Aircraft Fleet Analysis

City of San Diego

Prepared for:

City of San Diego
Financial Department
San Diego, CA

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Prepared by

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Introduction

The Overview in Exhibit A of the Helicopter Study Contract stated The City of San Diego seeks the assistance of Conklin & de Decker with a thorough assessment of the City's current helicopter fleet to make more informed decisions on the purchase, operation, maintenance, and disposition of aircraft by providing objective and impartial information. More specifically, the Exhibit requested that Conklin & de Decker focus on the following areas to accomplish the intent of the Overview.

- Based on the City's historical usage, identify the preliminary specifications of the helicopter(s) required. Preliminary specifications could include such items as aircraft weight range, size, number of engines, and useful load.
- Estimate the cost of the acquisition and operation of helicopter alternatives. The operating costs estimates will include maintenance options and fuel costs, and other operating or overhead costs.
- Establish a defined framework for a City-wide helicopter replacement plan including the anticipated useful life of the equipment, as well as a comparison of phasing of purchases versus purchasing all replacement aircraft all at once.
- Determine the advantages and disadvantages for purchasing helicopters using the following scenarios: (A) Cash only purchase; (B) a financed purchase using the City's lease-purchase program; (C) and other financing scenarios.
- Thoroughly research the resale value of the current fleet and explore the primary and secondary markets for helicopters to determine the feasibility of replacement within specified timeframes. Such as lead times in acquiring helicopters and expected duration in selling the current fleet.
- Provide a comprehensive summary of the Maintenance Steering Group – 3rd Task Force (MSG-3) maintenance requirements based on usage parameters such as flight hours, calendar times, or flight cycles. Compare/contrast to current maintenance schedules deployed by the City.

To address the specific areas, Conklin & de Decker created five sections, with each containing the following categories.

- A restatement of the County's original issue, concern or question.
- Conklin & de Decker's proposed approach.
- A summary of the analysis and research.
- Conklin & de Decker's analysis explaining the process and research to support the summary.

Listed below are the sections with the respective page numbering.

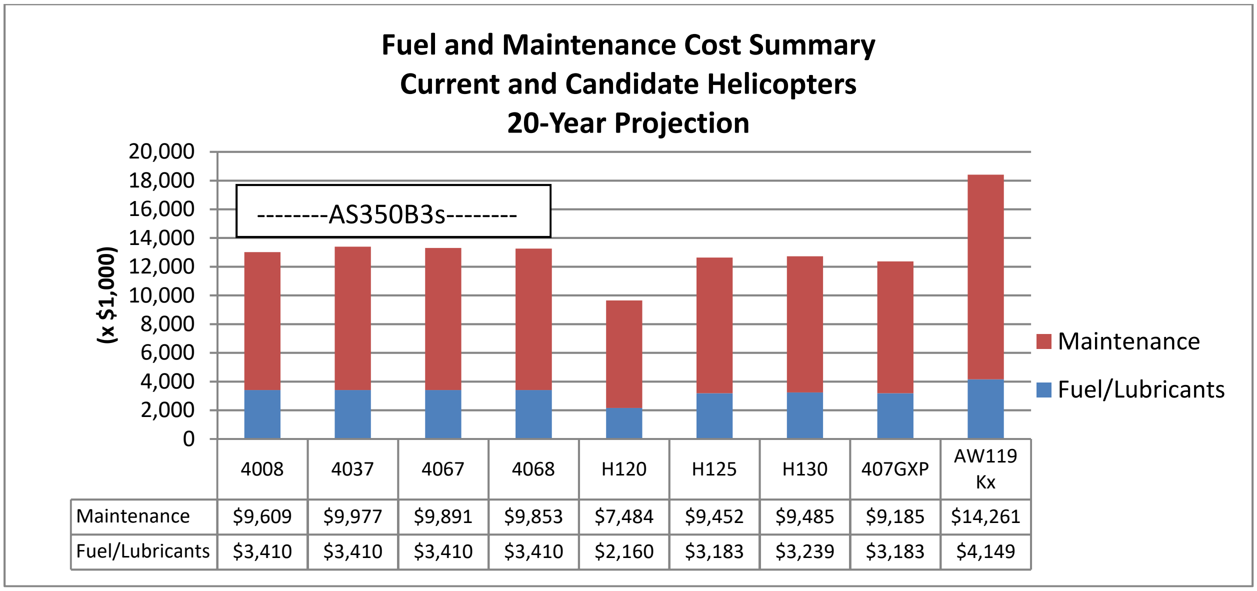
Executive Summary

The City of San Diego entered into a contract with Conklin & de Decker seeking assistance with a thorough assessment of the City's current helicopter fleet to make more informed decisions on the purchase, operation, maintenance, and disposition of aircraft by providing objective and impartial information.

The City has two aviation units, one that supports the police department and the other that supports the fire-rescue department. The following summarizes the results to Conklin & de Decker's analysis and research for ABLE, the police aviation unit. The summary for the San Diego Fire-Rescue aviation unit begins on page 4.

San Diego Police Air Support Unit (ABLE)

- Section 1, Fleet Review:
    - ABLE personnel do not foresee that its mission will change in the near or long-term future and that the current AS350B3 helicopters do not have any shortcomings when performing the department's missions.
    - Conklin & de Decker selected other similar performing helicopter types to give the City a basis to make decisions regarding the make-up of its fleet should it decide to acquire new aircraft in the future. The types, all light single-engine helicopters, included three Airbus Helicopters – H120, H125, and H130, one Bell Helicopter – 407GXP, and one Leonardo – AW119Kx.
    - Each candidate helicopter, with the exception of the H120, meets or exceeds the current performance and specifications of the AS350B3. The AW119Kx exceeds the needs of the current law enforcement missions.
- Section 2, Life Cycle Cost Projection:
    - The estimated maintenance and fuel costs over a 20-year period for each of the current police helicopters and selected candidate helicopters. The chart highlights the similarities in operating costs of the current AS350B3 (serial numbers 4008, 4037, 4067, and 4068) helicopters and the three candidate helicopters, which are the most similar in performance to the AS350B3s, the H125, H130, and 407GXP.



- The time remaining for significant scheduled maintenance items and events have an effect on an aircraft's value during its life cycle. Table 2-1 reflects that effect for the current and candidate helicopters. The years marked with yellow represent periods when the remaining lives of significant scheduled maintenance have a positive effect on value when compared to an assumption of 50 percent remaining life. The single red block for each helicopter represents the lowest value during the 20-year period. The letters in the yellow blocks identify the years with the highest estimated values. "A" identifies the highest value. The white blocks are the years when the value is below the average baseline.

Table 2-1

ABLE Helicopters - Annual Summary of Adjusted Values

Serial Number	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4008			E			D								B	A			C		
4037	B	A			C												E	D		
4067		A		C												D	E		B	
4068	E	D		C												B	A			
Candidate Helicopters - Annual Summary of Adjusted Values																				
H120	A	B	D	C			E													
H125	A	B	E		D	C														
H130	A	B	D	E	C															
407GXP	A	B	C				E		D											
AW119Kx	A	B		C			D			E										

- Section 3, Market Conditions
  - On average helicopters hold their value quite well. However, the current slow economy has had a negative effect on the average. Used helicopter deliveries have experienced a 25 percent decline between 2014 and 2016. Three industry sources

indicate that during this period, the amount of inventory for pre-owned helicopters has increased, which places pressure on the value of used helicopters.
    - An industry source estimated the resale values for the existing four AS350B3 helicopters to be between $0.8 and $1.2 million dollars. The source also indicated that in the short-term, conditions existed that could reduce the values further than this estimate.
    - A second source indicated the decline in values for the AS350B3 helicopters in 2016 when compared to the prior during year was between 9 and 13 percent.
- Section 4, Topics for Acquisition
    - Guaranteed maintenance programs (GMP) provide certainty for the erratic and often hard-to-predict behavior of maintenance costs. Often overlooked but just as important, GMP will improve helicopter availability. A strong understanding of the many variables and factors that influence what a program potentially covers is important. Negotiate with the vendors for better value.
    - The estimated purchase price for a mission-configured helicopter for the candidate helicopters is summarized in the following table.

Candidate Helicopters Estimated Purchase Price (x $1,000) Mission Configuration – Law Enforcement				
H120	**H125**	**H130**	**407GXP**	**AW119Kx**
$3,277	$4,511	$5,184	$4,891	$4,789

    - Three purchase methods were considered to acquire a new H125 helicopter. Including the 20-years of operating costs, the cash purchase method ($14.6 million) will consume an amount of assets between $0.4 and $0.6 million dollars less than when compared to the lease-to-purchase options ($15.0 to $15.2 million), depending on lease terms.
    - If the time value of money is considered, the lease-to-purchase option over 10 years and 2.7 percent interest is the best option over the 20-year period but only by $200,000. There is little difference between the two lease-to-purchase options.
    - The maintenance philosophy of MSG-3 was not applicable to the existing fleet or the candidate helicopters; therefore we did not pursue this subject further.
    - Due to the 12-year inspection and its adverse effect on aircraft availability, the City should contact Airbus Helicopters regarding the continued requirement of the inspection. The likely candidate helicopter to replace the AS350B3 fleet is the H125, which also has the inspection.
- Section 5, Fleet Replacement Plan:
    - We chose the H125 on which to base the estimates for this alternative because ABLE personnel indicated its law enforcement mission would not change in the foreseeable future and based on the analysis in Section 1 Fleet Review, the current helicopters perform the missions well. The H125 is a newer version of the AS350B3.
    - Consider using a three-helicopter fleet rather than four.

- The following table summarizes the analysis for the three options, retain current fleet, replace current fleet at one time, and replace current fleet in phases. For the replace-the-fleet options, the table contains estimated costs for a three or four helicopter fleet. The H125 purchase prices in the table reflect mission-ready helicopters. If the City
  - Retained its current fleet for another 20 years, the maintenance and fuel costs to operate the fleet of four helicopters would be almost $53 million.
  - Replaced its fleet and reduced the number of helicopters to three, it would spend approximately $55 million to operate, purchase, and dispose of the current helicopters.
  - Acquired and retained a fleet of four helicopters, the cost would be between $60.7 and $61.9 million.

ABLE - Summary of Fleet Options				
20-Year Estimate (x $1,000)				
Option	**Operating Cost**	**Disposition Amount**	**Purchase**	**Total**
1) Retain Current Fleet	$52,969	Not Applicable	Not Applicable	$52,969
2) Replace Fleet at Same Time				
Three Aircraft	$44,720	($4,897)	$15,174	$54,997
Four Aircraft	$45,368	($4,897)	$20,232	$60,703
3) Replace Fleet in Phases				
Three Aircraft	$45,169	($4,974)	$15,174	$55,369
Four Aircraft	$46,659	($4,974)	$20,232	$61,917

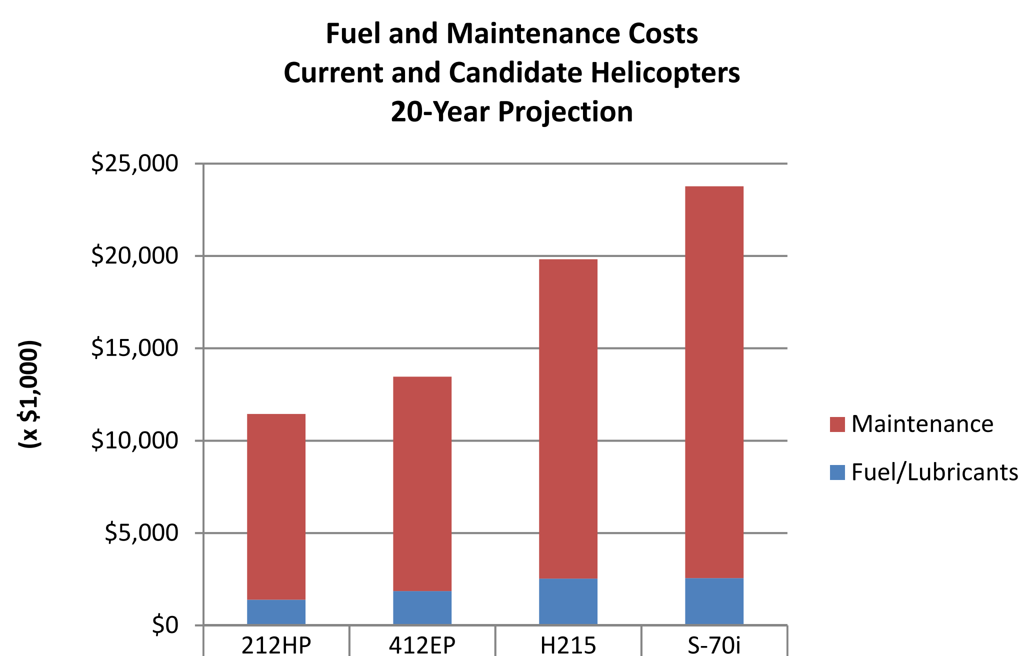
San Diego Fire-Rescue Department (SDFD)

- Section 1, Fleet Review:
  - SDFD does not see its primary missions changing; however, the organization does believe it needs to increase its water delivery capabilities during the firefighting mission. The current fleet of helicopters can deliver less than 300 gallons per drop. A more acceptable volume would be in the range of 700 to 1,000 gallons. SDFD also mentioned that current cabin volume and seating limits their ability to carry certain mission equipment and personnel during other missions.

- Conklin & de Decker selected two helicopter types that have the capacity to deliver more water per drop, while also providing more cabin volume and seating. Those aircraft were the Sikorsky S-70i and Airbus Helicopters H215.

➢ <u>Section 2, Life Cycle Cost Projection:</u>

- We estimated the maintenance and fuel costs over a 20-year period for each of the current helicopter fleet and for the selected replacement candidate helicopters. While the chart highlights the increase in costs for the candidate helicopters, it does not represent the significant increase in water dropping capacity.



	212HP	412EP	H215	S-70i
Maintenance	$10,054	$11,612	$17,290	$21,208
Fuel/Lubricants	$1,389	$1,852	$2,526	$2,557

- The time remaining for significant scheduled maintenance items and events have an effect on an aircraft's value during its life cycle. Table 2-2 reflects that effect for the current and candidate helicopters. The years marked with yellow represent periods in the life cycle when the remaining lives of significant scheduled maintenance have a positive effect on value when compared to an assumption of 50 percent remaining life. The single red block for each helicopter represents the lowest value during the 20-year period. The letters in the yellow blocks identify the years with the highest estimated values. "A" identifies the highest value. Yellow blocks without letters represent estimated aircraft revalues that are less than the fifth highest year ("E"). The white blocks are the years when the value is below the average baseline.

Table 2-2																				
SDFD Helicopters - Annual Summary of Adjusted Values																				
Serial Number	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
31147						A	D		C	B	E									
36466		A	C					B	E			D								
Candidate Helicopters - Annual Summary of Adjusted Values																				
H215	A	B	C	D	E															
S-70i	A	B	C	D	E															

- <u>Section 3, Market Conditions:</u>
  - On average helicopters hold their value quite well. However, the current slow economy since 2014 has had a negative effect on the average value. Used helicopter deliveries have experienced a 25 percent decline between 2014 and 2016.
  - Using two industry resources, Conklin & de Decker and HeliValue$, the range of costs for a used Bell 212 is $1.45 to $1.75 million and for the Bell 412EP is $4.90 to $5.80 million.
  - An industry source reemphasized that estimated helicopter values are only applicable if there are available buyers. And as of the end of 2016, the lack of buyers at the current estimated values indicates the actual value is somewhere lower than the estimated values.
- <u>Section 4, Topics for Acquisition:</u>
  - Guaranteed maintenance programs (GMP) provide certainty for the erratic and often hard-to-predict behavior of maintenance costs. Often overlooked but just as important, GMP will improve helicopter availability. A strong understanding of the many variables and factors that influence what a program potentially covers is important. Negotiate with the vendors for better value.
  - The estimated purchase price for a mission-configured helicopter for the candidate helicopters is summarized in the following table.

Candidate Helicopters	
Estimated Purchase Price (x $1,000)	
Mission Configuration – Fire-Rescue	
Airbus H215	**Sikorsky S-70i**
$21,500	$18,500

  - Three purchase methods were considered to acquire a new H215 helicopter. We selected the H215 to illustrate the difference in the acquisition methods, not to imply a preference among the candidate helicopters. Including the 20-years of operating costs, the cash purchase method ($29.3 million) will consume an amount of assets between $1.9 and $3.0 million dollars less than when compared to the lease-to-purchase options ($31.2 to $32.3 million), depending on lease terms.

- If the time value of money is considered, the lease-to-purchase options are better than the purchase option by a significant amount. The 10-year and 2.7 percent interest lease-to-purchase option over the 20-year period had the best net present value at $18.8 million. The 7-year and 2.5 percent interest lease-to-purchase option had a net present value of $20.1 million.
- The maintenance philosophy of MSG-3 was not applicable to the existing fleet or the candidate helicopters; therefore we did not pursue this subject further.
- The Airbus H215 is similar to the H125 in that it also has a calendar-based inspection, which occurs every 120 months or ten years. Due to the low annual hours for the SDFD helicopters, the effect on the cost per hour will be more significant than the H125. The H215 will accumulate an estimated 2,500 hours every ten years, while the H125 will accumulate over 10,000 hours before reaching the 12-year inspection.

➢ <u>Section 5, Fleet Replacement Plan:</u>

- Although retaining the current fleet is not likely, it serves as a benchmark when compared to the other possible alternatives. Based upon the life cycle cost assumptions stated in Section 2 Cost Projections, we projected the estimated fuel and maintenance costs for the next 20 years for Bell 212HP and 412EP.
- If the City acquired helicopters with greater water-drop capacity, we assumed the Bell 212HP would be sold, due its age, and the Bell 412EP would remain in the fleet. SDFD expressed the need to retain a 412 over the long-term.
- We used the Sikorsky S-70i in lieu of the Airbus H215 for one reason. For the primary firefighting mission, only the Sikorsky S-70i meets the SDFD parameter to deliver between 700 and 1,000 gallons of water per drop. When compared to the Airbus H215, the Sikorsky S-70i can deliver between 30 and 42 percent more water per drop.
- Recommend the purchase of two Sikorsky S-70i helicopters. Significant scheduled maintenance events have an adverse effect on the availability rate of the S-70i. If delivering larger amounts of water is a priority and having at least one S-70i helicopter available 24/7, then a second helicopter is suggested for adequate coverage.
- The following table summarizes the analysis for the three options, retain the current fleet, replace the 212HP with one S-70i, and replace the 212HP with two S-70i helicopters. The purchase prices reflect mission-ready helicopters. If the City
  - Retained its current fleet for another 20 years, the maintenance and fuel costs to operate the fleet of two helicopters would be almost $25 million.
  - Replaced its 212HP in Year 2, retained the 412EP, and acquired one S-70i in Year 2, the cost to operate, purchase, and dispose of the 212HP would be approximately $53.3 million.
  - Replaced its 212HP in Year 2, retained the 412EP, and acquired two S-70i helicopters (one in Year 2 and one in Year 3), the cost to operate, purchase, and dispose of the 212HP would be $92.7 million.

SDFD – Summary of Fleet Options				
20-Year Estimate (x $1,000)				
Option	**Operating Cost**	**Disposition Amount**	**Purchase**	**Total**
1) Retain Current Fleet	$24,907	Not Applicable	Not Applicable	$24,907
2) Acquire S-70i Helicopters				
One S-70i	$33,573	($1,310)	$21,065	$53,327
Two S-70i	$51,860	($1,310)	$42,130	$92,680

Note:

1) **Purchase: Based upon the lease-to-purchase option at 10 years and a 2.7 percent annual interest rate. Acquisition price is estimated at $18.5 million for a mission-ready helicopter.**

Section 1 – Fleet Review

1.0 City of San Diego Original Request

Based on the City's historical usage, identify the preliminary specifications of the helicopter(s) required. Preliminary specifications could include such items as aircraft weight, range, size, number of engines, and useful load.

1.1 Conklin & de Decker Approach

In interviews with the police and fire aviation unit personnel, there was no indication that their respective missions would be changing in the future. As a result, the primary objective for the police aviation unit was to identify and then compare alternative helicopter types with the current fleet to determine if there might be better-suited helicopters to perform the law enforcement mission. In conjunction with the City, we determined that useful load, mission endurance, hover capability, cabin volume and seating, and purchase price were good parameters to compare the existing helicopter fleet with candidate helicopters.

While the fire department's missions also did not change, its interest in identifying a more effective helicopter to perform its missions was a priority. We used the same approach as was used for the police analysis but we added two more parameters to compare the existing fleet to the candidates, aircraft speed and water drop capacity.

1.2 Summary

1.2.1 San Diego Police Air Support Unit

The San Diego Police Air Support Unit (ABLE) helicopters fly a variety of missions, both night and day, with the primary objective to support ground personnel by improving safety. Missions can include assistance with foot and vehicle pursuits, missing person searches, vehicle recovery, surveillance, and first-at-scene support. Certain missions also require the carriage of personnel in addition to the two-person flight crew. Typically, the duration of patrols will last 1.0 to 1.5 hours, which is based on safety reasons for the crew and annual budgetary resources.

ABLE personnel do not foresee that its mission will change in the near or long-term future and that the current AS350B3 helicopters do not have any shortcomings when performing the department's missions.

As a result, Conklin & de Decker selected other similar performing helicopter types to give the City a basis to make decisions regarding the make-up of its fleet should it decide to acquire new aircraft in the future. The types, all light single-engine helicopters, included three Airbus Helicopters – H120, H125, and H130, one Bell Helicopter – 407GXP, and one Leonardo – AW119Kx.

To allow for a meaningful comparison between the existing and candidate helicopters, we compiled information for the following parameters:

- Useful Load
- Mission Endurance
- Hover Capabilities
- Cabin Volume and Seating
- Purchase Price

With the exception of the H120 and its available useful load, each of the candidate helicopters meets or exceeds the current performance and specifications of the AS350B3. The AW119Kx probably exceeds the needs of the current law enforcement missions. The remaining helicopters, the H125, H130, and 407GXP, and based upon the above-mentioned parameters, could fulfill the ABLE requirements. Table 1-7 compares each of the helicopters based on the parameters.

1.2.2 San Diego Fire-Rescue Department

San Diego Fire-Rescue Department (SDFD) operates two types of medium twin-engine helicopters, a 36-year old Bell 212HP and a Bell 412EP purchased new in 2008. SDFD responds to more than 400 emergencies while flying between 400 and 500 hours per year. Support of firefighting operations in San Diego and the region is the primary mission, but SDFD also participates in hoist-air rescue, short-haul air rescue, shoreline rescue, helicopter swift-water rescue, night vision goggle operations, patient transport, vehicle rescue, large animal rescue, fire mapping, infrared detection, disaster assessment, and has the ability to assist in high-rise fire incidents. Of the two helicopters, one is available 24-hours- a-day, 7-days-a-week, and 365-days-a-year. The second helicopter meets more of a seasonal need that typically lasts from July 1 through December 31. During this period, the helicopter is available 9-hours-a-day, daylight only, and 7-days-a-week. For each helicopter, the crew consists of a pilot, fire captain/crew chief, and firefighter/paramedic.

Similar to ABLE, SDFD did not see its primary missions changing. However, the organization does believe it needs to increase its water delivery capabilities during the firefighting mission. Currently, the helicopters can deliver less than 300 gallons per drop. A more accepted volume would be in the range of 700-to 1,000 gallons. SDFD also mentioned that current cabin volume and seating limits their ability to carry certain mission equipment and personnel during other missions.

Conklin & de Decker selected two helicopter types that have the capacity to deliver more water per drop while also providing more cabin volume and seating. Those aircraft were the Sikorsky S-70i and Airbus Helicopters H215.

Based on prior discussions with city personnel and the nature of the SDFD missions, with an emphasis on firefighting, we selected the following parameters to compare the current Bell 212 HP and 412 EP helicopters to the candidate helicopters.

- Useful Load
- Mission Endurance
- Speed
- Hover Capabilities
- Water Drop Capabilities
- Cabin Volume and Seating
- Purchase Price

The candidate helicopters have significantly more water capabilities. The water tank capacity ranges from 600 gallons for the H215 Long version to 1,000 gallons for the S-70i. The H215 Short version utilizes water bucket technology which can hold up to 663 gallons. In a mission-ready configuration, the S-70i has the capability to meet the 700 to 1,000-gallon objective, while the H215s fall into the 500-gallon range.

In addition to improved water capacity, the candidate helicopters also offer larger cabins than the current helicopters, which translate into the potential to carry more passengers and equipment. The H215 versions almost double the useful load of the 212HP and 412EP, while the S-70i is almost three times higher.

Obtaining the benefits that come with the candidate helicopters means an increase in costs, both to purchase and operate the helicopters. Table 1-16 offers an estimated purchase price of a basic-configured aircraft for the current and candidate helicopters. A mission-configured helicopter would add another 10-20 percent to the purchase prices provided in the table. While the prices are higher for the S-70i and H215, the current economic conditions in the helicopter industry could push them lower. Also, creating competition between the manufacturers in a slow market can further reduce the purchase price.

1.3 Conklin & de Decker Analysis

We divided the current fleet review into two primary categories, one discussing the police aviation unit and the other the fire department aviation unit. Each primary category contains information about the current fleet, the possible candidate aircraft, and performance and specification information for the current and candidate helicopters. The performance and specification information allows comparison between the helicopter types should the City consider changing its fleet. Section 1.3.1 contains the information related to the police aviation unit, while Section 1.3.2 contains the same type of information related to the fire aviation unit.

1.3.1 San Diego Police Air Support Unit

1.3.1.1 Current Fleet

Background:

The San Diego Police Air Support Unit (ABLE) operates four AS 350B3 helicopters that were purchased in 2004 and 2005 and are configured for law enforcement missions. The helicopters are manufactured by Airbus Helicopters, formerly known as The Eurocopter Group. Eurocopter was formed in 1992 through the merger of the French state-owned aerospace manufacturer Aerospatiale and German aerospace manufacturer Messerschmitt-Bölkow-Blohm (MBB). The manufacturer's history in the United States dates back to the 1974 acquisition of Texas-based Vought Helicopter by Aerospatiale. In 1979, MBB also formed a unit in the United States, headquartered in Pennsylvania.

The AS350 family of light single-engine helicopters was started in the early 1970's and was one of the first designs by the newly-formed helicopter division of Aerospatiale. It was the successor to the popular SA316 Alouette and the AS341 Gazelle. The AS350 was a completely new design that introduced several major innovations to the helicopter world, including the use of composites for the cabin structure, rotor head, and blades. The cabin's design offered a wide and unobstructed cabin, similar to the SA316 Alouette. The standard seating configuration for an AS350 has a pilot and one or two passengers up front and a three-place bench in the back. The helicopter is approved for external lift work and is specifically designed to perform in hot temperatures and high altitudes. The AS350 series has proven to be very popular with all segments of the commercial helicopter industry including many law enforcement organizations.

The ABLE helicopters are powered by a single turbine engine, the Arriel 2B1, which is manufactured by Safran (formally known as Turbomeca). The first flight of the AS350B3 was in 1997 and production started in 1998. The first version of the AS350B3 was powered by Turbomeca's Arriel 2B and was in production until 2008. In 2009, Turbomeca increased the performance of the Arriel 2B, which is known as the Arriel 2B1.

Mission:

The ABLE helicopters fly a variety of missions, both night and day, with the primary objective to support ground personnel by improving safety. Missions can include assistance with foot and vehicle pursuits, missing person searches, vehicle recovery, surveillance, and first-at-scene support. Certain missions also require the carriage of personnel in addition to the two-person flight crew. Typically, the duration of patrols will last 1.0 to 1.5 hours, which is based on safety reasons for the crew and annual budgetary resources. The AS350B3 is capable of flying between 2.0 and 2.4 hours without refueling.

To perform the law enforcement missions more effectively, the ABLE helicopters are equipped with the following mission equipment.

- Forward-Looking Infrared (380 HDc)
- Moving Map System (Aerocomputers UCR-5300)
- Digital Video Recorder (Avalex AVR 8345 HD)
- Video Monitors (Avalex 12.1 and 8 inch)
- Searchlight (Spectrolab Nightsun)
- Vehicle Locator (LoJack)
- Police Radios (2) (Motorola)
- VHF/UHF/FM radio Transceivers (Wulfsburg RT 5000 and 30)
- Siren/ PA System
- Night Vision Goggles

Basic Fleet Information:

Table 1-1 offers more basic information about the current fleet.

Table 1-1				
Basic Information - Police Helicopters				
Serial Number	**N Number**	**Total Time (Flight Hours)**	**Month/Year Placed in Service**	**Average Flight Hours per Year**
4008	N707SD	8,992	Oct 2005	830
4037	N708SD	6,170	Dec 2005	578
4068	N709SD	6,967	May 2006	680
4067	N710SD	7,515	May 2006	733

Notes:

- Serial Number: Unique identification for each aircraft as assigned by the manufacturer.
- N Number: Civil aircraft must be registered with the Federal Aviation Administration. The registration number is frequently referred to as the aircraft's N Number because all registered aircraft registered have a number starting with the letter N.
- Total Time (Hours): The total airframe hours as reflected on August 22, 2016, by the Rotorcraft Support, Inc. maintenance tracking reports for the respective aircraft.
- Month/Year Placed in Service: Based on the maintenance tracking reports provided by Rotorcraft Support, Inc.
- Average Hours per Year: Calculation based upon the approximate months the aircraft has been in service divided into the Total Time. The monthly average was multiplied by 12 months to reach an estimated annual amount.

The following image shows one of ABLE's AS350B3 helicopters.

AS350B3

1.3.1.2 Candidate Helicopters

We identified five helicopter types that were in the same class of performance and size as the current AS350B3 helicopters. In the group, we purposely selected a helicopter type that, while considered as light single-engine, it clearly was at the lower end of the range in performance parameters (Airbus H120). We did so to determine the floor in performance for this class of helicopter. We also selected a helicopter that was at the high end of the spectrum to determine the ceiling (Leonardo AW119Kx). The candidate helicopters chosen for further analysis were the

- Airbus H120
- Airbus H125
- Airbus H130
- Bell 407GXP
- Leonardo AW119Kx

Airbus H120 - Design of the EC 120B (originally called the P120L) light single-engine helicopter was started in early 1990 as a joint effort between Airbus Helicopters, CATIC/HAMC (a Chinese Aerospace company) and Singapore Technologies Aerospace (STA). Airbus Helicopters is the program leader with a 61% share and is responsible for the dynamic system, final assembly, flight test, and certification. CATIC/HAMC has a 24% share and is responsible for the cabin, landing gear, and fuel system. STA has a 15% share and is responsible for the tail boom, doors, and instrument pedestal.

The H120 was a new design and brought certain innovations, such as the fenestron tail and composite rotor hub and blades, to the five-seat helicopter field. The standard seating configuration has a pilot and one passenger up front and three passengers in the back all in energy attenuating seats. The helicopter is also approved for external lift work.

The H120 uses a Turbomeca Arrius 2F engine, a three-bladed composite rotor head, composite blades and an 8-bladed, composite fenestron shrouded tail rotor. The H120B had its first flight in 1995, was certificated in 1997, and first deliveries were made in 1998.

H120

Airbus H125 – Prior to its marketing name change, the H125 was known as the AS350B3e, which was an upgrade to the AS350B3. The AS350B3e received an upgraded Turbomeca Arriel 2D engine, a digital engine control system, and an engine data recorder for condition monitoring. The AS350B3e also comes with improved interior design and tail rotor modifications. For a comparison as to how the H125's performance parameters and specifications compare to the existing AS350B3, refer to Table 1-7.

Airbus H130 – Originally developed as the EC130 B4, the H130 is based upon the AS350B3 but with some significant changes to the airframe. The airframe change included the insertion of a plug widening the fuselage while also lengthening the cabin. The wider and longer cabin can accommodate one pilot and seven passengers, an increase of two passengers over the AS350B. A substantial portion of the cabin is composite rather than metal. The redesign also changed the external appearance of the fuselage by incorporating the nose of the H120 and the tail of the H135. The redesign reduced the external noise to levels below current noise limits.

The drivetrain system also had significant changes. A fenestron tail rotor replaced the conventional two-blade tail rotor, while retaining composite main rotor blades, composite rotor head, and the main transmission from the AS 350B3. The engine, Turbomeca Arriel 2B1, was also upgraded.

The EC 130 B4 was certificated in late 2000 and deliveries started in 2001. The EC130 T2 was a further development of the 130 B4. It replaced the Arriel 2B1 with the Arriel 2D offering a 14% power increase and a higher overhaul interval.

H130

Bell 407GXP - Bell Helicopter Textron is one of the largest manufacturers of civilian, military, and police helicopters worldwide. Bell has also had partnerships with Boeing and Agusta Westland in developing tiltrotor aircraft for military and civilian use.

The original Bell 407 was certified in 1996, with an all-composite four-bladed semi-rigid rotor and hub as well as a soft-mounted pylon isolation system to reduce vibration. The fuselage is the same as the Bell 206L4 fuselage but is widened by 7 inches and has larger windows. The fuselage is made of conventional aluminum alloy but the tail boom is constructed of composites. The cabin has two seats in front and an aft cabin with two seats facing aft and 3-seat bench facing forward.

The 407GXP, introduced in 2015, has an improved Rolls Royce, 250-C47B/8 engine, which improves hot (temperatures) and high (altitude) performance when compared to the original 407. The avionics suite was also improved.

Bell 407GXP

AW119Kx – The manufacturer of the AW119 series, Leonardo, has had a flurry of name changes during its lengthy history. Started in 1923 by its namesake, Giovanni Agusta, Agusta retained its name until 2000 when it merged with Westland Helicopter of the United Kingdom. Known as Agusta/Westland, the aircraft manufacturer was actually a wholly-owned subsidiary of Finmeccanica, which became the next short-lived name beginning in 2016. The name will change again at the beginning of 2017 to Leonardo.

Milestones for the initial version of the AW119, the Koala, included first flight of the prototype in 1995, certification obtained in 2000, and first deliveries started the same year.

The Agusta 119 is a light/medium single-engine helicopter with seating for eight, two crew members and up to six passengers depending on the configuration. In addition, the aluminum fuselage is mounted on skids rather than a retractable, wheeled gear, has four composite main rotor blades, fully articulated rotor hub, and a two-bladed tail rotor.

The current version of the AW119 is the AW119Kx. The helicopter is powered by the Pratt & Whitney PT6B-37A engine and features the Garmin G1000H glass integrated flight deck system.

AW119Kx

1.3.1.3 Performance Parameters/Specifications – Current AS350B3

As mentioned previously, the primary mission of ABLE's helicopters is to support ground units so they can perform their jobs more safely and effectively. The potential to arrive quickly on-scene allows the aviation unit to ascertain situations from a broader perspective while also communicating with those on the ground. Additionally, helicopters can assume a lead role in certain missions.

Vehicular pursuits from the air reduce not only the risks associated with ground pursuits but also the city's liability.

To perform the aerial law enforcement missions appropriately, certain performance, specification, and cost variables become important. Stated another way, does the helicopter have what it takes to get the job done, while consuming reasonable financial resources? Relevant questions related to the law enforcement missions might include:

- How much weight can the helicopter carry (a.k.a. useful load)?
- How long can the helicopter fly before requiring refueling (a.k.a. mission endurance)?
- How well can the helicopter perform in certain conditions (e.g. high temperatures, high altitude)?
- Can the helicopter carry passengers and equipment?
- How much does it cost to acquire the helicopter?

Based on prior discussions with city personnel and the nature of the law enforcement mission, we selected the following parameters to compare the existing AS350B3 helicopters to the candidate helicopters.

- Useful Load
- Mission Endurance
- Hover Capabilities
- Cabin Volume and Seating
- Purchase

The following information explains the importance of each of the parameters, while using the existing AS350B3 as a benchmark to further illustrate each parameter. Following the explanation of the parameters, Table 1-7 compares the existing AS350B3 helicopters to the candidate helicopters.

Useful Load – The amount of available weight an aircraft can carry for fuel, supplies/cargo, and personnel is a premium. Therefore it is one of the more important factors in the selection process. A limited amount of useful load is one of the more common reasons for an operator to change aircraft as its mission and related equipment changes.

The useful load of an aircraft is calculated using two points of weight, the maximum take-off weight and the empty weight, as delivered by the manufacturer (also known as a green or basic aircraft). Maximum take-off weight is just what the name implies, the maximum weight at which the aircraft can take-off. This weight is part of the regulatory certification process and cannot be exceeded during operations. Actually, there are two maximum take-off weights, one for internal loads (e.g. all weight is internal or attached directly to the airframe) and one for external loads (e.g. sling load). The external load is normally a higher maximum weight.

The empty weight can vary based upon what items each manufacturer considers as part of the basic aircraft. An example will illustrate how the empty weight can vary. When a manufacturer completes an aircraft, the weight of the aircraft will include the obvious, airframe and engines and their related mounting structures. However, where manufacturers may differ involves items such as the basic interior, seating, other furnishings, and other basic systems (e.g. avionics). Referred to as the manufacturer's empty weight, it does not include equipment installed by the operator to perform its missions.

A second empty weight and the one that is most relevant to the operator is the mission's basic or empty operating weight. In essence, this weight reflects how much the aircraft weighs mission-ready. Primarily, this would include the mission equipment, basic fluids for operation (e.g. oil), and equipment required for flight (e.g. enhanced avionics package). It would not include such weights as fuel, passengers, and equipment. Generally, the weight associated with the crew is included but sometimes not.

Table 1-2 illustrates the different weights and useful loads for the ABLE helicopters.

Table 1-2	
Police AS350B3	
Useful Load Calculation	
Maximum Take-Off Gross Weight	4,960
Less: Manufacturer's Empty Weight	2,736
Useful Load from Manufacturer	2,224
Less: ABLE Mission Equip. Weight	780
Mission-Ready Useful Load	1,444
Less: Flight Crew	426
Available Useful Load	1,018

Notes:

- **Maximum Take-Off Gross Weight: Source of weight was Conklin & de Decker's *Aircraft Cost Calculator 16.2*.**
- **Manufacturer's Empty Weight: Obtained from Airbus Helicopters' Technical Data brochure.**
- **Useful Load from Manufacturer: Calculated by subtracting Manufacturer's Empty Weight from the Maximum Take-Off Gross Weight. This is the useful load for the basic-configured aircraft.**
- **ABLE Mission Equipment: Obtained from ABLE weight and balance reports.**
- **Mission-Ready Useful Load: Useful load available after considering the mission equipment rate.**
- **Flight Crew: Obtained from ABLE crew information. The average individual weight for pilots and tactical flight officer was 213 pounds outfitted with gear and vests. The typical mission requires a police crew of two, one pilot and one tactical flight officer. The average weight for the flight crew would be 426 pounds.**
- **Available Useful Load: The useful load available prior to considering the weight of fuel, passengers, and equipment.**

Mission Endurance – An aircraft's mission endurance or the time the aircraft can fly without refueling is determined by two primary factors, the fuel capacity and rate at which the aircraft burns fuel. The fuel capacity, like the maximum take-off weight, is a fixed amount and is measured in volume (e.g. gallons, liters) or weight (e.g. pounds, kilograms). Fuel consumption will vary based upon several factors including the aircraft's speed, weight, and environmental conditions (e.g. temperature, altitude, wind). The amount of fuel carried, which is not always the capacity, will reduce the amount of Available Useful Load displayed in Table 1-2.

Table 1-3 displays the relevant information for the ABLE helicopters regarding fuel and how long it can fly based on certain assumptions.

