2 Purpose and Need

As discussed in Chapter 1, the FAA Modernization and Reform Act of 2012 ("the Act") was enacted in February 2012 to help modernize the nation's air transportation system. Among other provisions, the Act requires the implementation of performance-based airspace procedure enhancements at 35 of the nation's busiest airports[32] and at any medium or small hub airports located within the same Metroplex area as determined by the FAA Administrator. The Act also requires that all performance-based procedures be certified, published, and implemented by June 30, 2015. Accordingly, the Federal Aviation Administration (FAA) proposes to increase the efficiency of the DC Metroplex airspace through the implementation of area navigation (RNAV) defined Instrument Flight Procedures (IFPs)[33] that improve upon existing, but less efficient ground-based and/or radar vector procedures.[34] The FAA Administrator has decided to implement the DC Metroplex enhancements before the June 30, 2015 deadline.

This EA is being prepared by the FAA to evaluate the potential environmental impacts associated with implementation of RNAV-defined IFPs for the DC Metroplex (Proposed Action). NEPA requires EAs to articulate the purpose of and need for the action being proposed. Identification of the need for an action provides the basis for identification of reasonable alternatives, including the Proposed Action, that can meet the purpose, and therefore, address the need or problem. The following sections discuss the need for and the purpose of the Proposed Action. Following this discussion, the Proposed Action is described in detail.

2.1 The Need for the Proposed Action

In the context of an EA, "need" refers to the problem that the Proposed Action is intended to resolve. The problem in this case is the inefficiency of the existing airspace structure and aircraft flight procedures in the DC Metroplex. This is due to the use of older NAVAID technology when newer RNAV technology is readily available. As described in Chapter 1, a majority of commercial aircraft operating in the DC Metroplex are RNAV equipped; however, most procedures currently used in the DC Metroplex are conventional and rely upon ground-based NAVAIDs. Because conventional procedures cannot provide more predictable controls inherent in RNAV procedures, such as specific speeds or altitudes, controllers use vectoring and speed adjustments to manage traffic. This leads to increased controller and pilot workload. RNAV procedures are free of the lateral and vertical flight path limitations typical of conventional procedures. This inefficient use of available technology impedes FAA's ability to meet one of its primary missions as mandated by Congress – to provide for the efficient use of airspace. Furthermore, as discussed in Section 1.2.6.1, RNAV technology can add efficiency to an air traffic system with enhanced predictability, flexibility, and route segregation.

[32] The 35 airports are identified under the Act as Operational Evolution Partnership (OEP) airports. OEP airports are commercial U.S. airports with significant activity. These airports serve major metropolitan areas and also serve as hubs for airline operations. More than 70 percent of U.S. passengers move through these airports.

[33] Instrument Flight Procedures (IFP) - Instrument flight procedures specify standard routings, maneuvering areas, flight altitudes, and visibility minimums for instrument flight rules (IFR). These procedures include airways, jet routes, off-airway routes, Standard Instrument Approach Procedures (SIAP(s)), Standard Instrument Departure Procedures/ Departure Procedures (SID(s))/ DP(s)), and Standard Terminal Arrival Routes (STAR(s)). (FAA Order 8200.1C *United States Standard Flight Inspection Manual*).

[34] "Procedure" is a predefined set of guidance instructions that define a route for a pilot to follow.

The following sections describe the problem in detail followed by a discussion of the causal factors that have contributed to the problem. A detailed explanation of the technical terms and concepts used in this chapter can be found in Chapter 1, *Background*.

2.1.1 Description of the Problem

Many existing Standard Instrument Departure (SID) and Standard Terminal Arrival Route (STAR) procedures require aircraft to use ground-based NAVAIDs to navigate to and from air carrier and General Aviation (GA) airports in the DC Metroplex. As discussed in Section 1.2.6.1, *RNAV*, conventional procedures are less accurate because of radio signal limitations that can arise between NAVAIDs and aircraft due to factors such as terrain. As a result, ground-based NAVAID procedures require large areas of clearance on either side of a route's main path to account for potential obstructions. Furthermore, conventional procedures are dependent upon where ground-based NAVAIDs are located which can result in less efficient routing. Because conventional procedures are less accurate, the actual location of an aircraft both laterally and vertically, can be less predictable for both ATC and pilots.

The lack of accuracy and predictability requires ATC to use aircraft management tools and coordination techniques such as speed control, level flight segments, and vectoring to guide aircraft. These tools and coordination techniques are further discussed in Section 1.2.2., *Air Traffic Control within the National Airspace System*. Applying these tools and techniques without a more precise means to predict exactly where aircraft are located along an assigned procedure is complex. In most situations, these tools and techniques lead to less efficient aircraft operations and inefficient use of airspace. For example, Air Traffic Control (ATC) may issue instructions requiring an aircraft to level off during climb and descent to prevent conflicts with other aircraft. This leads to increased flight time and distance than would otherwise be necessary. Furthermore, increased communications between controller and pilot may result in less precise flight paths due to the time it takes the controller to issue an instruction to the pilot and for the pilot to read the instruction back to the controller for confirmation before the instruction can be executed. As a result, more airspace must be protected to allow aircraft the latitude to operate leading to less efficient and less flexible operations.

