difference =	$31,599,637
1 T1 Heli @ Quincy	66,330	$79,891,223	-$65,920,740	$145,811,963	$1,480,821	$147,292,784	
1 T1 Heli @ Van Nuys	94,252	$116,134,445	-$101,770,942	$217,905,387	$1,480,821	$219,386,208	
1 T1 Heli @ Mariposa	91,207	$107,518,417	-$88,735,319	$196,253,736	$1,480,821	$197,734,557	
1 T1 Heli @ Hemet	96,040	$117,457,265	-$102,483,181	$219,940,446	$1,480,821	$221,421,267	
1 T1 Heli @ Casitas	95,301	$116,892,643	-$101,938,303	$218,830,946	$1,480,821	$220,311,767	
1 T1 Heli @ Bighill	69,201	$83,414,967	-$68,202,301	$151,617,268	$1,480,821	$153,098,089	
					Average =	$193,207,445	
1 AT @ C1, CH, FR, MO, RD, NO	52,382	$60,870,987	-$60,282,305	$121,153,292	$3,900,000	$125,053,292	$13,947,192
1 T1 Heli @ C1, CH, FR, MO, RD, NO	57,221	$70,519,457	-$59,596,101	$130,115,558	$8,884,926	$139,000,484	

Table F-6 – Northwest GACC

Description	Acres	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. Between AT & Heli
No. AT or Helis	61,496	$58,814,963	-$62,072,265	$120,887,228	$0	$120,887,228	
1 AT @ Redmond	51,771	$45,254,997	-$51,017,138	$96,272,135	$650,000	$96,922,135	$11,413,936
1-TI Heli @ Redmond	56,426	$51,063,391	-$55,791,859	$106,855,250	$1,480,821	$108,336,071	
1 AT @ Moses Lake	51,412	$46,141,776	-$52,115,170	$98,256,946	$650,000	$98,906,946	$13,851,670
1-TI Heli @ Lake Chelan	56,581	$53,703,086	-$57,574,709	$111,277,795	$1,480,821	$112,758,616	
1 AT @ LaGrande	47,370	$42,639,981	-$50,512,621	$93,152,602	$650,000	$93,802,602	$15,017,105
1-TI Heli @ LaGrande	54,078	$51,723,785	-$55,615,101	$107,338,886	$1,480,821	$108,819,707	
1 AT @ Klamath Falls	52,867	$46,994,193	-$52,158,683	$99,152,876	$650,000	$99,802,876	$13,150,899
1-TI Heli @ Klamath Falls	58,514	$53,051,305	-$58,421,649	$111,472,954	$1,480,821	$112,953,775	
1 AT @ Medford	53,270	$47,522,152	-$52,421,563	$99,943,715	$650,000	$100,593,715	$12,893,254
1-TI Heli @ Medford	58,826	$53,434,950	-$58,571,198	$112,006,148	$1,480,821	$113,486,969	
					Average ATs =	$98,005,655	
					Average T-1s =	$111,271,028	
						Average Difference =	$13,265,373
1-TI Heli @ John Day	55,188	$51,833,275	-$55,421,050	$107,254,325	$1,480,821	$108,735,146	
1-TI Heli @ Oakridge	57,715	$52,130,364	-$56,674,822	$108,805,186	$1,480,821	$110,286,007	
1-TI Heli @ Roseburg	60,670	$56,925,320	-$61,455,914	$118,381,234	$1,480,821	$119,862,055	
					Average =	$112,538,559	
2 Each AT @ KF, LaG, RD, and MS	31,259	$27,692,439	-$35,593,099	$63,285,538	$5,200,000	$68,485,538	$25,208,127
1 T-1 Heli @ LC, KF, JD, LaG, OR, RD, RO, WE	45,921	$38,294,482	-$43,552,615	$81,847,097	$11,846,568	$93,693,665	

Table F-7 – Southern GACC

Description	Acres	FFF	NVC	FFF+NVC	Program Cost	C+NVC	Diff. Between AT & Heli
No. AT or Helis	31,683	$10,132,460	-$4,532,963	$14,665,423	$0	$14,665,423	
1 AT @ Fayetteville	9,062	$8,183,281	-$1,385,513	$9,568,794	$455,000	$10,023,794	$4,429,115
1-TI Heli @ Fayetteville	28,144	$9,919,266	-$3,497,083	$13,416,349	$1,036,560	$14,452,909	
1 AT @ Chattanooga	8,796	$9,092,708	-$2,658,712	$11,751,420	$455,000	$12,206,420	$3,631,857
1-TI Heli @ Chattanooga	12,650	$10,813,973	-$3,987,744	$14,801,717	$1,036,560	$15,838,277	
1 AT @ Shenandoah Valley	10,347	$10,434,430	-$3,014,304	$13,448,734	$455,000	$13,903,734	$2,265,767
1-TI Heli @ Shenandoah Valley	31,561	$10,517,882	-$4,615,059	$15,132,941	$1,036,560	$16,169,501	
1 AT @ Lake City	11,499	$9,693,946	-$3,026,499	$12,720,445	$455,000	$13,175,445	$2,922,962
1-TI Heli @ Lake City	31,717	$10,403,643	-$4,658,204	$15,061,847	$1,036,560	$16,098,407	
					Average ATs =	$12,327,348	
					Average T-1s =	$15,639,774	
						Average Difference =	$3,312,425
1 AT @ FV, CH, SV	5,399	$7,741,974	-$967,826	$8,709,800	$1,365,000	$10,074,800	$6,212,582
1 T-1 Heli @ FV, CH, SV	8,865	$10,441,680	-$2,736,022	$13,177,702	$3,109,680	$16,287,382	

This page intentionally left blank.

