Capstone Phase I – Bethel Core Area

Investment Analysis Report

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Version 0.7

Approved By: _____
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Concurrence: _____
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Background

Capstone is a safety demonstration project within the SF-21 Program Office that started as part of a congressional mandate in FY99. The objective of the program is to reduce in-flight accidents and incidents in the state of Alaska. The program approaches this objective using a bundled group of technologies to provide pilots and air traffic controllers with enhanced data concerning surveillance, weather, terrain and obstruction avoidance, and air traffic. This investment analysis is intended to help the JRC make a decision to baseline F&E and O&M costs for FY02 and beyond for the Bethel Core Area.

The systems used on board the aircraft include Global Positioning System (GPS) for navigation, a moving map featuring hazardous terrain/obstruction warning to reduce Controlled Flight Into Terrain (CFIT), and Automatic Dependent Surveillance-Broadcast (ADS-B) for increased traffic situation awareness. These tools are displayed on a common display monitor of the instrument panel. ADS-B data is also transmitted through ground-based transceivers to the Anchorage Air Route Traffic Control Center (ARTCC) to provide "radar-like" service in the Bethel area. Additional tools included in the Capstone program are: the Flight Information Services (FIS), which transmits text and graphical weather data via the ADS-B datalink such as Meteorological Aviation Routine Weather Reports (METARs), Terminal Area Forecasts (TAFs), and current Next Generation Weather Radar (NEXRAD) weather data; additional Automated Weather Observation System (AWOS) stations dispersed throughout the area; and development of additional GPS approaches to airports.

Preparation for this JRC involved tailoring of the Acquisition Management System (AMS) process, because it serves to baseline only the Bethel Core Area demonstration portion that was congressionally mandated. The IA was conducted in accordance with the FAA's AMS and Investment Analysis (IA) Process Guidelines with the following exceptions, which are also outlined in the FAA Advisory Board (FAB) waiver:

- Waive the MNS.
- In lieu of the iRD and FRD for the Bethel area, provide an iRD for ADS-B and equipment list by location and AF supportability requirements.
- Provide an Integrated Program Plan that is limited to explanation of the Capstone Phase I program actions and activities.
- Provide a modified Investment Analysis of Capstone Bethel Core Area that includes:
  - Cost Analysis, including cost risk
  - Human Factors Assessment
  - Architecture Assessment
  - Safety/Hazard Assessment
  - Affordability Assessment
  - Information Security Assessment
- Provide a limited "to-go" Acquisition Program Baseline (APB) for the Bethel Core Area which will baseline cost, schedule, and performance
- Provide a plan to track O&M expenditures.

While the benefits have been waived for this phase, it should be noted that Capstone has successfully equipped 150 aircraft with ADS-B which are operating regularly in the Bethel Core Area.

This Investment Analysis Report (IAR) provides, in detail, the methodology, analysis, activities, findings, and recommendations that comprised the basis for the decision. The expected costs and performance schedule are also outlined in this report. Below is a brief summary of the analyses and findings, followed by the IA Team's recommendations to the JRC.

Cost Analysis

Based on the FAA Acquisition Executive (FAE) Advisory Board (FAB) direction, the cost team considered the FAA Life Cycle Costs (LCC) for Ground Based Transceivers (GBT) and AWSS systems implemented in the Core Bethel Area of Alaska. The analysis was based on "most likely" values developed in conjunction with the IPT. The following table shows the range on the LCC estimate (LCCE) and the high-confidence and most likely estimates.

Table ES-1. Life Cycle Cost at High Confidence Level ($M)

	Most Likely	High Confidence	Delta
LCC (Current Year, $M)	**$53.6**	**$59.3**	**$5.7**

The cost estimates reflected in Table ES-2 below show the cost summary for Facilities and Equipment (F&E) and Operations and Maintenance (O&M). The costs include estimates for development, implementation, operations and maintenance, and disposition.

Table ES-2. High Confidence Cost Estimate for GBT and AWSS (Current Year, $M)

Cost Element	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09-FY22	Total
Total Life Cycle Cost	$4.15	$13.45	$6.26	$5.18	$5.58	$5.43	$6.28	$12.93	$59.27
F&E	$2.75	$10.81	$3.64	$0.00	$0.00	$0.00	$0.73	$0.62	$18.56
O&M	$1.40	$2.64	$2.62	$5.18	$5.58	$5.43	$5.54	$12.30	$40.71

The above costs represent the developed "To Go" life cycle cost estimate (both F&E and O&M) for Capstone Phase I Bethel Area beginning in FY02. For the AWSS portion, these costs are estimates from FY02 to FY22 and will be managed by the AWSS program office. The costs for the GBT portion are shown from FY02-FY08 since the team has assumed that subsequent phases of Capstone will capture the Bethel Core Area costs beyond FY08.

The main cost driver in this estimate for both the GBT and AWSS was the cost for Second Level Engineering Support. This element includes costs for engineering activities for GBTs, Capstone Communications Control Server (CCCS), and Micro En Route Automated Radar Tracking System (MicroEARTS) to support Alaska statewide efforts. These estimates are broken out in greater detail within the IAR to show the portion that will be managed by the AWSS program office and the remaining GBT portion.