Table 1-3	
Police AS350B3	
Mission Endurance	
Fuel Capacity (gallons)	143
Fuel Capacity (pounds)	972
Average Fuel Burn (gal.)/ Hour	60
Average Fuel Burn (lbs.)/ Hour	543
Endurance (hrs.) (Full Fuel)	2.4
Remaining Useful Load with Full Fuel (lbs.)	46

Notes:

- **Fuel Capacity (gallons): Obtained from Airbus Helicopters' Technical Data brochure and Conklin & de Decker's *Aircraft Performance Comparator 16.1*.**
- **Fuel Capacity (pounds): Obtained from Airbus Helicopters' Technical Data brochure. Assumed weight per gallon was 6.8 pounds.**
- **Average Fuel Burn (gal.)/ Hour: Based upon the average consumption by the ABLE helicopters.**
- **Average Fuel Burn (lbs.)/ Hour: Used the same assumption of 6.8 pounds per gallon.**
- **Endurance (hrs.) (Full Fuel): If the police helicopters departed on a mission with a full load of fuel (143 gallons/972 pounds), it would be able to fly for an estimated 2.4 hours based upon the average fuel burn rate of 60 gallons per hour.**
- **Remaining Useful Load with Full Fuel (lbs.): Calculated by subtracting the fuel capacity of 972 pounds from the available useful load in Table 1-2 of 1,018 pounds.**

Based upon our assumptions described in Table 1-2 and with full fuel, the current helicopters would have 46 pounds of remaining useful load.

Hover Capabilities – Unlike fixed-wing aircraft, helicopters have a unique capability, hovering, which makes them invaluable in a variety of missions. Helicopters are able to hover because their rotating blades provide lift, which allows them to remain airborne without any forward flight. Fixed-wing aircraft must have a certain amount of forward movement in order for its wings to provide enough lift to keep the aircraft airborne.

When hovering, the helicopter requires a great deal of power since forward motion is not contributing to the lift effect. If the helicopter is hovering just several feet above the ground, it is said to be hovering in-ground-effect (HIGE). Due to the downwash of the blades reflecting off the ground, the helicopter is receiving a lifting effect. Helicopters that are hovering without the benefits of the ground effect are said to be hovering out-of-ground effect (HOGE).

Three primary factors will affect a helicopter's ability to hover – aircraft weight, altitude, and temperature. In short, as any of the three factors increases, the less effective the blades' lift becomes and the more difficult hovering is. Also, at a given set of factors, an aircraft will HIGE at a higher altitude than HOGE.

As it relates to the ABLE mission, there are times when the helicopter will be required to hover. For example, when supporting a ground unit during a search, many times a helicopter will circle the area of interest; however there are those situations when the helicopter will be required to remain stationary while at a considerable altitude. Will the helicopter be able to maintain the HOGE if the temperature is extremely high?

Table 1-4 illustrates the altitude limitations when the ABLE AS350B3 is required to hover at maximum gross weight at a standard temperature used in aviation.

Table 1-4	
Police AS350B3	
Hover Capabilities	
Maximum Take-Off Gross Weight	4,960
Temperature	ISA +20 C
Hover-in-ground-effect (HIGE) (feet)	9,500
Hover-out-of-ground-effect (HOGE) (feet)	6,750

Notes:

- **Maximum Take-Off Gross Weight: Source of weight was Conklin & de Decker's *Aircraft Cost Calculator 16.2*. This aircraft also has an optional kit that will increase the MTOGW to 5,225 pounds.**
- **Temperature: ISA +20° C is a commonly-used parameter to express the performance capabilities of aircraft. ISA stands for International Standard Atmosphere and serves as a common reference for temperature and pressure. At sea level the standard temperature is 15° Centigrade or 59° Fahrenheit. Adding 20° C would be 35° C or 95° F.**
- **Hover-in-ground-effect (HIGE) (feet): Obtained from Airbus Helicopters' Technical Data brochure.**
- **Hover-out-of-ground-effect (HOGE) (feet): Obtained from Airbus Helicopters' Technical Data brochure.**

Cabin Volume and Seating – While the aircraft is performing the typical law enforcement missions, the requirements regarding space and seating is limited to the needs of the two-person flight crew. However, there are occasions when the helicopter needs to have more capacity for equipment and cargo as well as passengers. Two important measures of capacity are the size of the cabin and the number of seats.

Table 1-5 displays the cabin volume and seating capacity for the ABLE AS350B3 helicopters.

Table 1-5	
Police AS350B3	
Cabin Information	
Volume (cubic feet)	61.0
Seating (Crew/Passengers)	2/3

Notes:

- **Volume: Obtained from Conklin & de Decker's *Aircraft Cost Evaluator, V16.2*. The calculated volume considers the curvature of the airframe and any unusable space due to obstructions. As such, Conklin's cabin volume will not equal the product of the dimensions provided by the manufacturer (length x width x height).**
- **Seating (Pilot/Passengers): The Crew number is occupied by the pilot and tactical flight officer, while the Passengers' count represents the seats available for other personnel.**

Purchase Price – If the prior specifications and parameters are the only items analyzed in the acquisition process, then an important variable is missing, the purchase price. Analyzing purchase price introduces the concept of value, not only what an aircraft provides but also what it costs to obtain the asset. The purchase price for the AS350B3 represents a basic-configured aircraft. The mission-ready aircraft would cost more and is discussed in subsequent sections of this report.

Table 1-6	
Police AS350B3	
Purchase Price	
Purchase Price (x1,000)	$2,100

Notes:

- **Purchase Price: Obtained from Conklin & de Decker's *Aircraft Cost Evaluator, V16.2*.**

1.3.1.4 Performance Parameters/Specifications – Comparison to Candidate Helicopters

Table 1-7 offers a comparison between the current ABLE helicopters (highlighted in grey) and the candidate helicopters. The comparisons are based on the parameters explained in Section 1.3.1.3 for the current AS350B3 helicopters.

The helicopters summarized in the table are commonly grouped together by being referred to as light single-engine helicopters. But within the group, it is important to highlight some of the differences between the helicopters based on the parameters used for the comparison.

Based on cabin size the Airbus H120 is the smallest of the group. This parameter by itself is not that significant as the current ABLE law enforcement mission only requires seating for the two crew members. The H120 is able to meet this need. However, considering the Remaining Useful Load on the H120 (21 pounds), this aircraft type is not appropriate because it does not allow for mission growth, should that occur.

The Remaining Useful Load also highlights that the current AS350B3 could carry two additional passengers, based on the Flight Crew weights (426 lbs.), and have some useful load left for cargo or supplies. Should ABLE predict that its future missions or their requirements will change requiring additional useful load, each of the candidate helicopters, except the H120, will meet that need.

As mentioned previously, the Purchase Price is only a point of reference, a starting point for negotiations with the manufacturers. Given the current weak sales conditions in the helicopter market, this parameter becomes even more important should the City choose to purchase new helicopters.

For this group of helicopters, the hovering capabilities and mission endurance based on fuel capacity are very similar. Each candidate will meet the typical 1 to 1.5-hour mission currently used by ABLE.

As a final comment, if ABLE believes it has the correct aircraft type for the mission, the most important parameter becomes the predicted maintenance costs for an existing fleet of helicopters versus new helicopters. Sections 2 and 5 of the report discuss this parameter.

Table 1-7						
Police Helicopters						
Helicopter Candidate Comparisons						
Airframe Manufacturer /Type	Airbus/ AS350B3	Airbus/ H120	Airbus/ H125	Airbus/ H130	Bell/ 407GXP	Leonardo/ AW119
Engine Manufacturer /Type	Safran/ Arriel 2B1	Safran/ Arrius 2F	Safran/ Arriel 2D	Safran/ Arriel 2D	Rolls Royce/ C47B/8	Pratt & Whitney/ PT6B-37A
Useful Load						
Maximum Take-Off Gross Weight	4,960	3,781	5,225	5,512	5,250	6,283
Mission Configured	3,516	2,987	3,542	3,986	3,409	4,049
Flight Crew	426	426	426	426	426	426
Useful Load Available for Mission	1,018	368	1,257	1,100	1,415	1,808
Fuel Consumed (lbs.)	543	347	510	521	510	662
Remaining Useful Load	475	21	747	579	905	1,146
Mission Endurance	2.4	2.8	2.5	2.5	2.3	2.2
Hover Capabilities						
In-Ground-Effect	9,500	3,650	9,100	9,675	8,600	7,500
Out-of-Ground Effect	6,750	1,700	6,850	6,700	7,000	2,250
Cabin						
Volume (cubic feet)	61.0	54.0	61.0	65.0	84.0	121.0
Seating (Pilot/Passengers)	1/4	1/4	1/4	1/6	1/6	1/7
Purchase Price (x1,000)	$2,100	$2,087	$2,873	$3,302	$3,115	$3,050

Notes:

- **Fuel Consumed (lbs.): Represents the estimated amount of fuel consumed during the typical one-hour ABLE mission plus a 20-minute reserve.**

1.3.2 San Diego Fire-Rescue Department

1.3.2.1 Current Fleet

Background:

San Diego Fire-Rescue Department (SDFD) operates two types of medium twin-engine helicopters, a modified Bell 212 called the 212HP and a Bell 412EP.

The manufacturer, Bell Helicopter (Bell), was originally started by Lawrence Bell as Bell Aircraft Corporation in 1935. The company initially designed and built fighter aircraft and experienced a great deal of success during and after World War II. Bell Aircraft was probably best known for building the X-1 rocket plane, the first plane to break the sound barrier, and its subsequent work for the US space program. Bell started its helicopter development in 1941. The Bell 30 was developed and served as the test bed for the first commercial helicopter certified by a civilian aviation authority, the Bell 47.

Both of SDFD helicopters came from the same development lineage, a military helicopter designed for the US Army, the Bell UH-1 Iroquois. The stretched version of this model became the most popular version of the UH-1 series and was known as the UH-1H (aka Huey). The single-engine turbine helicopter served as the basis for Bell’s commercial 205, also a single-engine turbine.

The Bell 212 is the twin-engine version of the 205 and is powered by Pratt & Whitney PT6T-3B engines. The cabin features two pilot seats up front and a passenger/cargo cabin that has a flat floor and two large sliding doors, which provide ready access to the cabin. When used for passenger transport, it can seat up to 13. When used for cargo, it can carry up to 5,000 pounds internally or externally. The Bell 212 is certified for single-pilot Instrument Flight Rules (IFR) and Category A operations (i.e. operate with one engine inoperative). Bell produced the 212 from 1971 to 1998 with about 900 built. SDFD operates a Bell 212HP, which is a post- production performance improvement in hot and high conditions.

The initial Bell 412 model was almost identical to the Bell 212 with the exception of the number of main rotor blades, which increased from two to four and the blades’ material changed from aluminum to composite. Introduced in 1981, the Bell 412 has experienced improvements in its fuel capacity, take-off weight, transmission, and fuel control system. In 2013, a new version was introduced, the 412EPI. All versions of the Bell 412 are also Category A-approved and single-pilot IFR certified. Approximately 500 Bell 412 helicopters have been built.

Mission:

SDFD responds to more than 400 emergencies while flying between 400 and 500 hours of flight per year. While supporting firefighting operations in San Diego and the region is the primary mission of the Air Operations program, it also performs a wide variety of missions -- advanced life support, hoist-air rescue, short-haul air rescue, shoreline rescue, helicopter swift-water rescue, night vision goggle operations, patient transport, vehicle rescue, large animal rescue, fire mapping, infrared detection, disaster assessment, and has the ability to assist in high-rise fire incidents. The planned firefighting mission has a duration of one hour and twenty minutes. Of the two helicopters, one is available 24-hours- a-day, 7-days-a-week, and 365-days-a-year. The second helicopter meets more of a seasonal need that typically lasts from July 1 through December 31. During this period, the helicopter is available 9-hours-a-day, daylight only, and 7-days-a-week. For each helicopter, the crew consists of a pilot, fire captain/crew chief, and firefighter/paramedic.

To perform its various missions, both of the SDFD helicopters are equipped with the following mission equipment.

- Forward-Looking Infrared (FLIR 8500) system: Mounted on the nose of the aircraft is used to detect hotspots during day and night operations.
- Searchlight (Spectrolab Nightsun): Illuminates locations at night.
- Digital Downlink System: Transmits FLIR images from flight crew to ground personnel.
- AeroComputer mapping system.
- Iridium Satellite communications.
- Night Vision System and Goggles: SDFD is the only air resource in the region capable of providing night fire-fighting operations and also has a firefighting contract with the County of San Diego for night coverage.
- Rescue Hoist
- Simplex Water Tank (375-gallon capacity) and Snorkel:

Basic Fleet Information:

Table 1-8 offers more basic information about the current fleet.

Table 1-8				
Basic Information - SDFD Helicopters				
Aircraft Type	**Serial Number**	**N Number**	**Total Time (Flight Hours)**	**Average Flight Hours per Year**
212HP	31147	N800DM	16,945	200-250
412EP	36466	N807JS	1,996	200-250

Notes:

- **Aircraft Type:** **Manufacturer's designation for the model type.**
- **Serial Number:** **Unique identification for each aircraft as assigned by the manufacturer.**

- **<u>N Number:</u> Civil aircraft must be registered with the Federal Aviation Administration. The registration number is frequently referred to as the aircraft's N Number because all registered aircraft have a number starting with the letter N.**
- **<u>Total Time (Hours):</u> The total airframe hours as reflected on August 22, 2016, by the Rotorcraft Support, Inc. maintenance tracking reports for the respective aircraft.**
- **<u>Average Hours per Year:</u> Calculation based upon the approximate months the aircraft has been in service divided into the Total Time. The monthly average was multiplied by 12 months to reach an estimated annual amount.**

The following images show the SDFD Bell Helicopter 212HPand 412EP helicopters.

Bell 212HP

Bell 412EP

1.3.2.2 Candidate Helicopters

As was the situation for the ABLE missions, SDFD does not foresee that its multiple types of missions would change. Unlike ABLE, SDFD sees the need to improve how it accomplishes it missions. For example, a commonly accepted premise when fighting fires is that more water delivered improves the odds of extinguishing a fire more quickly. The current Bell 212HP and 412EP fleet can typically deliver 275 and 225 gallons respectively. On the other end of the capability spectrum, the San Diego Gas & Electric S64F Erickson Aircrane can deliver up to 2,650 gallons but more likely averages around 1,600 to 1,800 gallons. Based on the success in fighting fires experienced by the Los Angeles County Fire Department, SDFD believes a helicopter that delivers an average of 700 to 1,000 gallons would be a significant improvement over the current fleet's capabilities.

SDFD also mentioned that another area of concern involved the cabin volume. Currently and for certain missions other than firefighting the fleet has limitations regarding the ability to carry certain mission equipment and personnel.

We considered two helicopter types that could deliver 700 to 1,000 gallons of water, the

- Airbus H215
- Sikorsky S-70i.

Helicopter types that were considered but could not meet this requirement were the Leonardo AW139 and AW189, and Airbus H175. We did not consider the Bell 525 due to the time remaining before it receives certification, circa 2018.

Airbus H215 – When Airbus changed its name from Eurocopter, it also changed its aircraft names. The H215 is the current name for what was formerly known as the AS332. The H215 is available in two versions, a short and long fuselage. The short version can seat up to 17 passengers and was designed for performance in hot and high conditions while performing aerial and utility work. It is also designed to carry external loads. The long version received its name due to the fuselage plug that extended its length. Designed for passenger and cargo transport, this version has flexible seating and can seat up to 22 depending upon the configuration. Due to the longer airframe, the long version sacrifices some of the useful load compared to the short version.

The initial AS332 version began operating in the early 1980s with almost 600 delivered to date. This total includes the civil and military versions. Almost 75 percent operate in the military environment. The majority of the civil versions support the oil and gas industry.

Both versions of the H215 have four composite main rotor blades and are powered by two Makila 1A1 turboshaft engines. While the H215 is viewed as a lower-cost version of the five-bladed H225, it features modern avionics, including the same four-axis autopilot. The H215 delivers water for the firefighting mission using either a 600 gallon tank or 663 gallon bucket.

Sikorsky S-70i – Known as Sikorsky Manufacturing Corporation in 1925, the company expanded quickly, relocated to Stratford, Connecticut, and reorganized as the Sikorsky Aviation Company in 1929. It became part of the United Aircraft and Transport Corporation, which would be reorganized as the United Technologies Corporation (UTC) in 1975. Lockheed Martin, its current parent company, purchased Sikorsky in 2015.

Certificated as the S-70, the helicopter was first built for the US military. The UH-60 was designed in response to a US Army competition in the early 1970's for a replacement of the UH-1 "Huey." Sikorsky has built versions of this helicopter for every branch of the US Armed Forces, the US Coast Guard, and numerous foreign armed forces. To date well over 3,000 have been delivered.

The current non-US military designation is the S-70i. Los Angeles County Fire Department currently operates the S-70A version, which is the equivalent to the UH-60L military designation. The primary improvements for the S-70i are more powerful engines, T700 GE 701D, and a modern avionics glass cockpit. The fuselage provides one large compartment with two seats for the flight crew and flexible seating for between 11 to 20 individuals. For the firefighting mission, the S-70i can carry a water tank with a 1,000-gallon capacity.

S-70

1.3.2.3 Performance Parameters/Specifications – Current Bell 212HP and 412EP

The primary mission for the SDFD helicopters is firefighting. Secondary missions include various advanced life support operations, fire department assistance, and emergency assistance (e.g. HAZMAT). While the specific missions may differ from ABLE, the questions regarding the performance parameters and specifications are still relevant. For example, the primary SDFD mission requires larger helicopters but we still need to know the basics -- how much useful load is available, what is the potential endurance, how many passengers and how much equipment can be carried, how well does it perform in hot and high conditions, and what does it cost to acquire and operate the helicopter?

Two additional parameters are important as they relate to the firefighting mission.

- How much water per load can the helicopter deliver?
- How fast can the helicopter fly?

Based on prior discussions with city personnel and the nature of the SDFD missions, with an emphasis on firefighting, we selected the following parameters to compare the current Bell 212 HP and 412 EP helicopters to the candidate helicopters.

- Useful Load
- Mission Endurance
- Speed
- Hover Capabilities
- Water Drop Capabilities
- Cabin Volume and Seating

- Purchase Price

The following information explains the importance of each of the parameters, while using the existing Bell 212HP and 412EP as a benchmark to further illustrate each parameter. Following the explanation of the parameters, Table 1-15 compares the existing fleet to the candidate helicopters.

Useful Load –The amount of available weight an aircraft can carry for fuel, supplies/cargo, and personnel is a premium. Therefore, it is one of the more important factors in the selection process. A limited amount of useful load is one of the more common reasons for an operator to change aircraft as its mission and related equipment requirements change. (Other common reasons that cause an aircraft change include technology improvements, the age of an aircraft as measured in hours and years, deterioration of the support network, and increasing operational costs.)

The useful load for the SDFD helicopters was calculated using the same methodology as the ABLE helicopters. This method is described on pages 10-11.

Table 1-9 illustrates the different useful loads for the SDFD helicopters.

Table 1-9		
Useful Load Calculation		
	Bell Helicopter	
	212HP	**412EP**
Maximum Take-Off Gross Weight	11,200	11,900
Less: Manufacturer's Empty Weight	6,202	6,964
Useful Load from Manufacturer	4,998	4,936
Less: SDFD Mission Equip. Weight	1,365	1,369
Mission-Ready Useful Load	3,633	3,567
Less: Flight Crew	420	420
Available Useful Load	3,213	3,147

Notes:

- **Maximum Take-Off Gross Weight: Source of weight was Conklin & de Decker's *Aircraft Cost Calculator 16.2*.**
- **Manufacturer's Empty Weight: Obtained from Bell's Technical Data brochure.**
- **Useful Load from Manufacturer: Calculated by subtracting Manufacturer's Empty Weight from the Maximum Take-Off Gross Weight. This is the useful load for the basic-configured aircraft.**
- **SDFD Mission Equipment: Obtained from SDFD weight and balance reports.**
- **Mission-Ready Useful Load: Useful load available after considering the mission equipment rate.**
- **Flight Crew: Used the average weight that was calculated for the ABLE crew (213 pounds), which included gear and vests. Rounded down to 210 pounds per crew member. The typical mission requires a crew of two, one pilot and one fire captain/crew chief. The average weight for the flight crew would be 420 pounds.**

- **Available Useful Load: The useful load available prior to considering the weight of fuel, passengers, and equipment.**

Mission Endurance – The mission endurance for the SDFD helicopters was calculated using the same methodology as the ABLE helicopters. This method is described on page 12.

Table 1-10 displays the relevant information for the SDFD helicopters regarding fuel and how long it can fly based on certain assumptions.

Table 1-10		
Mission Endurance		
	Bell Helicopter	
	212HP	**412EP**
Fuel Capacity (gal.)	216	330
Fuel Capacity (lbs.)	1,469	2,244
Average Fuel Burn (gal.)/ Hour	100	115
Average Fuel Burn (lbs.)/ Hour	680	782
Endurance (hrs.) (Full Fuel)	2.2	2.9
Remaining Useful Load with Full Fuel (lbs.)	1,744	903

Notes:

- **Fuel Capacity (gallons): Obtained from Bell's Technical Data brochure.**
- **Fuel Capacity (pounds): Assumed weight per gallon 6.8 pounds. Multiplied gallons times 6.8 pounds.**
- **Average Fuel Burn (gal.)/ Hour: Based upon the average consumption by the SDFD helicopters.**
- **Average Fuel Burn (lbs.)/ Hour: Used the same assumption of 6.8 pounds per gallon.**
- **Endurance (hrs.) (Full Fuel): If the SDFD 212HP departed on a mission with a full load of fuel (216 gallons/1,469 pounds), it would be able to fly for an estimated 2.2 hours based upon the average fuel burn rate of 100 gallons per hour. Based on the same assumptions, the 412EP would be able to fly for 2.9 hours.**
- **Remaining Useful Load with Full Fuel (lbs.): Calculated by subtracting the 212HP fuel capacity of 1,469 pounds from the available useful load in Table 1-9 of 3,213 pounds. Used the same methodology to calculate the 412EP.**

Based upon our assumptions described in Table 1-9 and with full fuel, the 212HP would have 1,744 pounds of remaining useful load and the 412EP would have 903 pounds.

Speed – During the typical firefighting mission, speed of the helicopter is one of the important variables in determining the amount of water that can be delivered during a given period of time. Simply stated, a faster speed means more water delivered.

Table 1-11 summarizes the relevant information for the SDFD helicopters regarding speed.

Table 1-11		
Speed		
	Bell Helicopter	
	212HP	**412EP**
Cruise Speed Max (knots)	111	126
Cruise Speed Long Range (knots)	104	126
Calculated Speed (knots)	82	93

Notes:

- **Cruise Speed Max (knots): Source was Conklin & de Decker's *Aircraft Cost Calculator 16.2*.**
- **Cruise Speed Long Range (knots): Source was Conklin & de Decker's *Aircraft Cost Calculator 16.2*.**
- **Calculated Speed (knots): Represents a more likely speed utilized during the firefighting mission and is based on discussions with other firefighting organizations. This speed does not imply that the cruise speeds provided in the table would not be obtained in certain circumstances.**

<u>Hover Capabilities</u> – The hovering capabilities for the SDFD helicopters were calculated using the same methodology as the ABLE helicopters. This method is described beginning on page 12.

For the SDFD missions, the helicopters are required to hover frequently (e.g. filling water tanks, hoist rescues). For example, when the helicopters fill their water tanks during the firefighting mission, they will HIGE above the water resource. Also, while performing hoist rescues, the helicopters are required to HOGE above the rescue area.

Table 1-12 illustrates the altitude limitations when the SDFD helicopters are required to hover at maximum gross weight at a standard temperature used in aviation. It is important to remember that as the helicopters reduce their weight due to fuel consumption, the ability to hover at higher altitudes is possible.

Table 1-12		
Hover Capabilities		
	Bell Helicopter	
	212HP	**412EP**
Maximum Take-Off Gross Weight	11,200	11,900
Temperature	ISA +20 C	ISA +20 C
Hover-in-ground-effect (HIGE)	2,500	6,200
Hover-out-of-ground-effect (HOGE)	2,000	Sea Level

Notes:

- **Maximum Take-Off Gross Weight: Source of weight was Conklin & de Decker's *Aircraft Cost Calculator 16.2*.**
- **Temperature: ISA +20° C is a commonly-used parameter to express the performance capabilities of aircraft. ISA stands for International Standard Atmosphere and serves as a**

common reference for temperature and pressure. At sea level the standard temperature is 15° Centigrade or 59° Fahrenheit. Adding 20° C would be 35° C or 95° F.

- **Hover-in-ground-effect (HIGE) (feet): Obtained from the respective Technical Data brochures from Bell.**
- **Hover-out-of-ground-effect (HOGE) (feet): Obtained from the respective Technical Data brochures from Bell.**
  - **212HP: Cannot HOGE at maximum gross weight in ISA +20° C conditions. At approximately 10,900 pounds, it can HOGE at 2,000 feet.**
  - **412EP: At maximum gross weight and ISA +20° C, the 412EP can only HOGE at sea level. If the aircraft is 900 pounds lighter, 11,000 pounds, then it can hover at 4,000 feet.**

Water Drop Capabilities – In addition to a helicopter's speed, the quantity of water delivered per drop is another important variable in determining the amount of water that can be delivered during a given period of time. A helicopter's tank or bucket size represents the maximum amount that a particular helicopter can deliver with each drop.

However, the tank capacity does not necessarily represent what the helicopter can actually deliver. Available useful load for all helicopter types is often a parameter that limits the actual amount of water delivered to something less than the tank's capacity.

Table 1-13 illustrates this point. Both the 212HP and 412EP are equipped with 375-gallon tanks. However, when the available useful loads for both types are considered, the amount of water that can be carried is reduced. If the 212HP carries a full load of fuel, the amount of water it can carry is 209 gallons. If the amount of fuel carried is for a 1.5-hour mission, the common SDFD firefighting mission duration before refueling, the amount of water carried is 286 gallons. The 412EP is affected similarly but with even less water capacity. The water drop amounts would increase as the helicopters consume fuel during the mission.

Table 1-13

Water Drop Capabilities (gallons)

	Bell Helicopter	
	212HP	**412EP**
Tank Size	375	375
Water Drop Amounts		
With Full Fuel	209	108
1.5-Hour Mission	286	255

Notes:

- **Tank Size: Obtained from Simplex Aerospace, a provider of fire attack systems.**
- **Water Drop Amounts with Full Fuel: Calculated using the current SDFD-configured helicopters with the weight associated with full load of fuel, 216 gallons for the 212HP and 330 gallons for the 412EP.**

- **Water Drop Amounts, 1.5-Hour Mission: Calculated using the current SDFD-configured helicopters with the fuel load for a one-hour-and-thirty-minute mission plus a twenty-minute fuel reserve. For the 212HP the gallons consumed would be approximately 183 gallons and for the 412EP approximately 210 gallons.**

Cabin Volume and Seating – The 212HP and 412EP airframes as built by Bell Helicopter are the same, therefore the cabin's dimensions and volume will be the same. During the firefighting mission, SDFD uses two crew members, a pilot and fire captain or crew chief. When transporting fire ground crews or equipment and personnel for other SDFD missions, the passenger cabin can seat up to 13, carry stretchers for rescued individuals, or be configured for the transport of equipment rather than passengers.

Table 1-14 displays the cabin volume and seating capacity for the SDFD helicopters.

Table 1-14		
Cabin Information		
	Bell Helicopter	
	212HP	**412EP**
Volume (cubic feet)	208	208
Seating (Crew/Passengers)	2/13	2/13

Notes:

- **Volume: Obtained from Conklin & de Decker's *Aircraft Cost Evaluator, V16.2*. The calculated volume considers the curvature of the airframe and any unusable space due to obstructions. Conklin's cabin volume will not equal the product of the dimensions provided by the manufacturer (length x width x height).**
- **Seating (Crew/Passengers): The crew information was obtained from SDFD personnel. The passenger seating was obtained from Conklin & de Decker's *Aircraft Cost Evaluator, V16.2*.**

Purchase Price – If the prior specifications and parameters are the only items analyzed in the acquisition process, then an important variable is missing, the purchase price. Analyzing purchase price introduces the concept of value, not only what an aircraft provides but also what it costs to obtain the asset. The purchase price for the 212HP represents the sales price for a used Bell 212 helicopter. We could not use a new acquisition price since this helicopter type has been out of production since 1998. The purchase price for the 412EP is actually the price for Bell's most current version of the 412, the 412EPI. The 412 price reflects a basic-configured aircraft. The mission-ready aircraft would cost more and is discussed in subsequent sections of this report.

Table 1-15		
Purchase Price		
	Bell Helicopter	
	212HP	**412EP**
Purchase Price (x 1,000)	$4,860	$11,155

Notes:

- **Purchase Price: Obtained from Conklin & de Decker's *Aircraft Cost Evaluator, V16.2*.**

1.3.2.4 Performance Parameters/Specifications – Comparison to Candidate Helicopters

Table 1-16 offers a comparison between the current SDFD helicopters (highlighted in grey) and the candidate helicopters. The comparisons are based on the parameters explained in Section 1.3.2.3 for the current SDFD helicopters.

The maximum take-off gross weights highlight the significant difference between the current and desired helicopters. The 212HP and 412EP are generally referred to as medium twin-engine helicopters and in US firefighting terms are classified as Type II helicopters. Type II helicopters have a maximum weight of 6,000 to 12,500 pounds. Helicopters classified as Type I weigh over 12,500 pounds, which is the case for the S-70i and H215 helicopters. On a side note, light single-engine helicopters, such as the ones used by ABLE, are classified as Type III helicopters, those that weigh less than 6,000 pounds.

While the maximum take-off weight is important, it does not directly reflect a more important parameter as it relates to the firefighting mission, water drop capabilities. As Table 1-13 shows, the current helicopters have a tank capacity of 375 gallons but can only deliver less than 300 gallons due to useful load limitations when prepared for the typical firefighting mission.

The candidate helicopters have significantly more capabilities. The tank capacity ranges from 600 gallons for the H215 Long version to 1,000 gallons for the S-70i. The H215 Short version utilizes water bucket technology which can hold up to 663 gallons. Although not included in this report but mentioned as an additional point of information, the Erickson S-64 Aircrane has a tank capacity of 2,650 gallons and will typically drop between 1,600-1,800 gallons of water per load.

In addition to higher useful loads, the candidate helicopters also offer larger cabins than the current helicopters, which translate into the potential to carry more passengers and equipment. The H215 versions almost double the useful load of the 212HP and 412EP, while the S-70i is almost three times higher. The cabin volume for the H215 versions more than doubles the current helicopters, while the S-70i is almost double.

Obtaining the benefits that come with the candidate helicopters means an increase in costs, both to purchase and operate the helicopters. Table 1-16 offers an estimated price purchase price of a basic-configured aircraft for the current and candidate helicopters. A mission-configured helicopter would add another 10-20 percent to the purchase prices provided in the table. Another significant element that will affect the purchase price is the economic conditions of the helicopter industry. Currently, new aircraft sales are significantly lower than in prior years, which have the tendency to reduce the purchase price. Also, creating competition between the manufacturers in a slow market can further reduce the purchase price.

Table 1-16					
Firefighting Helicopters					
Helicopter Candidate Comparisons					
Airframe Manufacturer /Type	Bell / 212HP	Bell / 412EP	Sikorsky / S-70i	Airbus / H215 Long	Airbus / H215 Short
Engine Manufacturer /Type	Pratt & Whitney/ PT6T-3B	Pratt & Whitney/ PT6T-3D	General Electric / T700 GE 701D	Safran / Makila 1A1	Safran / Makila 1A1
Useful Load					
Maximum Take-Off Gross Weight	11,200	11,900	22,000	18,960	18,960
Mission Configured - Fire	7,567	8,333	13,916	13,082	13,082
Flight Crew	420	420	420	420	420
Useful Load Available for Mission	3,213	3,147	7,664	5,458	5,458
Fuel Consumed (lbs.)	1,244	1,431	2,016	1,991	1,929
Remaining Useful Load	1,969	1,716	5,648	3,467	3,529
Mission Endurance	**2.2**	**2.9**	**2.2**	**3.4**	**2.7**
Hover Capabilities					
In-Ground Effect	2,500	6,200	12,400	7,400	7,600
Out-of-Ground-Effect	2,000	SL	9,600	4,400	4,500
Helicopter Speed					
Cruise Speed Max (knots)	111	126	149	141	141
Cruise speed Long Range (knots)	104	126	132	136	136
Calculated Speed (knots)	82	93	110	104	104
Water Drop Capabilities (gallons)					
Tank Size	400	400	1000	600	663
Ninety-Minute Mission	286	255	726	511	556
Cabin					
Volume (cubic feet)	208	208	397	481	405
Crew/Passengers	2/14	2/14	2/17	2/22	2/20
Purchase Price (x1,000)	**$4,860**	**$11,155**	**~$14,000**	**$16,500**	**$16,500**

Notes:

- **Maximum Take-Off Gross Weight:**
  - **The S-70i can carry a maximum external load of 23,500 pounds. If the helicopter filled its water tank after take-off at the maximum weight of 22,000 pounds, the useful load would increase by 1,500 pounds, which would increase the water drop capacity.**
  - **The H215 also has an increase in external gross weight to 20,615 pounds. Similar to the S-70i scenario, the H215 would be able to increase its useful load carrying an external load, which would also increase its water drop capacity.**

- **Useful Load:**
  - **Fuel Consumed (lbs.): Based upon the typical firefighting mission duration of ninety minutes plus a 20 minute reserve.**
- **Mission Endurance: Based upon the assumptions the helicopter started with a full load of fuel.**
- **Hover Capabilities: Both types of hover are based upon ISA +20° C at maximum gross weight.**
- **Water Drop Capabilities:**
  - **Tank Size: Based upon discussions with SDFD personnel for the tank capacity on the current fleet. Used literature from Simplex Aerospace, a primary provider of water tanks. Simplex did not offer a water tank for the H215 Short. However, it does offer a 663-gallon bucket.**
  - **Ninety-Minute Mission: The amount of water that could be carried at the start of a ninety-minute mission plus a twenty-minute fuel reserve. The water amount would increase with each drop as fuel was consumed.**
- **Cabin:**
  - **Crew/Passengers: Seating in the passenger cabin is flexible in each helicopter type. The number for passengers represents the maximum seating capacity.**
- **Purchase Price (x 1,000): All purchase prices could be lower based upon a continuation of the difficult economic environment and creation of a competitive bidding process with the manufacturers.**
  - **Sikorsky S-70i: The estimated price for a basic-configured aircraft has fluctuated widely in the last 12 to 15-month period. We have chosen to use a price of $14.0M, which is the mid-point of the price range of $13 to $15 million. An actual price is difficult to obtain until actual negotiations occur with this particular manufacturer.**
  - **Airbus H215: The basic-configured aircraft purchase price ranges from $15 to $18 million. We chose to use the mid-point value of the price range of $16.5 million.**

Section 2 – Life Cycle Cost Projection

2.0 City of San Diego Original Request

Estimate the cost of the acquisition and operation of helicopter alternatives. The operating cost estimates will include maintenance options and fuel costs, and other operating or overhead costs.

2.1 Conklin & de Decker Approach

Conklin & de Decker used the concept of life cycle cost analysis to examine the current and candidate helicopters for the police and fire aviation units. In general and as it relates to aircraft operators, a life cycle cost analysis has three main elements – acquisition, operating costs, and disposition of the aircraft. This section deals with the costs of operating aircraft with a primary focus on maintenance and fuel costs. Subsequent sections of this report deal with the acquisition and disposition of an aircraft.

More specifically, this section contains 20-year estimates, with a beginning point of August 2016, for the current and candidate helicopters for the police and fire organizations. The estimates provide totals for maintenance and fuel costs, while also highlighting the annual and sometimes significant annual cost variations ("peaks" and "valleys") associated with maintenance costs. The ultimate objective for summarizing the costs is to identify key potential times in the life cycle to dispose of the helicopter. Conklin & de Decker used its *Life Cycle Cost, 16.2* software version to calculate the respective projections.

Similar to Section 1 Fleet Review, we divided Section 2, Life Cycle Cost Estimates, into two primary pieces, one for the San Diego Police Air Support Unit and the other for the San Diego Fire-Rescue Department aviation unit. The report's content for each aviation unit consists of a summary (2.2) of Conklin & de Decker's analysis and the analysis itself (2.3). Life cycle cost projections are provided for the current fleet and possible candidate aircraft for each aviation unit. The projections for each of the current aircraft include an overall summary table, an annual maintenance cost chart for 20 years, a table highlighting the significant maintenance cost events in the respective years, and a residual value chart for the 20-year period. The projections for the candidate aircraft include the overall summary table, an annual maintenance cost chart, and the 20-year residual value chart.

2.2 Summary

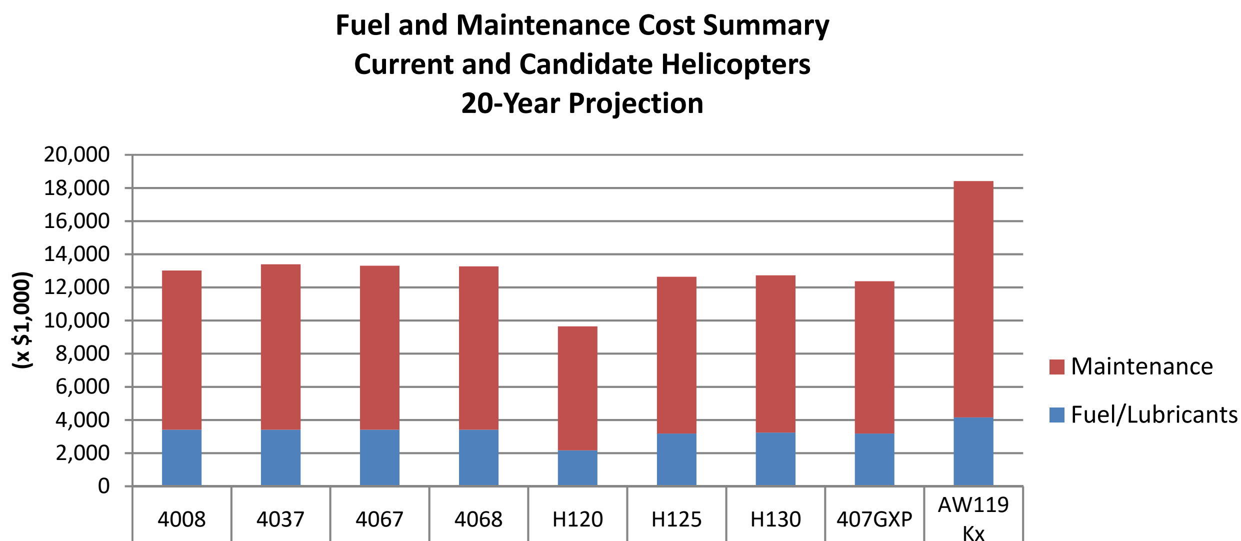
2.2.1 San Diego Police Air Support Unit (ABLE)

Section 2 Cost Projections focused on the costs of operating aircraft with a primary emphasis on maintenance and fuel costs. Using Conklin & de Decker's *Life Cycle Cost 16.2* software, we projected maintenance and fuel costs over a 20-year period for each of the current police helicopters and for selected candidate helicopters should the City decide to change to a different type of helicopter. The beginning point for the 20-year life cycle estimate was August 2016. Chart 2-1 summarizes the results to the analysis.