Appendix G

Documentation of Analysis of Example Fixed-Wing Airtanker Platforms

This page intentionally left blank.

Albuquerque Service Area –
NF (Carson, Cibola, Gila, Lincoln, Santa Fe) Blm - (Albuquerque)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TA	AB	17	73	$46,457	-$2,164		$48,621	
GEN AT	G2	37	176	$374,319	-$17,017		$391,336	
	G3	111	408	$542,074	-$8,382		$550,456	
	G6	261	15,311	$14,008,960	-$1,082,479		$15,091,439	
	G8	59	904	$554,008	-$15,178		$569,186	
	H0	143	671	$1,696,526	-$28,258		$1,724,784	
				Daily Availability	$6,500	$1,300,000		
	Totals	**628**	**17,543**	**$17,222,344**	**-$1,153,478**	**$1,300,000**	**$19,675,822**	**$0**
TB	AB	17	73	$45,355	-$2,164		$47,519	
Q200	G2	37	111	$274,082	-$7,723		$281,805	
	G3	111	415	$527,253	-$9,037		$536,290	
	G6	261	15,422	$14,094,337	-$1,083,292		$15,177,629	
	G8	59	1,815	$761,763	-$227,687		$989,450	
	H0	143	2,838	$4,696,219	-$105,255		$4,801,474	
				Daily Availability	$7,507	$1,501,400		
	Totals	**628**	**20,674**	**$20,399,009**	**$1,501,400**	**$1,501,400**	**$23,335,567**	**-$3,659,745**
TC	AB	17	73	$46,484	-$2,164		$48,648	
Q400	G2	37	176	$374,720	-$17,021		$391,741	
	G3	111	408	$544,066	-$8,382		$552,448	
	G6	261	15,309	$14,009,421	-$1,082,417		$15,091,838	
	G8	59	972	$624,312	-$17,651		$641,963	
	H0	143	847	$1,943,922	-$36,035		$1,979,957	
				Daily Availability	$18,226	$3,645,200		
	Totals	**628**	**17,785**	**$17,542,925**	**$3,645,200**	**$3,645,200**	**$22,351,795**	**-$2,675,973**

Albuquerque Service Area –
NF (Carson, Cibola, Gila, Lincoln, Santa Fe) Blm - (Albuquerque)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TD	AB	17	73	$47,762	-$2,164		$49,926	
BAE 146	G2	37	111	$290,607	-$7,699		$298,306	
	G3	111	408	$585,379	-$8,382		$593,761	
	G6	261	15,311	$14,089,990	-$1,082,886		$15,172,876	
	G8	59	897	$596,605	-$14,956		$611,561	
	H0	143	285	$1,158,841	-$5,235		$1,164,076	
				Daily Availability	$8,107	$1,621,400		
	Totals	**628**	**17,085**	**$16,769,184**	**$1,621,400**	**$1,621,400**	**$19,511,906**	**$163,916**
TG	AB	17	73	$47,829	-$2,164		$49,993	
C130 E	G2	37	111	$289,779	-$7,692		$297,471	
Military	G3	111	408	$588,681	-$8,382		$597,063	
	G6	261	10,625	$10,366,854	-$977,928		$11,344,782	
	G8	59	654	$425,979	-$10,568		$436,547	
	H0	143	284	$1,153,189	-$5,227		$1,158,416	
				Daily Availability	$6,797	$1,359,400		
	Totals	**628**	**12,155**	**$12,872,311**	**$1,359,400**	**$1,359,400**	**$15,243,672**	**$4,432,150**
TH	AB	17	73	$47,829	-$2,164		$49,993	
C130 E	G2	37	111	$289,779	-$7,692		$297,471	
Comm	G3	111	408	$588,681	-$8,382		$597,063	
	G6	261	10,625	$10,366,854	-$977,928		$11,344,782	
	G8	59	654	$425,979	-$10,568		$436,547	
	H0	143	284	$1,153,189	-$5,227		$1,158,416	
				Daily Availability	$14,393	$2,878,600		
	Totals	**628**	**12,155**	**$12,872,311**	**$2,878,600**	**$2,878,600**	**$16,762,872**	**$2,912,950**
TI	AB	17	73	$45,825	-$2,164		$47,989	
S3	G2	37	111	$278,487	-$7,707		$286,194	
	G3	111	408	$529,198	-$8,382		$537,580	
	G6	261	15,317	$13,988,856	-$1,082,752		$15,071,608	
	G8	59	1,643	$737,101	-$222,089		$959,190	
	H0	143	2,607	$4,381,166	-$100,372		$4,481,538	
				Daily Availability	$5,052	$1,010,400		
	Totals	**628**	**20,159**	**$19,960,633**	**-$1,423,466**	**$1,010,400**	**$22,394,499**	**-$2,718,677**