Recommendations

The IA Team recommends that the JRC:

- Approve the F&E and O&M Baselines for Capstone Phase I, Bethel.
- Assign the Capstone program office, AAl-1SC, to manage the GBT equipment.
- Assign the AWSS program office, AUA-430, to manage the AWSS equipment.

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1.0 INTRODUCTION

This report documents the activities that led to the development of the Investment Analysis Report (IAR) and the Acquisition Program Baseline (APB) for the Capstone Phase I – Bethel Core Area. As specified in the Acquisition Management System (AMS) and the Investment Analysis (IA) Process Guidelines, this report summarizes the requirements, assumptions, cost and related analysis, and the results of the affordability assessment by the System Engineering Operational Analysis Team (SEOAT). This IA is tailored, at the direction of the FAA Acquisition Executive (FAE) upon recommendation from the FAE Advisory Board (FAB), which waived the requirements for a Mission Need Statement (MNS), alternatives assessment, and benefits assessment because the Phase I portion of Capstone is congressionally mandated and, largely, already fielded. Finally, it summarizes the investment recommendations on Capstone Phase I – Bethel Core Area to the Joint Resources Council (JRC).

1.1 Bethel Core Area Investment Analysis

Capstone-Phase I addresses the operational needs identified in the Bethel Core Area region. The Capstone Program is a project under the SF-21 Program Office. This IAR summarizes the investment analysis activities and findings in the Bethel Core Area. The data presented supports a Joint Resources Council (JRC) 2 investment decision for Capstone Phase I Bethel Core Area Program.

1.1.1 Background

Capstone is a safety demonstration project under the SF-21 Program Office that started as part of a congressional mandate in FY99. The Federal Aviation Administration (FAA) inserted a budget wedge for FY00 and beyond. The objective of the program is to reduce in-flight accidents and incidents in the Alaska region. The program approaches this objective using a bundled group of technologies to provide pilots and air traffic controllers with enhanced data concerning surveillance, weather, terrain and obstruction avoidance, and air traffic. The systems used on board the aircraft include:

- Global Positioning System (GPS) for navigation,
- Moving map featuring hazardous terrain/obstruction warning to reduce Controlled Flight Into Terrain (CFIT), and
- Automatic Dependent Surveillance-Broadcast (ADS-B) for increased traffic situation awareness.

These tools are displayed on a common display monitor mounted in the center console of the instrument panel. ADS-B data is also transmitted through ground-based transceivers to the Anchorage Air Route Traffic Control Center (ARTCC) to provide “radar-like” service in the Bethel area.

Additional tools included in the Capstone program are:

- Flight Information Services (FIS), which transmit text and graphical weather data via the ADS-B datalink such as
  1. Meteorological Aviation Routine Weather Reports (METARs),
  2. Terminal Area Forecasts (TAFs), and

3. Current Next Generation Weather Radar (NEXRAD) weather data;

- Automated Weather Observation System (AWOS) stations dispersed throughout the area; and
- Development of additional GPS approaches to airports.

The JRC for Capstone Phase I Bethel Area is part of a planned series of JRCs to support improved communication, navigation, and surveillance capabilities throughout Alaska. Capstone received congressional funding for the equipment and installation costs and is seeking JRC approval for the follow-on operations. Preparation for this JRC involved tailoring the AMS process, because it serves to baseline only the Bethel Core Area demonstration portion that was congressionally mandated. The IA was conducted in accordance with the FAA's AMS and IA Process Guidelines with the following exceptions, which are outlined in the FAB:

1) Mission Need to be waived
2) No initial Requirements Document
3) Tailored Investment Analysis
4) Benefits Assessment waived
5) No Alternatives Assessment
6) A limited Risk Assessment relevant to identified Risk/Mitigation Plan
7) APB will baseline cost, schedule, and performance

The subsequent JRCs will be conducted in association with additional phases of Capstone as shown in Figure 1-1 and Table 1-1 below.