The lack of precision resulting from inefficient use of technology also contributes to reduced available airspace. In addition, the lower levels of predictability and accuracy associated with these procedures require ATC to issue additional instructions to pilots, increasing pilot workload and requiring constant monitoring by ATC. Combined, these factors form the basis for the problem within the DC Metroplex.

The lack of SIDs and STARS based on current RNAV technology adversely affects FAA's ability to efficiently manage available airspace. Therefore, the problem is the inability to provide additional efficiency afforded by RNAV technology. **Table 2-1** presents the number of standard instrument procedures dependent upon conventional navigation (radar vectors or ground-based NAVAIDs), the number of procedures dependent upon RNAV, and the total number of standard instrument procedures, unique and shared.

Table 2-1 Standard Instrument Procedure Counts

Airport	Conventional Procedures	RNAV Procedures	Total Unique (Shared) Standard Procedures
KIAD	CAPITAL EIGHT, DELRO TWO, PHILIPSBURG TWO, SELSINGROVE THREE (COATT FOUR)	STOIC TWO, BARIN ONE, LEGGO TWO, PRTZL THREE (HYPER FOUR, SHNON, ROYIL)	8
KDCA	NATIONAL TWO (IRONS FOUR)	LAZIR THREE, BILIT ONE, CLIPR ONE, OJAAY ONE, SKILS TWO (ELDEE FIVE)	6
KBWI	PALEO THREE, SWANN THREE (NOTTINGHAM SIX, WESTMINSTER FIVE)	TERPZ TWO (RAVNN THREE)	3
KRIC	COLIN FIVE, YEAST ONE	None	2
KADW	ANDREWS ONE, CAMP SPRINGS ONE, MORNINGSIDE ONE, WZZRD TWO (IRONS FOUR)	None (ELDEE FIVE)	4
KESN	None	None	0
KFDK	None	None	0
KGAI	None	None	0
KHEF	ARSENAL TWO (COATT FOUR)	None (HYPER FOUR, SHNON, ROYIL)	1
KJYO	None(COATT FOUR)	None (SHNON, ROYIL)	0
KOKV	None	None (HYPER FOUR)	0
KMRB	TRIXY FOUR	None (HYPER FOUR)	1
KMTN	None (NOTTINGHAM SIX, WESTMINSTER FIVE)	None (RAVNN THREE)	0
KRMN	None	None (HYPER FOUR)	0
Total	15(4)	10(5)	25(9)

Table Notes:
Counts in parentheses represent procedures shared by more than one airport.
Airports
KIAD: Dulles International Airport
KDCA: Ronald Reagan Washington National Airport
KBWI: Baltimore-Washington International Thurgood Marshall Airport
KRIC: Richmond International Airport
KADW: Andrews Air Force Base
KESN: Easton/Newnam Field Airport
KFDK: Frederick Municipal Airport
KGAI: Montgomery County Airpark
KHEF: Manassas Regional Airport
KJYO: Leesburg Executive Airport
KOKV: Winchester Regional Airport
KMRB: Eastern WV Regional Airport/Shepherd Field
KMTN: Martin State Airport
KRMN: Stafford Regional Airport

Source: National Flight Data Center (NFDC), accessed 8/29/2012.
Prepared By: ATAC Corporation, June 2013.

To take full advantage of current RNAV technology, the number of RNAV procedures should be close to the total number of existing procedures. For the DC Metroplex, as of December 2011, there were 34 standard instrument procedures, 44 percent of which were RNAV based (10 unique procedures and five shared procedures). The conventional procedures do not segregate traffic efficiently due to dependence on conventional navigation using ground-based NAVAIDs or a mix of conventional and RNAV navigation. Section 2.1.3 describes the current factors that lead to limited means of providing additional efficiency.

It is important to note that a key design constraint is safety. Any proposed change to a procedure to resolve the problem must not degrade safety, and if possible enhance safety. Current procedures do not include any safety issues because published procedures must meet defined safety criteria; accordingly, the Proposed Action is not being proposed to address any safety issues.

2.1.2 Causal Factors

A problem (or need) is best addressed by examining the circumstances or causal factors that together serve as a foundation for the need. As previously described, the problem for the DC Metroplex is the prevalence of existing SID and STAR procedures dependent on older ground-based NAVAID technology leading to inefficiencies in the DC Metroplex airspace.

The need for the Proposed Action can be better understood and addressed based on the specific factors causing the problem. Addressing the causal factors that lead to the problem will ultimately facilitate development of a reasonable alternative designed to resolve the problem (or meet the purpose).

Three key factors were identified by the DC Metroplex Study Team as causes for the lower level of efficiency in the DC Metroplex:

- Lack of flexibility in the efficient transfer of traffic between the enroute and terminal area airspace;
- Complex converging interactions between arrival and departure flight paths; and,
- Lack of predictable standard routes defined by procedures to/from airport runways to/from enroute airspace.

The following sections describe these three causal factors in detail.