Boise Service Area –
NF (Boise, Humboldt, Salmon, Sawtooth)
BLM - (Boise, Burley, Elko, Idaho Falls, Shoshone, Winnamuca)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TA	BO	117	31,535	$1,864,909	-$4,085,607		$5,950,516	
Generic	BU	39	12,408	$500,318	-$3,299,657		$3,799,975	
	EK	97	28,555	$1,325,726	-$785,121		$2,110,847	
	IF	58	8,281	$1,032,381	-$2,297,603		$3,329,984	
	J2	130	3,493	$2,654,430	-$3,708,708		$6,363,138	
	J9	23	6,063	$853,134	-$256,310		$1,109,444	
	K3	109	10,705	$6,932,464	-$372,416		$7,304,880	
	K4	53	2,247	$1,973,452	-$586,608		$2,560,060	
	SH	62	36,093	$996,777	-$8,488,697		$9,485,474	
	WI	73	14,715	$862,864	-$299,140		$1,162,004	
				Daily Availability	$6,500	$1,300,000		
	Totals	**761**	**154,095**	**$18,996,455**	**-$24,179,867**	**$1,300,000**	**$44,476,322**	**$0**
TB	BO	117	33,770	$1,794,512	-$4,279,261		$6,073,773	
Q200	BU	39	12,466	$493,352	-$3,311,384		$3,804,736	
	EK	97	28,739	$1,142,707	-$788,512		$1,931,219	
	IF	58	8,379	$1,002,926	-$2,323,041		$3,325,967	
	J2	130	3,717	$2,924,305	-$3,797,057		$6,721,362	
	J9	23	6,781	$918,814	-$284,154		$1,202,968	
	K3	109	12,726	$7,912,218	-$455,499		$8,367,717	
	K4	53	2,464	$2,113,116	-$658,731		$2,771,847	
	SH	62	36,093	$993,610	-$8,488,697		$9,482,307	
	WI	73	14,736	$833,708	-$299,495		$1,133,203	
				Daily Availability	$7,507	$1,501,400		
	Totals	**761**	**159,871**	**$20,129,268**	**-$24,685,831**	**$1,501,400**	**$46,316,499**	**-$1,840,177**

Boise Service Area –
NF (Boise, Humboldt, Salmon, Sawtooth)
BLM - (Boise, Burley, Elko, Idaho Falls, Shoshone, Winnamuca)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TC	BO	117	31,578	$1,869,289	-$4,090,162		$5,959,451	
Q400	BU	39	12,408	$500,953	-$3,299,548		$3,800,501	
	EK	97	28,664	$1,276,986	-$787,124		$2,064,110	
	IF	58	8,284	$1,027,696	-$2,298,407		$3,326,103	
	J2	130	3,554	$2,717,373	-$3,710,163		$6,427,536	
	J9	23	6,071	$855,730	-$256,554		$1,112,284	
	K3	109	11,178	$7,127,128	-$389,769		$7,516,897	
	K4	53	2,266	$1,984,952	-$592,511		$2,577,463	
	SH	62	36,093	$996,926	-$8,488,697		$9,485,623	
	WI	73	14,724	$854,914	-$299,312		$1,154,226	
				Daily Availability	$18,226	$3,645,200		
	Totals	**761**	**154,820**	**$19,211,947**	**-$24,212,247**	**$3,645,200**	**$47,069,394**	**-$2,593,072**
TD	BO	117	32,086	$1,855,581	-$4,165,165		$6,020,746	
BAE 146	BU	39	12,404	$513,129	-$3,298,253		$3,811,382	
	EK	97	28,627	$1,422,987	-$786,421		$2,209,408	
	IF	58	8,245	$1,097,001	-$2,288,475		$3,385,476	
	J2	130	3,386	$2,625,768	-$3,706,676		$6,332,444	
	J9	23	6,246	$901,248	-$261,873		$1,163,121	
	K3	109	8,394	$5,937,203	-$304,009		$6,241,212	
	K4	53	2,247	$1,984,609	-$585,702		$2,570,311	
	SH	62	36,093	$1,000,598	-$8,488,697		$9,489,295	
	WI	73	14,718	$887,748	-$299,214		$1,186,962	
				Daily Availability	$8,107	$1,621,400		
	Totals	**761**	**152,446**	**$18,225,872**	**-$24,184,485**	**$1,621,400**	**$44,031,757**	**$444,565**

Boise Service Area –
NF (Boise, Humboldt, Salmon, Sawtooth)
BLM - (Boise, Burley, Elko, Idaho Falls, Shoshone, Winnamuca)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TG	BO	117	31,957	$1,832,443	-$4,134,075		$5,966,518	
C 130 E	BU	39	12,815	$492,567	-$3,421,849		$3,914,416	
Military	EK	97	28,648	$1,158,951	-$787,583		$1,946,534	
	IF	58	8,330	$1,005,549	-$2,310,148		$3,315,697	
	J2	130	3,521	$2,715,181	-$3,752,439		$6,467,620	
	J9	23	7,547	$971,854	-$317,011		$1,288,865	
	K3	109	7,447	$5,530,624	-$263,126		$5,793,750	
	K4	53	1,970	$1,802,574	-$522,762		$2,325,336	
	SH	62	36,093	$988,764	-$8,488,697		$9,477,461	
	WI	73	14,701	$876,490	-$298,968		$1,175,458	
				Daily Availability	$6,797	$1,359,400		
	Totals	**761**	**153,029**	**$17,374,997**	**-$24,296,658**	**$1,359,400**	**$43,031,055**	**$1,445,267**
TH	BO	117	31,957	$1,832,443	-$4,134,075		$5,966,518	
C 130 E	BU	39	12,815	$492,567	-$3,421,849		$3,914,416	
Comm	EK	97	28,648	$1,158,951	-$787,583		$1,946,534	
	IF	58	8,330	$1,005,549	-$2,310,148		$3,315,697	
	J2	130	3,521	$2,715,181	-$3,752,439		$6,467,620	
	J9	23	7,547	$971,854	-$317,011		$1,288,865	
	K3	109	7,447	$5,530,624	-$263,126		$5,793,750	
	K4	53	1,970	$1,802,574	-$522,762		$2,325,336	
	SH	62	36,093	$988,764	-$8,488,697		$9,477,461	
	WI	73	14,701	$876,490	-$298,968		$1,175,458	
				Daily Availability	$14,393	$2,878,600		
	Totals	**761**	**153,029**	**$17,374,997**	**-$24,296,658**	**$2,878,600**	**$44,550,255**	**-$73,933**