Figure 1-1. Capstone Phases

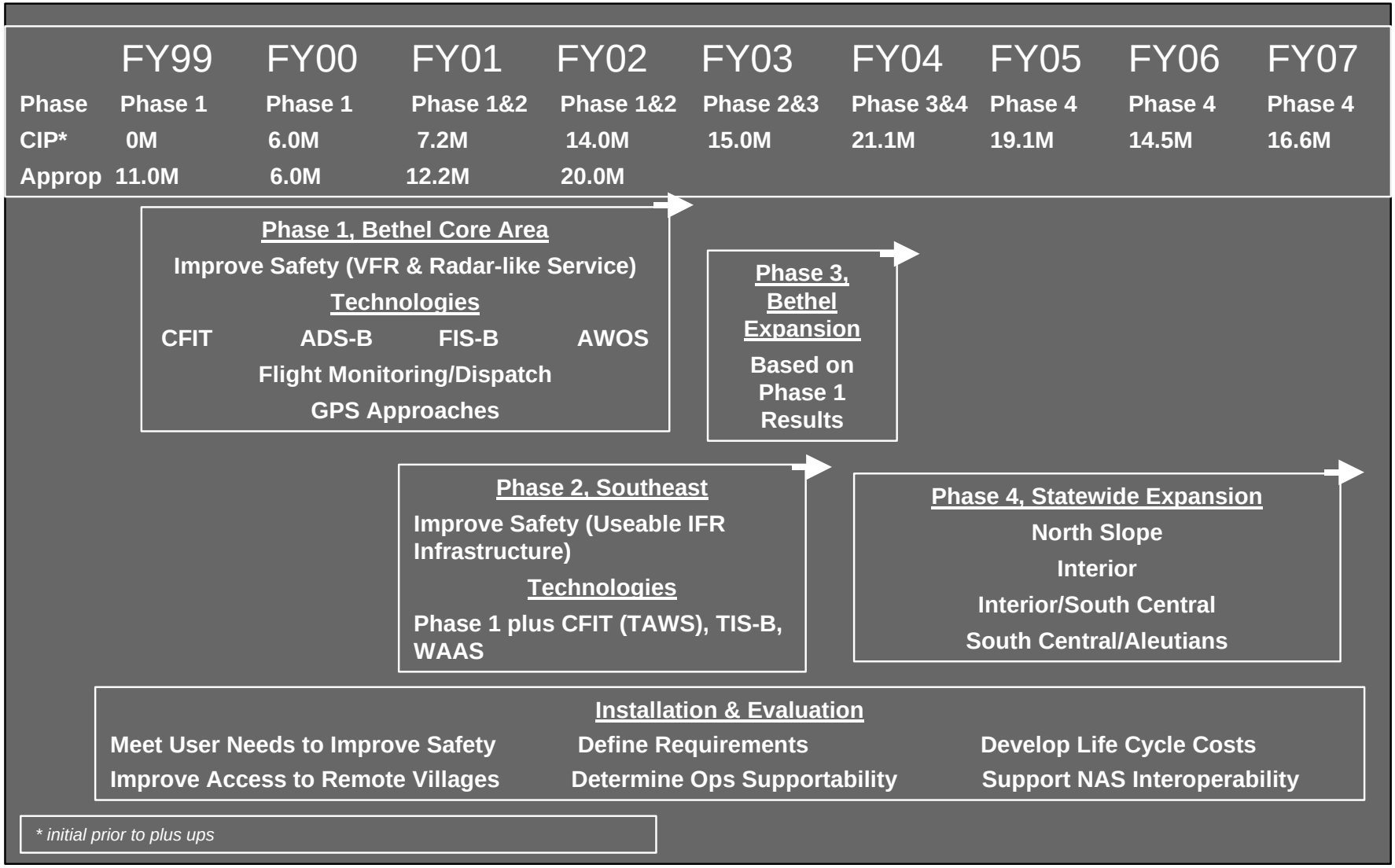


Table 1-1. Requirements for Future JRCs

Location	Mission Need	IRD	FRD	IA	IPP	APB	JRC
Bethel Core Area	No[i] Congressionally directed project	No – equipment and performance requirements defined by research[1]	Equipment list by location and AF supportability requirements[ii]	Tailored to focus primarily on operations, baseline cost and system performance. Note: no alternatives, benefits, and safety assessment, and risk assessment limited to costs	Yes – limited to Bethel Core Area	Yes, for cost. No benefits, safety, or risk	JRC 2 decision to baseline costs (F&E and O&M) and to obtain approval for O&M for FY04 and beyond JRC 3 in service decision to pick up for continued ops and maintenance
SE Alaska **(initial work will be in the Juneau area)**	No Congressionally directed project	No – equipment and performance requirements defined by research	Equipment list and system performance requirements derived from research[iii]	Tailored for the 2A (similar to Bethel Core). After 2A, would collect performance data for benefits and performance measurement. JRC 2B would include benefits, and performance, and future ops costs of continued use as part of the LCCE for baselining the program	Yes	Yes for F&E costs, schedule and performance[iv] Update for benefits and Ops costs for JRC 2b	JRC 2a Exit criteria based on benefits and performance exist in going to JRC 2b (go to JRC 2B after performance and benefit data indicate a business case?) JRC 2b to baseline the program (F&E and Ops) when experiments meet performance threshold defined by exit criteria JRC 3[v]
Y/K Expansion	Yes	Equipment list and hardening requirements necessary to sustain Operations and Maintenance[vi]	Equipment list by location and AF supportability requirements as an expansion of same capabilities as Bethel	Full IA	Yes[vii]	Yes for F&E and Ops costs, schedule and performance	JRC 2b, since it is an extension of Bethel a two-step JRC 2 is not necessary. Baselines program and ops tail for ops and maintenance JRC 3
Statewide	Yes[viii]	Yes – due to integration of technologies and procedures broader than Capstone[ix]	Yes	Full IA focused on statewide modernization for safety	Yes	Yes – Full Cost, Schedule, Performance, and Benefits	JRC 1 on mission need JRC 2a and b JRC 3 Most likely developed in multi-year phases so that the JRC 3 may be multiple acceptances occurring at different times but one JRC 2b

[1] The initial direction from the FAB, to furnish a "list of equipment" instead of an fRD, does not allow for a means to measure performance. Consequently, ARQ is developing an iRD. The iRD will be updated and finalized for Capstone statewide expansion. The performance standards will be those developed for the Minimum Operations Performance Standards.