It is no surprise the four ABLE helicopters have very similar projections since they were all purchased about the same time and will encounter similar significant scheduled maintenance during the 20-year projection. The range in costs is approximately $200,000 between the four helicopters with a high projection of $13.3 million and a low of $13.1 million.

The Airbus H120, the smallest of the candidate helicopters as measured by maximum gross take-off weight, has the lowest estimated costs over the 20-year period at approximately $9.6 million. The largest helicopter, the Leonardo AW119K, has the highest estimated cost at $18.4. The remaining three candidates, which are similar to each other in size and performance, have costs that are also similar. The range is $12.3 million for the Bell 407GXP to $12.7 million for the Airbus H130. The H125 is estimated to be $12.6 million. These three helicopter types compare similarly to the current ABLE helicopters.

Chart 2-1



	4008	4037	4067	4068	H120	H125	H130	407GXP	AW119 Kx
Maintenance	$9,609	$9,977	$9,891	$9,853	$7,484	$9,452	$9,485	$9,185	$14,261
Fuel/Lubricants	$3,410	$3,410	$3,410	$3,410	$2,160	$3,183	$3,239	$3,183	$4,149

Notes:

1) **4008, 4037, 4067, and 4068 are the serial numbers for the current ABLE helicopters.**

Table 2-1 summarizes the adjusted values for each of the helicopters in the current ABLE fleet and the candidate helicopters. The analysis for each helicopter includes a chart that compares the Base Value, which assumes mid-life on all significant scheduled maintenance (e.g. major inspections, life-limited items, component overhauls, engine restoration), to an Adjusted Value, which is based upon the remaining times for the same significant scheduled maintenance events. If the remaining time for a given event is greater than the mid-life, then the helicopter's value is increased. If the opposite is true about the remaining time for a given item, then the helicopter's value is decreased. A compilation of all significant scheduled maintenance events will yield an overall Adjusted Value.

The years that are marked with yellow represent when the Adjusted Value is the same as or greater than the Base Value of the helicopter. The single red block for each helicopter represents the lowest value during the 20-year period. The letters in the yellow blocks identify the years with the highest Adjusted Values. "A" identifies the highest value and "E" is the fifth highest. The white blocks are the years when the Adjusted Value is below the Base Value.

In essence, Table 2-1 identifies the years when the helicopters have positive Adjusted Values, which represents when the City could expect to receive a higher amount when selling the asset than a helicopter around the Base Value. It is important to mention that the actual amount received in the sale of a pre-owned helicopter can differ from the adjusted values in this model due to current market activity. The model is highlighting the relationship between the Base and Adjusted Values.

Table 2-1

ABLE Helicopters - Annual Summary of Adjusted Values																				
Serial Number	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4008			E			D								B	A			C		
4037	B	A			C												E	D		
4067		A		C												D	E		B	
4068	E	D		C												B	A			
Candidate Helicopters - Annual Summary of Adjusted Values																				
H120	A	B	D	C			E													
H125	A	B	E		D	C														
H130	A	B	D	E	C															
407GXP	A	B	C				E		D											
AW119Kx	A	B		C			D			E										

Serial number 4008 can serve as an example to explain the table. In years 2 through 7 and 14 through 20, the helicopter's adjusted value is higher than its base value, when all of the significant scheduled maintenance events are assumed to have remaining lives of 50 percent. In years 8 through13, the adjusted value is less than the base value because enough of the significant scheduled maintenance events have less than 50 percent remaining lives. Year 12 has the lowest adjusted value. Year 15 has the highest adjusted value.

2.2.2 San Diego Fire-Rescue Department (SDFD)

The approach for the SDFD cost projections was identical to the one used for ABLE. Using Conklin & de Decker's *Life Cycle Cost 16.2* software, we projected maintenance and fuel costs over a 20-year period for each of the current fire and rescue helicopters and for selected candidate helicopters should the City decide to change to a different type of helicopter. The beginning point for the 20-year life cycle estimate was August 2016. Chart 2-2 summarizes the results to the analysis.

The current Bell 212HP and 412EP are very similar in size and performance, yet during the 20-year projection, the 412EP will encounter higher costs, approximately $13.4 million compared to $11.4 million for the 212HP. That difference equals about $100,000 per year.

Due to SDFD's desire to improve its capabilities in the fire and rescue missions, the candidate helicopters represent an increase in size and performance when compared to the current helicopters. For example and as discussed in Section 1 Fleet Review, SDFD would like to increase its water drop capabilities from the current capacity of 375 gallons to 700-1,000 gallons.

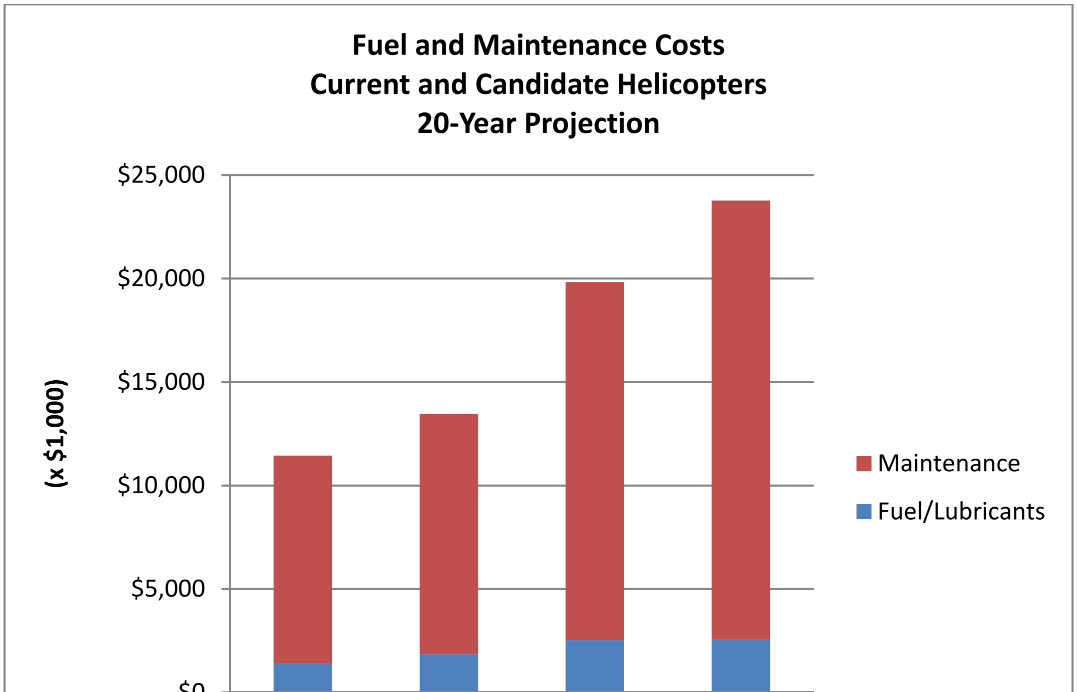
To acquire helicopters with that capability, the costs to operate will also increase. Chart 2-2 highlights the increase. During a 20-year period, the candidate helicopters will increase fuel and maintenance costs anywhere from 48 percent, comparing the Bell 412EP to the Airbus H215, or 109 percent, comparing the Bell 212HP to the Sikorsky S-70i.

While the increase may seem excessive, the increase in performance must also be considered. Using the Bell 212HP to the Sikorsky S-70i comparison, the increase in water delivered during the typical mission scenario, the S-70i will carry 154 percent more per tank load (286 gallons for the Bell 212HP versus 726 gallons for the Sikorsky S-70i). Rather than basing the decision on cost only, a more meaningful parameter is value.

As another point of reference, when the same information is compared between the Bell 212HP and H215, the cost increase is 74 percent ($11.4 million for the Bell 212HP versus $19.8 million for the Airbus H215 long version) and the amount dropped per load would increase 93 percent (286 gallons versus 551 respectively).

Based on these two comparisons, the Sikorsky S-70i would seem to deliver more value despite its higher operating costs.

Chart 2-2



	212HP	412EP	H215	S-70i
Maintenance	$10,054	$11,612	$17,290	$21,208
Fuel/Lubricants	$1,389	$1,852	$2,526	$2,557

Table 2-2 provides the same type of analysis as Table 2-1 in section 2.2.1 for the ABLE helicopters. Please refer to section 2.2.1 to obtain an explanation of the analysis and the effect that the remaining useful lives of significant scheduled maintenance can have on helicopter values.

In Table 2-2, the years that are marked with yellow represent when the Adjusted Value is the same as or greater than the Base Value of the helicopter. The single red block for each helicopter represents the lowest value during the 20-year period. The letters in the yellow blocks identify the years with the highest Adjusted Values. “A” identifies the highest value and “E” is the fifth highest. The white blocks are the years when the Adjusted Value is below the Base Value.

In essence, Table 2-2 identifies the years when the helicopters have positive Adjusted Values, which represents when the City could expect to receive a higher amount when selling the asset than a helicopter around the Base Value. It is important to mention that the actual amount received in the sale of a pre-owned helicopter can differ from the adjusted values in this model due to current market activity. The model is highlighting the relationship between the Base and Adjusted Values.

Table 2-2																				
SDFD Helicopters - Annual Summary of Adjusted Values																				
Serial Number	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
31147						A	D		C	B	E									
36466		A	C					B	E			D								
Candidate Helicopters - Annual Summary of Adjusted Values																				
H215	A	B	C	D	E															
S-70i	A	B	C	D	E															

Serial number 31147 can serve as an example to explain the table. In years 6 through 12 and 14 through 15, the helicopter's adjusted value is higher than its base value, when all of the significant scheduled maintenance events are assumed to have remaining lives of 50 percent. In years 1 through 5, 13, and 16 through 20, the adjusted value is less than the base value because enough of the significant scheduled maintenance events have less than 50 percent remaining lives. Year 20 has the lowest adjusted value. Year 6 has the highest adjusted value.

2.3 Conklin & de Decker Analysis

2.3.1 San Diego Police Air Support Unit (ABLE)

2.3.1.1 Current Fleet

Life Cycle Assumptions: Life cycle cost estimates are based on a number of assumptions. Listed below are the assumptions that support the 20-year estimates for each of the current AS350B3 ABLE helicopters and the candidate helicopters.

- Life Cycle Start Month – August 2016. The date coincides with the Rotorcraft Support, Inc. maintenance tracking report dates. Reports contain the remaining times for significant scheduled events such as major inspections, overhaul components, life-limited items, and engine restorations. Based on the start date, Year 1 covers from the beginning of August through July.
- Program Length – 20 years.
- Hours per Year – Each helicopter was estimated to fly 900 hours per year. The assumption was based upon discussions with police personnel, who indicated, that after a number of years with reduced flight hours due to the economic slowdown, the 2017 goal is to increase the average back to a more "normal" level. Estimating the annual hours accurately is important as they have an important effect on the timing of certain significant maintenance events (e.g. 12-year inspection, engine overhaul, life-limited items).
- Fuel Cost – Assumed $2.40 cost per gallon. Discussions with police and fire personnel indicated a cost lower than $2.00 per gallon in 2016. However, the overall average as computed from

police information over a period of years shows a cost of $2.38 per gallon. After discussions with SDFD personnel, we agreed that $2.40 would be a good rate to use.

- Fuel Consumption – Assumed 60 gallons per hour. Based upon the average burn rate experienced by the police AS350B3. Police personnel indicated the fuel burn rate per hour can range from 55 to 65 gallons per hour. The police average of 60 differed by 20 percent or 10 gallons per hour from the value used by Conklin & de Decker. A difference of this amount is not surprising as many factors can affect the fuel flow -- aircraft weight, type of mission, aircraft speed, and temperature. However, it is important that the life cycle estimates for the candidate helicopters are based on a consumption rate that approximates the actual rate of the police helicopters. Therefore, we also increased the Conklin & de Decker fuel burn rate for each candidate helicopters by 20 percent in our estimates.
- Labor - Two contract maintenance technicians maintain the fleet of police helicopters. To reflect the cost of their labor as discussed with police personnel, we used $90 per hour.
- Inflation Rates – The life cycle cost model uses two inflation factors. The first affects the increasing cost of parts in aviation and the second is more general and is applied to such categories as fuel and labor. The assumed annual inflation factors affecting parts is 3.5 percent and the general inflation rate is 2.5 percent.

This portion of the report contains a combination of tables and charts summarizing the information generated by the life cycle cost software. The information provided for each helicopter consists of

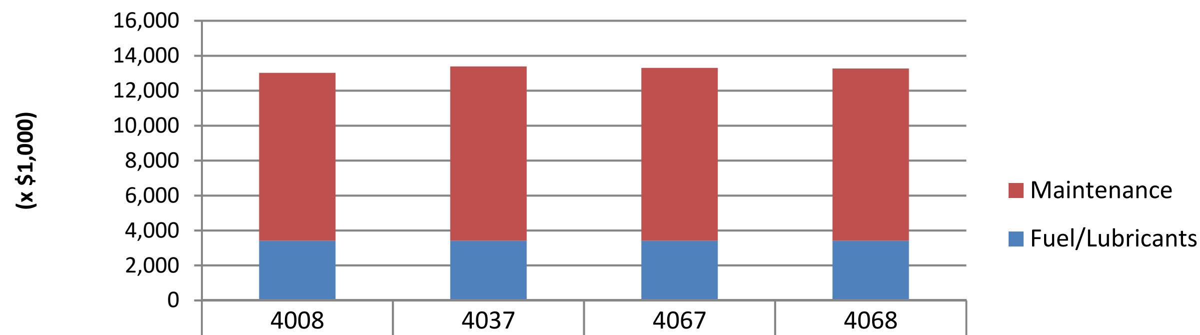
- A summary table showing the maintenance and fuel costs for the 20-year estimate.
- A line chart showing the estimated annual maintenance costs for the 20-year period.
- A table highlighting the significant maintenance events occurring in specific years.
- A line chart displaying the estimated annual residual value based on the aircraft's age and status of significant maintenance events for the 20-year period.

We have provided an explanation for each chart and its significance for the ABLE helicopter serial number 4008, registration number N707SD. To avoid redundancy with the explanations, we did not repeat them for each helicopter. We provided only the tables and charts for serial numbers 4037, 4067, and 4068. However, and for each helicopter, we have identified when the City might consider disposing of each helicopter based upon their respective estimated residual values. Our suggestion for disposition in this section of the report considers each helicopter individually and does represent the fleet plan as there will be other factors that may affect the fleet plan.

Chart 2-3 summarizes the projected fuel and maintenance costs for each of the ABLE helicopters over a 20-year period. It is no surprise the four helicopters have very similar projections since they were all purchased about the same time and will encounter similar significant scheduled maintenance during the 20-year projection. The range in costs is approximately $200,000 between the four helicopters with a high projection of $13.3 million and a low of $13.1 million.

Chart 2-3

Current ABLE Helicopters
Fuel and Maintenance Costs
20-Year Projection



	4008	4037	4067	4068
Maintenance	$9,609	$9,977	$9,891	$9,853
Fuel/Lubricants	$3,410	$3,410	$3,410	$3,410

Serial Number: 4008
Registration Number N707SD

Table 2-3 summarizes the estimated fuel and airframe and engine maintenance costs over a 20-year period, a period with a beginning point of August 2016. The estimate was based upon Conklin & de Decker's *Life Cycle Cost 16.2* software while using relevant police department information (e.g. remaining lives on scheduled components and items). The 20-year estimated costs for this helicopter is $13 million with 26 percent of the costs associated with fuel and lubricants, 53 percent with airframe maintenance, and 21 percent with engine restoral.

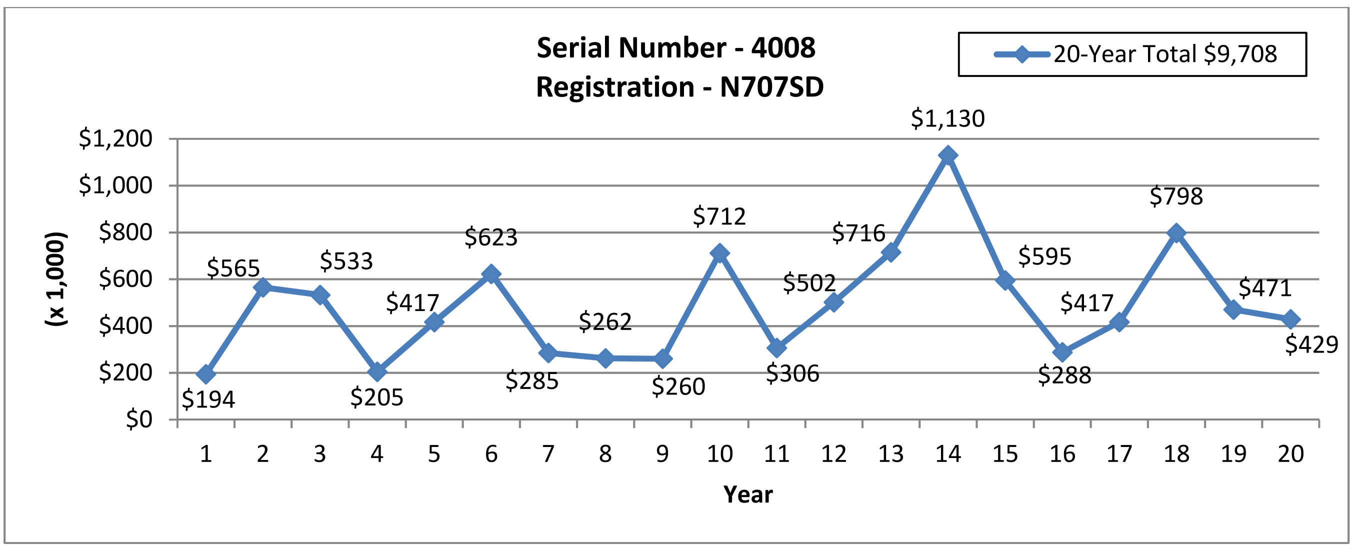
Table 2-3		
20-Year Projection - N707SD		
Fuel	$3,310,588	25%
Lubricants	$99,318	1%
Subtotal	$3,409,905	26%
Airframe Maintenance		
Labor	$2,182,961	17%
Parts	$1,667,087	13%
Inspections	$851,621	7%
Component Overhaul	$624,500	5%
Life Limited Items	$1,556,556	12%
Subtotal	$6,882,725	53%
Engine Maintenance		
Engine Restoral	$2,725,891	21%
Total	$13,018,522	100%

Chart 2-4 displays the estimated annual maintenance (fuel not included) costs during the 20-year period. Due to the nature of helicopter maintenance requirements certain significant costs will occur at scheduled intervals. For example, in Year 14, helicopter N707SD will encounter its highest maintenance costs. Sixty-three percent of the $1.130 million is related to scheduled maintenance, $361 thousand for a 12-year inspection, $408 thousand for an engine overhaul, and $145 thousand for airframe component overhauls and life limited items. (This detail is provided in Table 2-4.)

To use this helicopter as an example, Year 13 would not be the ideal time to dispose of the aircraft. Upcoming significant maintenance due in Year 14 will subtract substantially from the resale value of the helicopter. Generally, disposition of an aircraft should occur a period of time (e.g. two or three years) prior to or after significant maintenance events. However, the general rule does not always apply. Chart 2-5, which is based on the effect of all significant scheduled maintenance events as captured in Life Cycle Cost, displays how this helicopter's values vary over a 20-year period.

Also, it is important to remember one of the assumptions underlying the 20-year estimate; it is based on 900 flight hours per year. If the actual accumulation of flight hours varies, then the year in which the significant maintenance costs occur could change.

Chart 2-4



The information in Table 2-4 supplements Chart 2-4. The table highlights the more significant maintenance categories that are driving the costs in the peak years. For example in Year 5, two categories of significant maintenance occur; the engine will retire certain life-limited parts ($130,000) as well as life-limited items on the airframe ($78,000). The two categories add to $208,000. The two categories account for 50% of the total estimated maintenance costs of $417,000 for Year 5. It should be pointed out that our life cycle cost model accounts for engine life-limited items (Year 5) separately from the engine overhaul that occurs in Year 6. In practice, it is likely the overhaul would coincide with the replacement of the engine life-limited items in Year 5 since both activities require teardown of the engine.

Table 2-4

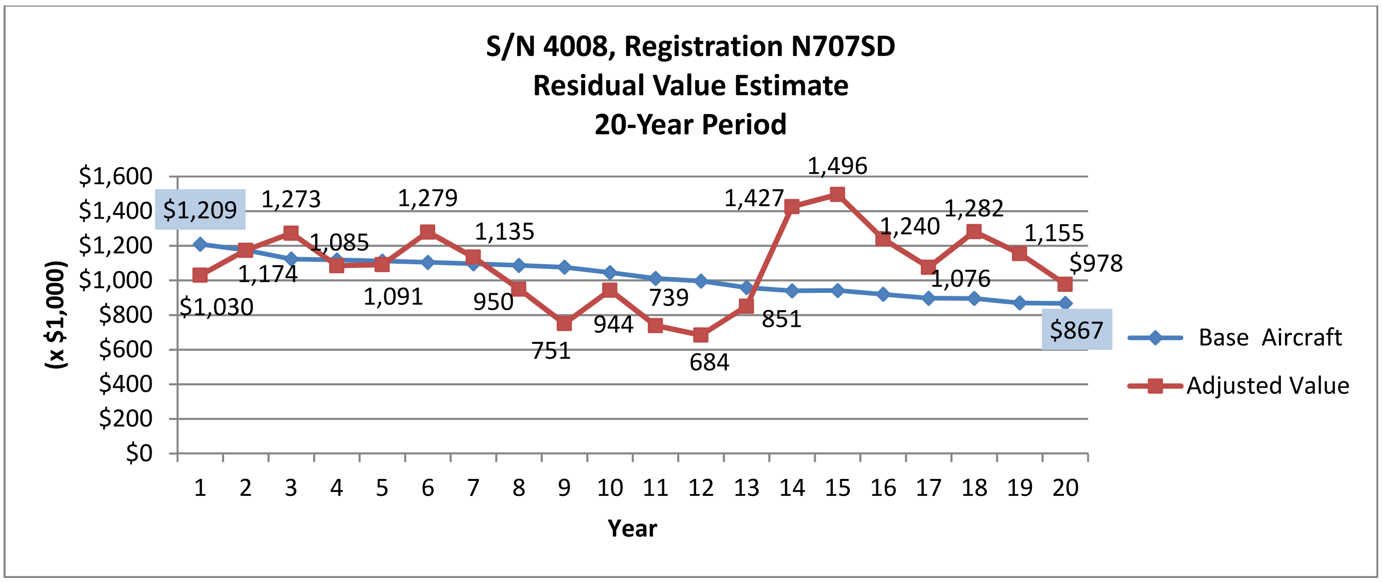
Summary of Annual Significant Scheduled Events – N707SD

Year	Category	Significant Maintenance Description	Estimated Cost (x1,000)	Significant Maintenance Subtotal (x1,000)	Annual Maintenance Total (x1,000)	Significant to Annual Total (%)
2	Inspections	12-Year	$268			
	Airframe Life-Limited	Several Items	$96	$364	$565	64%
3	Engine Restoration	Overhaul	$275	$275	$533	52%
5	Engine Restoration	Life-Limited	$130			
	Airframe Life-Limited	Several Items	$78	$208	$417	50%
6	Engine Restoration	Overhaul	$377	$377	$623	61%
10	Engine Restoration	Overhaul	$369			
	Airframe Life-Limited	Several Items	$82	$451	$712	63%
13	Airframe Life-Limited	Several Items	$482	$482	$716	67%
14	Inspections	12-Year	$361			
	Engine Restoration	Overhaul	$408			
	Airframe Component Overhaul	Several Items	$77			
	Airframe Life-Limited	Several Items	$68	$914	$1,130	81%

Chart 2-5 offers another perspective for serial number 4008, the estimated residual value. The chart actually shows two perspectives for the residual value. The first perspective (Base Aircraft, blue line) involves the steady declining value of the helicopter as it ages in years and its remaining lives for significant scheduled maintenance is 50 percent. In this life cycle cost estimate, serial number 4008 begins as a ten-year old aircraft, manufactured in 2006. After 20 years or as a 30-year old aircraft, the helicopter would have an estimated market value of $867,000. The average annual two-percent rate of depreciation is a general rate in the life cycle cost tool that would apply to all AS350B3 helicopters with the same year of manufacture.

The second line (Adjusted Value, red line) in Chart 2-5 reflects the estimated residual value based upon the status of the helicopter's significant scheduled maintenance events (e.g. component overhauls, life-limited items, engine restoration, major inspections). Due to the high costs associated with these maintenance events such as a transmission overhaul, main rotor blade retirement, engine overhaul, and/or long duration inspections, a helicopter's market value will be increased or decreased depending upon how much time remains before the occurrence of the event. And because the various maintenance events occur during different times in the helicopter's life cycle, the market value is affected differently by each significant maintenance event. For example, an engine overhaul that just occurred will add (betterment) to the helicopter's base market value, while a set of blades to be retired in the coming year will decrease the base market value (detriment).

Chart 2-5



If we combine the information in Chart 2-4, which reflects the estimated maintenance costs, with the maintenance details provided in Table 2-4, we'll better understand why Year 3 in Chart 2-5 shows a peak in value ($1,273K) for serial number 4008. In Year 2, the helicopter will experience its first 12-year inspection and in Year 3, it will experience an engine overhaul. Both are significant maintenance events that when completed will increase the Adjusted Value in Year 3. Year 15 has the highest estimated Adjusted Value due to the many significant maintenance events completed in the prior year. (e.g. 12-year inspection, engine overhaul and activity with component overhauls and life-limited items.)

The recommended years to dispose of serial number 4008 can go two directions. The first direction is to base the decision on the Adjusted Value only. Using this method, the Adjusted Value is above the Base Value in years 3 through 7 and 14 through 20. The beginning point for the 20-year life cycle estimate was August 2016; therefore Year 3 would occur in 2019.

The second direction would suggest it might be better to dispose of the aircraft when the Adjusted Value is below the Base Value but prior to incurring significant maintenance-related expenses. Said another way, is it worthwhile to spend more to gain less increase in value? In Year 3, serial number 4008 will experience an estimated $275,000 engine overhaul to improve the helicopter's value by $100,000.

Regardless of the chosen direction, the City should be cognizant of the current depressed used market values in the industry. (A more complete explanation about the current market is provided in Section 3 Aircraft Acquisition and Timing.) The Base Values displayed in Chart 2-5 are based upon long-term depreciation values and do not necessarily reflect current market values.

Serial Number: 4037

Registration Number N708SD

Table 2-5		
20-Year Projection - N708SD		
Fuel	$3,310,588	25%
Lubricants	$99,318	1%
Subtotal	$3,409,905	25%
Airframe Maintenance		
Labor	$2,110,196	16%
Parts	$1,667,087	12%
Inspections	$1,028,520	8%
Component Overhaul	$622,870	5%
Life Limited Items	$1,585,141	12%
Subtotal	$7,013,814	52%
Engine Maintenance		
Engine Restoral	$2,963,097	22%
Total	$13,386,816	100%

Chart 2-6

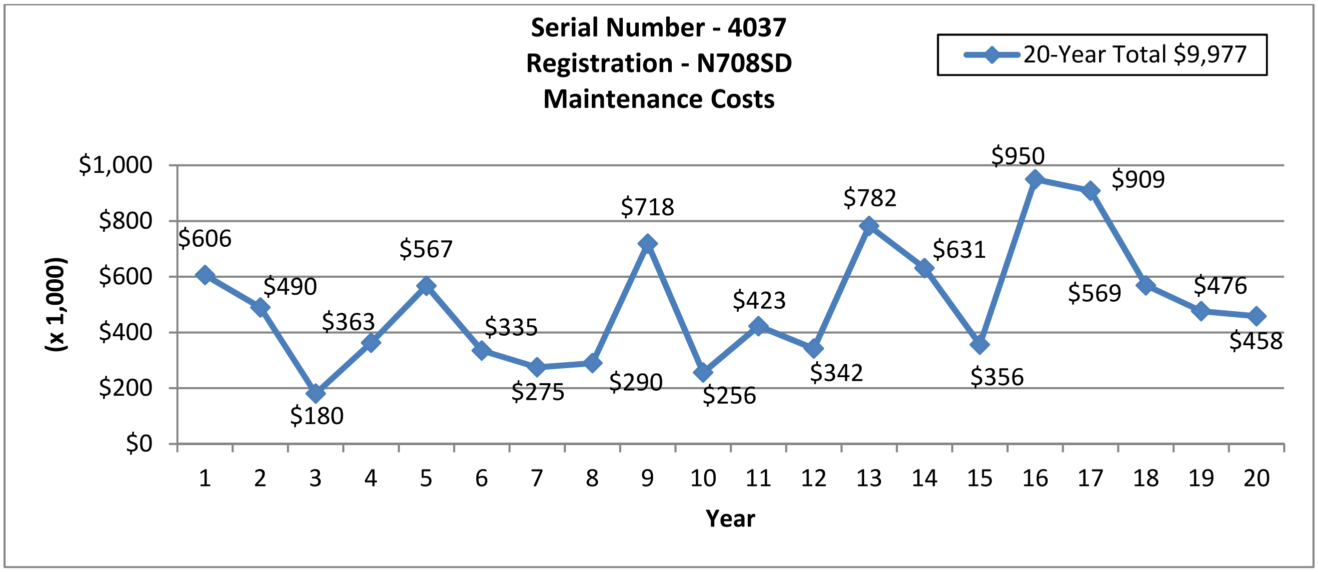
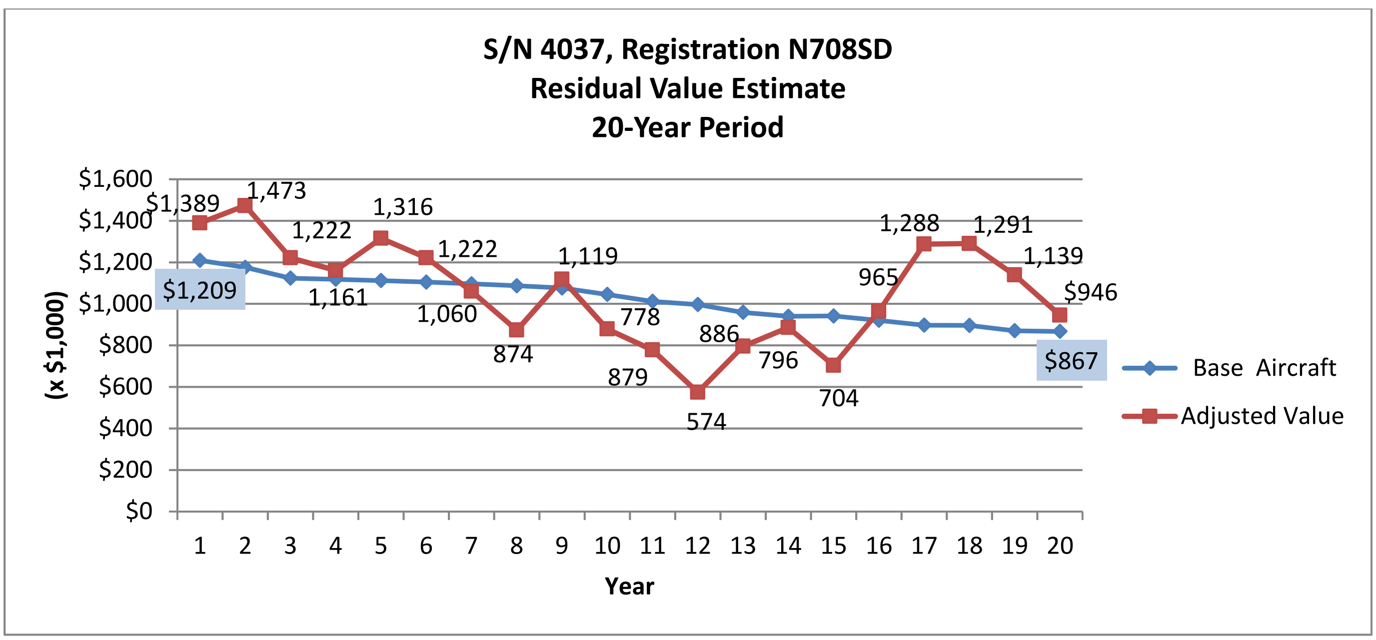


Table 2-6						
Summary of Annual Significant Scheduled Maintenance Events – N708SD						
Year	**Category**	**Significant Maintenance**	**Estimated Cost (x1,000)**	**Significant Maint. Subtotal (x1,000)**	**Annual Maint. Total (x1,000)**	**Significant Maint. / Annual Total (%)**
1	Engine Restoration	Overhaul	$378			
	Airframe Component Overhaul	Several Items	$64	$442	$606	73%
2	Inspection	12-Year	$258			
	Airframe Life Limited	Several Items	$84	$342	$490	70%
5	Engine Restoration	Overhaul	$314			
	Airframe Component Overhaul	Several Items	$70	$384	$567	68%
9	Engine Restoration	Overhaul	$420			

	Airframe Life Limited	Several Items	$57			
	Airframe Component Overhaul	Several Items	$36	$513	$718	71%
13	Engine Restoration	Overhaul	$428			
	Airframe Life Limited	Several Items	$84			
	Airframe Component Overhaul	Several Items	$40	$552	$782	71%
14	Inspection	12-Year	$346			
	Engine Restoration	Life-Limited Items	$51	$397	$631	63%
16	Airframe Life Limited	Several Items	$408			
	Airframe Component Overhaul	Several Items	$64	$472	$950	50%

Chart 2-7



The beginning point for the 20-year life cycle estimate was August 2016.

Based on Adjusted Value only, the recommended period to dispose of serial number 4037 is years 1 through 6. The helicopter will have completed its 12-year inspection in year 2 (2018) and an engine overhaul in year 4 (2020). Accomplishment of these significant maintenance events will create a peak in value in year 5 ($1,316K). By Year 5 (2021) the current slow helicopter market may have improved and values, as estimated in the projection, may be possible.

A steady decline in value after Year 6 keeps the Adjusted Value below or equal to the Base Aircraft value until year 17 when the next 12-year inspection would occur. Year 17 would mean serial number 4037 would be approximately 27 years old.

The City could receive a good value in year 2 and after the 12-year inspection but the big question for 2018 is what will be the economic state of the industry? Will market values still be mired in the current slump?

The Base Aircraft values displayed in Chart 2-7 is based upon long-term depreciation values and do not necessarily reflect current market values.

Serial Number: 4067

Registration Number N710SD

Table 2-7		
20-Year Projection - N710SD		
Fuel	$3,310,588	25%
Lubricants	$99,318	1%
Subtotal	$3,409,905	26%
Airframe Maintenance		
Labor	$2,182,961	16%
Parts	$1,667,087	13%
Inspections	$822,320	6%
Component Overhaul	$627,926	5%
Life Limited Items	$1,562,867	12%
Subtotal	$6,863,161	52%
Engine Maintenance		
Engine Restoral	$3,027,347	23%
Total	$13,300,413	100%

Chart 2-8

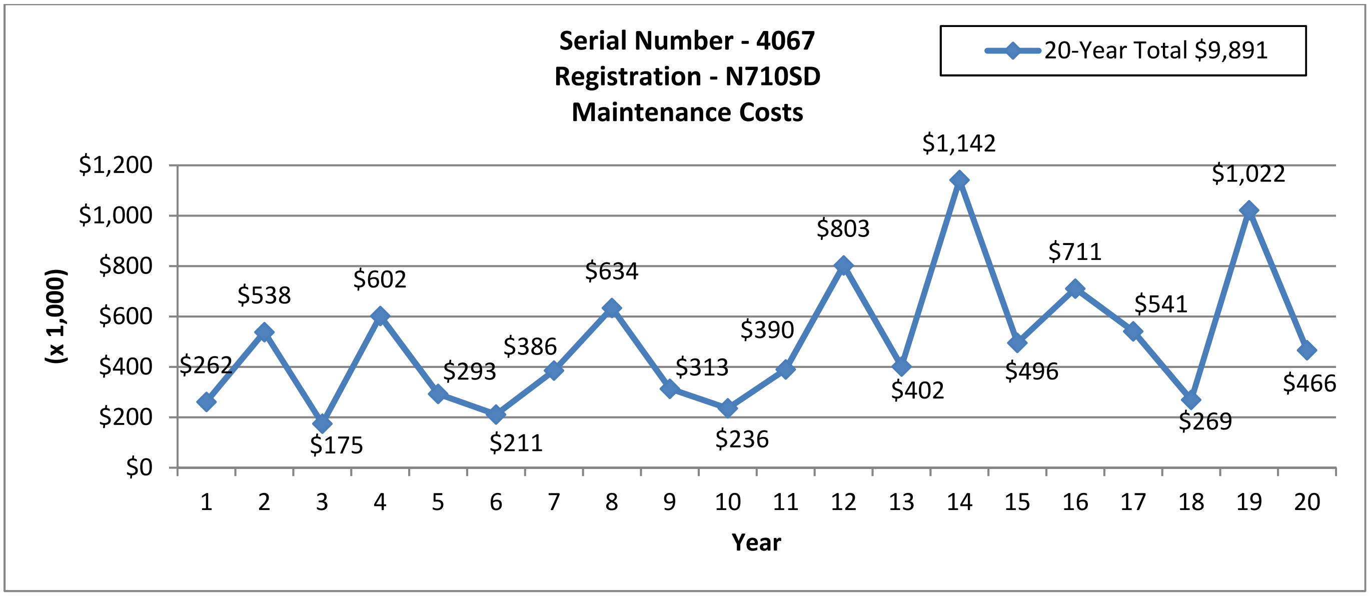
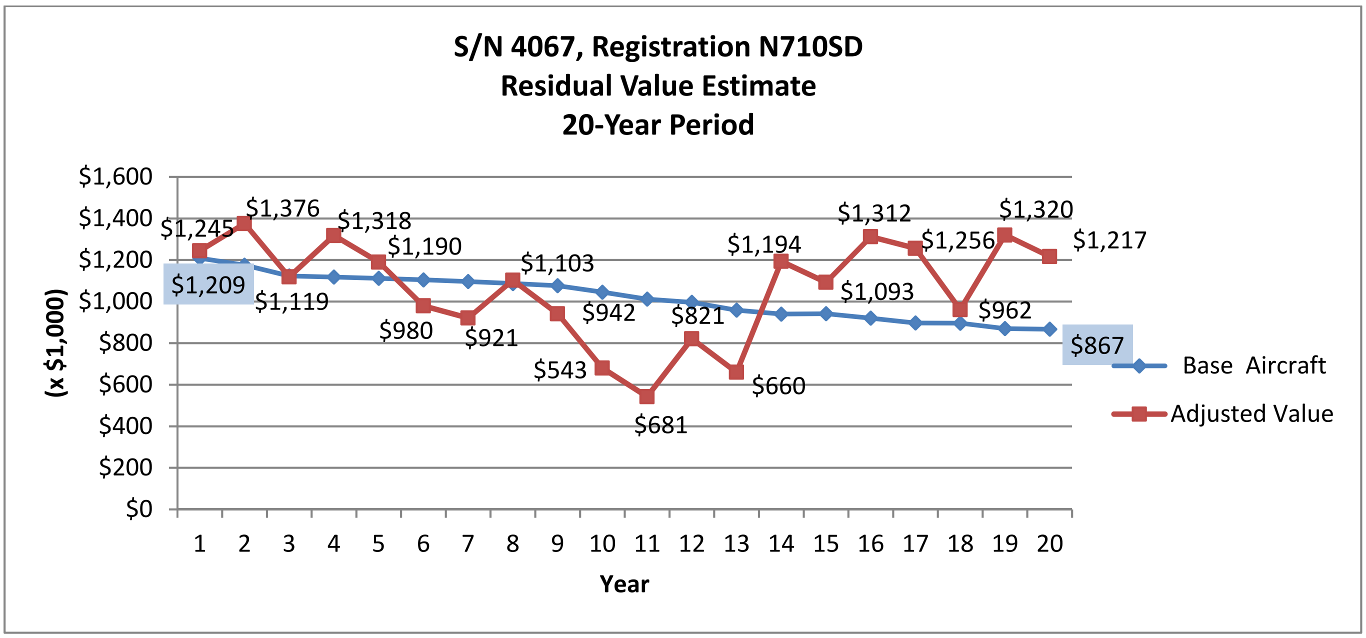


Table 2-8						
Summary of Annual Significant Scheduled Maintenance Events – N710SD						
Year	**Category**	**Significant Maintenance**	**Estimated Cost (x1,000)**	**Significant Maint. Subtotal (x1,000)**	**Annual Maint. Total (x1,000)**	**Significant Maint. / Annual Total (%)**
2	Inspection	12-Year	$256			
	Airframe Component Overhaul/Life-Limited Items	Several Items	$64	$320	$538	59%
4	Engine Restoration	Overhaul	$306			
	Airframe Life-Limited	Several Items	$112	$418	$602	69%
8	Engine Restoration	Overhaul	$408			
	Airframe Component Overhaul	Several Items	$44	$452	$634	71%
12	Engine Restoration	Overhaul	$421			
	Airframe Life-Limited	Several Items	$105			

	Airframe Component Overhaul	Several Items	$79	$605	$803	75%
14	Inspection	12-Year	$345			
	Airframe Life-Limited	Several Items	$580	$925	$1,142	81%
16	Engine Restoration	Overhaul	$429			
	Airframe Component Overhaul/Life-Limited Items	Several Items	$49	$478	$711	67%

Chart 2-9



The beginning point for the 20-year life cycle estimate was August 2016.