Boise Service Area –
NF (Boise, Humboldt, Salmon, Sawtooth)
BLM - (Boise, Burley, Elko, Idaho Falls, Shoshone, Winnamuca)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TI	BO	117	32,796	$1,851,574	-$4,205,059		$6,056,633	
S3	BU	39	12,426	$496,041	-$3,303,945		$3,799,986	
	EK	97	28,736	$1,215,924	-$788,437		$2,004,361	
	IF	58	8,360	$1,024,190	-$2,318,111		$3,342,301	
	J2	130	3,695	$2,872,745	-$3,796,644		$6,669,389	
	J9	23	6,275	$876,127	-$262,728		$1,138,855	
	K3	109	12,677	$7,882,284	-$442,330		$8,324,614	
	K4	53	2,311	$2,030,053	-$604,875		$2,634,928	
	SH	62	36,093	$995,033	-$8,488,697		$9,483,730	
	WI	73	14,731	$844,132	-$299,420		$1,143,552	
				Daily Availability	$5,052	$1,010,400		
	Totals	**761**	**158,100**	**$20,088,103**	**-$24,510,246**	**$1,010,400**	**$45,608,749**	**-$1,132,427**

Klamath Falls Service Area –
NF (Klamath, Modoc, Shasta-Trinity, Deschutes, Fremont, Rogue River, Umpqua, Winema)
BLM - (Lakeview, Susanville)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TA	LA	64	4,352	$467,451	-$66,093		$533,544	
Generic	M5	166	10,314	$13,299,161	-$17,674,878		$30,974,039	
	M9	113	3,763	$2,861,202	-$2,461,512		$5,322,714	
	N4	200	2,873	$8,094,768	-$5,853,650		$13,948,418	
	P1	190	1,077	$1,096,416	-$990,562		$2,086,978	
	P2	87	1,537	$2,765,710	-$1,710,283		$4,475,993	
	Q0	74	30	$293,138	-$29,633		$322,771	
	Q5	98	420	$1,398,676	-$2,033,476		$3,432,152	
	R0	84	2,677	$1,786,764	-$3,287,737		$5,074,501	
	SU	61	4,238	$387,245	-$480,887		$868,132	
					$6,500	$1,300,000		
	Totals	**1137**	**31,281**	**$32,450,531**	**-$34,588,711**	**$1,300,000**	**$68,339,242**	**$0**
TB	LA	64	7,822	$578,801	-$93,836		$672,637	
Q200	M5	166	10,644	$13,669,648	-$17,694,518		$31,364,166	
	M9	113	4,863	$3,839,620	-$2,837,069		$6,676,689	
	N4	200	2,992	$8,433,253	-$6,095,145		$14,528,398	
	P1	190	1,145	$1,212,094	-$1,043,935		$2,256,029	
	P2	87	1,652	$3,178,819	-$1,793,338		$4,972,157	
	Q0	74	30	$240,780	-$29,801		$270,581	
	Q5	98	531	$1,693,398	-$2,686,528		$4,379,926	
	R0	84	2,694	$1,835,601	-$3,303,416		$5,139,017	
	SU	61	4,264	$385,657	-$483,294		$868,951	
					$7,507	$1,501,400		
	Totals	**1137**	**36,637**	**$35,067,671**	**-$36,060,880**	**$1,501,400**	**$72,629,951**	**-$4,290,709**