1.1.2 Scope of Analysis

The analysis focused on Capstone Phase I Bethel Core Area. For the Bethel Core Area region, the following equipment has been or will soon be installed: 11 Ground Based Transceivers (GBTs) and 10 AWOSs, and associated infrastructure. The team assessed the life cycle costs of upgrading and maintaining that equipment. To support the maintenance concept, the AWOSs will be upgraded to AWSSs and managed under the National AWSS program. All costs associated with the AWOS/AWSSs will be captured in the Capstone Bethel Core Area baseline. The intent of the JRC for the Bethel Core Area is to baseline both Facilities and Equipment (F&E) and Operations and Maintenance (O&M) costs for FY02 and beyond. Table 1-2 below summarizes the associated tasks for this area.

Table 1-2. Associated Tasks of Phase 1 Capstone Bethel

Task
GBT Installations (Service certification of 11 sites)
ZAN/Capstone Architecture Upgrades
MEARTS Upgrades
CCCS certification
Information Services and Dispatch Flight Monitoring Completion
Dispatch Flight Monitoring (VFR and IFR ADS-B aircraft)
Bethel Special VFR Improved Operations
Bethel Tower Display
Sector 13 Hi/Low Resectorization
AWOS III/AWSS – 10 locations
GPS Non-Precision Approaches (11 airports with new approaches)
Operational Evaluation and Safety Study – UAA

1.2 GBT/Automation Program Overview

The Ground-Based Transceiver (GBT) is the ground-based component of the overall ADS-B system located at remote airport locations. The GBT receives ADS-B information from aircraft and transmits it via the Alaskan NAS Interfacility Communications System (ANICS) satellite-based telecommunications system to the MicroEARTS at the Air Route Traffic Control Center (ARTCC). It is then displayed as “radar like” data on the Air Traffic Controller’s display. Cisco 3662 Routers connect the telecommunications channels from each GBT site to the MicroEARTS. In the future, a Sun Enterprises 250 PC, the Capstone Communications Control Server (CCCS), will be involved in the routing of FIS-B/TIS-B data both to and from the ARTCC. The GBT estimate serves three purposes:

1. Assists program and financial managers in making informed budgetary and programmatic decisions. This is accomplished by

   - Providing input for JRC (March FY02) and Resource Planning Document (RPD) submission
   - Baselining the systems in Bethel Core Area

2. Supplies the Alaska Capstone Program with a comprehensive, dynamic cost model to support budget drills, "what-if" exercises, and costing efforts for future expansion of technology in the Alaska Region (AAL)
3. Provides supporting documentation to and a Basis of Estimate (BOE) for the above cost model.

1.3 AWOS/AWSS Program Overview

AWSS is an automated surface weather observing system similar to the AWOS/ASOS. The system provides pilots and other users with all the weather information furnished by the AWOS/ASOS systems. AWSS contains a powerful microprocessor-based computer system that collects and processes an array of sensor data that is formatted for display and output. In addition to the various sensors, AWSS also consists of a computer-generated voice subsystem, and a transmitter to broadcast local, minute-by-minute weather data. The AWSS estimate serves four purposes:

1. Assists program and financial managers in making informed budgetary and programmatic decisions. This is accomplished by

    - Providing input for JRC (March FY02) and RPD submission
    - Baselining the systems in Bethel Core Area, which will be managed by the AWSS program office.

2. Supplies the Alaska Capstone Program with a comprehensive, dynamic cost model to support budget drills, "what-if" exercises, and costing efforts for future expansion of technology in Alaska Region
3. Provides supporting documentation and a basis of estimate for the above cost model.
4. Develops a baseline for the 10 AWSSs that will be managed by the AWSS program office.

2.0 COST ANALYSIS

The Capstone Project Team developed "To Go" life cycle cost estimate (both F&E and O&M) for Capstone Phase I Bethel Area beginning in FY02. The Basis of Estimate (BOE) for the cost baselines were developed in accordance with standard cost estimating practices and guidance provided by ASD-410. Estimates were coordinated with the appropriate offices within the Alaska region and Headquarters, including AOS, ARU, AFZ, ARQ, AAL, NATCA, and ASD. AFZ-400 and ASD-400 validated and evaluated the estimates for sufficiency and suitability through a review process that included detailed cost reviews, follow-up with organizations that provided the data, and review of the BOE documentation. Detailed documentation of the estimates is contained as an attachment to this report.

2.1 Approach

As previously mentioned, based on the FAE direction, the cost team considered the FAA Life Cycle Costs (LCC) for GBT and AWSS systems implemented in the Core Bethel Area. Costs are presented in current year dollars and were derived by applying the Office of Management and Budget (OMB) inflation rates of April 18, 2001. The analysis was based on "most likely" values developed in conjunction with the Integrated Product Team (IPT). A cost risk assessment was performed in which the uncertainties of costs were captured as a range of values.

Table 2-1 shows the ranges on the LCC estimate and the high-confidence and most likely estimates.