2.1.2.1 Lack of Flexibility for the Efficient Transfer of Traffic Between the Enroute and Terminal Area Airspace

Flexibility allows ATC to plan and adapt to traffic demands, which change frequently within any given hour. Even though flights are scheduled, delays in other regions of the U.S. or severe weather along an aircraft’s route may cause aircraft to enter or exit the enroute and terminal area airspace at times other than those previously scheduled. Controllers require options to manage dynamic traffic demand.

Elements such as additional entry and exit points, individual procedures for each Study Airport, and the ability to diverge aircraft (turn aircraft on different headings away from each other) earlier reduces the amount of vectoring needed to merge traffic and maintain safe separation. These elements also provide additional options when one procedure is too busy to accommodate additional traffic.

The "four corner post" airspace design presents the most efficient way to transfer aircraft to an airport from an entry gate and from an airport to an exit gate. In a typical four-corner post system, aircraft depart the terminal airspace through exit gates to the north, east, south, and west. Aircraft arrive to the terminal airspace through entry gates to the northeast, southeast, southwest, and northwest. However, implementation of a four corner post system in the PCT terminal airspace is restricted by various factors including geographic location, close proximity among airports, runway geometry, traffic demand, and other constraints. Consequently, the transfer control areas for PCT are found in locations that best meet the unique characteristics of the DC Metroplex airspace.

The limited number of terminal airspace entry and exit points serving as offloads and/or separate traffic routes result in gaps in arrival and departure flows to and from Study Airports within the PCT terminal area airspace.[35] For arrivals, the gaps between aircraft on a given procedure are large enough to fit another aircraft. Due to the need to merge flows that could otherwise operate independently with development of the appropriate procedures, the controller is not able to use the existing airspace as efficiently as possible.

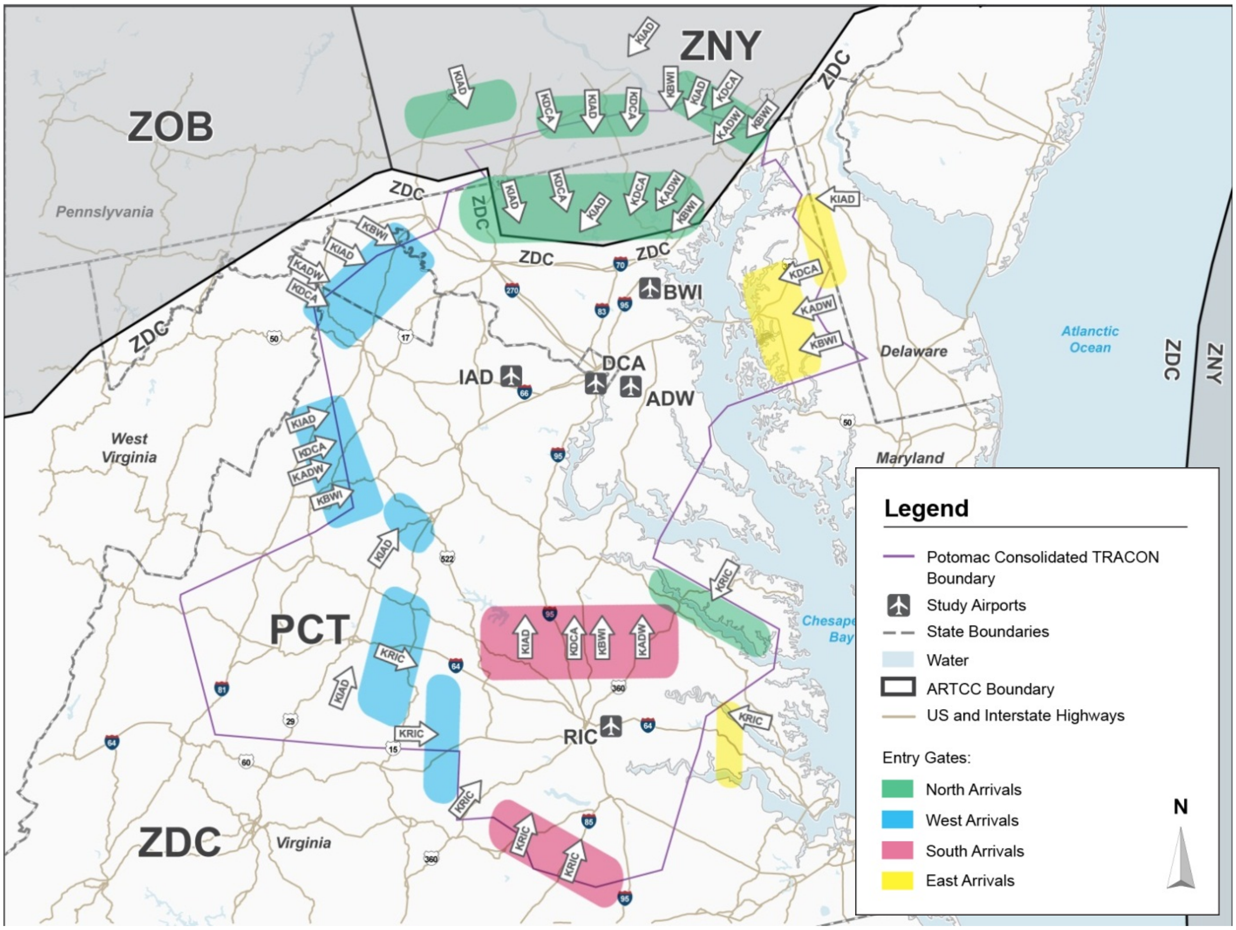
The following sections further discuss flexibility issues specific to the terminal area airspace entry and exit points.