Klamath Falls Service Area –
NF (Klamath, Modoc, Shasta-Trinity, Deschutes, Fremont, Rogue River, Umpqua, Winema)
BLM - (Lakeview, Susanville)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TC	LA	64	5,056	$487,201	-$72,054		$559,255	
Q400	M5	166	10,315	$13,302,157	-$17,675,985		$30,978,142	
	M9	113	3,764	$2,870,086	-$2,461,741		$5,331,827	
	N4	200	2,875	$8,148,914	-$5,856,427		$14,005,341	
	P1	190	1,118	$1,189,794	-$1,029,631		$2,219,425	
	P2	87	1,539	$2,767,756	-$1,711,518		$4,479,274	
	Q0	74	31	$298,209	-$30,028		$328,237	
	Q5	98	423	$1,409,235	-$2,051,540		$3,460,775	
	R0	84	2,677	$1,789,493	-$3,288,476		$5,077,969	
	SU	61	4,241	$389,576	-$481,169		$870,745	
					$18,226	$3,645,200		
	Totals	**1137**	**32,039**	**$32,652,421**	**-$34,658,569**	**$3,645,200**	**$70,956,190**	**-$2,616,948**
TD	LA	64	3,675	$459,756	-$62,259		$522,015	
BAE-146	M5	166	10,305	$13,275,835	-$17,657,762		$30,933,597	
	M9	113	3,495	$2,652,469	-$2,181,398		$4,833,867	
	N4	200	2,847	$8,358,757	-$5,801,920		$14,160,677	
	P1	190	1,070	$1,117,075	-$984,566		$2,101,641	
	P2	87	1,506	$2,710,658	-$1,689,218		$4,399,876	
	Q0	74	31	$362,618	-$29,947		$392,565	
	Q5	98	286	$1,019,911	-$1,226,898		$2,246,809	
	R0	84	2,671	$1,778,897	-$3,282,091		$5,060,988	
	SU	61	4,247	$394,285	-$481,764		$876,049	
					$8,107	$1,621,400		
	Totals	**1137**	**30,133**	**$32,130,261**	**-$33,397,823**	**$1,621,400**	**$67,149,484**	**$1,189,758**

Klamath Falls Service Area –
NF (Klamath, Modoc, Shasta-Trinity, Deschutes, Fremont, Rogue River, Umpqua, Winema)
BLM - (Lakeview, Susanville)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TG	LA	64	5,068	$503,667	-$69,883		$573,550	
C130 E	M5	166	6,599	$9,673,954	-$13,078,085		$22,752,039	
Military	M9	113	2,690	$2,204,546	-$1,866,622		$4,071,168	
	N4	200	1,934	$7,042,932	-$3,854,455		$10,897,387	
	P1	190	1,040	$1,030,869	-$955,762		$1,986,631	
	P2	87	1,434	$2,564,435	-$1,653,735		$4,218,170	
	Q0	74	30	$363,492	-$29,633		$393,125	
	Q5	98	194	$838,443	-$699,673		$1,538,116	
	R0	84	2,649	$1,710,790	-$3,264,664		$4,975,454	
	SU	61	4,233	$387,895	-$480,380		$868,275	
					$6,797	$679,700		
	Totals	**1137**	**25,871**	**$26,321,023**	**-$25,952,892**	**$679,700**	**$52,953,615**	**$15,385,627**
TH	LA	64	5,068	$503,667	-$69,883		$573,550	
C 130 E	M5	166	6,599	$9,673,954	-$13,078,085		$22,752,039	
Comm	M9	113	2,690	$2,204,546	-$1,866,622		$4,071,168	
	N4	200	1,934	$7,042,932	-$3,854,455		$10,897,387	
	P1	190	1,040	$1,030,869	-$955,762		$1,986,631	
	P2	87	1,434	$2,564,435	-$1,653,735		$4,218,170	
	Q0	74	30	$363,492	-$29,633		$393,125	
	Q5	98	194	$838,443	-$699,673		$1,538,116	
	R0	84	2,649	$1,710,790	-$3,264,664		$4,975,454	
	SU	61	4,233	$387,895	-$480,380		$868,275	
					$14,393	$2,878,600		
	Totals	**1137**	**25,871**	**$26,321,023**	**-$25,952,892**	**$2,878,600**	**$55,152,515**	**$13,186,727**

Klamath Falls Service Area –
NF (Klamath, Modoc, Shasta-Trinity, Deschutes, Fremont, Rogue River, Umpqua, Winema)
BLM - (Lakeview, Susanville)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TI	LA	64	7,771	$583,056	-$93,557		$676,613	
S3	M5	166	10,321	$13,340,501	-$17,681,300		$31,021,801	
	M9	113	4,827	$3,727,801	-$2,799,366		$6,527,167	
	N4	200	2,951	$8,371,439	-$6,006,309		$14,377,748	
	P1	190	1,124	$1,217,438	-$1,043,733		$2,261,171	
	P2	87	1,623	$3,087,218	-$1,769,722		$4,856,940	
	Q0	74	31	$266,243	-$30,083		$296,326	
	Q5	98	470	$1,506,510	-$2,320,942		$3,827,452	
	R0	84	2,688	$1,827,666	-$3,300,731		$5,128,397	
	SU	61	4,256	$388,257	-$482,528		$870,785	
					$5,052	$1,010,400		
	Totals	**1137**	**36,062**	**$34,316,129**	**-$35,528,271**	**$1,010,400**	**$70,854,800**	**-$2,515,558**