Table 2-1. Life Cycle Cost at High Confidence Level ($M)

	Most Likely	High Confidence	Delta
LCC (Current Year, $M)	**$53.6**	**$59.3**	**$5.7**

2.2 Ground Rules and Assumptions

The ground rules and assumptions used for developing the LCCE are as follows:
For GBT:

- Life cycle of estimate is 6 years, beginning in FY02, due to the hardware service life of the GBT.
  - It is expected that subsequent Capstone Phases will overtake the management of the GBT equipment before the first technical refresh decision, scheduled in 2008.)
- Bethel Core Area GBT/Automation costs beyond FY08 will be captured under a separate budget for statewide expansion.
- The LCCE addresses costs for
  - Production upgrades for 11 Ground Based Transceivers (GBTs)
  - Automation components for GBTs (CCCS system, MEARTS, Display)
  - Two support systems for GBT systems
  - Simulators for GBTs

- The Capstone Program Office will be the IPT for the above portion

For AWSS:

- The service life of the AWSS systems is 20 years, beginning with upgrade from AWOS in FY03.
- The LCCE addresses costs for:
  - Ten upgraded and commissioned operational AWSS systems
  - 3 support systems established under the National AWSS Program for AWSS systems
- The AWSS Program Office will be the IPT for the above portion.

2.3 Results

The cost estimates reflected in Table 2-2 below show the cost summary for F&E and O&M. The costs include estimates for development, implementation, operations and maintenance and disposition.

Table 2-2. High Confidence Cost Estimate for GBT and AWSS (Current Year $M)

Cost Element	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09-FY22	Total
Total Life Cycle Cost	$4.15	$13.45	$6.26	$5.18	$5.58	$5.43	$6.28	$12.93	$59.27
F&E	$2.75	$10.81	$3.64	$0.00	$0.00	$0.00	$0.73	$0.62	$18.56
O&M	$1.40	$2.64	$2.62	$5.18	$5.58	$5.43	$5.54	$12.30	$40.71

Tables 2-3 and 2-4 below show separately the costs for GBTs and AWSSs respectively.

Table 2-3. High Confidence Cost Estimate for GBT (Current Year, $M)

Cost Element	FY02	FY03	FY04	FY05	FY06	FY07	FY08	Total
Total Life Cycle Cost	$4.15	$11.81	$5.32	$4.47	$4.86	$4.69	$5.52	$40.82
F&E	$2.75	$9.68	$3.17	$0.00	$0.00	$0.00	$0.73	$16.34
O&M	$1.40	$2.13	$2.15	$4.47	$4.86	$4.69	$4.79	$24.48

Table 2-4. High Confidence Cost Estimate for AWSS (Current Year, $M)

Cost Element	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09-22	Total
Total Life Cycle Cost	$0.00	$1.64	$0.94	$0.71	$0.73	$0.74	$0.76	$12.93	$18.45
F&E	$0.00	$1.13	$0.46	$0.00	$0.00	$0.00	$0.00	$0.62	$2.22
O&M	$0.00	$0.51	$0.48	$0.71	$0.73	$0.74	$0.76	$12.30	$16.23

2.4 Key Drivers

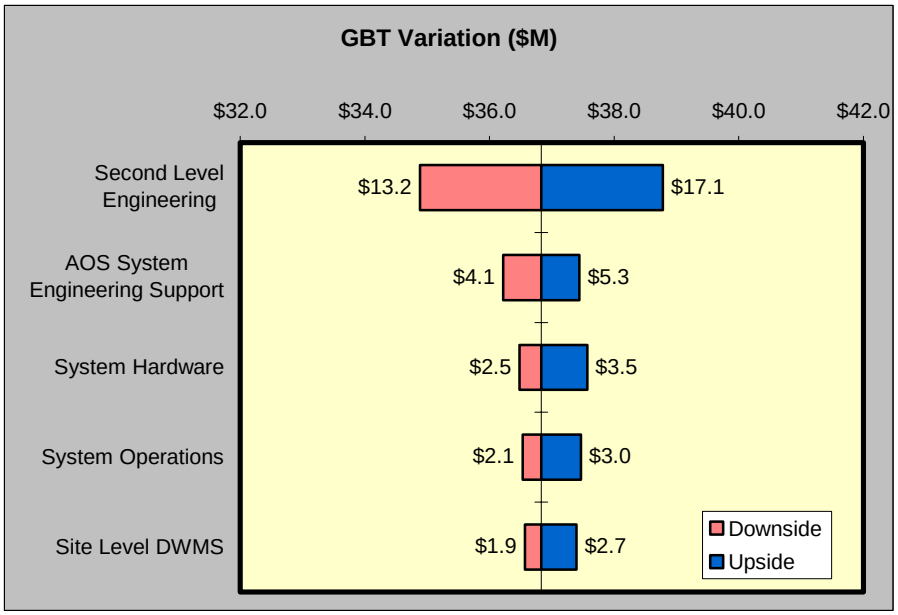
For this estimate, the major costs are accrued in the In-Service phase of the program. Approximately 70% ($40.7M) of the total costs ($59.3M) are applied towards O&M activities. In particular, Second Level Engineering Costs (WBS Element 5.10) were the main cost drivers in this estimate for both the GBT and AWSS. These elements include costs for engineering activities for such as development of modifications, documentation and configuration management for GBTs,

CCCS, and Micro-EARTS to support Capstone. This element also includes costs for evaluation of potential technology refresh.