Entry Points

Exhibit 2-1 depicts the entry points where control is transferred from the Centers to the TRACON in the DC Metroplex airspace. These entry points are often shared by aircraft arriving at different Study Airports. **Table 2-2** lists the STAR procedures and associated transition points for the major Study Airports.

[35] Flow: multiple aircraft operations assigned to a procedure that operate along the same route, and includes variation in aircraft location over the ground. A traffic flow is typically defined by several days of radar flight tracks. Traffic flows may also be represented by corridors based on a frequently traveled area characterized by one or more well-traveled routes.

Exhibit 2-1 Terminal Airspace Control Transfer Areas - Arrivals



Notes:

PCT – Potomac Consolidated TRACON	*ZDC – Washington ARTCC*	*ZNY – New York ARTCC*
ZOB – Cleveland ARTCC	*ADW – Joint Base Andrews*	*BWI – Baltimore/Washington International Thurgood Marshall Airport*
DCA – Ronald Reagan Washington National Airport	*IAD – Washington Dulles International Airport*	*RIC – Richmond International Airport*

Source: DC OAPM Metroplex Study Team, 2010
Prepared by: ATAC Corporation, March 2013.

Table 2-2 STAR Arrival Transitions

Arrival Transitions	STAR Procedure	Airport
AIR	EMI5	KBWI
ALB	HYPER4 (RNAV)	KIAD
BAF	HYPER4 (RNAV)	KIAD
BKW	ROYIL2	KIAD
	SHNON2	KIAD
	ELDEE5 (RNAV)	KDCA
	WZRRD2	KDCA
CSN	OTT6	KBWI
	RAVNN3 (RNAV)	KBWI
ESL	ROYIL2	KIAD
	SHNON2	KIAD
FAK	BARIN1 (RNAV)	KIAD
	COATT4	KIAD
	OTT6	KBWI
FQM	LEGGO2 (RNAV)	KIAD
	SEG3	KIAD
HVQ	ROYIL2	KIAD
	SHNON2	KIAD
	ELDEE5 (RNAV)	KDCA
	WZRRD2	KDCA
KEMAN	EMI5	KBWI
LAFLN	BILIT1 (RNAV)	KDCA
LRP	SKILS2 (RNAV)	KDCA
	DELRO2	KIAD
LVZ	LEGGO2 (RNAV)	KIAD
	SEG3	KIAD
MGW	EMI5	KBWI
MXE	CLIPR1 (RNAV)	KDCA
	DELRO2	KIAD
	HYPER4 (RNAV)	KIAD
PARKE	HYPER4 (RNAV)	KIAD
PSB	PSB2	KIAD
	PRTZL3 (RNAV)	KIAD
	SKILS2 (RNAV)	KDCA
RBV	HYPER4 (RNAV)	KIAD
RIC	IRONS4	KDCA
	RAVNN3 (RNAV)	KBWI
	OJAAY1 (RNAV)	KDCA
	OTT6	KBWI
RIDGY	BILIT1 (RNAV)	KDCA
SHAAR	ELDEE5 (RNAV)	KDCA
	WZRRD2	KDCA