Phoenix Service Area –
NF (Apache-Sitgraves, Coconino, Coronado, Gila, Prescott, Tonto) BLM - (Phoenix)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TA	G1	267	2,461	$2,888,623	-$1,351,458		$4,240,081	
GEN AT	G4	510	1,274	$2,529,683	-$895,453		$3,425,136	
	G5	128	4,035	$2,860,308	-$376,996		$3,237,304	
	G6	261	15,331	$14,070,943	-$1,083,072		$15,154,015	
	G9	71	2,213	$1,476,296	$31,166		$1,507,462	
	H2	329	12,707	$6,802,623	-$406,590		$7,209,213	
	PH	56	758	$160,736	-$14,151		$174,887	
					$6,500	$1,300,000		
	Totals	**1622**	**38,779**	**$30,789,212**	**-$4,096,554**	**$1,300,000**	**$36,185,766**	**$0**
TB	G1	267	4,280	$3,857,987	-$1,396,306		$5,254,293	
Q200	G4	510	1,354	$2,564,176	-$985,848		$3,550,024	
	G5	128	5,695	$3,591,674	-$470,402		$4,062,076	
	G6	261	17,217	$15,605,194	-$1,089,519		$16,694,713	
	G9	71	3,127	$1,996,958	$49,980		$2,046,938	
	H2	329	17,966	$9,562,780	-$912,324		$10,475,104	
	PH	56	1,109	$180,235	-$25,554		$205,789	
					$7,507	$1,501,400		
	Totals	**1622**	**50,748**	**$37,359,004**	**-$4,829,973**	**$1,501,400**	**$43,690,377**	**-$7,504,611**
TC	G1	267	2,461	$2,893,533	-$1,351,243		$4,244,776	
Q400	G4	510	1,277	$2,538,124	-$897,601		$3,435,725	
	G5	128	4,208	$2,966,863	-$407,192		$3,374,055	
	G6	261	15,330	$14,074,084	-$1,083,076		$15,157,160	
	G9	71	2,343	$1,557,878	$29,993		$1,587,871	
	H2	329	12,749	$6,882,126	-$408,193		$7,290,319	
	PH	56	761	$162,277	-$14,188		$176,465	
					$18,226	$3,645,200		
	Totals	**1622**	**39,129**	**$31,074,885**	**-$4,131,500**	**$3,645,200**	**$38,851,585**	**-$2,665,819**

Phoenix Service Area –
NF (Apache-Sitgraves, Coconino, Coronado, Gila, Prescott, Tonto) BLM - (Phoenix)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TD	G1	267	2,386	$2,891,809	-$1,360,179		$4,251,988	
Bae 146	G4	510	1,229	$2,465,675	-$872,405		$3,338,080	
	G5	128	3,693	$2,746,635	-$314,270		$3,060,905	
	G6	261	15,322	$14,127,347	-$1,082,889		$15,210,236	
	G9	71	1,672	$1,204,609	$9,981		$1,214,590	
	H2	329	12,720	$7,094,060	-$404,416		$7,498,476	
	PH	56	746	$194,786	-$13,919		$208,705	
					$8,107	$1,621,400		
	Totals	**1622**	**37,768**	**$30,724,921**	**-$4,038,097**	**$1,621,400**	**$36,384,418**	**-$198,652**
TG	G1	267	2,245	$2,779,933	-$1,345,163		$4,125,096	
C 130 E	G4	510	1,246	$2,473,555	-$890,483		$3,364,038	
Military	G5	128	2,175	$2,016,337	-$305,383		$2,321,720	
	G6	261	14,331	$13,344,065	-$1,061,378		$14,405,443	
	G9	71	1,540	$1,134,525	$11,255		$1,145,780	
	H2	329	12,208	$6,477,699	-$387,273		$6,864,972	
	PH	56	884	$191,216	-$22,308		$213,524	
					$6,797	$1,359,400		
	Totals	**1622**	**34,629**	**$28,417,330**	**-$4,000,733**	**$1,359,400**	**$33,777,463**	**$2,408,303**
TH	G1	267	2,245	$2,779,933	-$1,345,163		$4,125,096	
C 130 E	G4	510	1,246	$2,473,555	-$890,483		$3,364,038	
Comm	G5	128	2,175	$2,016,337	-$305,383		$2,321,720	
	G6	261	14,331	$13,344,065	-$1,061,378		$14,405,443	
	G9	71	1,540	$1,134,525	$11,255		$1,145,780	
	H2	329	12,208	$6,477,699	-$387,273		$6,864,972	
	PH	56	884	$191,216	-$22,308		$213,524	
					$14,393	$2,878,600		
	Totals	**1622**	**34,629**	**$28,417,330**	**-$4,000,733**	**$2,878,600**	**$35,296,663**	**$889,103**

Phoenix Service Area –
NF (Apache-Sitgraves, Coconino, Coronado, Gila, Prescott, Tonto) BLM - (Phoenix)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic
TI	G1	267	4,238	$3,858,885	-$1,395,117		$5,254,002	
S3	G4	510	1,303	$2,587,575	-$904,570		$3,492,145	
	G5	128	4,687	$3,204,108	-$450,928		$3,655,036	
	G6	261	15,455	$14,162,205	-$1,086,061		$15,248,266	
	G9	71	2,664	$1,784,946	$32,811		$1,817,757	
	H2	329	16,027	$8,742,286	-$872,484		$9,614,770	
	PH	56	1,069	$196,006	-$24,680		$220,686	
					$5,052	$1,010,400		
	Totals	**1622**	**45,443**	**$34,536,011**	**-$4,701,029**	**$1,010,400**	**$40,247,440**	**-$4,061,674**