Based on the Adjusted Value method, the recommended year to dispose of serial number 4067 is similar to serial number 4037. The helicopter will have completed its 12-year inspection in year 2 (2018) and an engine overhaul in year 4 (2020). Accomplishment of these significant maintenance events will create a peak in value in years 4 and 5 ($1,31K and $1,190K). With the exception of year 8 (2024), there is a steady decline in value until it reaches year 14 when the next 12-year inspection would occur.

The City could receive a good value in year 2 and after the 12-year inspection but the big question again for 2018 is what will be the economic state of the industry? Will market values still be mired in the current slump?

The Base Aircraft values displayed in Chart 2-9 are based upon long-term depreciation values and do not necessarily reflect current market values.

Serial Number: 4068

Registration Number N709SD

Table 2-9		
20-Year Projection - N709SD		
Fuel	$3,310,588	25%
Lubricants	$99,318	1%
Subtotal	$3,409,905	26%
Airframe Maintenance		
Labor	$2,182,961	16%
Parts	$1,667,087	13%
Inspections	$702,902	5%
Component Overhaul	$642,296	5%
Life Limited Items	$1,560,838	12%
Subtotal	$6,756,085	51%
Engine Maintenance		
Engine Restoral	$3,097,354	23%
Total	$13,263,344	100%

Chart 2-10

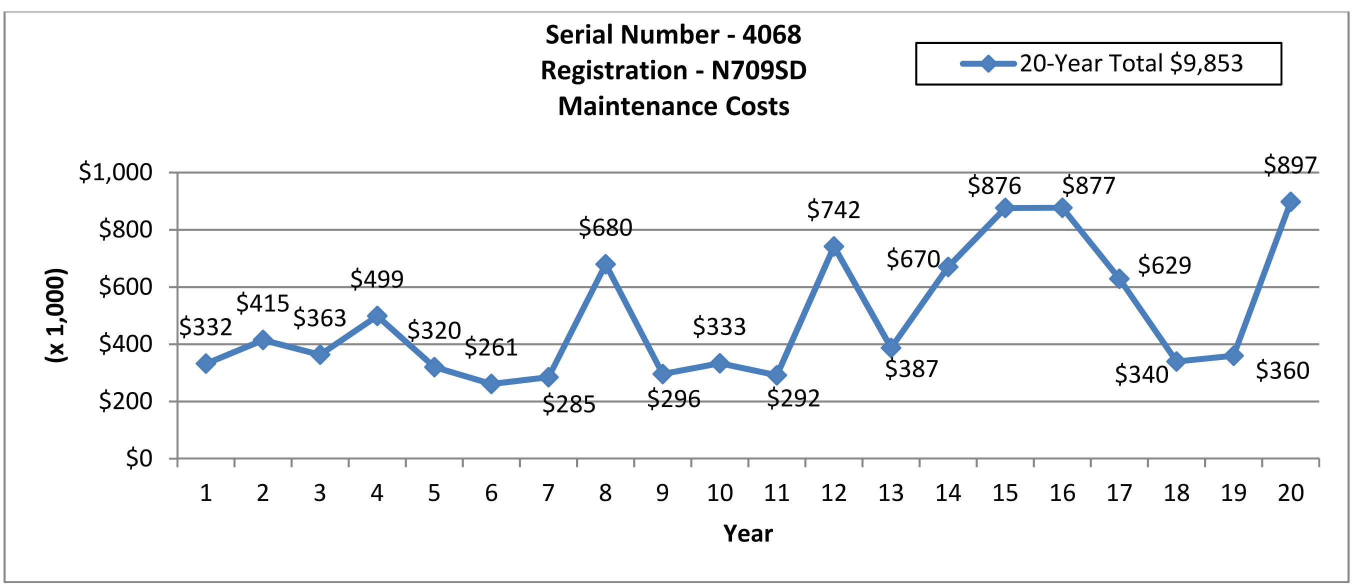
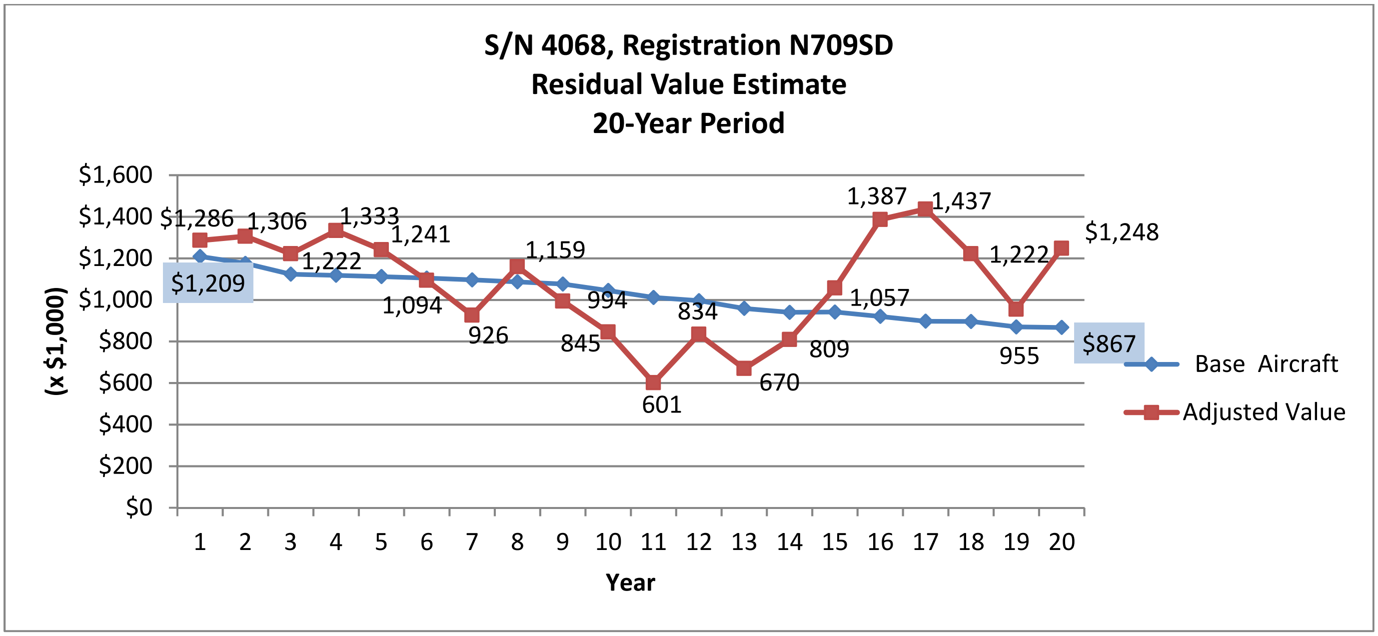


Table 2-10						
Summary of Annual Significant Scheduled Maintenance Events – N709SD						
Year	**Category**	**Significant Maintenance**	**Estimated Cost (x1,000)**	**Significant Maint. Subtotal (x1,000)**	**Annual Maint. Total (x1,000)**	**Significant Maint. / Annual Total (%)**
2	Inspection	12-Year	$258	$258	$415	62%
4	Engine Restoration	Overhaul	$267			
	Airframe Component Overhaul/Life-Limited Items	Several Items	$72	$339	$499	68%
8	Engine Restoration	Overhaul	$367			
	Airframe Component Overhaul/Life-Limited Items	Several Items	$136	$503	$680	74%
12	Engine Restoration	Overhaul	$417			
	Airframe Component Overhaul/Life-Limited Items	Several Items	$124	$541	$742	73%
14	Inspection	12-Year	$346			
	Airframe Component Overhaul/Life-Limited Items	Several Items	$67	$413	$670	62%
15	Airframe Life-Limited	Several Items	$636	$636	$876	73%
16	Engine Restoration	Overhaul	$552			
	Component Overhaul	Several Items	$87	$639	$877	73%

Chart 2-11



The beginning point for the 20-year life cycle estimate was August 2016.

Based on Adjusted Value only, the recommended year to dispose of serial number 4068 is between years 3 and 8 with an emphasis on years 5 and 6. Serial Number 4068 will have completed its 12-year inspection in year 2 and an engine overhaul in year 4, similar to the other helicopters in the fleet. However, years 5, 6, and 7 are relatively low maintenance cost years, while also retaining acceptable helicopter values in years 5 ($1,241) and 6 ($1,094). Year 7 represents a low adjusted value in this series of years.

The City could receive a good value in year 2 and after the 12-year inspection but the big question for 2018 is what will be the economic state of the industry? Will market values still be mired in the current slump? While year 4 peaks at $1,333, it obtains the peak by completing an estimated $267,000 engine restoral. The maintenance cost is more than the increase in Adjusted Value between years 3 and 4.

The Base Aircraft values displayed in Chart 2-11 are based upon long-term depreciation values and do not necessarily reflect current market values.

2.3.1.2 Candidate Helicopters

The purpose of this section is to apply the same life cycle cost analysis to the candidate helicopters that was used for the ABLE helicopters. The candidate helicopters were introduced in Section 1, Fleet Review and include the Airbus H120, H125, and H130, Bell Helicopter 407GXP, and Leonardo

AW119Kx. For the candidate helicopters, we used the life cycle cost software and based it on the same assumptions, except fuel consumption, as described on Pages 6-7.

Fuel consumption for the candidate helicopters differed from the 60-gallon consumption rate for the current ABLE helicopters. The respective rates for the candidate helicopters were

- Airbus H120: 38 gallons per hour
- Airbus H125: 56 gallons
- Airbus H130: 57 gallons
- Bell 407GXP: 56 gallons
- Leonardo AW119Kx: 73 gallons

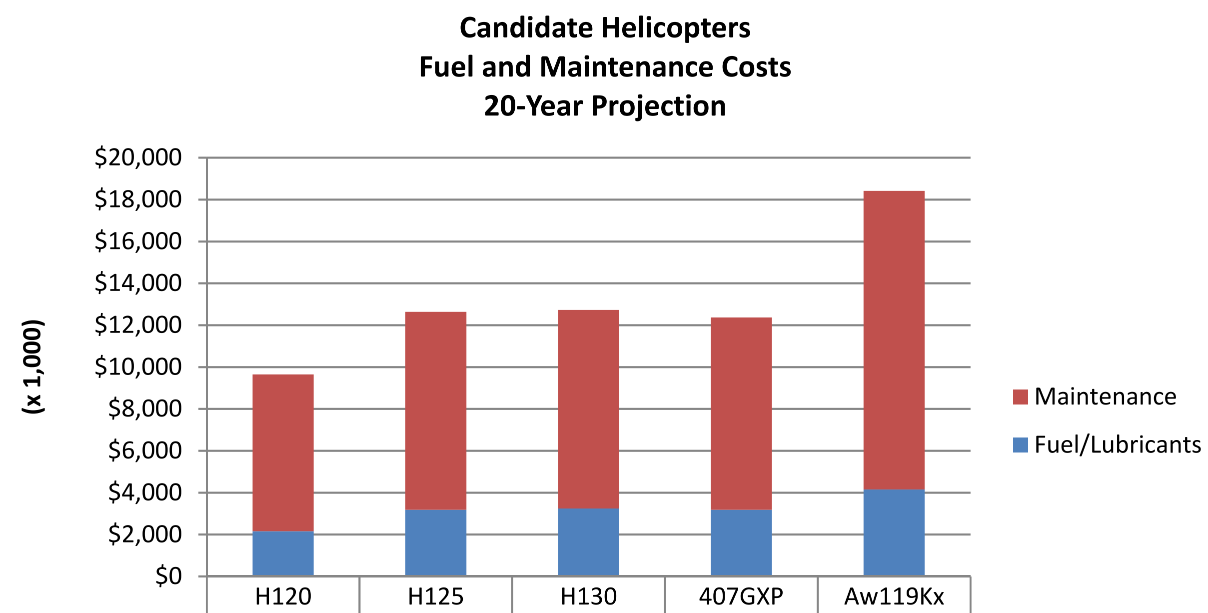
The information provided for each candidate helicopter is the same as the ABLE helicopters with the exception of one table, which identified the significant scheduled maintenance categories by year. The table and charts provided are

- A summary table showing the maintenance and fuel costs for the 20-year estimate.
- A line chart showing the estimated annual maintenance costs for the 20-year period.
- A line chart displaying the estimated annual residual value based on the aircraft's age and status of significant maintenance events for the 20-year period.

Because the table and charts convey the same type of information as was conveyed for the ABLE helicopters, we did not restate the explanation and meaning as was provided for ABLE helicopter serial number 4008, registration number N707SD.

Chart 2-12 summarizes the projected fuel and maintenance costs for each of the candidate helicopters over a 20-year period. The Airbus H120, the smallest of the candidate helicopters as measured by maximum gross take-off weight, has the lowest estimated costs over the 20-year period at approximately $9.6 million. The largest helicopter, the Leonardo AW119K, has the highest estimated cost at $18.4. The remaining three candidates, which are similar to each other in size and performance, have costs that are also similar. The range is $12.3 million for the Bell 407GXP to $12.7 million for the Airbus H130. The H125 is estimated to be $12.6 million.

Chart 2-12



	H120	H125	H130	407GXP	Aw119Kx
Maintenance	$7,484	$9,452	$9,485	$9,185	$14,261
Fuel/Lubricants	$2,160	$3,183	$3,239	$3,183	$4,149

Airbus Helicopters

H120

Table 2-11		
20-Year Projection - H120		
Fuel	$2,096,705	22%
Lubricants	$62,901	1%
Subtotal	$2,159,607	22%
Airframe Maintenance		
Labor	$2,453,686	25%
Parts	$1,576,593	16%
Inspections	$477,304	5%
Component Overhaul	$289,808	3%
Life Limited Items	$361,252	4%
Subtotal	$5,158,643	53%
Engine Maintenance		
Engine Restoral	$2,325,145	24%
Total	$9,643,395	100%

Chart 2-13

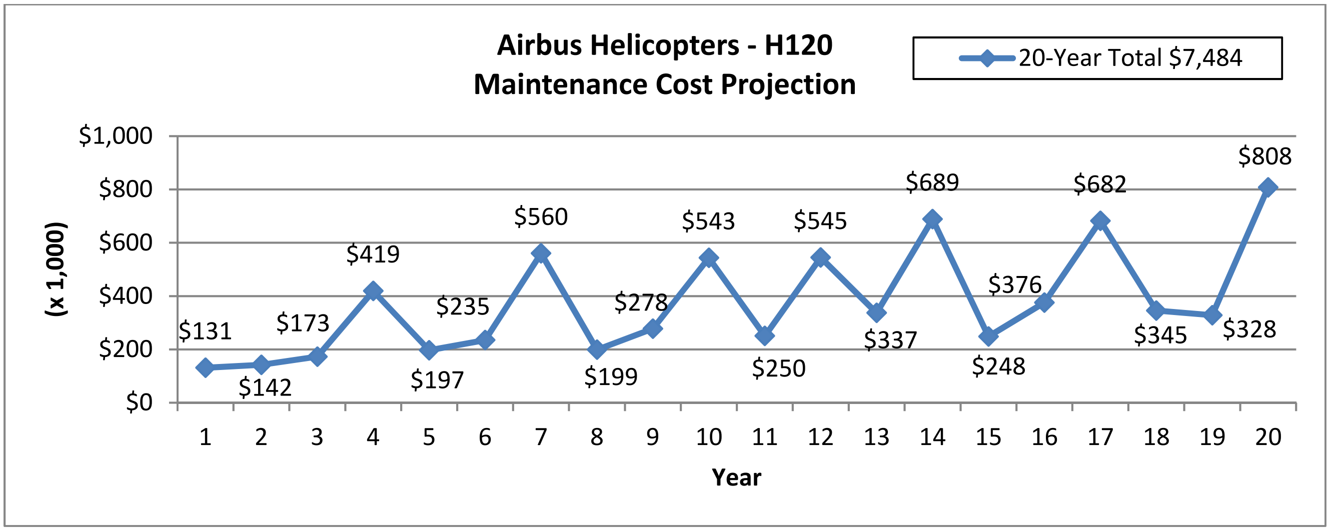
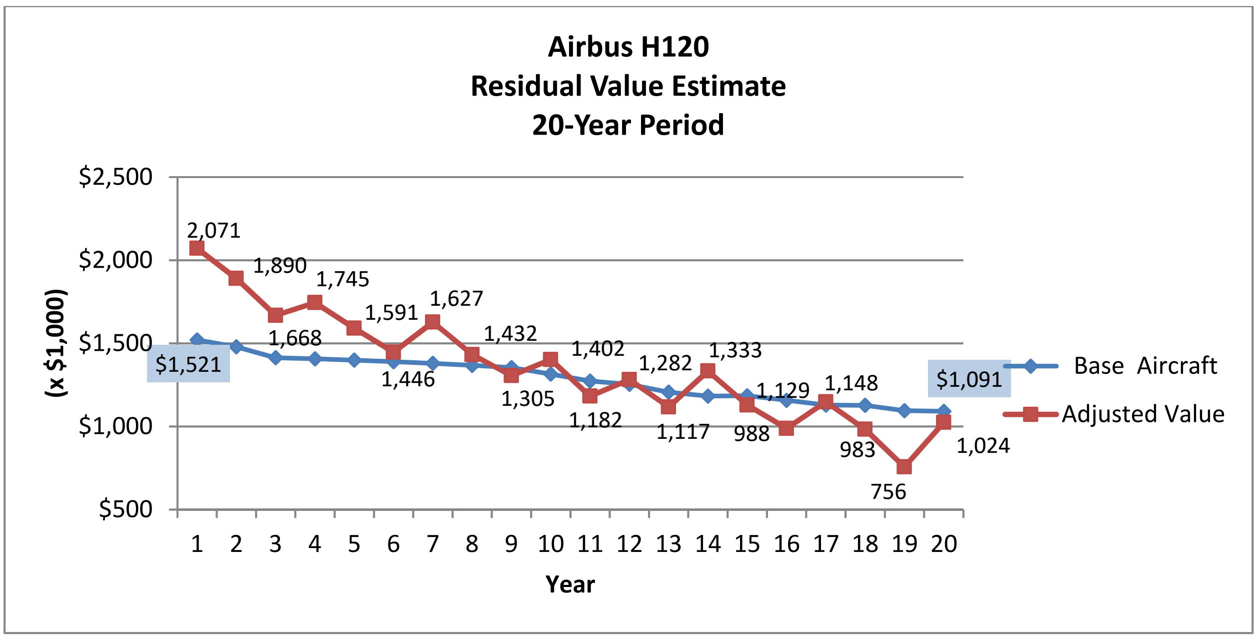


Chart 2-14



Airbus Helicopters

Airbus H125

Table 2-12		
20-Year Projection - H125		
Fuel	$3,089,882	24%
Lubricants	$92,696	1%
Subtotal	$3,182,578	25%
Airframe Maintenance		
Labor	$2,689,853	21%
Parts	$1,987,413	16%
Inspections	$1,515,883	12%
Component Overhaul	$459,040	4%
Life Limited Items	$966,324	8%
Subtotal	$7,618,513	60%
Engine Maintenance		
Engine Restoral	$1,833,201	15%
Total	$12,634,293	100%

Chart 2-15

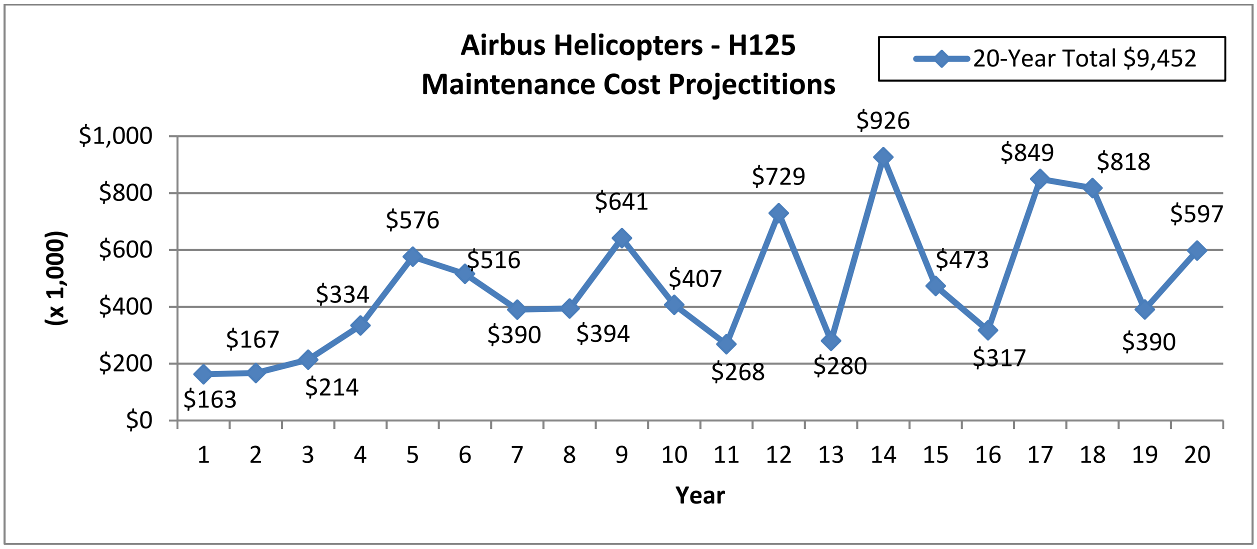
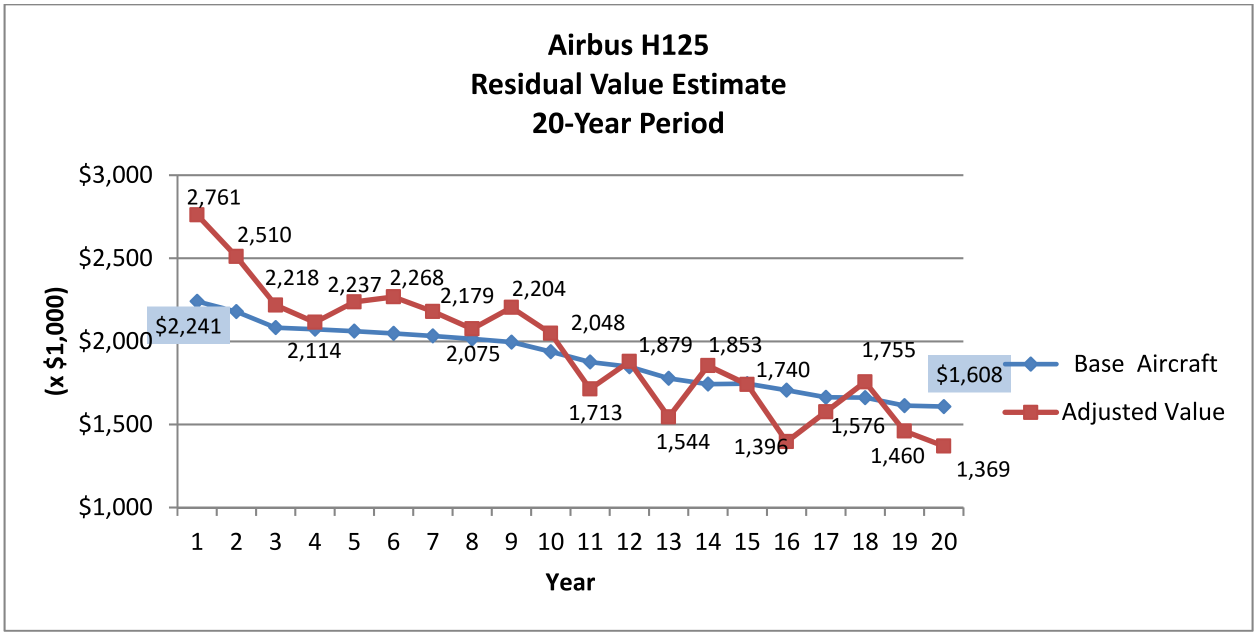


Chart 2-16



Airbus Helicopters
Airbus H130

Table 2-13		
20-Year Projection - H130		
Fuel	$3,145,058	25%
Lubricants	$94,352	1%
Subtotal	$3,239,410	25%
Airframe Maintenance		
Labor	$2,666,024	21%
Parts	$2,097,825	16%
Inspections	$1,652,768	13%
Component Overhaul	$479,649	4%
Life Limited Items	$755,268	6%
Subtotal	$7,651,534	60%
Engine Maintenance		
Engine Restoral	$1,833,201	14%
Total	$12,724,145	100%

Chart 2-17

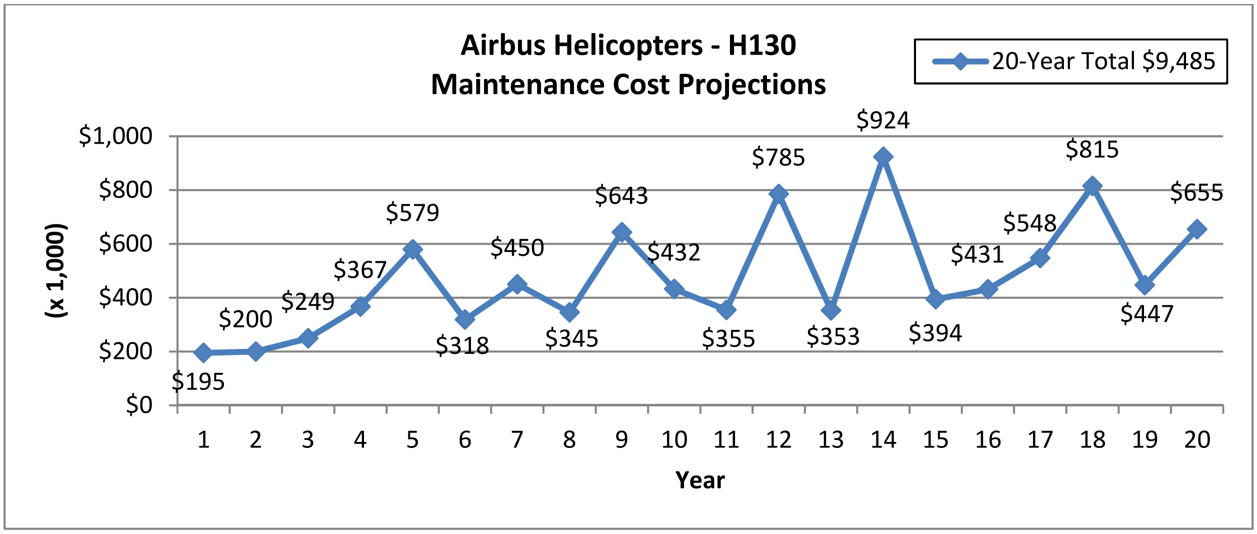
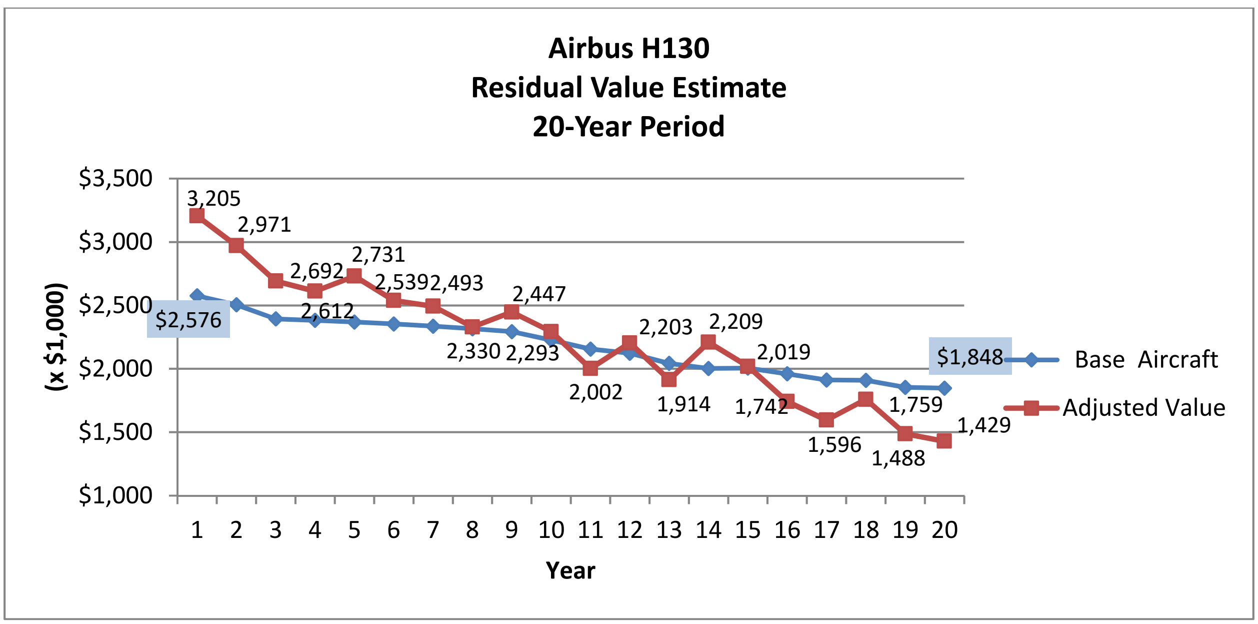


Chart 2-18



Bell Helicopter

Bell 407GXP

Table 2-14		
20-Year Projection - H130		
Fuel	$3,089,882	25%
Lubricants	$92,696	1%
Subtotal	$3,182,578	26%
Airframe Maintenance		
Labor	$2,595,244	21%
Parts	$1,811,827	15%
Inspections	$328,961	3%
Component Overhaul	$1,311,728	11%
Life Limited Items	$794,790	6%
Subtotal	$6,842,551	55%
Engine Maintenance		
Engine Restoral	$2,342,046	19%
Total	$12,367,176	100%

Chart 2-19

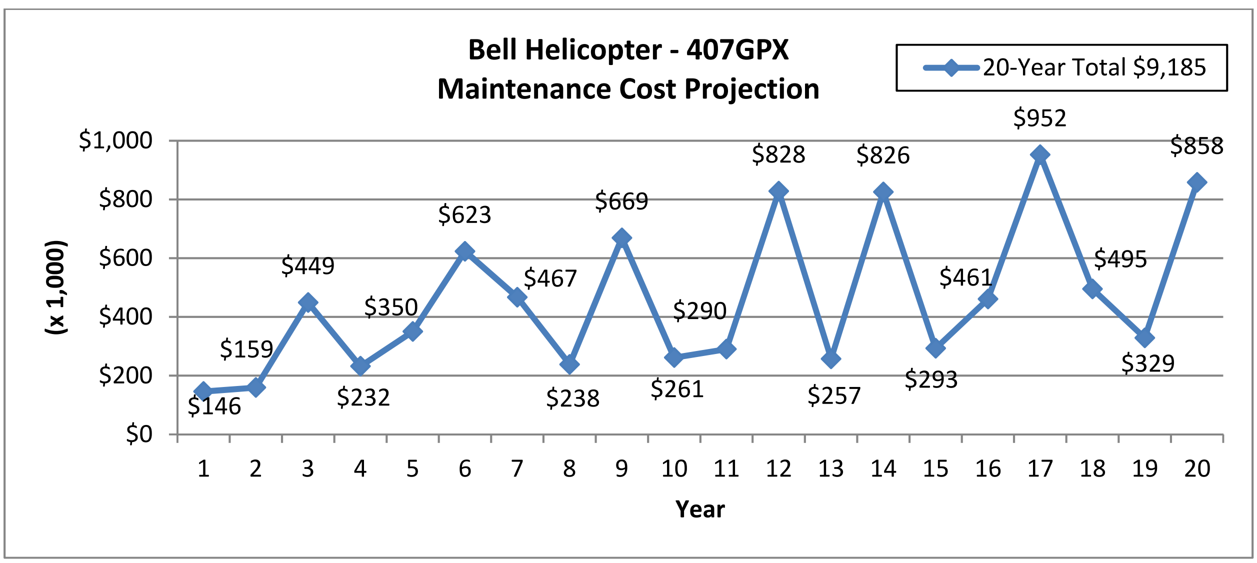
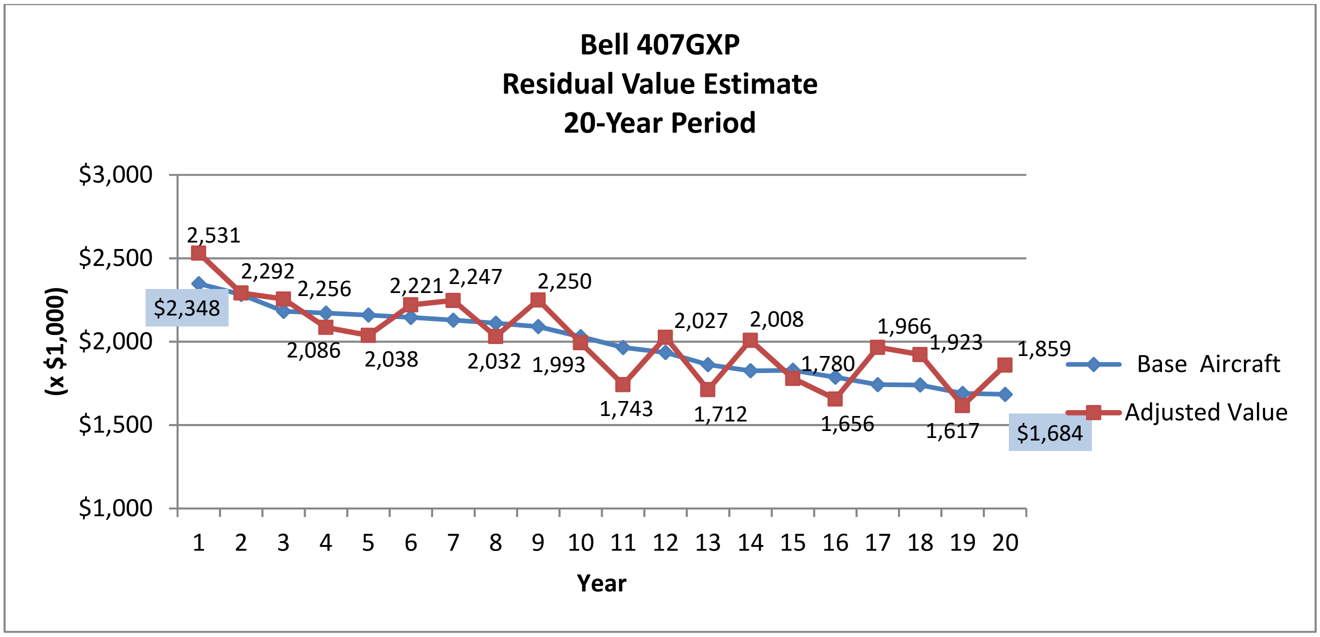


Chart 2-20



Leonardo
AW119Kx

Table 2-15		
20-Year Projection - H130		
Fuel	$4,027,882	22%
Lubricants	$120,836	1%
Subtotal	$4,148,718	23%
Airframe Maintenance		
Labor	$3,727,714	20%
Parts	$3,668,222	20%
Inspections	$805,933	4%
Component Overhaul	$1,258,980	7%
Life Limited Items	$536,762	3%
Subtotal	$9,997,611	54%
Engine Maintenance		
Engine Restoral	$4,262,899	23%
Total	$18,409,228	100%

Chart 2-21

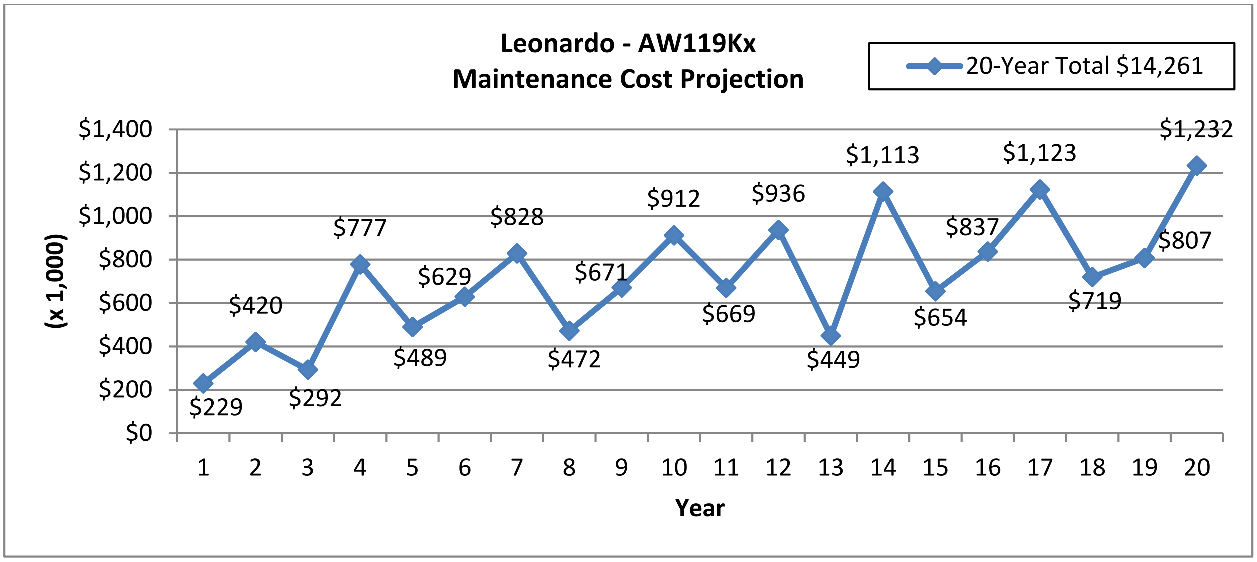
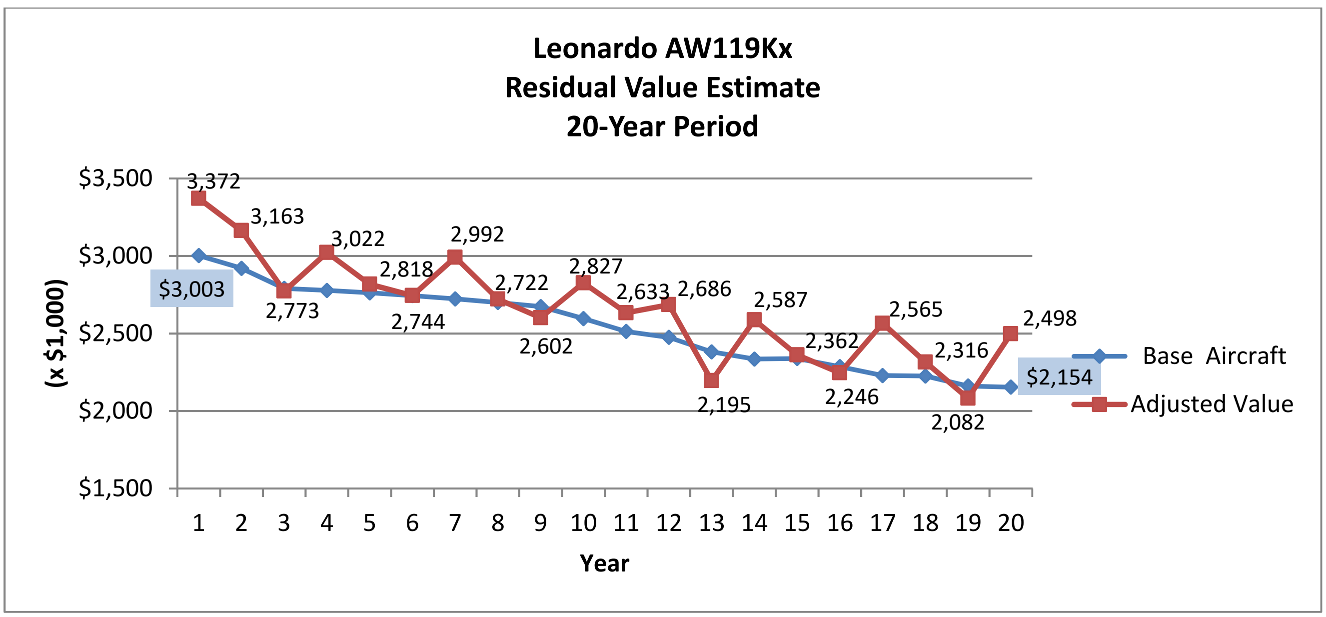


Chart 2-22



2.3.2 San Diego Fire-Rescue Department (SDFD)

2.3.2.1 Current Fleet

Life Cycle Assumptions: Life cycle cost estimates are based on a number of assumptions. Listed below are the assumptions that support the 20-year estimates for each of the current SDFD helicopters and the candidate helicopters.