Table Notes:
***Bold** indicate shared transitions.*

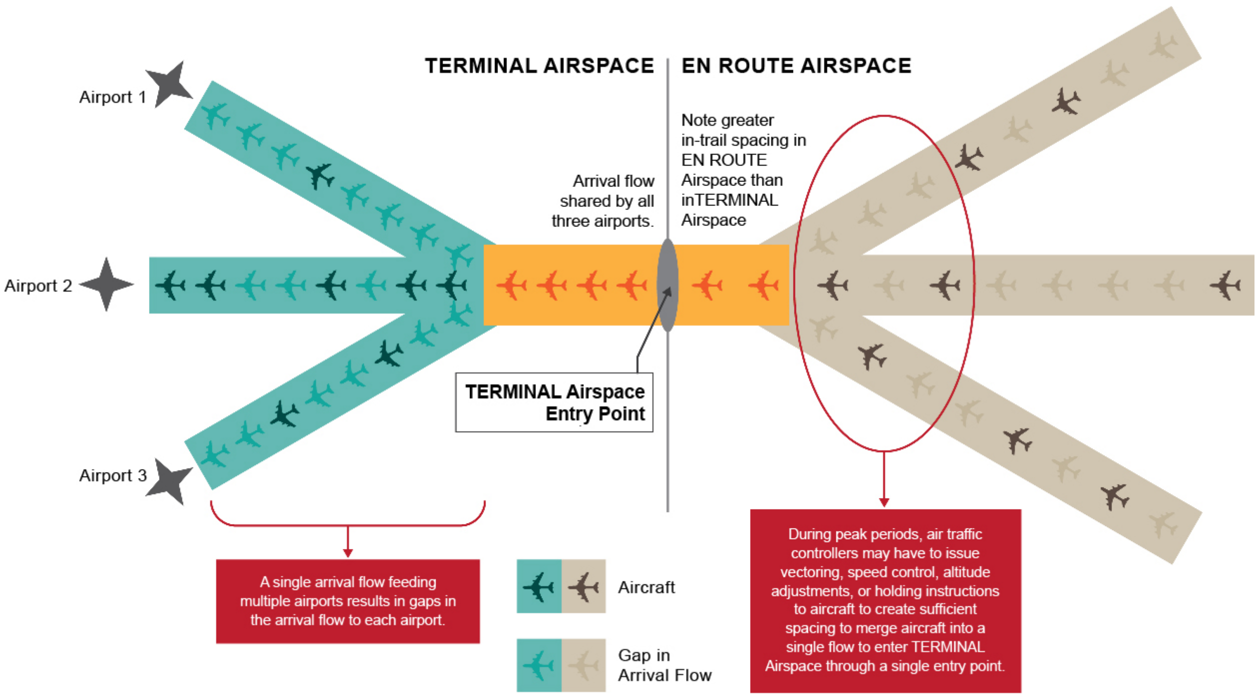
Ground-based NAVAIDS				Fixes
ALB: Albany VORTAC	*ESL: Kessel VOR/DME*	*LRP: Lancaster VORTAC*	*PSB: Philipsburg VORTAC*	*KEMAN, LAFLN*
BAF: Barnes VORTAC	*FAK: Flat Rock VORTAC*	*LVZ: Wilkes-Barre VORTAC*	*RBV: Robbinsville VORTAC*	
BKW: Beckley VORTAC	*FQM: Williamsport VOR/DME*	*MGW: Morgantown VORTAC*	*RIC: Richmond VORTAC*	*RIDGY*
CSN: Casanova VORTAC	*HVQ: Charleston VORTAC*	*MXE: Modena VORTAC*		*PARKE, SHAAR*

Source: NFDC, accessed May 31, 2012.
Prepared By: ATAC Corporation, 2012.

The limited number of well-defined entry points results in challenges that affect the efficient management of aircraft traffic. Because of the geographic location of the DC Metroplex area, the majority of aircraft enter the terminal airspace from the west, north, and south. Approximately 45 percent of traffic enters from the west, 25 percent enters from the north, and 17 percent enters from the south.[36] As a result, airspace congestion occurs during periods of high demand at each of these locations. The resulting congestion requires the issuance of air traffic instructions such as vectoring, controlling speed, holding aircraft, leveling off aircraft, or rerouting aircraft to other entry points, which, as described in Section 2.1.1, increases pilot and controller workload, increases complexity for both controllers and pilots, and can result in delays.

Exhibit 2-2 illustrates how aircraft arrivals are sequenced in the enroute airspace and then merged to enter terminal airspace at a single point.

Exhibit 2-2 Illustration of Single Terminal Airspace Entry Point and Single Arrival Flow with Traffic Sequenced to Multiple Airports



Source: Federal Aviation Administration, July 2012.
Prepared by: ATAC Corporation, June 2012.

Aircraft arriving from different enroute flows must be merged into a single arrival flow at an entry point to terminal airspace. This is similar to traffic in multiple freeway lanes merging into one lane which can cause congestion prior to the merge. To maintain safe separation between aircraft, controllers must create sufficient gaps between aircraft along the route to safely line up aircraft from multiple streams. This may require ATC to issue instructions directing a pilot to take actions that can result in slower air traffic and increased congestion. This also results in increased workload for both the controller and pilot. Aircraft destined for each of the Study Airports share standard instrument arrival procedures that enter the