Redding Service Area –
NF (Klamath, Lassen, Mendocino, Modoc, Six Rivers, Plumus, Shasta-Trinity)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic	Alternative	Unit
TA	M5	166	10,314	$11,584,671	$1,714,490	$13,299,161	-$17,674,878		$30,974,039	
Generic	M6	112	2,087	$1,869,883	$518,104	$2,387,987	-$1,556,246		$3,944,233	
	M8	46	872	$1,026,973	$199,319	$1,226,292	-$2,355,207		$3,581,499	
	M9	113	3,763	$2,522,028	$339,174	$2,861,202	-$2,461,512		$5,322,714	
	N0	85	2,290	$8,821,115	$298,634	$9,119,749	-$5,082,985		$14,202,734	
	N1	191	781	$2,162,282	$1,189,722	$3,352,004	-$5,040,279		$8,392,283	
	N4	200	2,873	$5,199,026	$2,895,742	$8,094,768	-$5,853,650		$13,948,418	
						Daily Availability	$6,500	$1,300,000		
	Totals	**913**	**22,980**	**$33,185,978**	**$7,155,185**	**$40,341,163**	**-$40,024,757**	**$1,300,000**	**$81,665,920**	**$0**
TB	M5	166	10,644	$11,952,810	$1,716,838	$13,669,648	-$17,694,518		$31,364,166	
Q200	M6	112	2,096	$1,897,158	$511,061	$2,408,219	-$1,565,105		$3,973,324	
	M8	46	1,020	$1,182,058	$190,292	$1,372,350	-$2,577,171		$3,949,521	
	M9	113	4,863	$3,418,589	$421,031	$3,839,620	-$2,837,069		$6,676,689	
	N0	85	2,290	$8,819,972	$299,777	$9,119,749	-$5,082,985		$14,202,734	
	N1	191	818	$2,399,395	$1,015,820	$3,415,215	-$5,169,707		$8,584,922	
	N4	200	2,992	$5,538,621	$2,894,632	$8,433,253	-$6,095,145		$14,528,398	
						Daily Availability	$7,507	$1,501,400		
	Totals	**913**	**24,723**	**$35,208,603**	**$7,049,451**	**$42,258,054**	**-$41,021,700**	**$1,501,400**	**$84,781,154**	**-$3,115,234**
TC	M5	166	10,315	$11,586,571	$1,715,586	$13,302,157	-$17,675,985		$30,978,142	
Q400	M6	112	2,087	$1,865,764	$522,448	$2,388,212	-$1,556,164		$3,944,376	
	M8	46	873	$1,043,860	$200,898	$1,244,758	-$2,355,729		$3,600,487	
	M9	113	3,764	$2,522,900	$347,186	$2,870,086	-$2,461,741		$5,331,827	
	N0	85	2,290	$8,820,951	$298,798	$9,119,749	-$5,082,985		$14,202,734	
	N1	191	787	$2,214,199	$1,205,308	$3,419,507	-$5,060,007		$8,479,514	
	N4	200	2,875	$5,178,047	$2,970,867	$8,148,914	-$5,856,427		$14,005,341	
						Daily Availability	$18,226	$3,645,200		
	Totals	**913**	**22,991**	**$33,232,292**	**$7,261,091**	**$40,493,383**	**-$40,049,038**	**$3,645,200**	**$84,187,621**	**-$2,521,701**

Redding Service Area –
NF (Klamath, Lassen, Mendocino, Modoc, Six Rivers, Plumus, Shasta-Trinity)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic	Alternative	Unit
TD	M5	166	10,305	$11,540,259	$1,735,576	$13,275,835	-$17,657,762		$30,933,597	
Bae 146	M6	112	2,086	$1,856,166	$550,227	$2,406,393	-$1,555,965		$3,962,358	
	M8	46	867	$1,013,645	$214,974	$1,228,619	-$2,346,841		$3,575,460	
	M9	113	3,495	$2,312,142	$340,327	$2,652,469	-$2,181,398		$4,833,867	
	N0	85	2,290	$8,817,484	$302,265	$9,119,749	-$5,082,985		$14,202,734	
	N1	191	764	$2,055,480	$1,431,285	$3,486,765	-$4,994,956		$8,481,721	
	N4	200	2,847	$5,069,571	$3,289,186	$8,358,757	-$5,801,920		$14,160,677	
					Daily Availability		$8,107	$1,621,400		
	Totals	**913**	**22,654**	**$32,664,747**	**$7,863,840**	**$40,528,587**	**-$39,621,827**	**$1,621,400**	**$81,771,814**	**-$105,894**
TG										
C 130 E	M5	166	6,599	$7,947,331	$1,726,623	$9,673,954	-$13,078,085		$22,752,039	
Military	M6	112	2,086	$1,866,046	$533,272	$2,399,318	-$1,555,561		$3,954,879	
	M8	46	864	$996,239	$207,694	$1,203,933	-$2,342,799		$3,546,732	
	M9	113	2,690	$1,876,942	$327,604	$2,204,546	-$1,866,622		$4,071,168	
	N0	85	2,225	$8,616,105	$300,681	$8,916,786	-$4,919,060		$13,835,846	
	N1	191	726	$2,069,705	$1,376,695	$3,446,400	-$4,954,622		$8,401,022	
	N4	200	1,934	$4,176,317	$2,866,615	$7,042,932	-$3,854,455		$10,897,387	
						Daily Availability	$6,797	$1,359,400		
	Totals	**913**	**17,124**	**$27,548,685**	**$7,339,184**	**$34,887,869**	**-$32,571,204**	**$1,359,400**	**$68,818,473**	**$12,847,447**
TH										
C 130 E	M5	166	6,599	$7,947,331	$1,726,623	$9,673,954	-$13,078,085		$22,752,039	
Comm	M6	112	2,086	$1,866,046	$533,272	$2,399,318	-$1,555,561		$3,954,879	
	M8	46	864	$996,239	$207,694	$1,203,933	-$2,342,799		$3,546,732	
	M9	113	2,690	$1,876,942	$327,604	$2,204,546	-$1,866,622		$4,071,168	
	N0	85	2,225	$8,616,105	$300,681	$8,916,786	-$4,919,060		$13,835,846	
	N1	191	726	$2,069,705	$1,376,695	$3,446,400	-$4,954,622		$8,401,022	
	N4	200	1,934	$4,176,317	$2,866,615	$7,042,932	-$3,854,455		$10,897,387	
						Daily Availability	$14,393	$2,878,600		