- Life Cycle Start Month – August 2016. The source for the maintenance tracking information was Rotorcraft Support, Inc. The maintenance tracking report dates were August 5, 2016 for the Bell 212 HP and July 27, 2016 for the Bell 412EP. Reports contain the remaining times for significant scheduled events such as major inspections, overhaul components, life-limited items, and engine restorations. Based on the start date, Year 1 covers from the beginning of August 2016 through July 2017.
- Program Length – 20 years.
- Hours per Year – Based on average annual hourly usage during operation by SDFD, the assumed flight hours for the Bell 212HP was 220 and the Bell 412EP was 255. Estimating the annual hours accurately is important as they have an important effect on the timing of certain significant maintenance events (e.g. 5-year major inspection, engine overhauls, life-limited items).
- Fuel Cost – Assumed $2.40 cost per gallon. Discussions with police and fire personnel indicated a cost lower than $2.00 per gallon in 2016. However, the overall average as computed from police information over a period of years shows a cost of $2.38 per gallon. After discussions with SDFD personnel, we agreed that $2.40 would be a good rate to use.
- Fuel Consumption – Assumed 100 gallons per hour for the Bell 212HP and 115 gallons for the Bell 412EP. The fuel consumption rate was obtained from SDFD personnel.
- Labor
    - Maintenance Technician – SDFD employs two maintenance technicians to maintain the SDFD helicopters. Each individual costs the City approximately $121,000 annually. One technician’s salary was assigned to each SDFD helicopter.
    - Other – This category covers the estimated overtime that is budgeted annually. The total annual overtime estimate of $100,000 was divided equally ($50,000) and then assigned to each helicopter.
    - Training – The estimated annual training budget for maintenance is $25,000. This covers annual training with the airframe and engine manufacturers. The training budget was split equally ($12,500) between the current helicopters.
- Inflation Rates – The life cycle cost model uses two inflation factors. The first affects the increasing cost of parts in aviation and the second is more general and is applied to such categories as fuel and labor. The assumed annual inflation factors affecting parts is 3.5 percent and the general inflation rate is 2.5 percent.

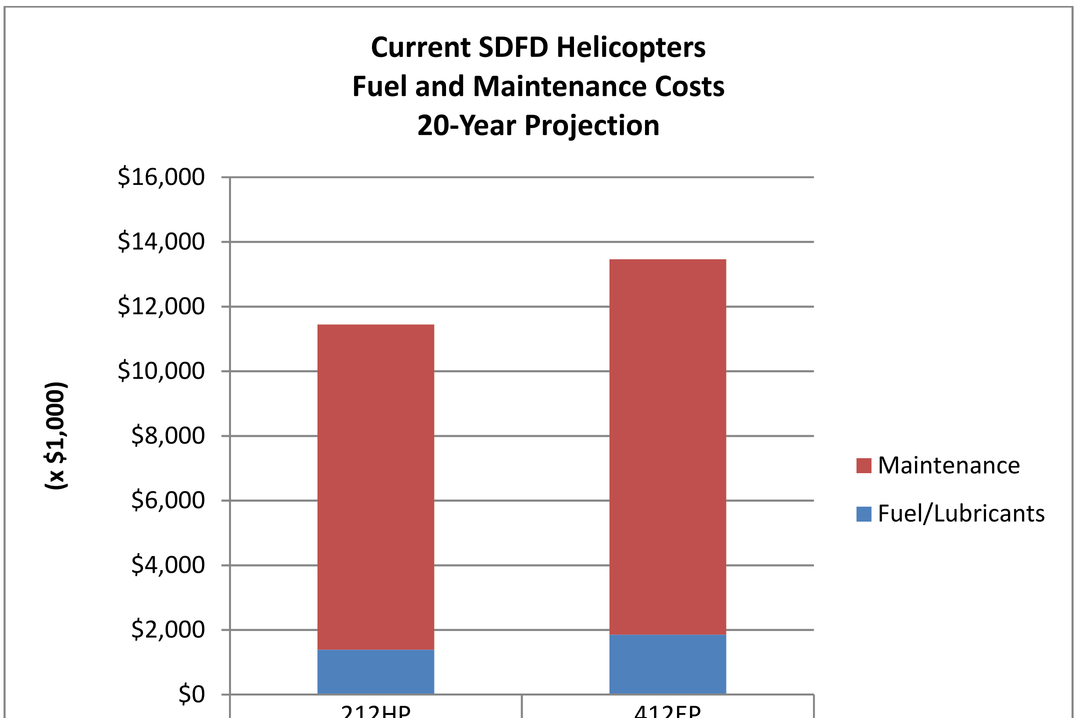
This portion of the report contains a combination of tables and charts summarizing the information generated by the life cycle cost software. The information provided for each helicopter consists of

- A summary table showing the maintenance and fuel costs for the 20-year estimate.
- A line chart showing the estimated annual maintenance costs for the 20-year period.
- A table highlighting the significant maintenance events occurring in specific years.
- A line chart displaying the estimated annual residual value based on the aircraft’s age and status of significant maintenance events for the 20-year period.

We have provided an explanation for each chart and its significance for the SDFD helicopter serial number 31147, registration number N800DM. To avoid redundancy with the explanations, we did not repeat them for each helicopter. We provided only the tables and charts for the Bell 412EP. However, and for both helicopters, we have identified when the City might consider disposing of each helicopter based upon their respective estimated residual values. Our suggestion for disposition in this section of the report considers each helicopter individually and does represent the fleet plan as there will be other factors that may affect the fleet plan.

Chart 2-23 summarizes the projected fuel and maintenance costs for each of the SDFD helicopters over a 20-year period. The current Bell 212HP and 412EP are very similar in size and performance, yet during the 20-year projection, the 412EP will encounter higher costs, approximately $13.4 million compared to $11.4 million for the 212HP. That difference equals about $100,000 per year.

Chart 2-23



	212HP	412EP
Maintenance	$10,054	$11,612
Fuel/Lubricants	$1,389	$1,852

<u>Helicopter: Bell 212HP</u>

<u>Serial Number: 31147</u>

<u>Registration Number: N800DM</u>

Table 2-16 summarizes the estimated fuel and airframe and engine maintenance costs over a 20-year period. The estimate was based upon Conklin & de Decker's *Life Cycle Cost 16.2* software while using relevant SDFD department information (e.g. remaining lives on scheduled components and items). The 20-year estimated costs for this helicopter is $11.4 million with 12 percent of the costs associated with fuel and lubricants, 80 percent with airframe maintenance, and eight percent with engine restoral.

The 20-year total of $11.4 million is less than one of the ABLE AS350B3 helicopters (approximately $13.0M), which might seem incorrect given the Bell 212HP is a twin-engine medium helicopter. The AS350B3 is a light single-engine helicopter. The primary factor causing the unexpected results is the annual flight hours. The AS350B3 helicopters had 900 hours per year, while the Bell 212HP had 220.

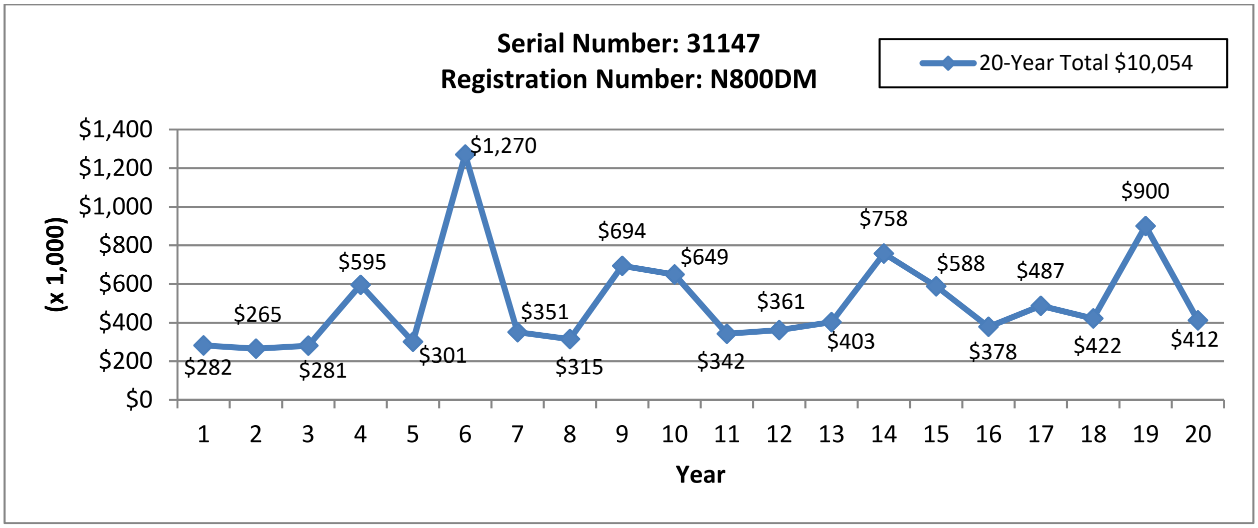
Table 2-16		
20-Year Projection - N800DM		
Fuel	$1,348,758	12%
Lubricants	$40,463	0%
Subtotal	$1,389,221	12%
Airframe Maintenance		
Labor	$4,687,445	41%
Parts	$877,796	8%
Inspections	$2,423,203	21%
Component Overhaul	$402,942	4%
Life Limited Items	$721,439	6%
Subtotal	$9,112,825	80%
Engine Maintenance		
Engine Restoral	$941,332	8%
Total	$11,443,377	100%

Chart 2-24 displays the estimated annual maintenance (fuel not included) costs during the 20-year period. Due to the nature of helicopter maintenance requirements certain significant costs will occur at scheduled intervals. For example in year 6, helicopter N800DM will encounter its highest maintenance costs. Seventy-four percent of the $1,270,000 is related to scheduled maintenance for an engine and combining gearbox overhaul. (This detail is provided in Table 2-17.)

To use this helicopter as an example, Year 5 would not be the ideal time to dispose of the aircraft. Generally, upcoming significant maintenance due in Year 6 will subtract substantially from the resale value of the helicopter. Ideally, disposing of an aircraft should occur two or three years from significant maintenance events. Chart 2-25 supports this statement.

Also, it is important to remember one of the assumptions underlying the 20-year estimate; it is based on 220 flight hours per year. If the actual accumulation of flight hours differs from the projection, then the year in which the significant maintenance costs occur could change.

Chart 2-24



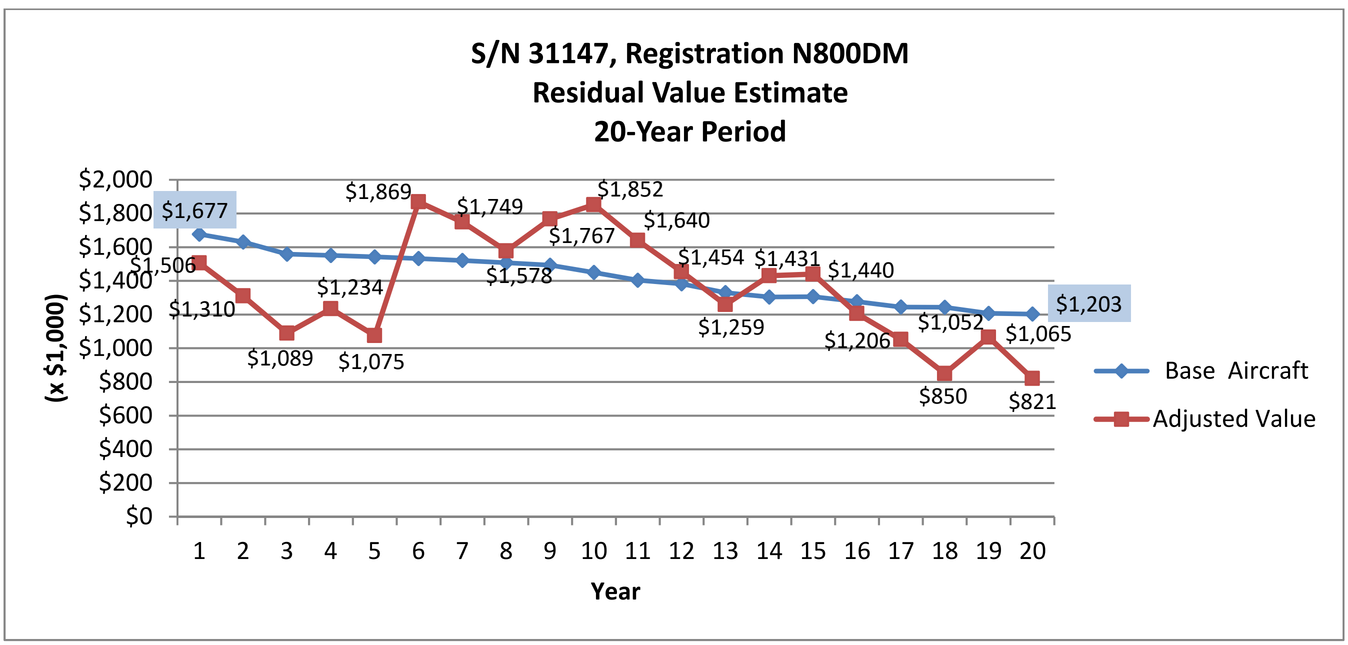
The information in Table 2-17 supplements Chart 2-24. The table highlights the more significant maintenance categories that are driving the costs in the peak years. For example in Year 4, the Bell 212HP will need its 3000-Hour/5-Year inspection. The inspection is estimated to cost almost $360,000, which is 60 percent of the maintenance costs for the year. Other years with significant scheduled maintenance are 6, 9, 10, 14 and 15.

Table 2-17						
Summary of Annual Significant Scheduled Events – N800DM						
Year	**Category**	**Significant Maintenance**	**Estimated Cost (x1,000)**	**Significant Maint. Subtotal (x1,000)**	**Annual Maint. Total (x1,000)**	**Significant Maint. / Annual Total (%)**
4	Inspections	3000-Hr/5-Year	$357	$357	$595	60%
6	Engine Restoration	Engine and C'Box Overhaul	$941	$941	$1,270	74%
9	Component Overhaul	Several Items	$404	$404	$694	58%
10	Airframe Life Limited	Several Items	$291	$291	$649	45%
14	Inspections	3000-Hr/5-Year	$444	$444	$758	59%
15	Airframe Life Limited	Several Items	$101			
	Component Overhaul	Several Items	$125	$226	$588	38%

Chart 2-25 offers another perspective for serial number 31147, the estimated residual value. The chart actually shows two perspectives for the residual value. The first perspective (Base Aircraft, blue line) involves the steady declining value of the helicopter as it ages in years. In this life cycle cost estimate, serial number 31147 begins as a 36-year old aircraft, manufactured in 1980. After 20 years this helicopter at 56 years old will have an estimated market value of $1.2 million. The average annual 1.5 percent rate of depreciation during the 20-year period is a general rate in the life cycle cost tool that would apply to all Bell 212 helicopters with the same year of manufacture.

The second line (Adjusted Value, red line) in Chart 2-25 reflects the estimated residual value based upon the status of the helicopter's significant scheduled maintenance events (e.g. component overhauls, life-limited items, engine restoration, major inspections). Due to the high costs associated with these maintenance events such as a transmission overhaul, main rotor blade retirement, engine overhaul, and/or long duration inspections, a helicopter's market value will be increased or decreased depending upon how much time remains before the occurrence of the event. And because the various maintenance events occur during different times in the helicopter's life cycle, the market value is affected differently by each significant maintenance event. For example, an engine overhaul that just occurred will add (betterment) to the helicopter's base market value, while a set of blades to be retired in the coming year will decrease the base market value (detriment).

Chart 2-25



If we combine the information in Chart 2-24, which reflects the estimated maintenance costs, with the maintenance details provided in Table 2-17, we'll better understand why Year 6 in Chart 2-25 shows a peak in value ($1,869K) for serial number 31147. In Year 4, the helicopter will incur a 5-year major inspection and then in year 6, both engine and the combining gearbox will require overhauls. Both the inspection and overhauls are significant maintenance events and when completed will increase the Adjusted Value in Year 6. Year 6 also represents the highest estimated Adjusted Value in the 20-year period. However, Year 10 also has a high Adjusted Value at $1.852 million.

Based on the relationship between the Base and Adjusted Value lines, the recommended period to dispose of serial number 31147 is between years 6 and 13. This is the period when the Adjusted Value is higher than the Base Aircraft line. During this period, serial number 31147 will be between 42 and 49 years old.

If the current used helicopter market improves, another period of years to consider for disposition is Years 1 through 3. The reason for this suggestion is the amount of money the City will pay for significant maintenance events in years 4 and 6, approximately $1.3 million. The gain in value of the helicopter in Year 6 will only be an estimated $0.8 million (difference between $1.9 million in Year 6 and 1.1 million in Year 3).

A more complete explanation about the current market is provided in Section 3 Aircraft Acquisition and Timing.) The Base Aircraft values displayed in Chart 2-25 are based upon long-term depreciation values and do not necessarily reflect current market values.

Helicopter: Bell 412EP

Serial Number: 36466

Registration Number: N807JS

Table 2-18		
20-Year Projection - N807JS		
Fuel	$1,797,833	13%
Lubricants	$53,935	0%
Subtotal	$1,851,768	14%
Airframe Maintenance		
Labor	$4,687,445	35%
Parts	$1,894,269	14%
Inspections	$2,220,505	16%
Component Overhaul	$908,289	7%
Life Limited Items	$543,999	4%
Subtotal	$10,254,507	76%
Engine Maintenance		
Engine Restoral	$1,357,784	10%
Total	$13,464,059	100%

Chart 2-26

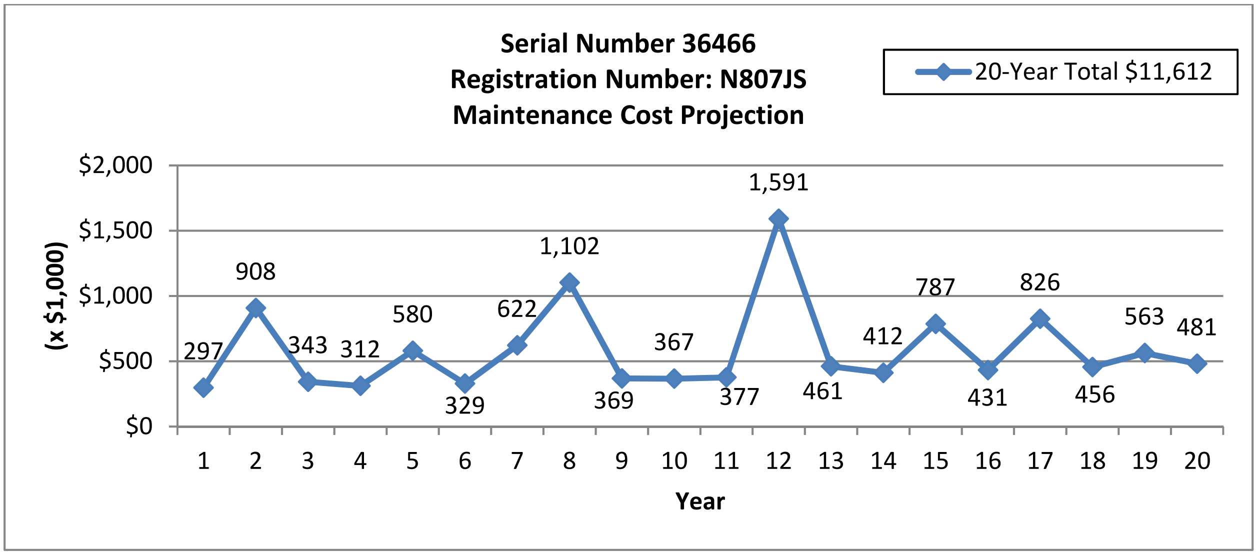
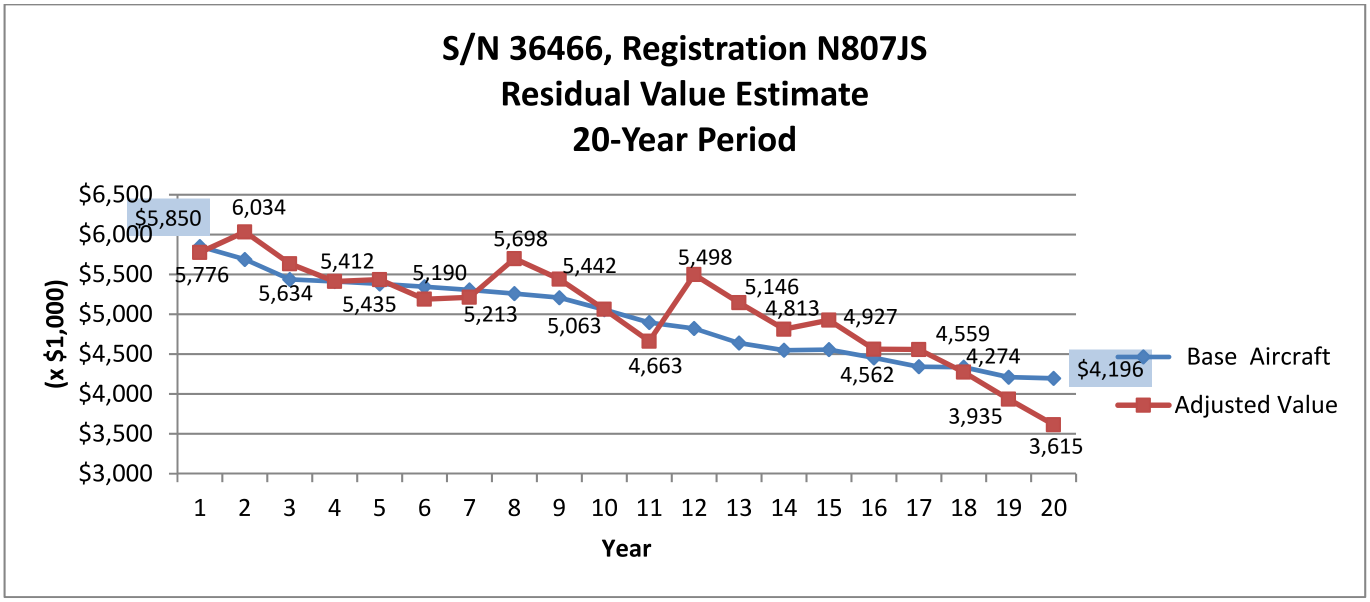


Table 2-19						
Summary of Annual Significant Scheduled Events – N807JS						
Year	**Category**	**Significant Maintenance**	**Estimated Cost (x1,000)**	**Significant Maint. Subtotal (x1,000)**	**Annual Maint. Total (x1,000)**	**Significant Maint. / Annual Total (%)**
2	Inspections	5000-Hr/5-Year	$289			
	Engine Restoration	C'Box Overhaul	$264			
	Component Overhaul	Several Items	$95	$648	$908	71%
8	Engine Restoration	Overhaul	$755	$755	$1,102	69%
12	Engine Restoration	C'Box Overhaul	$339			
	Airframe Life Limited	Several Items	$423			
	Component Overhaul	Several Items	$121			
	Inspections	5000-Hr/5-Year	$370	$1,253	$1,591	79%
15	Component Overhaul	Several Items	$343			

	Airframe Life Limited	Several Items	$24	$394	$787	50%
17	Inspections	5000-Hr/5-Year	$482	$482	$826	58%

Chart 2-27



The values for the Base Aircraft and Adjusted Values follow each other closely during the 20-year period with the exception of the last two years. This two-year trend reflects approaching significant scheduled maintenance. Also at this point in the life cycle, the Bell 412EP will be 27 years old. SDFD would want to avoid this period for disposing of the helicopter.

During the life cycle, Years 8 and 12, the Bell 412EP incurs significant maintenance events, which increases the Adjusted Value of the helicopter. In essence, the value of the helicopter's significant maintenance events is greater than the helicopter when the maintenance events are at the 50 percent level of remaining time. In Year 8, both engines and the combining gearbox are overhauled. In Year 12, several events occur including retirement of life limited items, overhaul of components, performance of a major inspection and overhaul of the combining gearbox.

While these two years represent the peak in the Adjusted Value, there are several years when SDFD could dispose of the aircraft based upon its estimated value. Years 5 through 10 are one period and Years 12 through 18 are another.

2.3.2.2 Candidate Helicopters

The purpose of this section is to apply the same life cycle cost analysis to the candidate helicopters that was used for the current SDFD helicopters. The candidate helicopters were introduced in Section 1, Fleet Review and include the Airbus H215 and the Sikorsky S-70i. For the candidate helicopters, we used the life cycle cost software and based it on the same assumptions as described on Pages 29-30, except for the following items.

- Hours per Year – As mentioned, the recent average annual hourly usage by SDFD, has been 220 flight hours for the Bell 212HP and 255 for the Bell 412EP. For the candidate helicopters, we used 250 annual flight hours.
- Fuel Consumption - The candidate helicopters consume significantly more fuel than the current helicopters. The values used were 160 gallons per hour for the Airbus H215 and 162 gallons for the Sikorsky S-70i. Both rates of consumption were the default values in the Life Cycle Cost software.
- Labor – Due to the increased size and performance of the candidate helicopters when compared to the current helicopters, we doubled the number maintenance employees per helicopter from one to two. The costs for this increase are reflected in each of the following categories.
    - Maintenance Technician –Each employee costs the City approximately $121,000 annually. Two technician's salaries, ($242,000) were assigned to each of the candidate helicopters.
    - Other – This category covers the estimated overtime that is budgeted annually. The total annual overtime estimate of $100,000 was applied to each candidate helicopter.
    - Training – The current estimated annual training budget for two maintenance technicians is $25,000. This covers annual training with the airframe and engine manufacturers. $25,000 was assigned to each of the candidate helicopters.

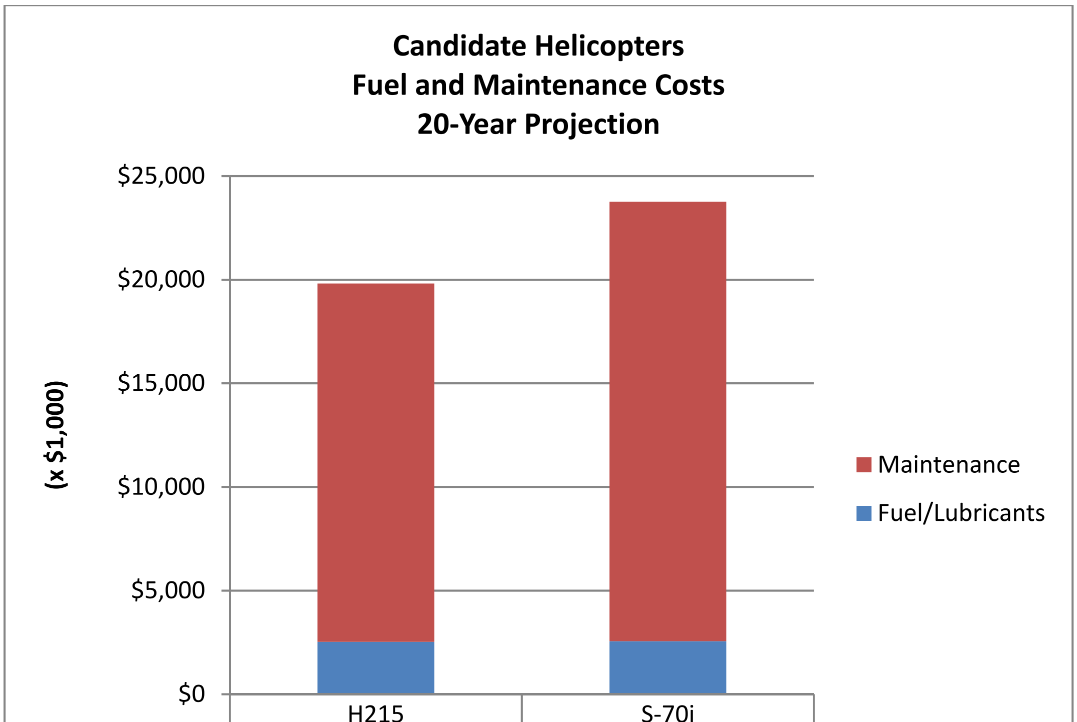
The information provided for each candidate helicopter is the same as the current SDFD helicopters with the exception of one table, which identified the significant scheduled maintenance categories by year. The table and charts provided are

- A summary table showing the maintenance and fuel costs for the 20-year estimate.
- A line chart showing the estimated annual maintenance costs for the 20-year period.
- A line chart displaying the estimated annual residual value based on the aircraft's age and status of significant maintenance events for the 20-year period.

Because the table and charts convey the same type of information that was shown for the current Bell 212HP and 412EP, we did not restate the explanation and meaning as was provided for the Bell 212HP.

Chart 2-28 summarizes the projected fuel and maintenance costs for the Airbus H215 and Sikorsky S-70i over a 20-year period. The Airbus H215 actually represents both the long and short airframe versions. In Section 1 Fleet Review, we showed the versions separately due to their difference in size and performance. For operating costs, we combine the versions in our products. Based on our assumptions, we estimate the H215 to cost almost $20 million dollars to operate new aircraft during the 20-year period. The Sikorsky S-70i is estimated to cost $23.8 million.

Chart 2-28



	H215	S-70i
Maintenance	$17,290	$21,208
Fuel/Lubricants	$2,526	$2,557

Airbus Helicopters

H215

Table 2-20		
20-Year Projection - H215		
Fuel	$2,452,287	12%
Lubricants	$73,569	0%
Subtotal	$2,525,856	13%
Airframe Maintenance		
Labor	$9,374,889	47%
Parts	$2,755,108	14%
Inspections	$2,128,023	11%
Component Overhaul	$1,198,012	6%
Life Limited Items	$86,407	0%
Subtotal	$15,542,440	78%
Engine Maintenance		
Engine Restoral	$1,747,727	9%
Total	$19,816,023	100%

Chart 2-29

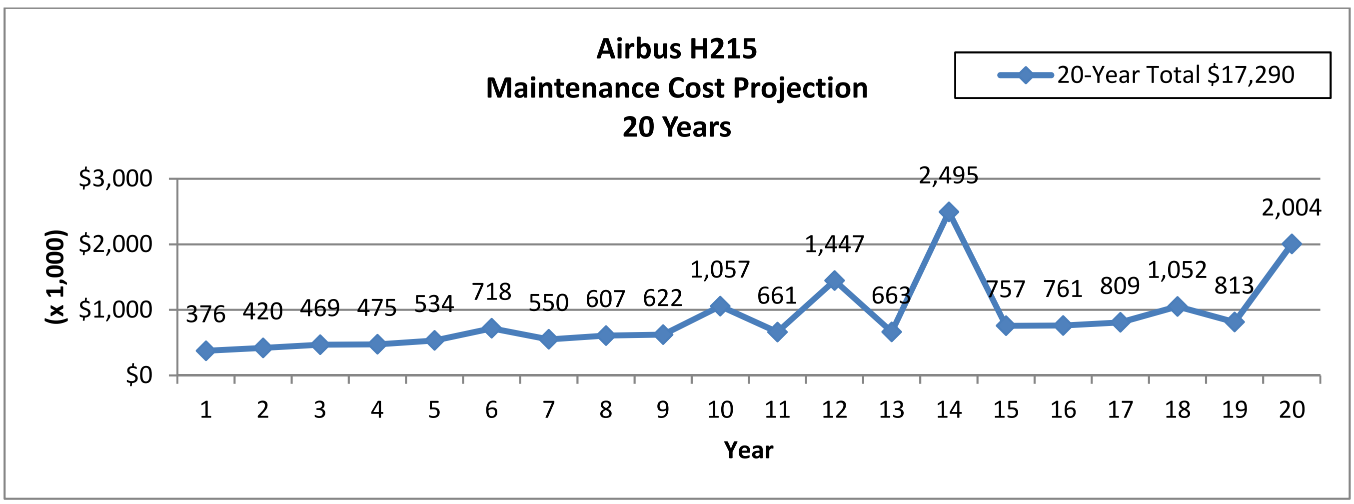
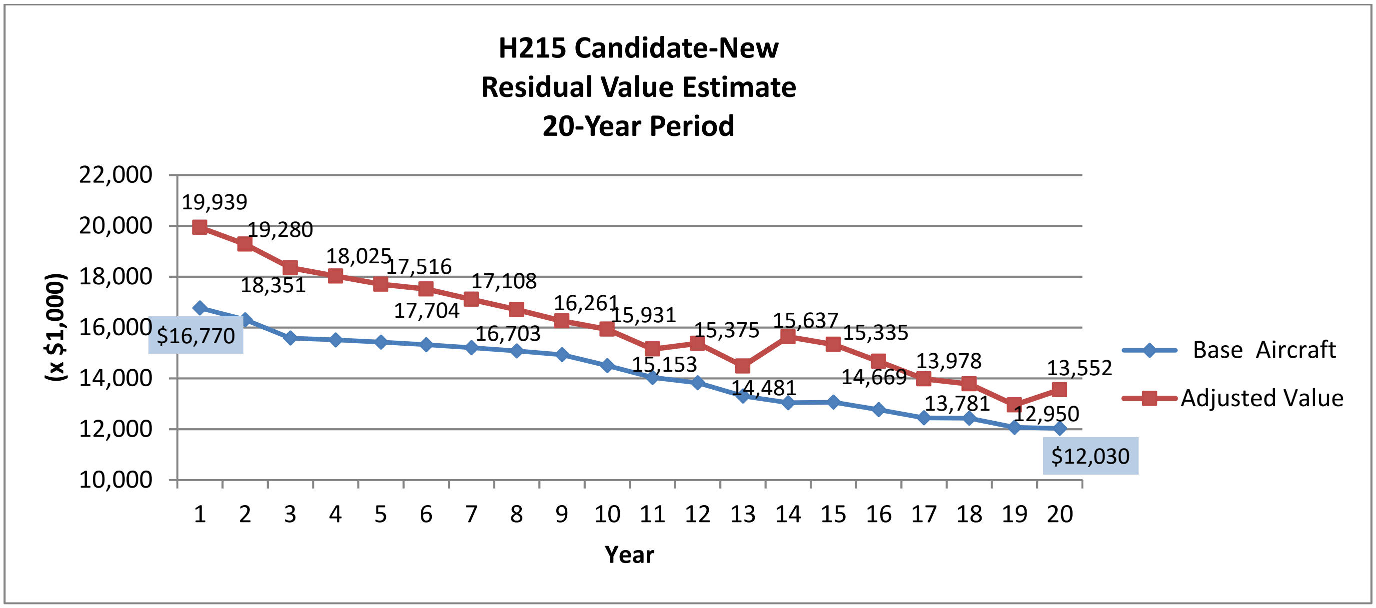


Chart 2-30



Sikorsky Helicopters
S-70i

Table 2-21		
20-Year Projection - S-70i		
Fuel	$2,482,941	10%
Lubricants	$74,488	0%
Subtotal	$2,557,429	11%
Airframe Maintenance		
Labor	$9,374,889	39%
Parts	$3,874,374	16%
Inspections	$2,458,674	10%
Component Overhaul	$532,075	2%
Life Limited Items	$555,499	2%
Subtotal	$16,795,512	71%
Engine Maintenance		
Engine Restoral	$4,412,915	19%
Total	$23,765,855	100%

Chart 2-31

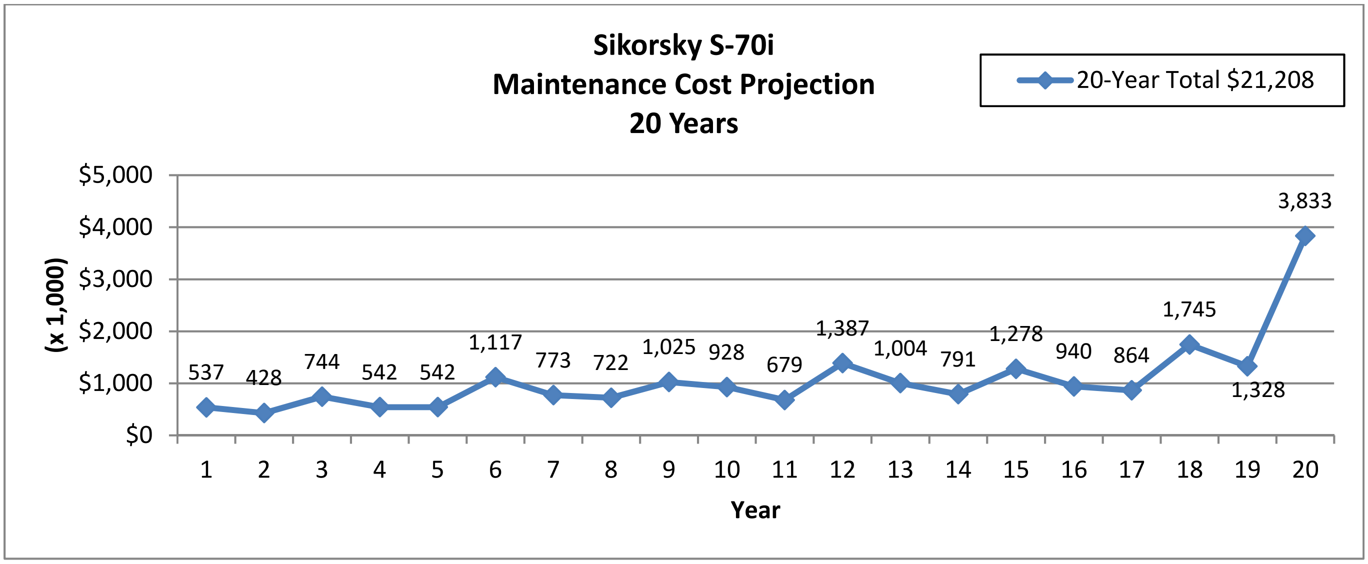
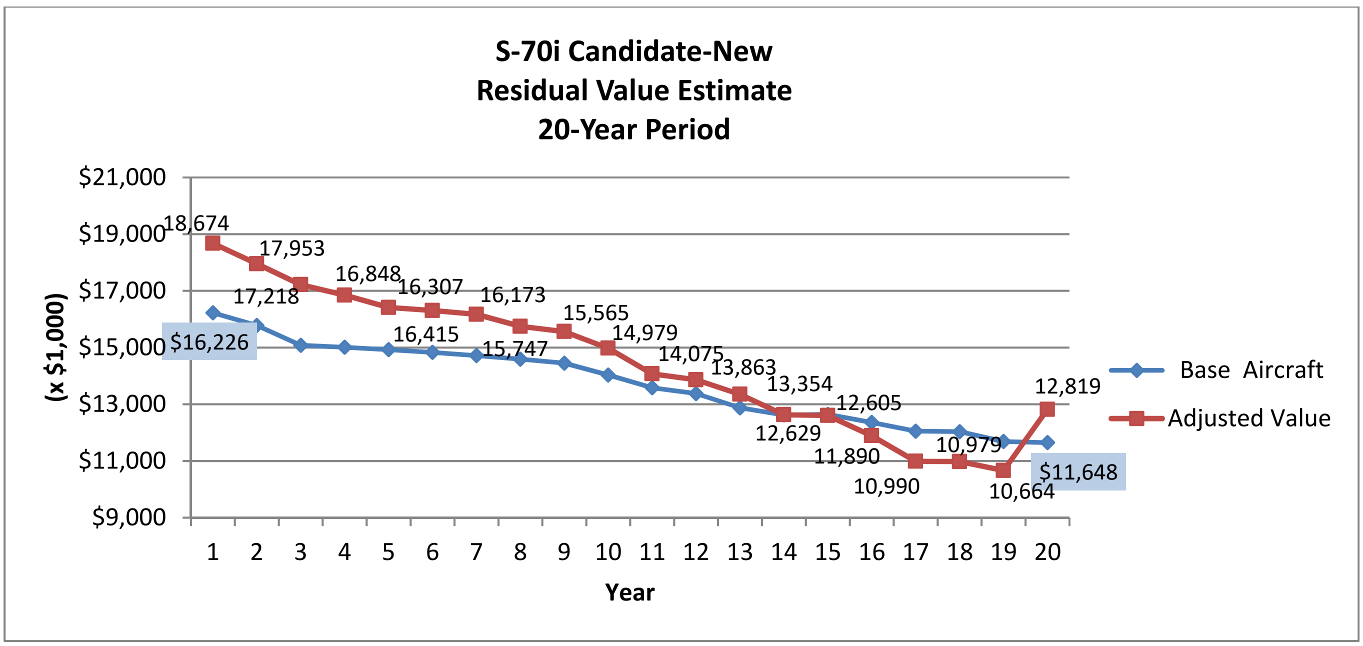


Chart 2-32



Section 3 – Market Conditions

3.0 City of San Diego Original Request

Thoroughly research the resale value of the current fleet and explore the primary and secondary markets for helicopters to determine the feasibility of replacement within specified timeframes; such as lead times in acquiring helicopters and expected duration in selling the current fleet.