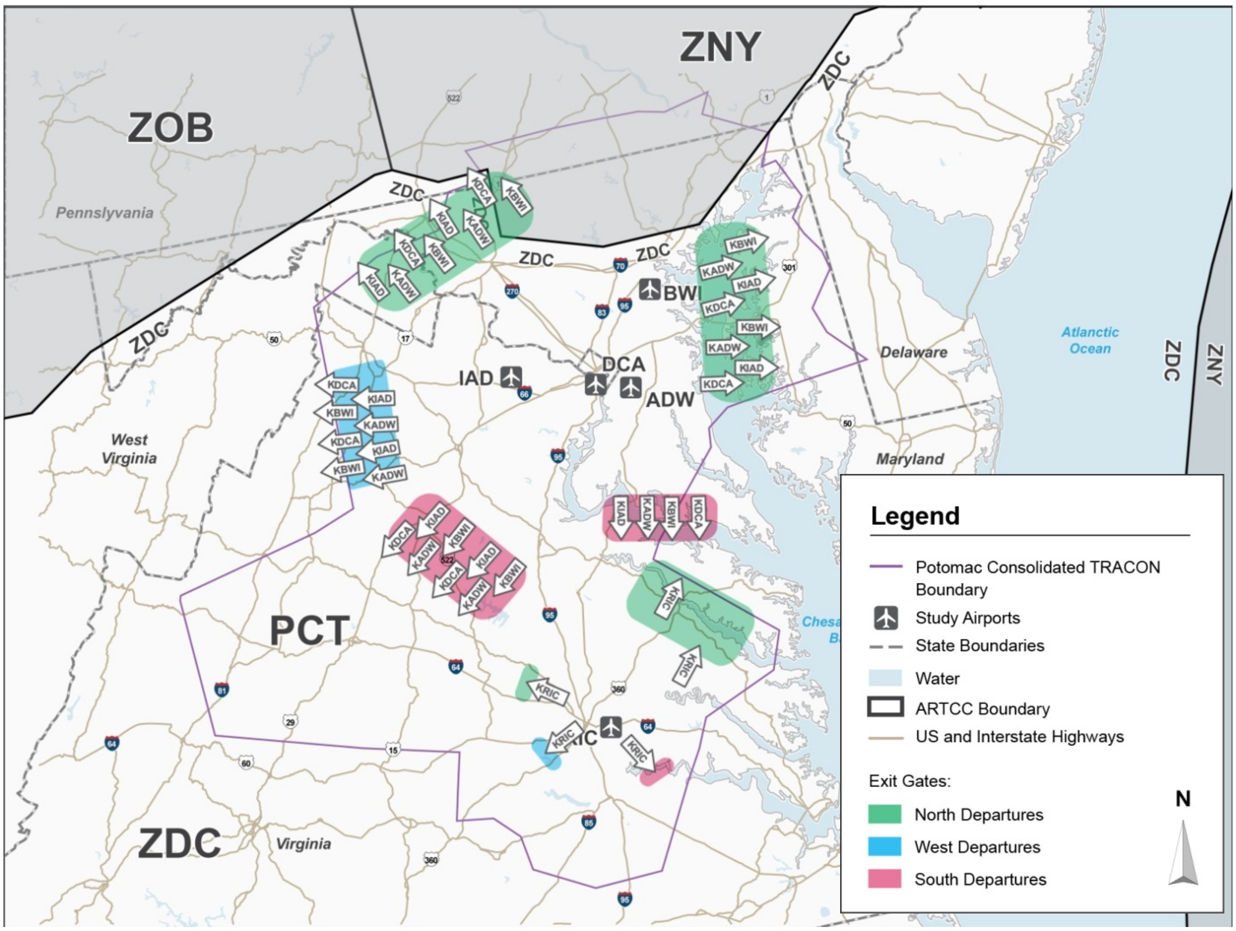
[36] Department of Transportation, Federal Aviation Administration, *OAPM Study Team Final Report, Washington D.C. Metroplex*, March 11, 2011.

terminal airspace on a single arrival flow through one of the entry points. Aircraft are then split from a single arrival flow and issued instructions to the final approaches to the various runways at the different Study Airports. Gaps in the flow to the individual Study Airports can develop after aircraft are sequenced and directed to the final approaches to the respective airport runways.

Exit Points

Exhibit 2-3 depicts the exit points where control is transferred from the TRACON to the ARTCCs for aircraft departing the DC Metroplex airspace.

Exhibit 2-3 Terminal Airspace Control Transfer Areas - Departures



Notes:

PCT – Potomac Consolidated TRACON	*ZDC – Washington ARTCC*	*ZNY – New York ARTCC*
ZOB – Cleveland ARTCC	*ADW – Joint Base Andrews*	*BWI – Baltimore/Washington International Thurgood Marshall Airport*
DCA – Ronald Reagan Washington National Airport	*IAD – Washington Dulles International Airport*	*RIC – Richmond International Airport*

Source: DC OAPM Metroplex Study Team, 2010.
Prepared by: ATAC Corporation, March 2013.

Table 2-3 lists the transitions for each SID that serves the four major study area airports. During peak periods of departure to the west, south, and north, controllers must merge departing aircraft from the Study Airports into single departure flows that pass through the terminal area exit points. Merging departing aircraft into departure flows can lead to delays.

Accordingly, controllers must frequently employ management tools such as holding departing aircraft on the ground before takeoff to control air traffic volume in the surrounding airspace. This directly affects departure efficiency at the Study Airports.

In addition to holding aircraft on the ground, controllers may also assign vectors and level-offs to aircraft during their departure climbs to provide adequate separation as aircraft are gradually merged into a departure route. The need to merge aircraft into departure routes increases the complexity of managing the terminal airspace and can decrease the efficiency of the airspace volume. Vectoring can also increase flight distances and reduce predictability, as aircraft are assigned less direct routes which they must continue to follow as they proceed further away from an airport.

Table 2-3 SID Departure Transitions (1 of 2)

Departure Transitions	SID Procedure	Airport
ACY	PALEO3	KBWI
BUFFR	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	TERPZ2 (RNAV)	KBWI
	CPTAL8	KIAD
COLIN	COLIN5	KRIC
CSN	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	CPTAL8	KIAD
DAILY	STOIC2 (RNAV)	KIAD
	LAZIR2 (RNAV)	KDCA
DQO	SWANN3	KBWI
DRAIK	YEAST1	KRIC
EMI	CPTAL8	KIAD
ENO	PALEO3	KBWI
	CPTAL8	KIAD
FLUKY	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	TERPZ2 (RNAV)	KBWI
GVE	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	CPTAL8	KIAD
GINYA	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
HAFNR	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	TERPZ2 (RNAV)	KBWI
HCM	COLIN5	KRIC
JERES	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	CPTAL8	KIAD
	TERPZ2 (RNAV)	KBWI
LDN	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	TERPZ2 (RNAV)	KBWI
	CPTAL8	KIAD