Redding Service Area –
NF (Klamath, Lassen, Mendocino, Modoc, Six Rivers, Plumus, Shasta-Trinity)

100 = Days of Availability for 1st Air Tanker
100 = Days of Availability for 2nd Air Tanker

Alternative	Unit	Freq	Acres Burned	Fire Suppression Costs	Net Value Change	Air Tanker Daily Availability	Row Totals	Change From Generic	Alternative	Unit
	Totals	**913**	**17,124**	**$27,548,685**	**$7,339,184**	**$34,887,869**	**-$32,571,204**	**$2,878,600**	**$70,337,673**	**$11,328,247**
TI										
S3	M5	166	10,321	$11,616,517	$1,723,984	$13,340,501	-$17,681,300		$31,021,801	
	M6	112	2,095	$1,885,939	$522,882	$2,408,821	-$1,563,457		$3,972,278	
	M8	46	911	$1,162,388	$197,612	$1,360,000	-$2,360,707		$3,720,707	
	M9	113	4,827	$3,322,943	$404,858	$3,727,801	-$2,799,366		$6,527,167	
	N0	85	2,290	$8,818,453	$301,296	$9,119,749	-$5,082,985		$14,202,734	
	N1	191	808	$2,370,552	$1,115,222	$3,485,774	-$5,133,287		$8,619,061	
	N4	200	2,951	$5,327,414	$3,044,025	$8,371,439	-$6,006,309		$14,377,748	
						Daily Availability	$5,052	$1,010,400		
	Totals	**913**	**24,203**	**$34,504,206**	**$7,309,879**	**$41,814,085**	**-$40,627,411**	**$1,010,400**	**$83,451,896**	**-$1,785,976**

Appendix H

AutoAT4 Modeling – Platform Capacity Less Than 5,000 Gallons

Narrative of Results

This page intentionally left blank.

Findings by Example Aircraft Platforms with Platform Capacity Less Than 5000 Gallons

C-130H (Military)

This aircraft provided the highest change in C+NVC from the currently defined generic future airtanker. This increase is mainly due to the increase in tank size from 3,000 gallons to 4,300 gallons. It is a reflection of the value of fireline production support during the very early stages of a fire when its perimeter is relatively small compared to later timeframes.

Figure H-1 – C-130H (Military)

C-130H (Private)

All of the comments made for the C-130H (Military) platform apply to the C-130H (Private) platform except for cost. The procurement of a platform from military surplus is less expensive than via a private acquisition reducing the estimated daily availability from $14,400 for the private acquisition to about $6,800. It is important to note that it is not necessary to acquire aircraft platforms from the military for the conversion to and use as an airtanker to have positive economic value.

Figure H-2 – C-130H (Private)

BAe-146

This platform had a positive comparison in C+NVC with the currently defined generic future airtanker at three of the airtanker bases tested. The difference at the other two varied from about -$106,000 to about -$199,000. These differences are within any expected variation of this analysis. In general, it appears this platform is roughly equivalent to the currently defined generic future airtanker based on the metric of C+NVC. This aircraft also is compatible with a high percentage of airtanker bases (88%).

Figure H-3 – BAe-146

S-3, Viking

This platform had a negative comparison in C+NVC with the currently defined generic future airtanker at all of the airtanker bases tested. This is mainly due to its smaller tank size (1,800 vs. 2,700 gallons) as the daily availability and flight rates are less. This smaller tank size also affects its ranking versus the C-130H (4,300 gallons). This is particularly true when travel is below 10,000 feet since the travel speed is the same. The compatibility with airtanker bases is low at 62% (Table 6).

Figure H-4 – S3, Viking

Bombardier Aerospace Q-400

This platform had a negative comparison in C+NVC with the currently defined generic future airtanker at all of the airtanker bases tested. This is mainly due to the higher daily availability ($18,226 vs. $6,500) as the flight rates and tank size are similar. The daily availability value used assumes the aircraft is performing additional work outside the fire season. If not, the daily availability is estimated to $37,785. On the positive side, this platform has a high compatibility with airports (86%) (Table 6).

Figure H-5 – Q-400

Bombardier Aerospace Q-200

This platform had a negative comparison in C+NVC with the currently defined generic future airtanker at all of the airtanker bases tested. This is mainly due to its smaller tank size (1,600 vs. 2,700 gallons) and the daily availability ($7,507 vs. $6,500). On the positive side, this platform has the highest compatibility with airports (92%) (Table 6).

Figure H-6 – Q-200