3.1 Conklin & de Decker Approach

Based on the city's original request, we divided our approach into two primary parts. 1) Researched recent sales activity in the aviation industry with a focus on helicopters to estimate the expected resale values for the existing fleets of the police and fire departments. 2) Based on the industry's current level of activity, estimated the timeframe to

- Acquire new or replacement helicopters,
- Configure the acquired helicopters for their respective missions for the departments, and
- Dispose of or sell the current fleet of the respective departments.

Unlike Section 1 Fleet Review and Section 2 Cost Projections, we did not break the analysis for each department into separate sections. Section 3 consists of 3.3.1 the status of the current aviation market with subsections discussing current aviation market conditions, current market values, and estimated market values for the current helicopters in the police and fire-rescue departments. Section 3.3.2 summarizes the elements associated with acquiring and completing new helicopters and disposing of the current helicopters.

3.2 Summary

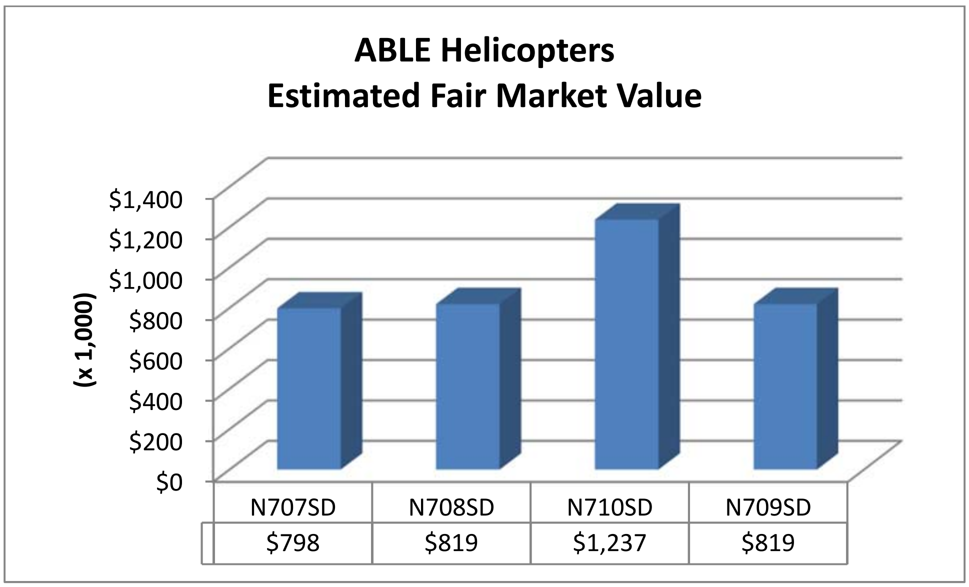
On average helicopters hold their value quite well. Conklin & de Decker estimates that in general, helicopters depreciate in value about five percent annually when compared to the cost to replace the same type of helicopter.

Many variables will cause an individual helicopter to deviate from the average, including the remaining time on items or events that are considered to have significant scheduled maintenance, the popularity of the helicopter type (e.g. number produced), the production status (i.e. in or out of production), and the configuration of the helicopter (i.e. special or common mission). However, one factor has more influence on a helicopter's short-term value than any other, the state of the economy. And unfortunately, the helicopter industry has been in a slow economy since 2014.

According to a Helicopter Association International (HAI) monthly market newsletter, new helicopter deliveries in the US attained their peak in 2013 with 342 units. In 2014, the deliveries dropped almost 35 percent and have continued to drop through 2016. Between 2013 and 2016, the decline in deliveries was 54 percent or down to approximately 160 units. Used helicopter deliveries have also experienced a 25 percent decline between 2014 and 2016. Three industry sources indicate that during this period, the amount of inventory for pre-owned helicopters has increased while the number of new deliveries has declined.

ABLE Fleet - As expected, the decline in helicopter deliveries has caused a decline in helicopter values. Chart 3-1 reflects the estimated value for the ABLE helicopters based on an industry. resource, HeliValue$.

Chart 3-1



The report reflects general economic conditions and also highlights the effects on helicopter values that are based on the remaining lives of significant scheduled maintenance events and items. There are two additional important factors to consider regarding the value of the current fleet.

First, an accompanying footnote by HeliValue$ mentions an additional eight percent downward trend for the period June 2015 to June 2016, which supports the IBA report estimates presented in Chart 3-5. The footnote also predicts that the stagnate selling condition will continue at least through the next year and that helicopters are remaining on the market for more than 365 days even with the declining prices.

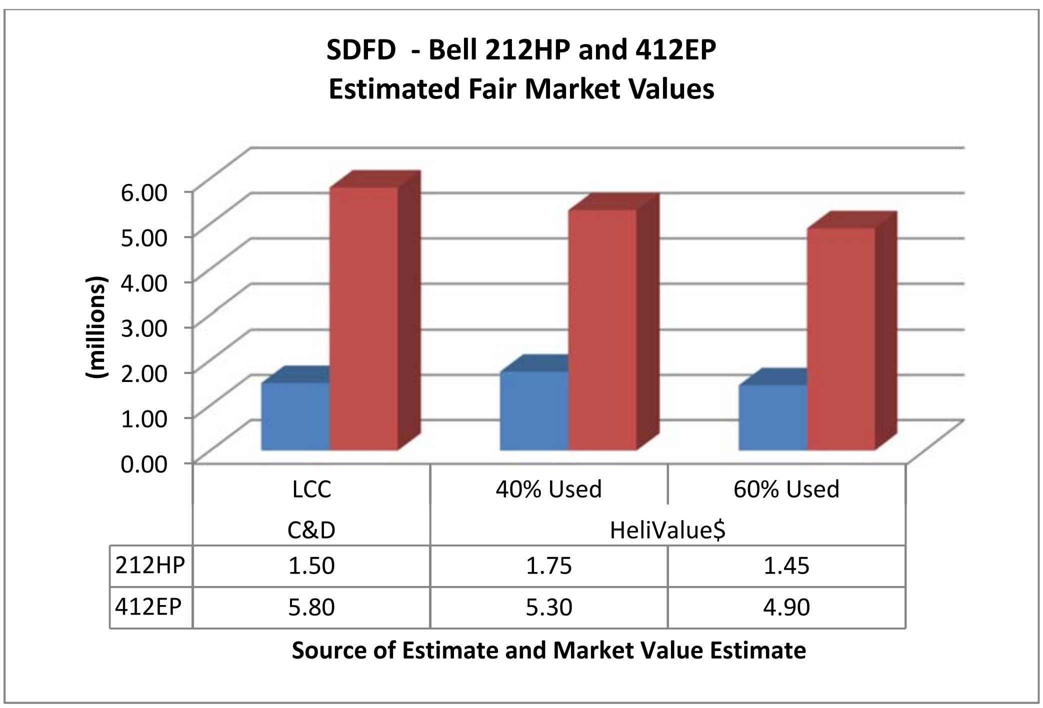
Second, in an interview with Helicopter Exchange, a company specializing in helicopter acquisitions, sales, leasing, marketing, and evaluation services, supported the HeliValue$ footnote. To paraphrase the interview: it is a tough market to sell any helicopters, especially helicopters with a law enforcement configuration because it’s difficult to find someone that is willing to reconfigure them. This situation would take the selling value well below $1 million dollars. Trade-in with the manufacturer would probably be lower, closer to $650,000.

SDFD Fleet – For the fire department, we used a slightly different approach by using three sources to estimate the market value of the Bell 212 and 412EP. The first source was Conklin & de Decker's *Life Cycle Cost 16.2* software which estimates the market value for the specific SDFD helicopters based upon the remaining times associated with overhaul components, engines, life-limited items and significant scheduled maintenance events. This valuation method is very similar to the one used by HeliValue$, which was the second source for estimating the helicopters' respective values. The third source, AMSTAT, summarizes asking prices for the Bell helicopters.

Chart 3-2 summarizes the range of current estimated market values for the Bell 212 and 412EP from the first two sources. The AMSTAT information was not included in this chart due to its inflationary effect on estimated aircraft values.

Helicopter Exchange reemphasized that estimated helicopter values are only applicable if there are available buyers. And as of the end of 2016, the lack of buyers at the current estimated values indicates the actual value is somewhere lower than the values reflected in Chart 3-2.

Chart 3-2



Other elements are also important in the acquisition process.

- With the exception of the Leonardo AW119Kx, which had a 10-month backlog, each of the candidate helicopters was available for immediate delivery.

- The estimated time to complete the helicopters for their intended missions was three months for the law enforcement configuration and four to six months for the firefighting and rescue configuration.
- Leonardo and Airbus would take the current helicopters on trade-in. Bell Helicopter and Sikorsky would prefer not taking a trade-in with the competitors' aircraft.
- If sold rather than traded in, the estimated time to do so is difficult to estimate due to the current slow resale market for used helicopters. Currently desired prices do not match perceived value, a key variable in extending the sales timeline.

3.3 Conklin & de Decker Analysis

3.3.1 Current Aviation Market

Generally, over a long period of time, general aviation aircraft have held their values quite well, well enough that until recent years, owners began to view their aircraft as investments rather than just working assets. General aviation is a large group of aircraft types that can be best described as what it is not. It is not scheduled passenger airline service. Therefore, general aviation includes fixed-wing aircraft -- jets, turboprops, pistons -- as well as helicopters.

Since it is such a large group of aircraft types, it should be recognized that any general statement about values will have its exceptions. With that said and as one source, Conklin & de Decker historically has estimated that depreciation based on aircraft replacement cost is

- Four percent per year for business jets,
- Five percent for helicopters,
- Six percent for turboprops, and
- Six percent for pistons.

Many factors may or will cause types of aircraft or individual aircraft within a type to have their actual depreciation rate or market value deviate from an average. Those factors could include the

- Number of the aircraft type produced,
- Production status of the aircraft type,
- Support network for the aircraft,
- Mission relevance of the aircraft type,
- Age of an aircraft as expressed in years or hours,
- Maintenance status (e.g. remaining lives on significant components, parts, and inspections),
- Configuration of the aircraft. (e.g. unique configuration for special mission),
- Mission profile (e.g. heavy loads),
- Type of environment (e.g. sand, salt laden),
- Development of technology (e.g. avionics), and

- Regulations.

However, one factor has more influence on aircraft values than those just mentioned: the economy. The general aviation industry as well as many other industries recently experienced and continue to experience what a slow economy can do to all aspects of an industry including the market values of aircraft. So while a general depreciation rate representing a long period of time may convey stability, it is important to recognize that in short timeframes actual depreciation rates, as reflected by market values, is more like a roller coaster with many up and downs.

Current Market Conditions - Simply said, current market values for general aviation aircraft are low when compared to historical averages. Starting with the Great Recession that began in 2007/2008, the negative effects on aircraft values were felt in the fixed-wing (jets, turboprops, pistons) aircraft more quickly than helicopters. However, the economy caught up with helicopters in 2014 when oil prices decreased significantly. The helicopter industry, despite the diverse types of industries it serves, is still heavily influenced by what happens in the oil industry. Its largest operators serve that industry.

Two examples illustrate the effects that the current slow economy has had on jet sale activities.

- Deliveries of fixed wing aircraft peaked in 2008 at 4,276, then dropped to a low of 2,000 in 2010, and have only recovered to 2,331 aircraft in 2015. This was a drop in deliveries of 45 percent between 2008 and 2015.
- The inventory of pre-owned jets for sale increased from approximately 1,600 in 2007 (pre-recession) to almost 2,900 in 2009, the year after the onset of the recession. Pre-owned jet inventory increased over 80 percent in a two-year period. In 2016, the inventory level of 2,400 is still above the 2007 level.

Compounding the effect of the high number of jets available for sale, both pre-owned and new, are the more stringent lending regulations placed on banks, historically the most common lender, since 2008. In essence, the regulations have caused a reduction in the number of lenders and tightened the requirements for those seeking financing.

What has been the effect on jet resale values given the higher levels of available aircraft inventory, a reduction of credit from lenders, and fewer candidates to purchase aircraft? James Simpson of First Republic Bank observes the following, “We now believe that long-range aircraft…have an economic depreciation of roughly one percent per month or 12 percent annually.” Supporting Mr. Simpson’s view is that of a broker that we interviewed on the subject of resale values. The individual was representing a 2015 long-range jet with less than 200 flight hours. The asking price for the one-year old aircraft was 50 percent of the new price. In the current market, he did not believe they would receive the asking price.

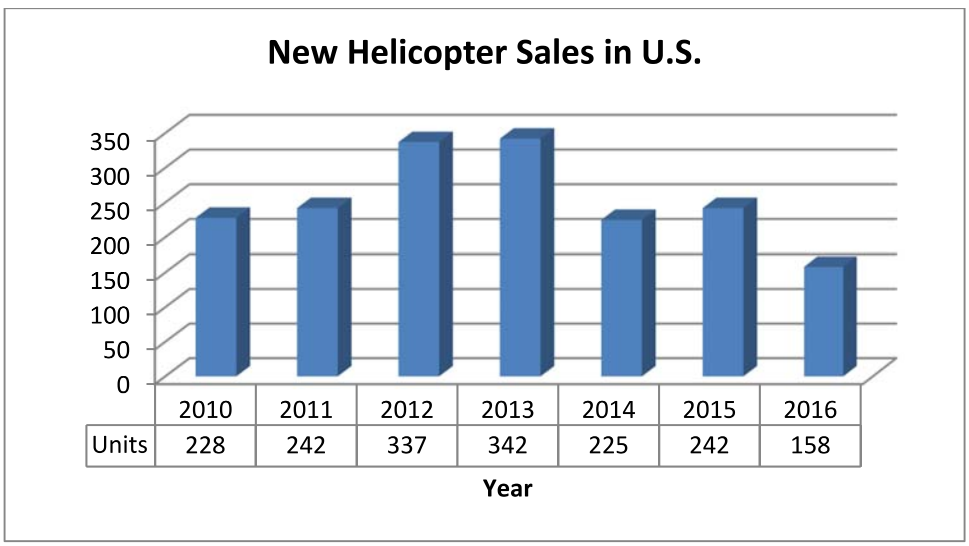
If we compare either the 12 percent or 50 percent rate decline with the more general, long-term Conklin & de Decker estimated depreciation rate of four percent, it becomes obvious the resale value of jets is in one of the down periods of the roller coaster ride.

How does the helicopter market compare to the jet market and its resale values? As mentioned previously, the helicopter market initially was not affected as quickly as the fixed-wing market, but within the last two years, that has changed. Market values have experienced a downturn when compared to the Conklin & de Decker average.

Sharon Desfor, President of HeliValue$, Inc., in the Jan/Feb publication of *rotorcraftpro.com*, estimated there was a "glut" of ten to eleven percent of the helicopter fleet available for sale. A normal market would have about six to nine percent. "Light single-turbine helicopters continue to flood the world market. There are over 700 light singles on the market… A third of them are AS350B/H125 series."

Helicopter Association International (HAI) produces a monthly report, Helicopter Market Newsletter, which summarizes the new and pre-owned helicopter transactions in the U.S. Charts 3-3 and 3-4 summarize the new and pre-owned transactions.

Chart 3-3

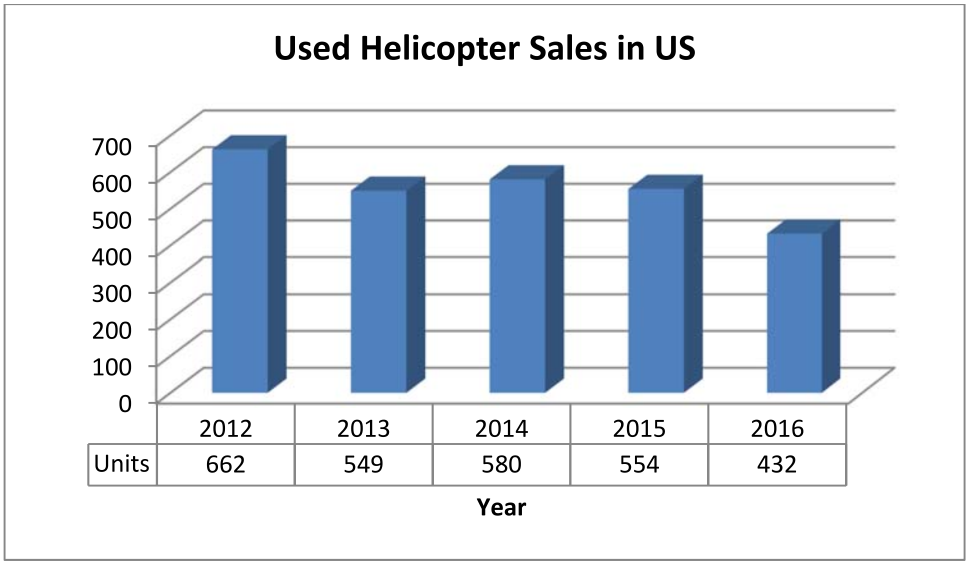


Note:

1) **The 2016 rate is projected based upon 10 months of actual activity. A monthly average for the 10 months served as the basis for the additional two-month projection.**

New helicopter sales attained their peak in 2013 with 342 units sold. In 2014, the deliveries dropped almost 35 percent and have continued to drop through 2016. Between 2013 and 2016, the decline in deliveries was 54 percent.

Chart 3-4



Note:

1) **The 2016 rate is projected based upon 10 months of actual activity. A monthly average for the 10 months served as the basis for the additional two-month projection.**

In its Helicopter Market Update dated January 2016, the IBA Group, a leading industry consultancy group established in 1988, states that total helicopter deliveries, worldwide, in 2015 dropped by 11 percent (718 units) when compared to 2014. The drop was more significant in 2014 with a drop of 21 percent (804 units). The categories most relevant to the City of San Diego, light single-engine and medium twin-engine helicopters, dropped by five and 25 percent respectively.

According to comments from Sharon Desfor and data from the HAI Market Newsletter and IBA Group, the amount of inventory for pre-owned helicopters has increased while the number of new deliveries has declined. Given these dynamics, what is the effect on market values?

Current Market Values - The IBA Group reported in its January 2016 report that market values for light single-engine and medium to heavy helicopters declined when comparing 2014 values to 2015.

Chart 3-5 for light single-engine helicopters summarizes how the market values declined for the current ABLE helicopter type, AS350B3, compared to the candidate helicopters in Section 1 Fleet Review. The type is estimated to have lost nine percent of its value in one year. This is the highest percentage aircraft value decline in the group other than older versions (AS350) of the same helicopter type at 13 percent. The Bell 407 and Airbus H120 declined the least, at one and three percent respectively.

Chart 3-5

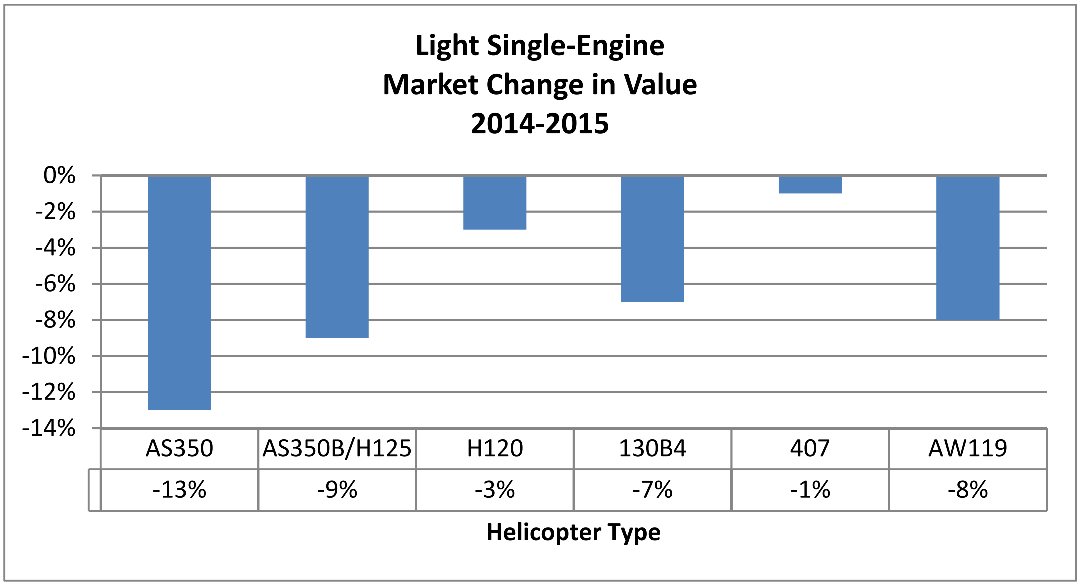
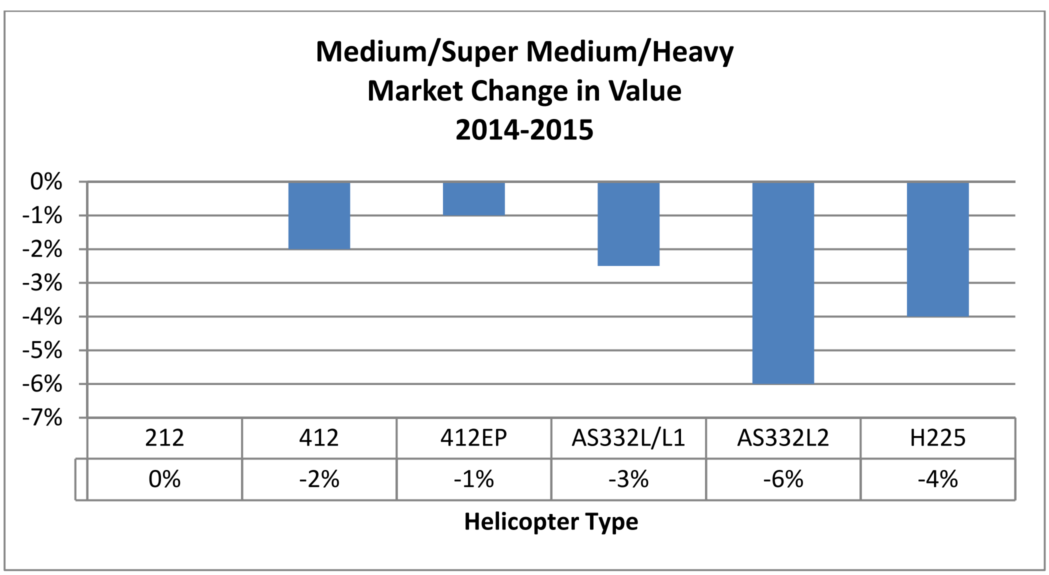


Chart 3-6 displays the same market value information but for a different group, the larger medium and heavy helicopters, which are comparative to the current SDFD helicopters. The Bell 212 type does not show a decline in its value, which is more than likely due to two factors. 1) The aircraft is out of production, which reduces the number of airframes available for purchase and 2) it is still valued by operators for its ability to perform various missions. A limited number in conjunction with usefulness will contribute to a stronger market value. The AS332 series is the prior designation for the candidate H215 helicopter. The H225 is related to the AS332 series but has a larger airframe. While the H225 is a class above the H215 in size, it was included only to serve as another data point for the trend in market values.

Chart 3-6



As a point of information, the H215 and H225 helicopter types are currently involved in a situation that could affect their future market values. An H225 crashed off the coast of Norway in May 2016, which led to a grounding of the fleet by regulatory authorities world-wide. Recently, some but not all authorities lifted the flight ban if operators complied with mandatory bulletins. The intent of mentioning this accident and subsequent corrective action is not to question the safety of these helicopter types. The industry and its operators will determine that. Rather, it is important to mention that, absent a totally accepted solution, there is a factor that could affect the long-term market values, positive or negative, of the H215 and H225. The information in Chart 3-6 does not represent this factor as it was compiled prior to the event.

Also absent from Chart 3-6 is market value information for the Sikorsky S-70 helicopters. Unlike other helicopter types mentioned in the report, the S-70 is the only one designed and developed for the US military. Sikorsky did not build the S-70 according to civil regulatory requirements as established by the Federal Aviation Administration. Therefore its usage has been limited primarily to the US military and some foreign governments. As a result of these circumstances, the S-70 has had very limited use by civil operators, which has led to an unknown market value. Only in the last 15 years has the S-70 or its military designation, the UH-60, become available to entities other than the military in the US. A few operators have acquired surplus UH-60 helicopters and one prominent local agency, Los Angeles County Fire Department, acquired new UH-60 helicopters more than 15 years ago. More recently, the US Army has started to surplus more of the original UH-60A helicopters, which commercial operators are purchasing. Various sources indicate a purchase amount of $500,000 or less. The mission for which the S-70/UH-60 helicopter is known is firefighting. Another important but less-mentioned mission performed by this helicopter is search and rescue.

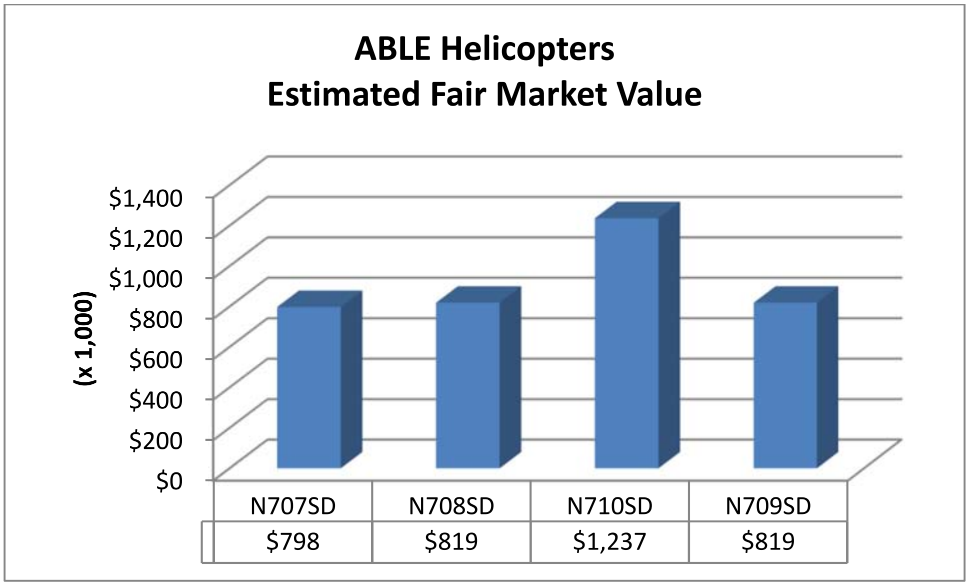
ABLE and SDFD Helicopter Market Values - Given the current market condition in aviation, what is the estimated market value of the current police and fire helicopters?

ABLE - The police department received reports on each of its AS350B3 helicopters from HeliValue$, which is known for its helicopter valuations and has been doing so since 1979. The valuations are based on several factors but the most influential is the remaining lives on significant overhaul components, engines, and life limited items. A helicopter has many expensive components and parts that require scheduled maintenance or retirement. The dollar amounts associated with these components and items are significant enough that, depending upon the time remaining, a helicopter’s fair market value can vary widely.

Also considered in the valuation are conditional events (e.g. significant inspections) and a helicopter’s configuration. Helicopter configuration refers to the equipment or systems on the current helicopter compared to new production helicopters. Older systems and equipment have the potential to reduce the fair market value.

Chart 3-7 summarizes the estimated fair market value for each of the police helicopters. Helicopter N710SD is an illustration of how remaining lives on components and life limited items can affect the estimated value. This helicopter has approximately 80 percent remaining lives while the other three helicopters are around 40 percent, which creates the almost 35 percent differences in their respective estimated values.

Chart 3-7



There are two additional important factors to consider regarding the disposal of the current fleet. First is a comment that accompanies the HeliValue$ reports. A footnote mentions an additional eight percent downward trend for the period June 2015 to June 2016, which supports the IBA report estimates presented in Chart 3-6. The HeliValue$ footnote continues with predictions that the stagnate selling condition will continue at least through the next year (2017) and that helicopters are remaining on the market for more than 365 days even with the declining prices.

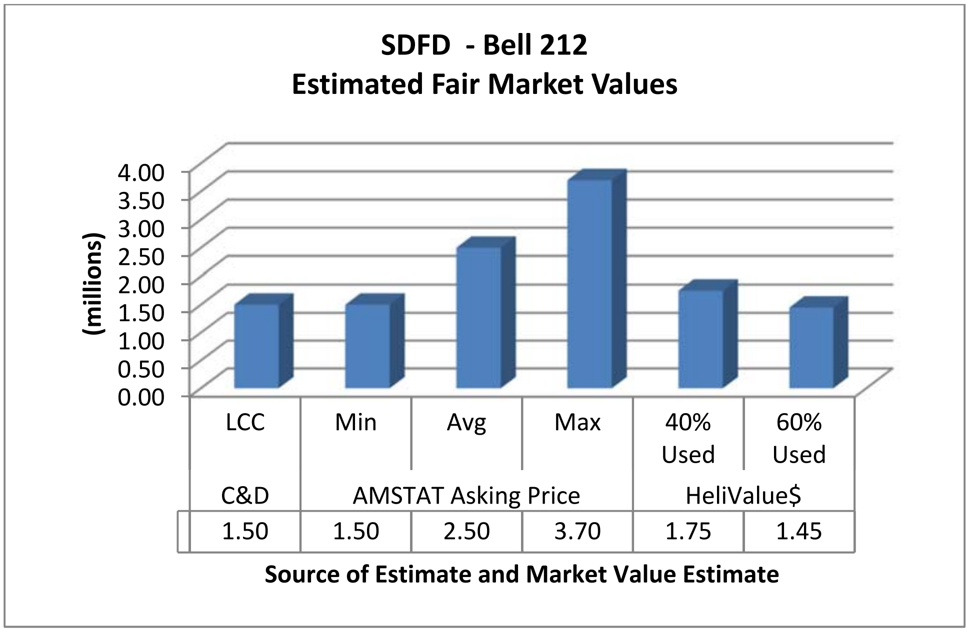
Second was a conversation with Helicopter Exchange, a company specializing in helicopter acquisitions, sales, leasing, marketing, and evaluation services, that supported the HeliValue$ footnote. To paraphrase the conversation: it is a tough market to sell any helicopters, especially helicopters with a law enforcement configuration because it's difficult to find someone that is willing to reconfigure them. This situation would take the selling value well below $1 million dollars. Trade-in with the manufacturer would probably be lower, closer to $650,000.

SDFD – For the fire department, we used a slightly different approach by using three sources to estimate the market value of the Bell 212 and 412EP. The first source was Conklin & de Decker's *Life Cycle Cost 16.2* software which estimates the market value for the specific fire helicopters based upon the remaining times associated with overhaul components, engines, life-limited items and significant scheduled maintenance events. This valuation method is very similar to the one used by

HeliValue$, which was the second source for estimating the helicopters' respective values. The third source, AMSTAT was started in 1982 and provides market information on the worldwide fleet of business aviation aircraft, which includes turbine helicopters. The company bases its estimates on what the seller is asking for the aircraft. Asking price generally is higher than the eventual selling price. This is especially true in today's pre-owned market.

Charts 3-8 and 3-9 summarize the range of current estimated market values for the Bell 212 and 412EP from the three sources.

Chart 3-8

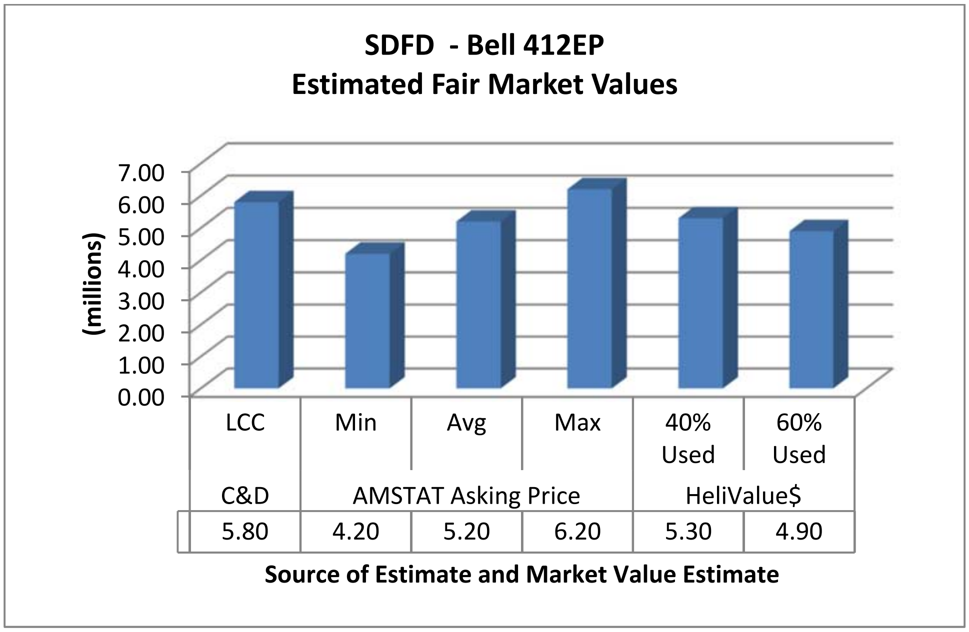


Notes:

- **LCC: Conklin & de Decker's *Life Cycle Cost 16.2* software. This information is based upon the current status of the SDFD Bell 212 helicopter. This estimated value will change based on the changing status of its significant maintenance items and events.**
- **AMSTAT Asking Price: AMSTAT publishes a range of estimates for each helicopter type, a minimum, average, and maximum. The range of estimates is a summary of the current Bell 212 helicopters listed for sale. It is not focused on any single helicopter as is the *Life Cycle Cost* estimate.**
- **HeliValue$ - The basis for the HeliValue$ estimates are similar to the basis for the Conklin & de Decker estimates. It is a basis that recognizes the important influence of remaining time associated with significant maintenance items and events and their influence on the value of the helicopter type. 40% and 60% Used represents the overall or average of the remaining times. Individual items and events could differ from the average.**

Chart 3-9, which summarizes the Bell 412EP market values, is very similar to the Bell 212. The AMSTAT estimates are higher than C&D and HeliValue$. However, the difference between the C&D estimate and the selected HeliValue$ percentages is larger. The $5.8 million market value reflected by the C&D estimate indicates a low-time helicopter with corresponding low-time significant maintenance events and items. The SDFD Bell 412EP has only 2,000 total hours as of August 2016. Estimated to fly slightly more than 250 hours per year, the aircraft won't encounter many of its significant maintenance costs until mid to latter years in the 20-year estimate. If we had assumed 20 percent usage using HeliValue$, the market value would have been around $5.7 million, which is similar to the C&D estimate.

Chart 3-9



Notes:

Similar approach as was used for the Bell 212.

3.3.2 Helicopter Acquisition, Completion, Disposition

Estimating the resale value of the current fleet is an important variable to understand. However, there are other elements of the sales transaction that are important. If the City chooses to acquire new helicopters, how quickly can the chosen manufacturer deliver the helicopter? If new helicopters are acquired, will the manufacturer accept as trade-in the current helicopters? With a new helicopter, how long does the completion process take to prepare it for its intended mission? The acquisition of new helicopters normally implies disposition of the current helicopter(s). What can the City expect as to how long it will take to dispose of the aircraft and how much can it expect to receive should trade-in not be part of the transaction?

Table 3-1 summarizes these variables associated with the acquisition of new aircraft.