Tornado charts (shown below) were developed for the GBT and AWSS portions using the Crystal Ball software. The software tested the ranges of each of the elements in the WBS at the 1st and 99th percentile and calculated the value of the estimate at each point. The ranges were developed based on engineering estimates and studies on risk ranges and include mitigation for risk from the cost risk assessment. The tornado charts illustrate the swing between the maximum and minimum values for each element, placing the element that causes the largest swing at the top and the element that causes the smallest swing at the bottom. The charts below individually depict the top five cost elements for GBT and AWSS that are likely to have the most variation. The top element, in this case, Second Level Engineering for both GBT and AWSS, have the most effect on the estimate. The bottom elements have the least effect on the estimate. The bars next to each element represent the value range across the element tested.

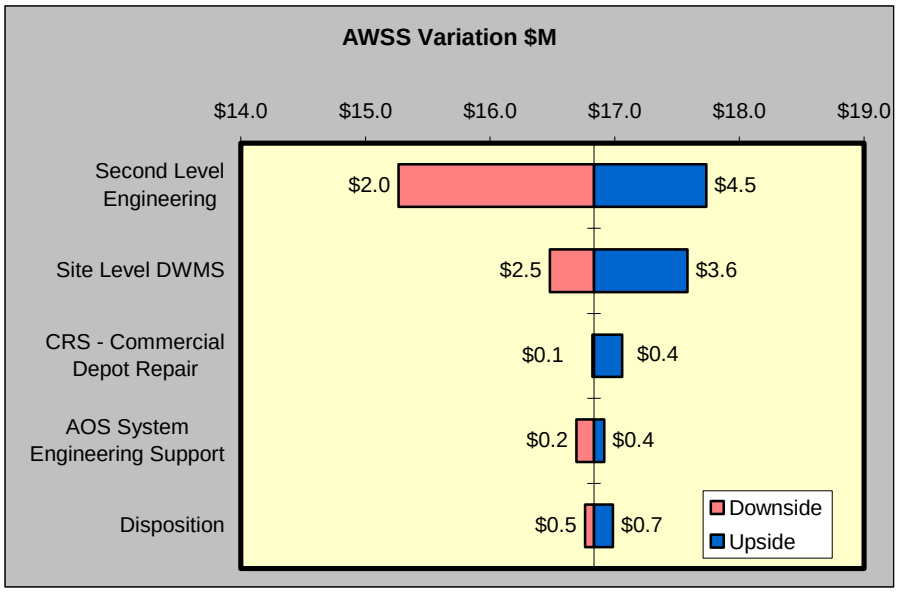
As shown below in Figure 2-1, the cost for Second Level Engineering (WBS Element 5.10) for GBT can vary from approximately $13.2M to $17.1M compared to the most likely value of $15.2M. This accounts for an approximate variation of 13% from the most likely. For the second largest varied element, AOS System Engineering Support (WBS Element 3.7.9.2), costs can range from $4.1M to $5.3M, with a most likely cost of $4.6M. This represents a spread of approximately 13% (high end) to 15% (low end) from the most likely value.

Figure 2-1. Variation of Elements for GBT (Current Year, $M)



For the AWSS portion, Second Level Engineering also has the greatest variation with ranges from approximately $2M to $4.5M as shown in Figure 2-2. This represents a deviation of 26% (high end) to 75% (low end) from the most likely value of $3.5M. For the second element, Site Level DWMS (WBS Element 5.2.2.1), the tornado chart shows the ranges of $2.5M to $3.6M. This implies a percent variation from the most likely of 16% on the low end to 25% on the high end.

Figure 2-2. Variation of Elements for AWSS (Current Year, $M)



It is clear that Second Level Engineering plays a major role in this program. As a high level observation, a simple calculation was done to compare the Second Level Engineering element costs to the total costs of the GBT and AWSS portions. It revealed that the difference between the high confidence and most likely values for Second Level Engineering comprises of approximately 30% of the total costs for GBT and AWSS components individually.

2.5 Affordability Assessment

The team reviewed and coordinated the cost estimate with the appropriate offices to ensure that the Bethel Core Area plans reflected in the estimate are affordable to the agency. ASD-300 provided the F&E affordability assessment and AFZ-400 provided the O&M affordability assessment for the IAR and the JRC.

ASD-300 reviewed the cost estimate for Bethel and reported that they have no significant concerns regarding affordability. The funding for Phase 1 falls within the Capstone CIP line, therefore there is sufficient funding for Capstone to fund the Phase 1 activities. ASD-300 plans to create a separate CIP segment within Capstone for Phase 1. When the other activities in Capstone are baselined (Phases 2, 3, and 4), separate CIP segments will be created. While there may be affordability concerns for the remaining phases of Capstone, there is sufficient funding for Phase 1 in the Capstone line, hence no current affordability issues.

Table 2-5. Capstone Phase I 0 Bethel Core Area F&E Affordability

Current Year $M	FY02	FY03	FY04	FY05	FY06	FY07	Total
Prototype, Testing & Documentation	$6.40	$4.00	$5.43	$4.00	$3.17	$4.00	**$27.00**
Bethel	**$2.75**	**$10.81**	**$3.64**	**$0.00**	**$0.00**	**$0.00**	**$17.20**
YK	$1.41	$1.14	$5.78	$1.29	$2.56	$0.44	**$12.62**
Southeast	$8.15	$6.20	$1.21	$0.19	$0.59	$0.17	**$16.51**
Remaining	$0.44	$0.31	$12.66	$15.87	$10.94	$10.30	**$50.52**
Total Capstone Requirements	**$19.15**	**$22.46**	**$28.72**	**$21.35**	**$17.26**	**$14.91**	**$123.85**
F&E -- CIP Dated 01/10/01	**$20.00**	**$15.00**	**$21.10**	**$19.10**	**$14.50**	**$16.60**	**$106.30**
Delta	**$0.85**	**($7.46)**	**($7.62)**	**($2.25)**	**($2.76)**	**$1.69**	**($17.55)**

3.0 RISK ANALYSIS

ASD-430 conducted a limited risk assessment tailored to reflect the reduced scope of this investment decision. This risk assessment focused on cost risk, reviewing to ensure that risk mitigation measures are reflected in the cost estimate. The team, in development of its risk-adjusted cost estimate, reviewed risks identified through its IA effort and documented risks from previous assessments conducted by the Alaska Capstone and Safe Flight 21 Program Offices. In addition, where appropriate, cost mitigation was included in the estimate.

3.1 Approach

The approach followed for this project included: identifying risk issues, which were relevant for the limited application of Capstone Phase I Bethel; identifying mitigation strategies; and coordinating with the IPT to ensure a common perspective. The general issues were identified for the Capstone Phase I Project from several documents: (a) the Capstone Phase I JRC Technical Issues Paper, version 1.5, prepared for AND-530 and dated September 27, 2001, and (b) the Draft Safe Flight 21 National Implementation Risks. In total, 78 issues were identified as being applicable to Capstone Phase I. However, because of the limited, localized application in the Bethel Core Area, only 27 issues were preliminarily assessed as having medium or high cost risk. These issues were then coordinated with the Alaska Region and AND-530 to ensure that the issues identified were relevant and consistent with the existing development of the project in the Bethel Core Area.

Simultaneous to the risk analysis for this IA, AND-530 and the Alaska Region developed and approved a Risk Management Plan for Capstone. The Risk Management Plan identifies a process for assessing and managing events that might impact the program adversely. The plan's process is ongoing, and it is expected that the risk issues and concerns identified for the IA could be assessed in more detail, commensurate with the expanding scope for the Capstone Project.

3.2 Results

After this coordination, 10 risk issues remained, which were estimated and included in the APB. These are identified in the following table:

Table 3-1. Risk Assessment Matrix

Risk Facet	Issue	Risk Level	Mitigation Strategy
Human Factors	- Controller adaptation to mixed equipage operation. - Adaptation to increased controller workload.	Medium	Augment training courses to address issues.
Supportability	Incomplete RMM of the GBT	Medium	Study RMM requirements from NIMS and include complete costs for all needed elements.
Cost-Estimating	Duration of AWSS hardware	Medium	Address in annual maintenance actions for AWSS
Schedule	Reasonableness of schedule	Medium	Incorporate schedule risk in software development, implementation, and testing costs
Physical Security	Compliance with ACO-400 plans and standards	Medium	Finalize preliminary security plans for GBT sites.
Information Security	Information security plans and standards	Medium	Conduct Security Certification and Assessment Package prior to Bethel Project Commissioning.
Operations	- Compliance with NAILS requirement and schedule - Operating procedures under loss of data not specified.	Medium	-Identify NAILS Requirements and include in cost baseline. - Develop operating procedures when scope of Bethel expands to other areas of Alaska.
Technical	Correction of faulty GBT operation (transmission, sidereal)	Medium	Undertake correction in 2nd generation units.

The mitigation measures identified above were coordinated with the cost team and are reflected in the cost estimate.

4.0 ADDITIONAL ASSESSMENTS

4.1 Safety/Hazard Assessment

After reviewing the safety/hazard assessment needs for the Bethel Core Area against what has been completed for Capstone already and the future planned activities, the team determined that a limited safety/hazard assessment was appropriate for this IA. ASD-110 performed a modified safety assessment that reflects the scope and the stage of this investment decision. The Capstone System Safety Program Plan was completed December 2, 2002 and appeared in the document titled "Capstone Safety Engineering Report #1, ADS-B Radar-Like Services, VOLUME 1, Preliminary Hazard Analysis."

The analysis evaluated approximately 200 scenarios (trimmed down to 81 in Volume 2) and produced 76 recommendations for controls to eliminate or reduce the risks associated with identified scenarios. The controls covered the end-to-end operation of the system and may therefore impact the manufacturers of the on-board avionics, the operators of the aircraft or vehicle, the services to be supplied by the NAS, the builders of the ground system, and the user community.

A Comparative Cross-Check Analysis was completed January 23, 2002. The Analysis compared controls developed from the Capstone Preliminary Hazard Analysis (PHA) against controls from the ADS-B Operational Safety Analysis and ADS-B PHA. The purpose of the Cross-Check Analysis was to identify any additional controls from the ADS-B analyses that were not identified in the Capstone PHA, but have applicability. No additional controls were identified and consequently no additional funding was identified. Capstone ADS-B radar-like services have been operational for over a year with no major safety issues identified (per safety review August 01). Closeout of the ADS-B radar-like service controls/requirements will be completed prior to ORD.