Table 3-1									
Summary of Aircraft Acquisition Process - Acquisition, Completion, Disposition									
	Currrent Fleet		Candidate Helicopters						
		Bell	Airbus				Bell	Leonardo	Sikorsky
	AS350B3	212/412	H120	H125	H130	H215	407GXP	AW119Kx	S-70i
Delivery Availability	N/A	N/A	Immediate	Immediate	Immediate	Unknown	Immediate	10 months	Early 2018
Trade-Ins									
Own Aircraft			Yes	Yes	Yes	Yes	N/A	N/A	N/A
Competitor's Aircraft			N/A	N/A	N/A	Most Cases	No	Yes	No
Configuration Completion	N/A	N/A	3-4 months			4-6 months	4-5 months	4 months	5-6 months
Disposition	Difficult	Difficult	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

- **Delivery Availability: Refers to how quickly the manufacturer could deliver a green basic-configured helicopter. Does the manufacturer have available inventory for sale or is there a backlog, which would delay delivery to a later time? Immediate implies helicopters are available. Actual delivery would take 15 to 30 days due to activities such as inspections, paperwork, document checks, and deliver preparation. N/A is not applicable for the AS350B3 and Bell 212/412 as these helicopters will be sold not purchased. The Leonardo AW119Kx is the only type that has a current backlog, a backlog of 10 months. The Airbus H215 was difficult to obtain an estimate for the delivery availability. However, this aircraft is part of the group that has experienced significant declines in deliveries due to the economy.**
- **Trade-Ins: If the City chooses to purchase new helicopters, one option to dispose of the current fleet is to trade them in to the selling manufacturer. The manufacturers' willingness to accept the current used helicopters becomes more important given the current slow helicopter market. Depending upon which new helicopter is selected, the manufacturer will have to decide if it will accept used helicopters that it has manufactured (Own) or those manufactured by the competition (Competitor's Aircraft).**
    - **Own Aircraft: If ABLE should acquire an H125, will Airbus Helicopters accept as trade-in the current AS350B3s? Yes. Bell and Leonardo are N/A because the current AS350B3 helicopters are Airbus. Sikorsky has a similar situation with SDFD fleet.**
    - **Competitor's Aircraft: If SDFD should acquire an S-70i, will Sikorsky accept as trade-in the Bell 212HP or 412EP? No, they encourage the customer to sell the aircraft on the market through independent sources. If SDFD should acquire an H215, will Airbus accept as trade-in the Bells? More than likely yes but there are some situations the manufacturer reserves the right to decline. Bell's current policy will not accept the AS350s if ABLE purchased the 407GXP. Would the current slow market for new helicopter sales change that policy?**
- **Configuration Completion: Once the new green basic-configured helicopters are delivered, how long does it take to configure the helicopter with the mission equipment? When this process is completed, the helicopter is assumed to be ready for use by the department. The current helicopters were considered Not Applicable (N/A) as they would not go through the completion process.**
- **Disposition: Intended to provide two estimates. 1) An estimate of the time required to sell the current helicopters if trade-in is not a viable option and 2) An estimate of the selling or trade-in price.**

  "Difficult" was short for Difficult to Determine. The term was used to describe the current slow market for selling used helicopters. As with any market, if the price correctly reflects the value, then transactions will occur in a timely manner. The current market seems to be having a difficult time identifying the correlation between price and value, therefore the timeline for a sale and the amount

are difficult to estimate. The helicopters receiving N/A were candidate helicopters and the disposition of these helicopters is not applicable to the sale of the current fleet.

Section 4 – Topics for Acquisition

4.0 City of San Diego Original Request

Determine the advantages and disadvantages for purchasing helicopters using the following scenarios: (A) Cash only purchase; (B) a financed purchase using the City's lease-purchase program; (C) other financing scenarios.

4.1 Conklin & de Decker Approach

We expanded the scope of this section as originally stated in Appendix A of the Request for Proposal. The original request asked Conklin & de Decker to look at the various methods for acquiring aircraft (see section 4.0 above). We moved the request to review the Maintenance Steering Group – 3rd Task Force (MSG-3) since the maintenance concept became a non-factor for the helicopters we evaluated. In addition to providing an overview of MSG3, we also discussed guaranteed maintenance programs, mission-ready purchase price estimates for the candidate helicopters, three methods for financing or purchasing the candidate helicopters, the importance of creating competition during the acquisition process, and a brief overview of the 12-year inspection associated with the AS350B3 helicopters.

We also did not divide the Conklin & de Decker analysis into separate sections based on the aviation departments, as was the format in other sections, due to the nature of the subjects.

4.2 Summary

- Guaranteed maintenance programs are growing in popularity primarily because they provide certainty for the erratic and often hard-to-predict behavior of maintenance costs. In essence, the programs provide a form of insurance for operators in a significant cost category. Often overlooked but just as important, guaranteed maintenance programs will improve helicopter availability.

  Prior to entering a guaranteed program, the operator should understand the many variables and factors that influence what a program potentially covers (scope) and what an operator will eventually pay to participate in the program. The basis for the pricing of programs varies from vendor to vendor. Also, if informed, the operator can negotiate with the vendors for better value. Other important areas are minimum usage requirements and renewal or exit policies for the contracts.

- The estimated purchase prices for the mission-ready candidate helicopters are presented in Chart 4-3 and 4-4 on Pages 9 and 10. The purchase price for the law enforcement, mission configured, candidate helicopters ranges from a low of $3.3 million for the Airbus H120 to a high of $5.2 million for the Airbus H130, which is an almost $2.0 million difference. A difference of this size is not unexpected based upon the difference in performance and size of the two helicopters. If the smaller H120 is removed from the comparison, the similar performing helicopters have a $0.7 million or about a 15 percent difference.

The candidate mission-ready helicopters for the fire-rescue department range in price from the Airbus H215 at $21.5 million and the Sikorsky S-70i at $18.5 million.

- Given the current economic conditions facing the helicopter industry, creating competition among the manufacturers leading up to the actual acquisition most likely will lead to additional concessions in areas such as helicopter purchase price, trade-in values, support commitments, and lower GMP rates. Competition creates negotiation and negotiation leads to a better deal for the City of San Diego.

- Based on the City's request, we evaluated three methods to acquire the helicopters, purchase without financing, lease to purchase over seven years at 2.5 percent annual interest, and lease to purchase over ten years at 2.7 percent annual interest. To compare the methods, we calculated, using life cycle cost and assumptions from prior sections, the total cash expended and net present value over a 20-year period for two candidate helicopters. Those helicopters were the Airbus H125 and H215. For each helicopter, the perspective changed as to the best method. If total cash expended is the measure, then the purchase method is the best option. If net present value is the measure, then the ten-year, 2.7 percent interest is the best option. Tables 4-1and 4-2 on Page 12 summarize the results.

- During initial discussions, City personnel expressed an interest in the concept of MSG-3. Due to the nature of MSG-3, its recent introduction to the helicopter industry, and its lack of applicability to the current and candidate police and fire-rescue helicopters, we did not pursue this subject further in the report. However, we have provided an overview of MSG-3 to introduce the concept to City personnel.

- The current ABLE AS350B3 helicopters have a major inspection that occurs every 12 years. The inspection presents a problem for ABLE as well as other AS350 operators due to the estimated time to complete the major inspection, an estimated six months. It came to our attention that the manufacturer may eliminate the 12-year inspection interval. Eliminate does not mean do away with the tasks of the inspection but rather break up the tasks and place them at different intervals. Because the company has not implemented the new concept, it is difficult to predict at this time what effect the changes will have on the maintenance schedule and related availability of the AS350 in the future. Due to the uncertainty regarding the implementation of the concept as of the report date, we proceeded with the assumption that the 12-year inspection will continue on its new H125 helicopters.

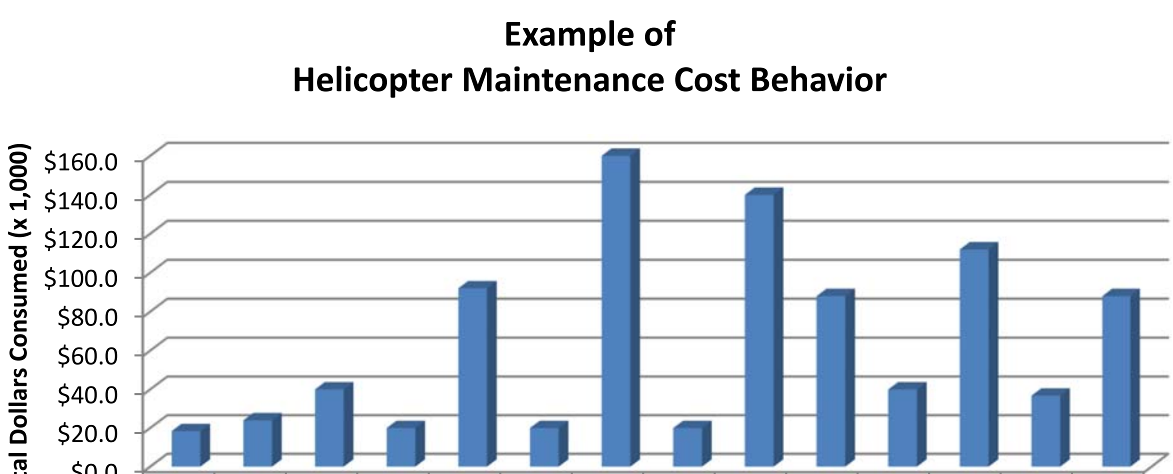
4.3 Conklin & de Decker Analysis

4.3.1 Guaranteed Maintenance Programs (GMP)

The term Guaranteed Maintenance Program (GMP) is a generic term to represent a concept that has become very popular in aviation in the last several years. Each entity that offers a program of this nature has their unique name. The most commonly-used trademarked name representing this concept was Rolls Royce's Power-by-the-Hour program (PBH). Another common reference is Pay-by-the-Hour. For clarity, we use GMP in this report to reference the concept.

What was the primary reason that pushed vendors to offer GMPs? The most obvious answer is their effect on the behavior of maintenance costs over a period of time. Chart 4-1 represents the maintenance costs of an actual helicopter whose costs we tracked over an extended period of time. The chart illustrates the erratic behavior, mostly caused by scheduled events, of maintenance costs. Using Year 7 as an example, how does an organization prepare for expenditures of this magnitude ($160 K) when they have been experiencing significantly less costs in the prior years?

Chart 4-1



1	2	3	4	5	6	7	8	9	10	11	12	13	14
$18.4	$24.0	$40.0	$20.0	$92.0	$20.0	$160.0	$20.0	$140.0	$88.0	$40.0	$112.0	$36.8	$88.0

The more astute operators would estimate the costs of the future significant maintenance events and then set aside or reserve funds until the events occurred. The amount reserved was accumulated based on a calculated cost per hour for the future events. In essence, the operator was reserving cash for future maintenance at a pre-determined rate of hours flown, the most commonly-used metric.

For example, if the estimated cost to overhaul a main transmission gearbox was $45,000 and its overhaul interval was 3,000 hours, the amount reserved for each hour flown would be $15. If the assumptions, $45,000 and 3,000 hours, turned out to be accurate, then the operator would have enough funds available to pay for the overhaul (The effects of inflation were not included in this example). Working through the exercise to build estimates for all of the scheduled maintenance as well as maintenance not scheduled (e.g. on-condition) would produce a total cost per hour to maintain the aircraft.

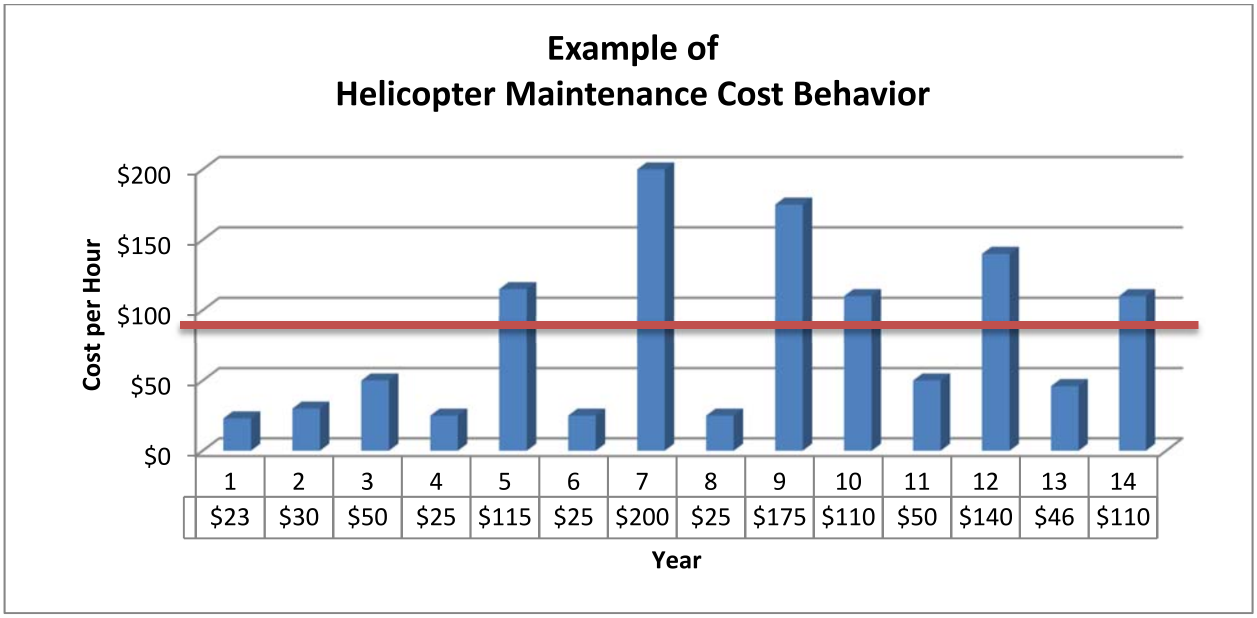
However, accurately estimating costs and avoiding premature component removals can be difficult and therefore risky from a cash flow perspective. If the transmission overhaul actually cost $100,000 and occurred at 2,000 hours, the operator would not have enough funds to pay for the event. Multiplying the effects of missing estimates related to many of the overhaul components, life-limited items, and engine(s) could have a devastating effect on the organization's long-term viability. Compounding the issue of developing accurate estimates is the lack of reliable industry information regarding costs. An organization's experience is the best source but one that is not always available.

It's also tempting to spend a growing fund of cash for purposes other than future maintenance, especially when cash is tight for the organization. Additionally, reserving funds in a for-profit organization cannot be recognized as an expense until the maintenance event occurs; therefore the hourly reserve is not tax deductible.

To answer the initial question more directly. What was the primary reason that pushed vendors to offer GMPs? GMPs offer predictability in the area of maintenance costs, while shifting risk from the operator.

Program mark-ups by the vendors are common and are applied to cover the risk associated with offering a program that serves as insurance. Also increasing the price of the program above the underlying costs is the desire by the vendor to realize a profit for offering the service to the operators. A good average increase above the underlying cost to recognize risk and profit is 15 to 20 percent.

Chart 4-2



As it relates to cost predictability, there are three other important benefits to consider.

- For governmental agencies, GMP makes even more sense since few of them have budgeting mechanisms that efficiently handle the wide variation in maintenance costs from year-to-year. As a result, in low cost years, there is a budget surplus that, more than likely, will be consumed on inventory. In high cost years, the finance department may have to scramble to find the necessary funds. Regardless of the costs that are actually incurred in a given year, the effects of the typical maintenance costs are magnified if communication between operations and finance are poor.
- GMP will serve as an insurance policy when premature maintenance events occur. If the main transmission requires an overhaul prior to the scheduled 3,000 hours, the GMP will cover the event. In essence, the risk has shifted from the operator to the entity that provides the GMP.
- GMP offers even more certainty in a changing maintenance environment. Historically most of the drive train, flight control, hydraulic, and engine systems had scheduled maintenance intervals (i.e. main transmission example). However, continued product improvements have created trends to move these schedule maintenance intervals to maintenance based on the item's condition, also referred to as on-condition maintenance. By its nature, the predictability of this type of maintenance becomes more difficult, not only its timing but also the cost.

In addition to cost predictability, there is another significant attribute of GMPs that has become more prominent over the last several years. In fact, an aircraft's availability is viewed by for-profit operators as more important. An aircraft that is not available cannot generate revenue and revenue is what keeps the business running. However, the importance of availability is important for all types of operations if viewed from another perspective. If an aircraft is unavailable for extended periods of time, the organization is incurring additional costs that are more difficult to measure, costs that are not as obvious as maintenance costs.

For example, if an organization has one aircraft to perform its regular missions, there will be times due to maintenance that the aircraft will not be available. When it is not available for an extended period of time, the operation has several choices. It can

- Choose not to perform the mission but if the mission is important, this is not a practical choice.
- Obtain temporarily (i.e. rent/lease) the use of another similar aircraft, which is not practiced much in our industry.
- Ask another organization to perform the mission, which is doable but not for a long period of time.
- Acquire another aircraft. This is not necessarily a bad solution, but it is expensive because of the acquisition costs for the second aircraft. Helicopters especially are an expensive asset.

Given the nature of aircraft and their maintenance, how does a GMP improve an aircraft's availability?

- Consigned Inventory – Often times the GMP provider will place inventory at the location of the operator. This is not normally part of the general contract, but if requested by the operator, certain key parts or components can be "stored" at the operator's location. A replacement part that resides at the operator's location will reduce the downtime due to maintenance, which in turn improves the availability rate.
- Rotable Exchange or Rental Inventory – The GMP provider will maintain a pool of rotable items. When requested, the provider will send the item to the operator to replace the existing item on the aircraft. In this scenario, the aircraft is unavailable only as long as it takes to remove and replace the item. In an exchange, the operator will operate the item until its replacement is required again. A rental will stay on the aircraft until the operator's repaired item is ready for install. Using a rental doubles the unavailability rate since the remove/replace cycle is performed twice, once to install the rental and once to install the repaired part. Regardless, if it's an exchange or rental, the aircraft's availability will improve significantly when compared to removing and waiting for the return of the same item. In many cases, the turnaround time for overhaul or repair can be several months.
- Technical service – Initially, providers offered GMPs that covered basically the same thing, parts and repair costs for significant maintenance events and on-condition parts. As the programs have become more popular, operators have requested that GMPs be designed to meet their specific needs. As a result, providers now offer more variations in their GMPs and have expanded the scope of the coverage to include technical

services. What technical services actually entails can vary by the program but could include technical engineering assistance, spare part priority, and even labor coverage. Each of these services has the potential to improve an aircraft's availability by shortening the downtime due to maintenance.

What is important to evaluate when considering a GMP? Due to the recent ongoing expansion of offerings by the GMP providers and the fact that GMP is very helpful in the marketing aspect of selling an aircraft, an operator should understand the many variables and factors that influence what GMP potentially covers and what an operator will eventually pay to participate in GMP. The following information highlights some of the more important factors to consider when deciding whether or not GMP is appropriate for the organization.

- Scope of Coverage – As already mentioned, the range of offerings is broad. For example, within its HCare customer service programs, Airbus Helicopters offers several GMPs through its HSmart Material Management -- Repair by-the-hour, Exchange by-the-hour, Parts by-the-hour, and Full by-the-hour. In a more general view, operators should know if the GMP covers such things as unscheduled maintenance, labor, bulletins (mandatory or optional), troubleshooting, mission equipment, and shipping. Scope of coverage is also affected by whether or not the operator wants airframe only, engine only, or both airframe and engine coverage. Unless there is a special arrangement, the airframe and engine manufacturers offer separate programs.
- Pricing – Obviously the scope of coverage will have an effect on pricing, but there are three other factors to consider. Due to the potential effect of the factors, it is very important for the operator to 1) understand what the pricing represents, and 2) negotiate with the provider for a rate that best represents the operator's situation.
  - First, what is the perspective of the provider when it offers a GMP contract? Is the hourly cost, which is the most common method for expressing the GMP pricing, based on a long-term or short term perspective? Chart 4-1 illustrates this point. For the aircraft in the chart, we know after 14 years, the average cost per hour for maintenance was $80 per hour. For simplicity, let's assume this represents a long-term perspective. From the same chart, we can also calculate that the actual cost experienced after five years was $39 per hour. When the operator signs the contract will the GMP's hourly rate represent the short or long-term perspective? This becomes important when the perspective is short-term and the operator plans to own the aircraft longer than the commonly-offered initial five-year contract. How much will the hourly rate have to increase to "make-up" for the short-term rate that does not reserve for maintenance items and events that occur after five years?
  - The second factor to consider is how many annual flight hours will the operator accumulate during the period of aircraft ownership? For example, if the total flight hours were 200 annual hours over a ten-year period, the expected flight-hour rate should be lower than an operator accumulating 1,000 hours per year.

The low-time operator would encounter fewer scheduled maintenance events in its 2,000 hours of ownership than 10,000 hours for the high-time operator. If the provider's rate was the same regardless of flight activity, then the operator will want to pay special attention to the contract clauses at the time of sale.

  - A third factor to consider is the basis for pricing of parts when GMP is not involved. Does the operator receive some level of discount pricing when purchasing spares or receiving services from the provider (e.g. government entity)? If so, does that basis also apply to the hourly rate of a GMP? Most GMP rates are based on list or "full" price.

- <u>Minimum Hour Requirement</u> – Is the GMP contract based upon a minimum number of annual flight hours? Because some maintenance events are based on calendar time (e.g. Airbus 12-year inspection), the GMP rate is based upon an assumption of minimum flight hours over a certain period of time. For example, if an aircraft has a 12-year inspection that is estimated to cost $200,000, the measurement rate is time(e.g. years) rather than activity (e.g. flight hours). The GMP rate must reserve enough for the maintenance event causing the need for a certain level of flight hours in the 12-year period. For the police department, a minimum hour requirement would not be relevant due to the high number of flight hours each aircraft accumulates annually. For the fire department, this factor probably would become relevant.
- <u>Exiting the GMP</u> – What happens when an operator exits the program? A number of factors may be relevant.
  - Is the contract transferable to the buyer? The GMP provider may not allow this to occur, which could affect the buyer's decision. If the contract does transfer, what portion of the accumulated reserve transfers? Does the buyer have to pay a "buy-in" fee?
  - If the operator exits the contract, what happens to the accumulated reserve? Is there a penalty taken from the reserve for exiting or not renewing the contract? Most providers have a penalty.
- <u>Who offers GMP programs?</u> Historically, the manufacturers of their respective products offered these programs. Also, airframe manufacturers offer programs separately from engine manufacturers. As mentioned previously, GMPs growing popularity are an important part of the marketing effort by the manufacturers, which means there can be flexibility in how the program is structured and what the program rate will be. Negotiations in both areas are important. Each of the manufacturers with candidate helicopters mentioned in Section 1 Fleet Review offer GMPs. The airframe manufacturers refer to their GMPs as:
  - Leonardo – Service Plans
  - Airbus Helicopters – Hcare, Smart and Easy
  - Bell Helicopter - Customer Advantage Plan (CAP)
  - Sikorsky – Total Assurance Plan (TAP) and Power Assurance Plan (PAP)

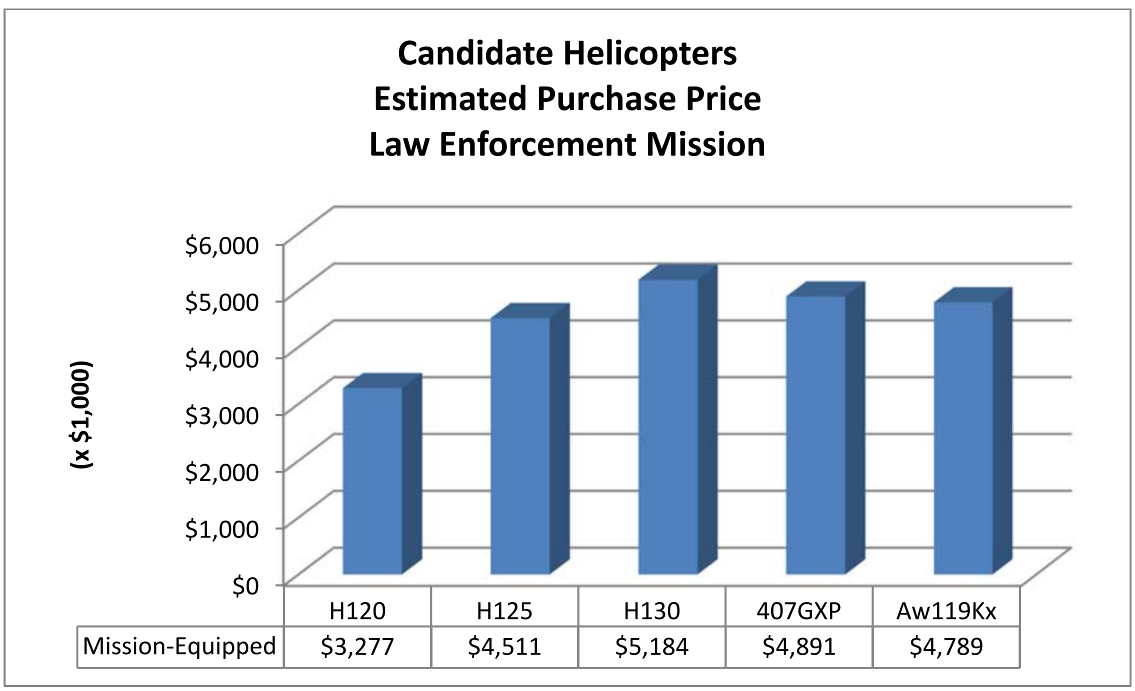
Jet Support Services, Inc. (JSSI), an independent provider of GMPs, has recently entered into the helicopter market. Like the manufacturers, it offers many different types of coverage. Unlike the manufacturers, they will cover both the airframe and engines. JSSI will also set up independent trust accounts to retain the reserve funds.

4.3.2 Purchase Prices

Charts 4-3 and 4-4 summarize the estimated purchase prices for the candidate mission-ready helicopters for ABLE and SDFD. To build the estimates shown in Chart 4-3 for the police helicopters, we

- Started with base prices for the respective helicopters from Conklin & de Decker's *Aircraft Cost Evaluator 16.1*.
- Used the current law enforcement configuration and mission equipment as the basis to estimate the cost to convert the base helicopter to a mission-ready helicopter.
- Researched the cost for the law enforcement mission equipment for two of the candidate helicopters.
- Calculated a ratio between base price of candidate helicopters and price to convert to law enforcement mission.
- Applied the calculated ratio to the remaining three candidate helicopters.

Chart 4-3



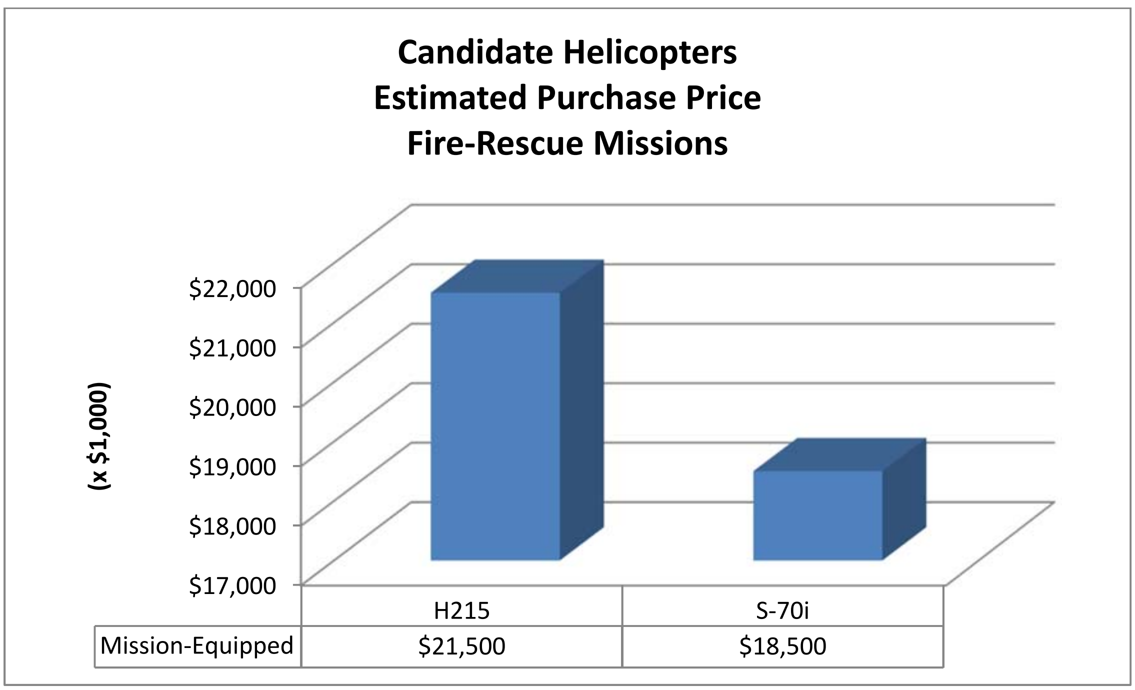
The purchase price for the law enforcement candidate helicopters ranges from a low of $3.3 million for the Airbus H120 to a high of $5.2 million for the Airbus H130, which is an almost $2.0

million difference. A difference of this size is not unexpected based upon the difference in performance and size of the two helicopters. If the smaller H120 is removed from the comparison, the similar performing helicopters have a $0.7 million or about a 15 percent difference.

To build the estimates shown in Chart 4-4 for the SDFD helicopters, we used a similar process for the H215 and S-70i. We

- Started with base prices for the respective helicopters from Conklin & de Decker's *Aircraft Cost Evaluator 16.1*.
- Researched further the base prices by contacting industry sources for both helicopters.
- Determined a base price range for both types.
  - For the S-70i, we established a range from $13.0 to $15.0 million. The wide range was caused by the rapidly changing economic conditions in the industry over the last two or three years.
  - For the H215, we established a range of $15.0 to $18.0 million.
- Used the mid-point for both helicopter types, $14.0 million for the S-70i and $16.5 million for the H215, for the base price.
- Determined the range of completion costs was $4 to $5 million. This was based on previous research for the S-70i. The mid-point of $4.5 million was applied to both types.

Chart 4-4



4.3.3 Acquisition Competition

Given the current economic conditions facing the helicopter industry, creating competition among the manufacturers leading up to the actual acquisition most likely will lead to concessions in areas such as helicopter purchase price, trade-in values, support commitments, and lower GMP rates. Competition creates negotiation and negotiation leads to a better deal for the City of San Diego. Unfortunately, creating a competitive environment during the acquisition process is not a common practice by operators in this industry. Too often, a manufacturer knows the customer's decision before negotiations begin.

4.3.4 Purchase Methods

We used two candidate helicopters to illustrate how different purchase methods can produce different results in the area of total cash expended and net present value. Based on the City's request, we used three methods to acquire the helicopters.

- Purchase without financing.
- Lease to purchase over seven years at 2.5 percent annual interest.
- Lease to purchase over ten years at 2.7 percent annual interest.

One of the candidate helicopters, the H125, was selected to represent ABLE and the H215 to represent SDFD. For each helicopter, we used the respective purchase prices discussed in Section 4.3.2, $4.5 million for the H125 and $21.5 million for the H215.

The *Life Cycle Cost* software used the same assumptions that were explained in the respective sections of Section 2 Cost Projections. The key assumptions included a 20-year projection with 900 annual hours for the H125 and 250 hours for the H215.

A new assumption in the projections involves the concept of internal cost of money for the City. Management at for-profit organizations make decisions about how they want to invest their money. Ideally, money is invested in assets that will produce revenue that covers costs as well as generating a return on the investment. If funds are to be invested in a non-revenue producing asset, the organization's expected return on investment is still an applicable concept. And when running a life cycle cost estimate for a non-revenue project, the return on investment rate is used so net present value (time value of money) can be calculated.

For government agencies "cost of investment" is difficult to determine due to their non-revenue status. To calculate net present value in these situations, Conklin & de Decker's benchmark is the rate required by the federal government's Office of Management and Budget (OMB). The current rate is 3.5 percent (Circular A-11, Appendix C). We applied this rate to our life cycle cost projections.

Table 4-1 summarizes the purchasing methods for the H125 and Table 4-2 for the H215. Each table shows the total cash that would be consumed during the 20-year projection based on our assumptions and the net present value (NPV) for each acquisition method.

Each table illustrates that if total cash expended is the basis upon which decisions will be made, then purchase-without-financing is the best method. However, when the concept of NPV is introduced the ranking of the options changes. In both tables, the Lease to Purchase over a ten-year period at 2.7 percent interest has the lowest NPV. This is due to less money expended in the early years when financing is used.

In the life cycle cost tool, the NPV values are actually negative values because they represent expenditures. Therefore, the option with the least negative value or least amount of expenditures per the NPV calculation is better than a higher negative value.

Table 4-2 summarizing the H215 illustrates how the difference between acquisition methods grows as the dollar amounts increase. The selection of the H215 was not intended to imply a preference for future acquisition.

Table 4-1

H125 – Summary: Method of Purchase Analysis (x $1,000)

Method	Total Cash Flow	Difference	Net Present Value	Difference
Purchase	$14,621	---	$11,808	---
Lease to Purchase: (7-Year, Annual Interest 2.5%)	$15,021	$400	$11,600	($208)
Lease to Purchase: (10-Year, Annual Interest 2.7%)	$15,247	$626	$11,598	($210)

Table 4-2

H215 – Summary: Method of Purchase Analysis (x$1,000)

Method	Total Cash Flow	Difference	Net Present Value	Difference
Purchase	$29,286	---	$26,191	---
Lease to Purchase: (7-Year, Annual Interest 2.5%)	$31,190	$1,904	$20,106	($6,085)
Lease to Purchase: (10-Year, Annual Interest 2.7%)	$32,267	$2,981	$18,829	($7,362)

4.3.5 Maintenance Steering Group-3 (MSG-3)

During initial discussions, City personnel expressed an interest in the concept of MSG-3. Due to the nature of MSG-3, its recent introduction to the helicopter industry, and its lack of applicability to the current and candidate police and fire-rescue helicopters, we did not pursue this subject further in the report. However, we have provided an overview of MSG-3 to introduce the concept to City personnel.

There are two givens associated with helicopters with which few will argue. Availability is important and maintenance is expensive. The ability to develop a maintenance schedule that will increase availability, reduce the time required to perform maintenance, and reduce cost while retaining high safety standards has become a priority. Bell Helicopter and Airbus Helicopter are leading the way in developing these maintenance schedules for the Bell 429 and Airbus H175 using a process called MSG–3.

Most helicopters today utilize what is known as "hard time" maintenance schedules. These schedules dictate overhauling and inspecting items at specified intervals regardless if the maintenance is needed or not. This approach causes too much downtime, is expensive, and many times creates more problems when items are taken apart too often.

The fixed wing industry had this issue as well, and in the 1960s, an organization called the Air Transport Association formed a Maintenance Steering Group (MSG). Their mandate was to analyze current maintenance practices and look for ways to reduce the time and cost involved while maintaining safety. The result was the first generation of a philosophy of maintenance known as MSG–1 in 1968. MSG– 3 is the third and latest iteration of this philosophy. It was first implemented in 1980 and updated again in 2009. It is slowly being implemented into the helicopter industry. The main difficulty for the helicopter industry in adopting MSG-3 has been adapting the philosophy to fit helicopter systems and maintenance programs.

The MSG–3 is normally accomplished during the development of a new aircraft. It is usually cost prohibitive to implement for existing aircraft. During the MSG–3 analysis, a team consisting of the OEM, operators, and the regulatory authorities analyze every aircraft system. This team is known as the Maintenance Review Board (MRB). This board determines the failure modes, how critical the failure modes are, how easy it will be to detect the failures, the level of inspection required, and the ideal occurrence of the inspections. The result has been an increase in overhaul intervals based on trend data showing that the mean time between component failure is better than first thought. Some inspections have been eliminated or condensed and combined with other inspections. Also inspection intervals have increased using this process. This is a process that can be revisited at a later date to determine if other improvements can be made.

Bell Helicopter was the first Original Equipment Manufacturer (OEM) to use this method to create the maintenance schedule for the Bell 429 helicopter during its development. Airbus Helicopters later used this approach during the development of the H175.

Implementation of MSG-3 can reduce maintenance costs and required maintenance time by up to 30% over the current “hard time” schedules used by most helicopters.

4.3.6 Airbus 12-Year Inspection

The current ABLE AS350B3 helicopters have a major inspection that occurs every 12 years. As is well-known by the police department and other City personnel, each of the four helicopters will encounter the respective 12-year inspection within a two-year period, which began in the second half of the calendar year 2016.

The 12-year inspection presents a problem for ABLE as well as other AS350 operators due to the estimated time to complete the major inspection. Estimates for the ABLE helicopters as performed by the current maintenance contractor are four to six months. This duration significantly affects the department’s aircraft availability.

During meetings with Airbus Helicopters for the purposes of verifying certain published maintenance cost information, it came to our attention that the manufacturer may eliminate the 12-year inspection interval. In the discussion with Airbus Helicopters, eliminate did not mean do away with the tasks of the inspection but rather break up the tasks and place them at different intervals. Because the company has not implemented the new concept, it is difficult to predict at this time what effect the changes will have on the maintenance schedule and related availability of the AS350 in the future.

This factor also affects the recommended fleet plan from Conklin & de Decker. Due to the uncertainty regarding the implementation of the concept as of the report date, we proceeded with the assumption that the 12-year inspection will continue on its new H125 helicopters.

Significant maintenance inspections based on calendar times are not limited to the Airbus H125. The Airbus H215 also has a calendar-based inspection, which occurs every 120 months or ten years.

Section 5 – Fleet Replacement Plan

5.0 City of San Diego Original Request

Establish a defined framework for a city-wide helicopter replacement plan including the anticipated useful life of the equipment, as well as a comparison of phasing of purchases versus purchasing all replacement aircraft all at once.

5.1 Conklin & de Decker Approach

Conklin & de Decker created a fleet replacement plan for each aviation department based on a similar process. First, we produced a 20-year benchmark estimate based upon retaining the current fleet. Next, we considered changes to the fleet by incorporating new aircraft. The approach differed slightly between the departments as each had different objectives. The police aviation unit's current aircraft performed the mission well and without any foreseen changes in the mission, its plan focused on the timing of changes. The fire-rescue department wanted to improve its service in the firefighting mission by increasing its capacity to deliver more water per drop. Therefore its analysis incorporated the possibility of helicopter type changes.

The structure of this section is the same as prior sections. Section 5.2 provides a summary of the analysis and 5.3 is the Conklin & de Decker analysis. Both sections are divided into analysis for each department.

5.2 Summary

5.2.1 San Diego Police Air Support Unit (ABLE)

Conklin & de Decker analyzed three options regarding the current ABLE fleet.

- <u>Retain the Current Fleet</u> - Although retaining the current fleet of AS350B3s is not likely, estimating its operating costs (maintenance and fuel) for the next 20-year period serves as a benchmark when compared to the other possible alternatives. We based the total cost for each AS350B3 helicopter on the life cycle cost analysis performed in Section 2 Life Cycle Cost Projections.
- <u>Replace the Current Fleet at the Same Time</u> – We based the estimate on certain key assumptions.
    - We chose the H125 on which to base the estimates for this alternative. We did so because ABLE personnel indicated its law enforcement mission would not change in the foreseeable future and based on the analysis in Section 1 Fleet Review, the current helicopters perform the missions well. The H125 is a newer version of the AS350B3.