4.2 Architecture Assessment

This section describes the degree to which Capstone - Bethel ADS-B is consistent with the NAS Architecture. When the FAA's JRC updates the FAA plans on the Capstone - Bethel ADS-B implementation, the NAS Architecture will be updated to reflect the new plans.

When the Capstone - Bethel ADS-B initial Requirements Document has been revised based on comments from ASD-140, Capstone - Bethel ADS-B will be consistent with the NAS Architecture in terms of its capability to provide radar-like ATC services in the Bethel region, thereby improving the safety and efficiency of aircraft operations. The Capstone - Bethel ADS-B system will provide for future enhancements to allow the system to conform to developing domestic and international technical standards for ADS-B. Capstone - Bethel ADS-B is not dependent on any emerging NAS systems.

4.3 Human Factors Assessment

AND-500 performed a high-level review of the Integrated Program Plan for Bethel core area to assess human factors concerns. Aside from those training concerns identified in the risk assessment

(controller adaptation to mixed equipage operation and adaptation to increased controller workload) no significant human factors concerns were identified.

4.4 Information Security Assessment

The team met with ASD-4 and AOP-500 to review the Information System Security Assessment requirements for Bethel. While no Security Certification and Authorization Package (SCAP) has been developed for Capstone, one is currently under development for the Safe Flight 21 ADS-B applications in the Ohio River Valley and the NAS. The Capstone Program office will draw on this information when developing its SCAP for Bethel. The costs for the SCAP are reflected in the baseline for Bethel Core Area as well as some funds for limited mitigation measures. Any additional mitigation measures identified as part of the SCAP would likely be identified as part of a later phase of Capstone.

5.0 FINDINGS AND RECOMMENDATIONS

The IA Team recommends that the JRC

- Approve the F&E and O&M Baselines for Capstone Phase I,
- Assign the Capstone program office, AAl-1SC, to manage the GBT equipment and
- Assign the AWSS program office, AUA-430, to manage the AWSS equipment.

Table 5-1 shows the Acquisition Program Baseline (APB) for Capstone Phase I – Bethel Core Area

Table 5-1. Acquisition Program Baseline

Acquisition Program Baseline – Phase I Bethel Core Area									
GBT	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**TOTAL**	
Total LCC	**$4.15**	**$11.81**	**$5.32**	**$4.47**	**$4.86**	**$4.69**	**$5.52**	**$40.82**	
F&E Total	**$2.75**	**$9.68**	**$3.17**	**$0.00**	**$0.00**	**$0.00**	**$0.73**	**$16.34**	
O&M Total	**$1.40**	**$2.13**	**$2.15**	**$4.47**	**$4.86**	**$4.69**	**$4.79**	**$24.48**	
AWSS	**FY02**	**FY03**	**FY04**	**FY05**	**FY06**	**FY07**	**FY08**	**09-22**	**Total**
Total LCC	$0.00	$1.64	$0.94	$0.71	$0.73	$0.74	$0.76	$12.93	$18.45
F&E Total	$0.00	$1.13	$0.46	$0.00	$0.00	$0.00	$0.00	$0.62	$2.22
O&M Total	$0.00	$0.51	$0.48	$0.71	$0.73	$0.74	$0.76	$12.30	$16.23

APPENDIX A

INVESTMENT ANALYSIS TEAM PARTICIPANTS

APPENDIX A: INVESTMENT ANALYSIS TEAM PARTICIPANTS

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[i] A congressionally directed program creates the mission need. No need to document a shortfall in capabilities through the MNS process. The MNS for ADS-B cannot be used because most of the direct safety and weather benefit is gained from CFIT avoidance and weather.

[ii] Several requirements are being developed to "harden" current Capstone hardware and software so that it can be maintained. These requirements also define the life cycle operations funding profile. Since the installed equipment is known, rather than develop a new requirements document, use the existing equipment list as the requirement (e.g., type

and number by location) rather than describing the requirements of the individual Commercial-off-the-Shelf (COTS) equipment requirements. If a weather sensor is needed, rather than specify its requirements, identify by make and model the equipment in use or scheduled for deployment.

[iii] This fRD is required at the end of the Juneau experiments and forms the basis for defining NAS transition and OPs costs.

[iv] The APB normally baselines cost, schedule, performance, and benefits.

[v] JRC 3 is the in-service decision and can be combined with JRC 2b where operational use is part of the development activity.

[vi] Y/K basin expansion is more of the same as Bethel, where the expansion is in coverage, not increased capabilities and functions as in the SE Alaska Capstone initiative.

[vii] Would be a modification of the Bethel Integrated Project Plan to reflect expansion in coverage of Bethel functionalities.

[8] An MNS for statewide application of Capstone is needed to define the shortfall in capabilities in Alaska and the extent of the network of services and capabilities necessary to meet a required level of safety and services. This mission need should be developed in parallel with the SE Alaska development work and be funded within the SE Alaska project funding so as to complete the MNS before the decision to harden SE Alaska and assume operations costs for sustained services.

[ix] There is a need to address safety services in Alaska that go beyond Capstone.