  - Consider changing the number of helicopters from the current four to three. Currently, a fleet of four is required to keep one and sometimes two helicopters available for missions. Downtime due to significant maintenance events affects aircraft availability, which distorts the number of helicopters required to meet the department's mission requirements.
  - To reduce the fleet's size, guaranteed maintenance programs (GMP) for both the airframe and engines is required. GMPs provide budget stability and can improve aircraft availability.
  - Create a competitive environment among the manufacturers leading up to the acquisition to gain concessions in areas such as helicopter purchase price, trade-in values, support commitments, and lower GMP rates.
- Replace Current Fleet with a Phased Plan – We relied on the same approach and assumptions used for replace-at-the-same-time method. The Adjusted Value estimates created in Section 2 Life Cycle Cost Projections served as the basis for identifying the best year in which to dispose of each helicopter.

Table 5-1 summarizes the analysis for the three options. If the City retained its current fleet for another 20 years, the maintenance and fuel costs to operate the fleet of four helicopters would be almost $53 million. If the City chose to replace its fleet and reduce the number of helicopters to three, it would spend approximately $55 million to operate, purchase, and dispose of the current helicopters during the 20-year period. If the ABLE fleet with new helicopters remained at four the cost during the same period would be between $60.7 and $61.9 million. The operating costs for new helicopters would drop by $7 to $8 million, depending upon the fleet size, when compared to the current fleet.

Table 5-1

ABLE - Summary of Fleet Options (x $1,000)

Option	**Operating Cost**	**Disposition Amount**	**Purchase**	**Total**
1) Retain Current Fleet	$52,969	Not Applicable	Not Applicable	$52,969
2) Replace Fleet at Same Time				
Three Aircraft	$44,720	($4,897)	$15,174	$54,997
Four Aircraft	$45,368	($4,897)	$20,232	$60,703
3) Replace Fleet in Phases				
Three Aircraft	$45,169	($4,974)	$15,174	$55,369
Four Aircraft	$46,659	($4,974)	$20,232	$61,917

5.2.2 San Diego Fire-Rescue Department (SDFD)

Conklin & de Decker analyzed two options regarding the current SDFD fleet.

- Retain the Current Fleet - Although retaining the current fleet as-is is not likely, it serves as a benchmark when compared to the other possible alternatives. Based upon the life cycle cost assumptions stated in Section 2 Cost Projections (pages 29-30), we projected the estimated fuel and maintenance costs for the next 20 years for Bell 212HP and 412EP.
- Replace the Current Fleet – The current fleet will change in that the Bell 212HP will depart the fleet early in the 20-year period. For this analysis, we left the Bell 412EP in the fleet as SDFD has expressed the need to retain a 412 over the long-term. We based replacement and acquisition plans on several key assumptions.
    - We used the Sikorsky S-70i in lieu of the Airbus H215 for one reason. For the primary firefighting mission, only the Sikorsky S-70i meets the SDFD parameter to deliver between 800 and 1,000 gallons of water per drop. When compared to the Airbus H215, the Sikorsky S-70i can deliver between 30 and 42 percent more water per drop.
    - Recommend the purchase of two Sikorsky S-70i helicopters. Significant scheduled maintenance events have an adverse effect on the availability rate of the S-70i. If delivering larger amounts of water is a priority and having at least one S-70i helicopter available, then a second helicopter is suggested for adequate coverage.
    - If SDFD does acquire Sikorsky S-70i helicopters, it must use guaranteed maintenance programs (GMP) for both the airframe and engines. Other than creating budget certainty, GMPs can improve availability percentages. The County of Los Angeles Fire Department has used Sikorsky's Total Assurance Plan (TAP) since acquiring its S-70A helicopters and believes the program was critical to improving its levels of aircraft availability.
    - Create a competitive environment among the manufacturers leading up to the acquisition to gain concessions in areas such as helicopter purchase price, trade-in values, support commitments, and lower GMP rates.

Table 5-2 summarizes the analysis for the two options. If the City retained its current fleet for another 20 years, the maintenance and fuel costs to operate the Bell 212HP and 412EP would be almost $25 million. If the City chose to replace its Bell 212HP and acquire one Sikorsky S-70i, it would spend approximately $53 million to operate, purchase, and dispose of the Bell 212HP during the 20-year period. If a second Sikorsky S-70i was acquired the cost over the same period would be almost $93 million.

Table 5-2				
SDFD - Summary of Fleet Options (x $1,000)				
Option	**Operating Cost**	**Disposition Amount**	**Purchase**	**Total**
1) Retain Current Fleet	$24,907	Not Applicable	Not Applicable	$24,907
2) Acquire S-70i Helicopters				
One S-70i	$33,573	($1,310)	$21,065	$53,327
Two S-70i	$51,860	($1,310)	$42,130	$92,680

Note:

1) **Purchase: Based upon the lease-to-purchase option at 10 years and a 2.7 percent annual interest rate. Acquisition price is estimated at $18.5 million for a mission-ready helicopter.**

5.3 Conklin & de Decker Analysis

5.3.1 San Diego Police Air Support Unit (ABLE)

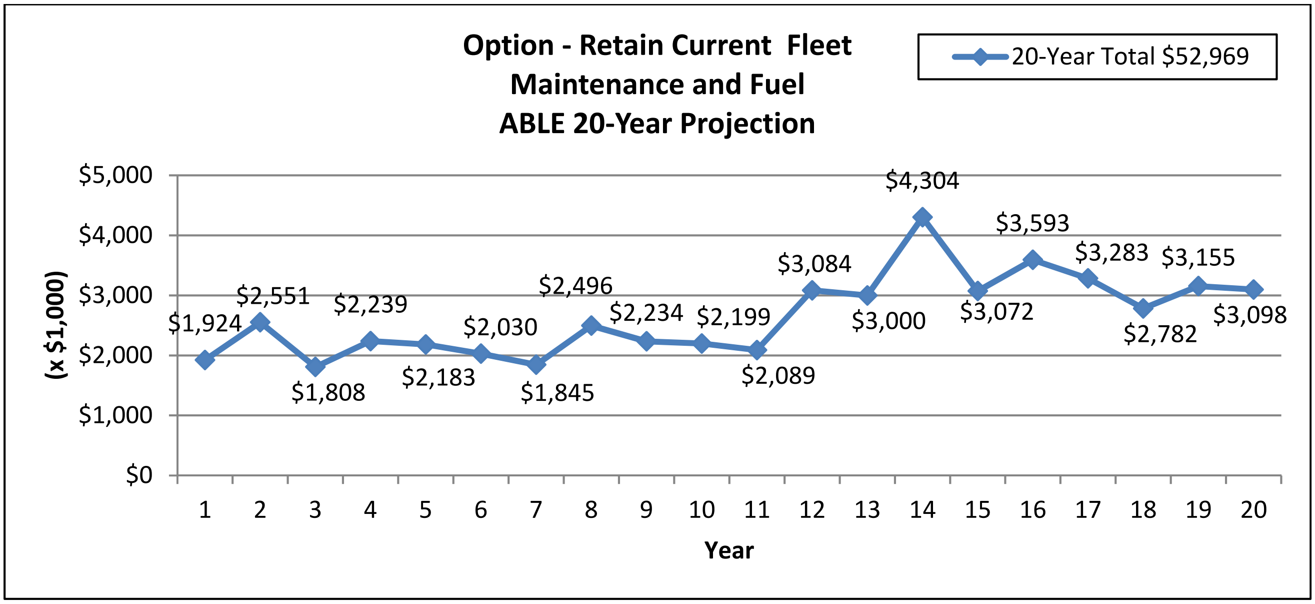
5.3.1.1 Retain Current Fleet

Although retaining the current fleet of AS350B3s is not likely, it serves as a benchmark when compared to the other possible alternatives. Based upon the life cycle cost assumptions stated in Section 2 Cost Projections (pages 6-7), we projected the estimated fuel and maintenance costs for the next 20 years for each of the current AS350B3s.

Key assumptions included the annual flight hours at 900 per helicopter, which is based on the projected hours for the current year, fuel rate per gallon of $2.40, annual inflation between 2.5 and 3.5 percent, a labor rate of $90 per hour to represent the contract maintenance technicians, and the remaining lives for the significant scheduled maintenance events and items for the respective helicopters.

Chart 5-1 combines the annual estimated fuel and maintenance costs for the four helicopters. For example, the fleet's cost in Year 1 is an estimated $1,924,000. The most expensive year for the current fleet would be Year 14. Over the 20-year period, the total costs expended on fuel and maintenance would be almost $53 million. Under this scenario, there would not be any acquisition costs for new helicopters or receipts for the disposition of the exiting helicopters.

Chart 5-1



5.3.1.2 Replace Current Fleet

We created two alternatives for changing the current fleet. 1) What would be the total cost to change the fleet if the new aircraft were 1) acquired at the same time or 2) phased into the fleet over a period of years? Regardless of the alternative pursued, we based the potential ABLE fleet changes on certain assumptions or recommendations.

- We chose the H125 on which to base the estimates for the two alternatives. We did so because ABLE personnel indicated its law enforcement mission would not change in the foreseeable future and based on the analysis in Section 1 Fleet Review, the current helicopters perform the missions well. The H125 is a newer version of the AS350B3. This assumption does not imply that other alternate helicopters would not be appropriate replacements. For example, the H130 and Bell 407GXP are very similar in cost and performance. Based on these similarities among the candidates and to keep the analysis from becoming overwhelming, we believed the H125 would serve as a good benchmark. If either the H120 or AW119Kx are determined to be the preferred replacement helicopter, then further analysis would be required since their cost and performance differed from the H125, H130, and Bell 407GXP.
- Consider changing the number of helicopters from the current four to three. Currently, a fleet of four is required to keep one and sometimes two helicopters available for missions. However, the downtime associated with certain significant maintenance events (e.g. engine overhauls can take 3 to 4 months, 12-year inspection can take up to 6 months, transmission overhaul can take 2-3 months) distorts the number of

helicopters required to meet the department's mission requirements. If the fleet was reduced to three and the number of budgeted annual hours remained at 3,600, each helicopter would average flying 1,200 hours per year. While this is a high utilization number, helicopters are capable of flying this many and more annual hours.

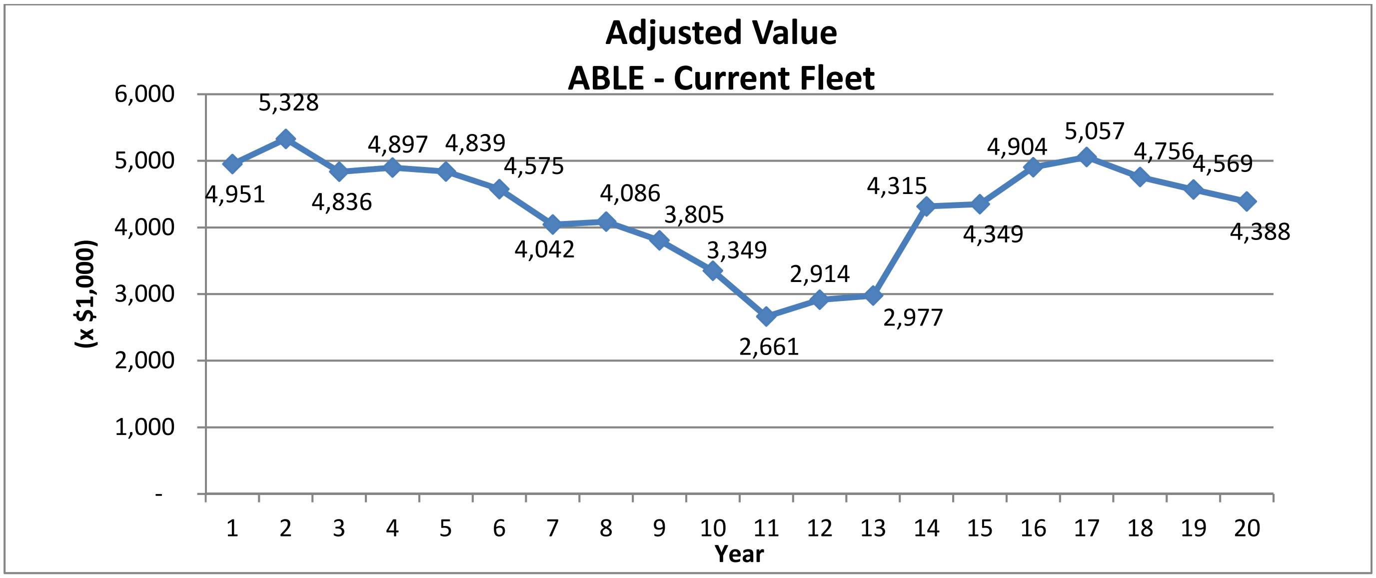
- If the fleet is reduced to three, then ABLE must use guaranteed maintenance programs (GMP) for both the airframe and engines. Section 4 Acquisition Options (pages 3-9) discusses the virtues and shortcomings of these programs. Other than creating budget certainty, GMPs can improve availability percentages due to consigned inventory on location, component exchange pools, and technical support.
- Recommend that, regardless of the new helicopter type chosen, the City create a competitive environment among the manufacturers during the acquisition process. Even if the City and police department have determined what the helicopter type will be, competition leading up to the acquisition most likely will lead to concessions in areas such as helicopter purchase price, trade-in values, support commitments, and lower GMP rates. Competition creates negotiation and negotiation leads to a better deal. Unfortunately, creating a competitive environment during the acquisition process is not common practice in the industry.

Replace the Current Fleet at the Same Time:

If the objective is to replace all of the ABLE helicopters at one time, then Chart 5-2 can serve as a resource to identify an appropriate year to execute the objective. The chart highlights the Adjusted Value of the fleet (four AS350B3s combined) for a 20-year period. The Adjusted Value is based upon the remaining times associated with significant scheduled maintenance items and events. Adjusted Value charts with explanations for each helicopter were provided in Section 2 Life Cycle Cost Projections

Chart 5-2 highlights years 2 through 6 as the best period of time to dispose of the current fleet. The next best period is years 16 through 18, but by that time the aircraft will be about 28 to 30 years old. Based on the life cycle cost analysis starting point, Year 2 would be from August 2017 through July 2018. By the end of Year 2, the fleet would have completed its respective 12-year inspections. Each inspection was estimated to cost $250,000 for a total of $1 million. The gain in the fleet's value between Years 1 and 2 is around $400,000. To realize some benefit from the completion of the major inspections, we selected Year 4 for the turnover of the fleet. The Adjusted Value is the highest ($4.8 million) after Year 2 but before Year 7.

Chart 5- 2



Using Year 4 as the year to sell or trade-in the current fleet, Table 5-3 summarizes what the costs would be for a 20-year period to acquire either a three or four-helicopter fleet. The total cost over the 20-year period is about $5.7 million less for the fleet with three helicopters. Most of the difference is related to purchasing three versus four helicopters. The operating costs were actually quite similar given the long period for the estimate. Their difference was almost $700,000.

A concern with replacing all of the fleet at the same time is encountering a similar situation to the one occurring now; all helicopters are due for the 12-year inspection in a relatively short timeframe. This can cause problems from the budgeting as well as the availability viewpoint. If the replacement helicopters are the Airbus H125, it is very important that the manufacturer communicate its intentions regarding this inspection. Will it be replaced by something that causes less downtime?

If the City choses to use GMP and replaces its fleet at the same time, the fleet's availability will improve immediately. All of the helicopters will receive the many benefits associated with GMP mentioned in Section 4.

A multiple helicopter purchase gives the City a strong negotiating position in a normal economy and market. In the current conditions, the City will have even more leverage when establishing the parameters for the purchase.

Table 5-3				
Summary of Program Costs - Replace Fleet at Same Time (x $1,000)				
Fleet Size	**Operating Cost**	**Disposition Amount**	**Purchase**	**Total**
Three Aircraft	$44,720	($4,897)	$15,174	$54,997
Four Aircraft	$45,368	($4,897)	$20,232	$60,703

Notes:

- **Fleet Size: Conklin & de Decker recommended the fleet size change to three aircraft. We also provided the costs for a fleet of four in case the City chooses that alternative. The three aircraft estimate is based on 1,200 flight hours per year per aircraft. The four aircraft estimate is based on the current 900 flight hours per year.**
- **Operating Cost: Represents a 20-year period of maintenance and fuel costs. The first four years were associated with the current fleet of AS350B3s and the next 16 years were the estimated costs for a new Airbus H125. The operating costs are not based on GMP but rather the current method of pay as the costs are encountered.**
- **Disposition Amount: In Year 4, the City would flip its fleet to Airbus H125s. Regardless of the fleet size, the City would be selling or trading in four helicopters. The amount represents the total Adjusted Value for the fleet as calculated by *Life Cycle Cost 16.2*. The calculated value does not consider the effects of the current economy.**
- **Purchase: This includes the principal and interest on a lease-to-purchase arrangement over a ten-year period with 2.75 percent annual interest. The period of time and interest rate were provided by the City. This option for lease-to-purchase generated the best net present value scenario among the alternatives for acquiring the helicopters, thus the reason we used it in the projection.**
- **Total: Represents the total resources consumed or received to replace the current fleet. The period of time was 20 years.**

<u>Replace Current Fleet with a Phased Plan:</u>

If the plan to replace the ABLE fleet was to occur in phases rather than all at once, we relied upon the following information and assumptions. The result was a 20-year estimate of the resources required to complete the fleet's transition to new helicopters.

C&D Observations/Assumptions:

- Based upon the maintenance tracking reports from Rotorcraft Support Inc., the 12-year inspections are scheduled to occur in the calendar Year 2018. That means the Conklin & de Decker life cycle cost analysis would place each of the 12-year inspections in Year 2, which represents the time period of August 2017 through July 2018.
- One of the current AS350B3, as of August 2016, was either in the process of or would soon begin its 12-year inspection. Whichever helicopter this was might change the order of helicopter disposals recommended in the replacement schedule. Because this

current helicopter would have already completed the inspections, the City would want to retain it for two to three years after the event.

- The City would not want to retain the current helicopters beyond Year 7 due to age and estimated resale values. At Year 7, the helicopters would be approximately 19 years old. This factor is not necessarily a negative by itself. However, when combined with the behavior of the Adjusted Values after Year 7, the helicopters would be quite old before the Adjusted Values adequately improved again around Year 15. For example, each of the helicopters would drop below the Basic Value beginning around Years 7 – 9 and remain below until Years 13 or 14, depending upon the specific helicopter. Table 5-4 and Chart 5-3 illustrate this trend in values. By the time the Adjusted Values recovered in Year 15, the age of the ABLE helicopters would be 27 years.
- It is important to mention that the actual amount received in the sale of a pre-owned helicopter can differ from the adjusted values in the *Life Cycle Cost 16.2* analysis model due to current market activity.

Table 2-1 from Section 2 Life Cycle Cost Projections served as the basis for the timing of the replacement schedule of the AS350B3s. Table 5-4 illustrates the relationship between a helicopter's Adjusted Value when compared to its Base Value. The yellow boxes indicate when the Adjusted Value is greater than the Base Value (a good relationship), white boxes represent the opposite, and red boxes highlight when the Adjusted Value is the lowest in the 20-year period. Section 2 explains in more detail the significance of the relationship between Adjusted and Base Values and how the Adjusted Value was calculated.

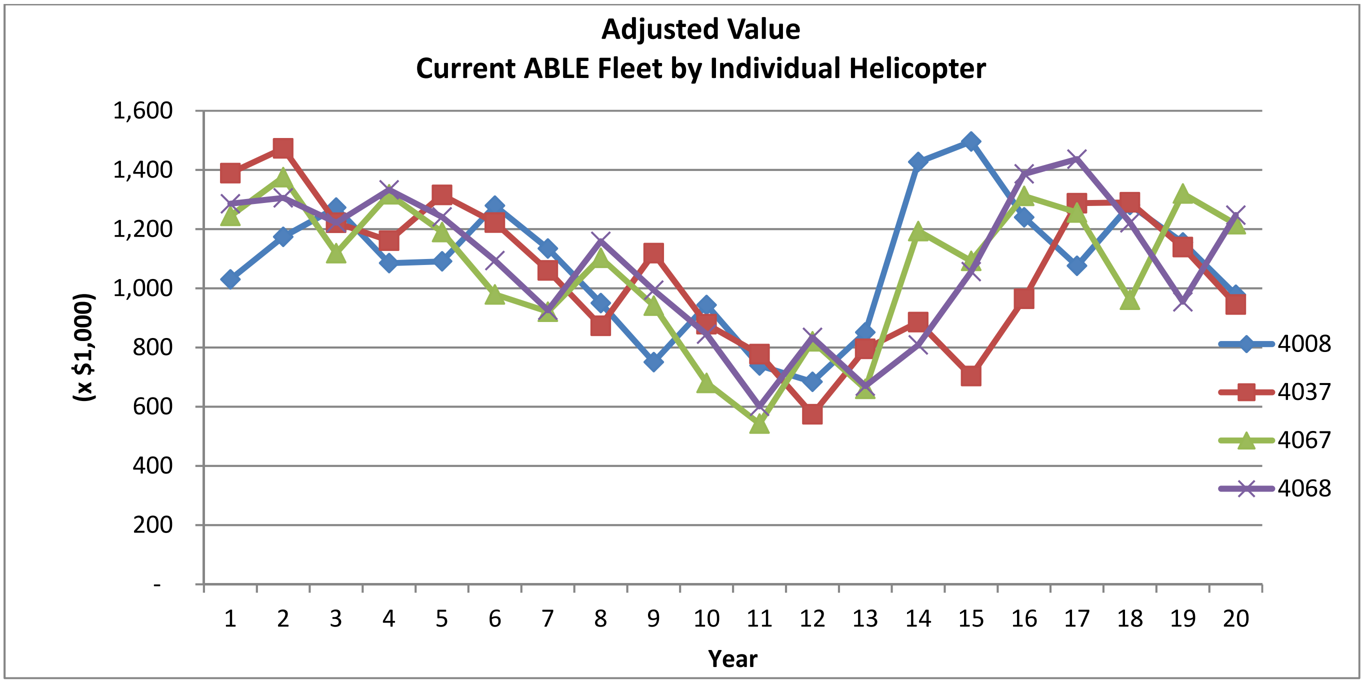
Chart 5-3, while somewhat overwhelming, illustrates the Adjusted Value behavior of each ABLE helicopter during the 20-year period. We intentionally omitted the actual data point values due to additional confusion if they were displayed. Rather, the purpose of this chart is to show the trends in the values. Table 5-4 helps to interpret Chart 5-3 by identifying the years when each ABLE helicopter had the highest Adjusted Value. The letter A indicates the highest value and E indicates the fifth highest value.

Table 5-4

ABLE Helicopters - Annual Summary of Adjusted Values

Serial Number	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
4008			E			D								B	A			C		
4037	B	A			C												E	D		
4067		A		C												D	E		B	
4068	E	D		C												B	A			

Chart 5-3



Based upon our assumptions, observations, and the information shown in Table 5-4 and Chart 5-5, we suggest the disposition of the ABLE helicopters in the following years. Because the helicopters are similar in age, selecting the "perfect" year for disposition was difficult because the respective Adjusted Value values behave in similarly.

Table 5-5	
Suggested Year of Disposition - ABLE Fleet	
Serial Number	**Year**
4008	6
4037	5
4067	2
4068	4

Notes:

- **Selected serial number 4008 for Year 6 because the year is the highest Adjusted Value in the years prior to Year 7. Most of the helicopter's higher value years occur in Year 14 and subsequent.**
- **Serial number 4037 has its three highest valued years prior to Year 7 and is also the low time in hours of the four helicopters. If the 12-year inspection does occur in Year 2, delaying the disposition until Year 5 will allow ABLE to recapture some of the cost of the inspection, while catching the Adjusted Value at a slightly higher value than Years 3 and 4.**
- **Serial Number 4067 has two of its highest valued years prior to Year 7. Its Year 2 value reflects the completion of the 12-year inspection. We assumed the disposition would occur before the**

inspection, which would drop the Adjusted Value to what was reflected in Year 1. As an alternative, we considered Year 4 as well. The value in that year represents another peak when compared to Year 3.

- **Serial Number 4068 follows a similar value curve as 4067. Due to this trend, serial numbers 4067 and 4068 could be switched as to the year of disposition. Because we selected Year 2 for serial number 4067, serial number 4068's disposition will occur in Year 4.**

If the City elects to reduce the ABLE fleet to three helicopters, then the year of disposition for the fourth helicopter becomes flexible. If the decision to transition to three helicopters with GMP does not improve availability as predicted, then ABLE has not lost its fourth helicopter and can chose a more appropriate year for disposition.

While the Adjusted Value is important, and in this exercise was the primary variable in the decision process for disposition of the respective helicopters, it should not be the only variable considered. Other factors that could contribute to alternate plans include a change in the economy, funding resources, and mission requirements.

Based on the sequence for disposition suggested in Table 5-5, we ran a 20-year life cycle cost estimate to determine the resources required to complete the fleet change. Table 5-6 summarizes the results of the analysis.

Table 5-6 Summary of Program Costs - Replace Fleet in Phases (x $1,000)				
Fleet Size	**Operating Cost**	**Disposition Amount**	**Purchase**	**Total**
Three	$45,169	($4,974)	$15,174	$55,369
Four	$46,659	($4,974)	$20,232	$61,917

Notes:

- **Fleet Size: Conklin & de Decker recommended the fleet size change to three aircraft. We also provided the costs for a fleet of four in case the City chooses that alternative. The three aircraft estimate is based on 1,200 flight hours per year per aircraft. The four aircraft estimate is based on the current 900 flight hours per year. Unlike the scenario when the helicopters were disposed of at the same time, the 1,200-hour rate did not apply until Year 7. This is the year when the fleet would drop from four to three aircraft. Prior to Year 7, we continued to use 900 hours per year.**
- **Operating Cost: Represents a 20-year period of maintenance and fuel costs. With the disposition schedule staggered, we used the current estimated maintenance and fuel costs for each serial number. When a helicopter was replaced, based on Tables 5-5 disposition schedule, we used the estimated costs for a new Airbus H125. The operating costs are not based on GMP but rather the current method of pay as the costs are encountered.**
- **Disposition Amount: Based on the schedule in Table 5-5, the City would sell or trade-in a current helicopter for a new Airbus H125. Regardless of the decision regarding the eventual fleet size (three versus four), the City would be selling or trading in four helicopters. The amount represents the total Adjusted Value for each helicopter in the year of disposition as**

calculated by *Life Cycle Cost 16.2*. The calculated value does not consider the effects of the current economy.

- **Purchase: This includes the principal and interest on a lease-to-purchase arrangement over a ten-year period with 2.75 percent annual interest. The period of time and interest rate were provided by the City. This option for lease-to-purchase generated the best net present value scenario among the alternatives for acquiring the helicopters, thus the reason we used it in the projection.**
- **Total: Represents the total resources consumed or received to replace the current fleet. The period of time was 20 years.**

The difference in total resources consumed between the two methods of disposition (same time versus phased), if the fleet is reduced to three, yield only an approximate $400,000 difference during the 20-year estimate. If the fleet size remains at four, the difference is larger at $1.2 million.

However, a big difference does exist in the total resources required when comparing the three helicopter fleet to the four in both disposition scenarios. If the helicopters are disposed in a phase and the fleet is reduced to three helicopters, the estimated savings in resources consumed during the 20-year scenario is $6.5 million. This savings decreases to $5.2 million if the fleet is converted at the same time.

5.3.2 San Diego Fire-Rescue Department (SDFD)

SDFD currently has two helicopters in its fleet, the Bell Helicopter 212 HP and 412EP. The variety of missions the department is equipped and trained to perform include wild land firefighting, which includes ground crew and supply transportation and water dropping capabilities; participation in advanced life support services; assistance during structure and wild land fires with command and control, and exposure protection; rescues that include vehicles, animals, and humans in a wide variety of settings such as water, rough terrain, and limited light; response to hazardous material situations; assistance during SWAT team activities; and when needed, transportation; and high-rise structure firefighting.

The wide variety of missions requires that the current helicopters carry a variety of specialized equipment, including rescue hoist, fixed tank for dispensing fire retardant, NightSun searchlight, harness for rescues, rappelling equipment, Jaws-of-Life, and paramedic equipment. In addition to the equipment, the helicopters carry personnel on certain missions, which also require additional cabin space and useful load.

While the Conklin & de Decker analysis for SDFD will follow a similar format as used for the ABLE analysis, the issue facing SDFD is slightly different. Like ABLE, the current SDFD fleet can perform its missions. However, when it performs its primary mission of firefighting, the overall objective is the more water that a helicopter can deliver in a given period of time the better. SDFD would like to move into a category of helicopter that will allow it to deliver more water per drop than it currently can.

The scope of the analysis limits our effort to summarizing the costs associated with adding a larger category helicopter to the SDFD, rather than justifying its need.

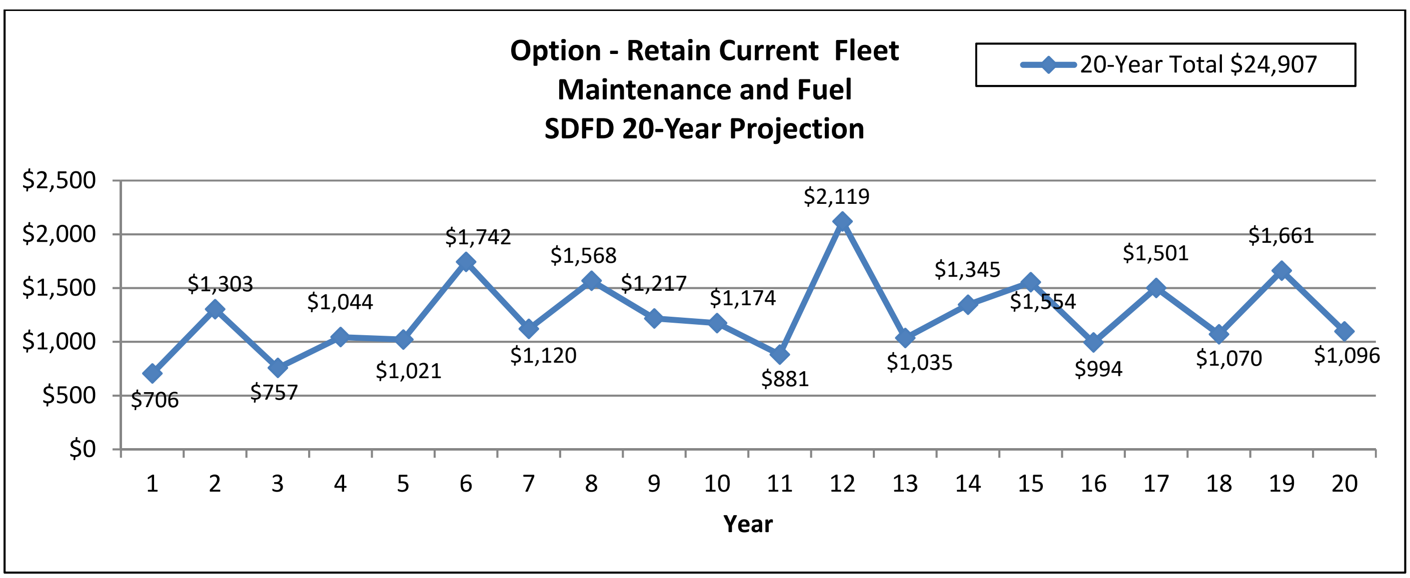
5.3.2.1 Retain Current Fleet

Although retaining the current fleet is not likely, it serves as a benchmark when compared to the other possible alternatives. Based upon the life cycle cost assumptions stated in Section 2 Cost Projections (pages 29-30), we projected the estimated fuel and maintenance costs for the next 20 years for Bell 212HP and 412EP.

Key assumptions included the annual flight hours at 250 per helicopter, which is based on the projected hours for the current year, fuel rate per gallon of $2.40, annual inflation between 2.5 and 3.5 percent, labor that includes the salaries, benefits, and training costs for the current maintenance technician employees, and the remaining lives for the significant scheduled maintenance events and items for the respective helicopters.

Chart 5-4 combines the annual estimated fuel and maintenance costs for the two helicopters. For example, the fleet's cost in Year 1 is an estimated $706,000. The most expensive year for the current fleet would be Year 12. Over the 20-year period, the total costs expended on fuel and maintenance would be almost $25 million. Under this scenario, there would not be any acquisition costs for new helicopters or receipts for the disposition of the exiting helicopters.

Chart 5-4



5.3.2.2 Replace Current Fleet

As mentioned previously, SDFD has two helicopters, the Bell 212HP and 412EP. Respectively, the helicopters are thirty-six and eight years old. Due to the number of helicopters and the likelihood of only the Bell 212HP being a candidate for disposal in the near future, we did not differentiate between changing the fleet at the same time versus changing it in phases. However, while SDFD has expressed its desire to increase its water delivery capability to improve its effectiveness fighting fires, it has also expressed the desire to acquire two of the helicopters rather than just one.

Based on this desire, we will show one cost summary to dispose of the Bell 212HP, while acquiring two Sikorsky S-70i helicopters at the same time.

Replace the Current Fleet:

- For the cost projections in this section, we chose to use the Sikorsky S-70i in lieu of the Airbus H215 for one primary reason. The Sikorsky S-70i met the desire to deliver between 700 and 1,000 gallons of water per drop. The Airbus H215 delivers in the range of 500 to 550 gallons. When comparing the two types during the average firefighting mission, the Sikorsky S-70i can deliver between 30 and 42 percent more water per drop.
- Recommend the City consider the Sikorsky S-70i fleet size be two due to availability reasons. As with the ABLE AS350B3, significant scheduled maintenance events have an adverse effect on the availability rate of the S-70i. The older versions of the S-70s have a major inspection that occurs every 500 hours. For SDFD, the inspection would occur every two or three years depending upon the amount of hours flown. The 500-hour inspection takes three to four months to complete. Fortunately, the S-70i version has extended the inspection interval to 750 hours, which would occur every three to four years. Also extended were the intervals for the less significant inspections, which formerly occurred every ten hours. If the aircraft was engaged in a big fire, an interval of this length would cause frequent unavailable periods. These inspections were extended to 40 hours.

  If delivering larger amounts of water is a priority and inspection intervals like the 500 or 750-hour are causing three to four months of downtime, then a second helicopter is required for adequate coverage.

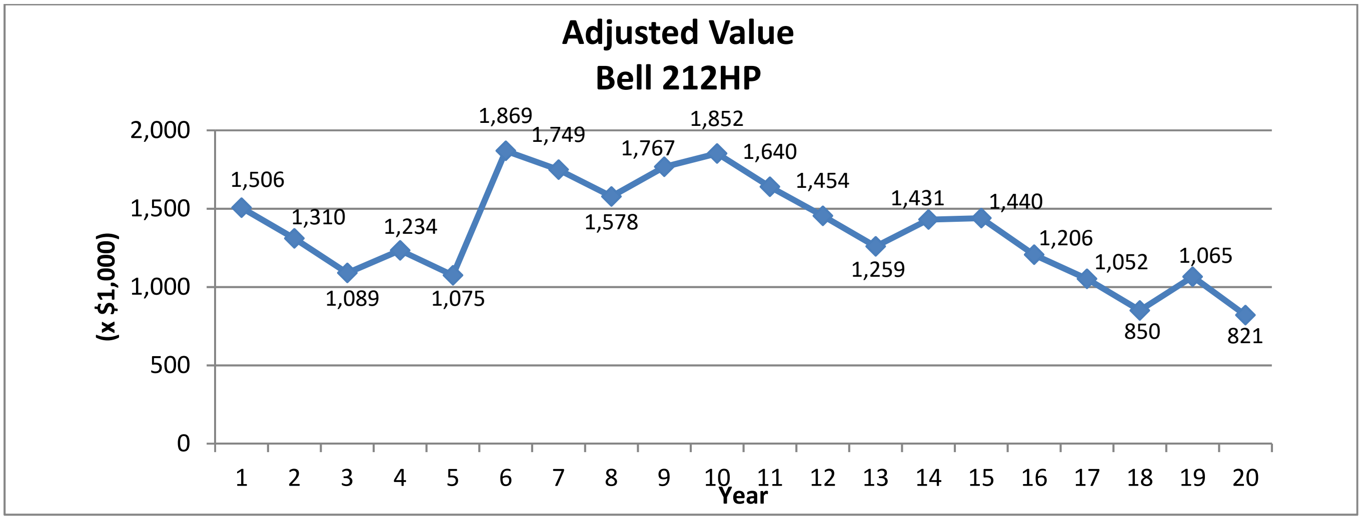
- If SDFD does acquire Sikorsky S-70i helicopters, it must use guaranteed maintenance programs (GMP) for both the airframe and engines. Section 4 Acquisition Options (pages 3-9) discusses the virtues and shortcomings of these programs. Other than creating budget certainty, GMPs can improve availability percentages due to consigned inventory on location, component exchange pools, and technical support. The county of Los Angeles Fire Department has used Sikorsky's Total Assurance Plan (TAP) since acquiring its S-70A helicopters and believes the program was critical to improving its levels of aircraft availability.

- Recommend that, regardless of the new helicopter type chosen, the City create a competitive environment among the manufacturers during the acquisition process. Even if the City and SDFD have determined what the helicopter type will be, competition leading up to the acquisition most likely will lead to concessions in areas such as helicopter purchase price, trade-in values, support commitments, and lower GMP rates. Competition creates negotiation and negotiation leads to a better deal. Unfortunately, creating a competitive environment during the acquisition process is not common practice in the industry.

As stated previously, the SDFD desire is to dispose of the Bell 212HP in concert with the acquisition of at least one but preferably two Sikorsky S-70i helicopters. Chart 5-5 provides the Adjusted Value for the Bell 212HP over the next 20-year period. The values are based upon the remaining times associated with significant scheduled maintenance items and events. Adjusted Value charts with explanations for each helicopter were provided in Section 2 Life Cycle Cost Projections.

As a reminder, Year 1 represents the actual calendar period of August 2016 through July 2017. For the first five years, Year 1 represents the highest Adjusted Value. Based on research from Section 4 on market values, it probably is not realistic that receipts of $1.5 million from a sale in Year 1 are likely. Despite the declining values through Year 5, disposal of this aircraft soon is preferable to spending the funds to recapture the Adjusted Value in Year 6. SDFD will encounter engine restoral costs equaling almost $1 million in that year. As a reminder, in Year 6 this Bell 212HP will be 40 years old.

Chart 5-5



Assuming, SDFD disposes of the Bell 212HP in Year 2 and acquires two Sikorsky S-70i helicopters, one in Year 2, the second in Year 3, Table 5-7 summarizes the costs over the next 20-year period.

Table 5-7				
Summary of Program Costs – 20 Years				
Dispose of 212HP, Purchase S-70i (x $1,000)				
Aircraft Acquired	**Operating Cost**	**Disposition Amount**	**Purchase**	**Total**
One S-70i	$33,573	($1,310)	$21,065	$53,327
Two S-70i	$51,860	($1,310)	$42,130	$92,680

Note:

2) **Purchase: Based upon the lease-to-purchase option at 10 years and a 2.7 percent annual interest rate. Acquisition price is estimated at $18.5 million for a mission-ready helicopter.**

If just one Sikorsky S-70i is purchased in Year 2 and the Bell 212HP is disposed of in the same year, the 20-year program costs would total $53.3 million. If the City acquires a second Sikorsky S-70i in Year 3, the total cost is $92.7 million. Both scenarios assume the Bell 412EP remains in the fleet for the entire 20-year period.

While we did not build the estimates based on GMP, we encourage the City to pursue these programs. All of the helicopters will receive the many benefits associated with GMP mentioned in Section 4.

In the current conditions, the City should have leverage when establishing the parameters for the purchase. It is important to remember to keep the purchase process a competition to ensure a better negotiation and final agreement.