Table 2-3 SID Departure Transitions (2 of 2)

Departure Transitions	SID Procedure	Airport
LYH	YEAST1	KRIC
MOL	YEAST1	KRIC
MRB	CPTAL8	KIAD
OOD	SWANN3	KBWI
OTT	CPTAL8	KIAD
PALEO	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	STOIC2 (RNAV)	KIAD
PAUKI	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
PXT	COLIN5	KRIC
RAMAY	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	TERPZ2 (RNAV)	KBWI
SANNY	YEAST1	KRIC
SIE	PALEO3	KBWI
SWANN	LAZIR2 (RNAV)	KDCA
	NATNL2	KDCA
	STOIC2 (RNAV)	KIAD
WOOLY	STOIC2 (RNAV)	KIAD
	NATNL2	KDCA

Table Notes:
***Bold** indicate shared transitions.*

Ground-based NAVAIDS			*Fixes*		
ACY: Atlantic City VORTAC	*GVE: Gordonsville VORTAC*	*MOL: Montebello VOR/DME*	*BUFFR*	*GINYA*	*RAMAY*
CSN: Casanova VORTAC	*HCM: Harcum VORTAC*	*OOD: Woodstown VORTAC*	*COLIN*	*HAFNR*	*SANNY*
DQO: Dupont VORTAC	*LDN: Linden VORTAC*	*OTT: Nottingham VORTAC*	*DAILY*	*JERES*	*SWANN*
EMI: Westminster VORTAC	*LYH: Lynchburg VORTAC*	*PXT: Patuxent VORTAC*	*DRAIK*	*PALEO*	*WOOLY*
ENO: Smyrna VORTAC	*MRB: Martinsburg VORTAC*	*SIE: Sea Isle VORTAC*	*FLUKY*	*PAUKI*	

Source: NFDC, accessed 05/31/2012.
Prepared By: ATAC Corporation, December 2012.

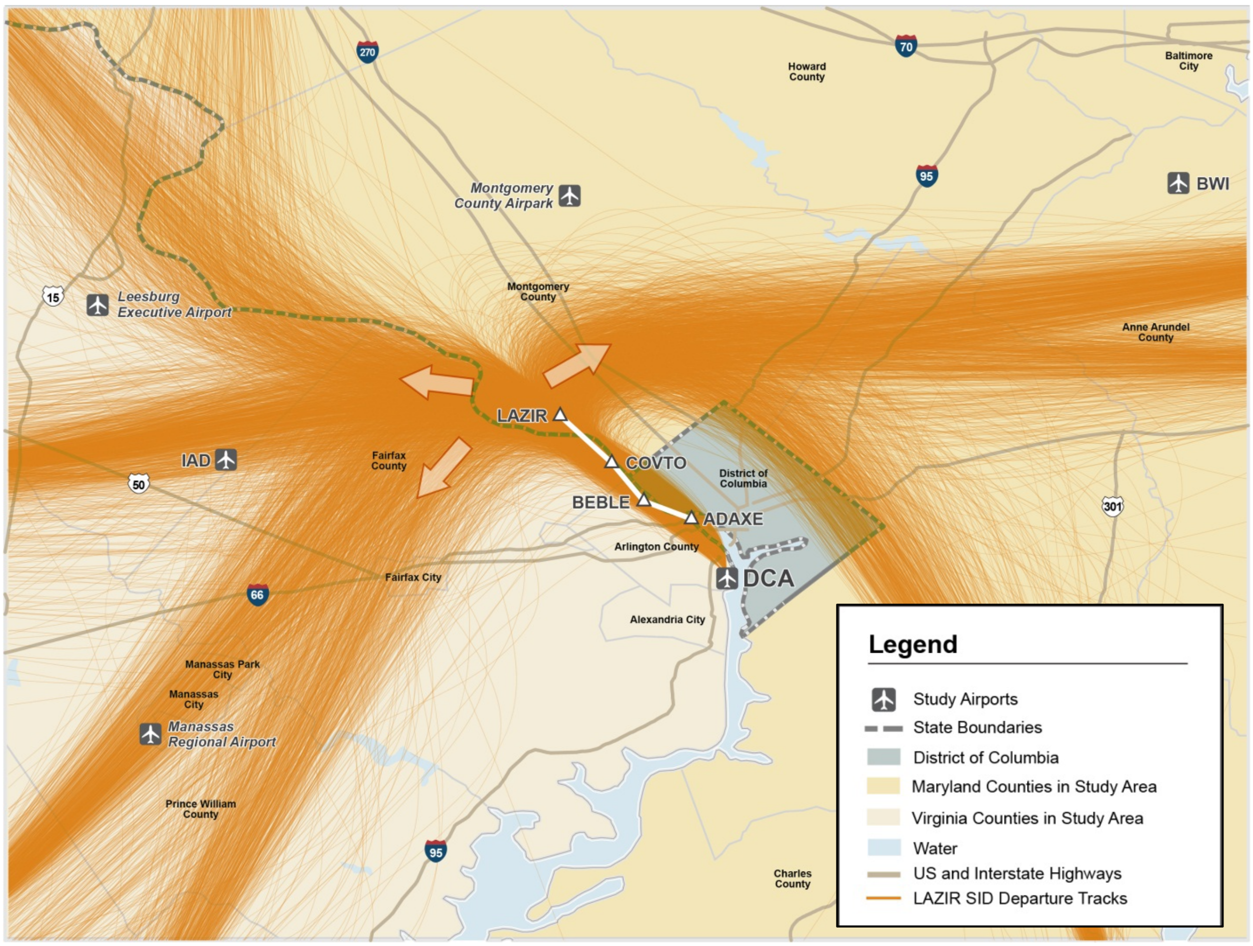
There are several consequences that result from all instrument arrivals and departures to and from the Study Airports using common standard instrument procedures and terminal airspace entry and exit points. These consequences include:

- The need to merge arriving aircraft into a single arrival flow at each entry point can increase flight time and distances.
- Gaps in the final arrival flows do not allow for the formation of a constant stream of aircraft to the Study Airports. This prevents the full use of the potential arrival throughput at the Study Airports.
- Merging aircraft from all Study Airports into single departure streams for each exit point requires controllers to create greater separations between subsequent departures from the same airport than would otherwise be required if the routes were separated or there were only a single airport in operations. Dedicated departure routes for each airport or runway would reduce the needed separation.
- Holding aircraft on the runway to create the necessary gaps in the departure routes leads to departure delays at all Study Airports, especially during peak travel periods. This prevents full use of the potential departure throughput at the Study Airports.

- The need for additional controller-to-pilot communication to issue the variety of instructions required to merge and desegregate the flow of aircraft adds to the workload of both controllers and pilots.
- Options for controllers to re-direct aircraft to avoid bad weather or more efficiently handle sequencing are limited when the pilot does not have the runway in sight due to low visibility.

Exhibit 2-4 shows the multiple routes DCA RNAV departures use for one SID, the LAZIR2 RNAV. Inefficiencies arise as the conventional departure SID for DCA shares the same routes. This procedure does not allow for efficient segregation of the departure routes and requires extensive radar vectoring. This contributes to ATC task complexity and flight path variability. The lack of additional departure procedures also reduces efficiency for aircraft.

Exhibit 2-4 LAZIR2 RNAV SID – DCA



Notes:
BWI – Baltimore/Washington International Thurgood Marshall Airport; DCA – Ronald Reagan Washington National Airport; IAD – Washington Dulles International Airport

Source: DC OAPM Metroplex Study Team, 2010.
Prepared by: ATAC Corporation, March 2013.

2.1.2.2 Complex Converging Interactions Between Arrival and Departure Flight Paths

This section describes three general examples of complex converging interactions between arrival and departure flight routes in the DC Metroplex airspace. The airspace in the DC Metroplex can be very complex, particularly because of the close proximity of three busy commercial service airports (DCA, IAD, and BWI) and the presence of restricted area of airspace such as the Flight Restriction Zone (FRZ) around central Washington D.C. (The FRZ is discussed further in Section 1.2.5, *Special Use Airspace*.) These following three examples are followed by discussion of how these types of interactions function in the DC Metroplex.

1. Many arrival and departure routes converge or cross. This is necessary to move aircraft to an airport from the appropriate entry point and from an airport to the appropriate exit point. To maintain appropriate separation between aircraft, the controller issues altitude assignments that rely on vertical distances of 1,000 feet or more. Crossing routes include level flight segment "bridges" where at key points aircraft stop their descent or climb and level off to allow arrivals or departures to cross and descend or climb away from another aircraft's path. Aircraft may then fly at this altitude until they have moved away from other aircraft crossing the same area.

2. ATC typically splits arrival and departure control responsibilities. Control of aircraft is passed on from one controller to the next as the aircraft progress through airspace. Vertical separation between aircraft arrivals and departures is maintained primarily through defined ceiling and floor altitudes. An arriving aircraft cannot descend until the aircraft is clear of the dimensional airspace reserved for departures. When an aircraft clears one airspace area, it is transferred by a controller to the next airspace area controlled by another controller. During the time between handoff and transfer of control between controllers, aircraft may have to level off until the next controller acknowledges control and the aircraft is able to resume its climb. The amount of time necessary to transfer control may be directly affected by the extent of controller workload.

3. Controllers may need to alert aircraft or another controller responsible for a neighboring airspace sector of the proximity of other aircraft (point-outs). Aircraft must be separated laterally by at least three nautical miles (nmi) within the terminal airspace and generally by at least five nmi in the enroute environment. This is achieved in the terminal environment by keeping an aircraft at least 1.5 nautical miles from the airspace boundary assigned to a specific controller. In the enroute portions of the DC Metroplex airspace, separation is maintained at 2.5 nmi. As conventional navigation is not as accurate as RNAV, two to three nautical mile buffers from the boundary are used to ensure the 1.5 and 2.5 nmi distances are always kept. These accuracy limitations result in areas of unusable airspace.

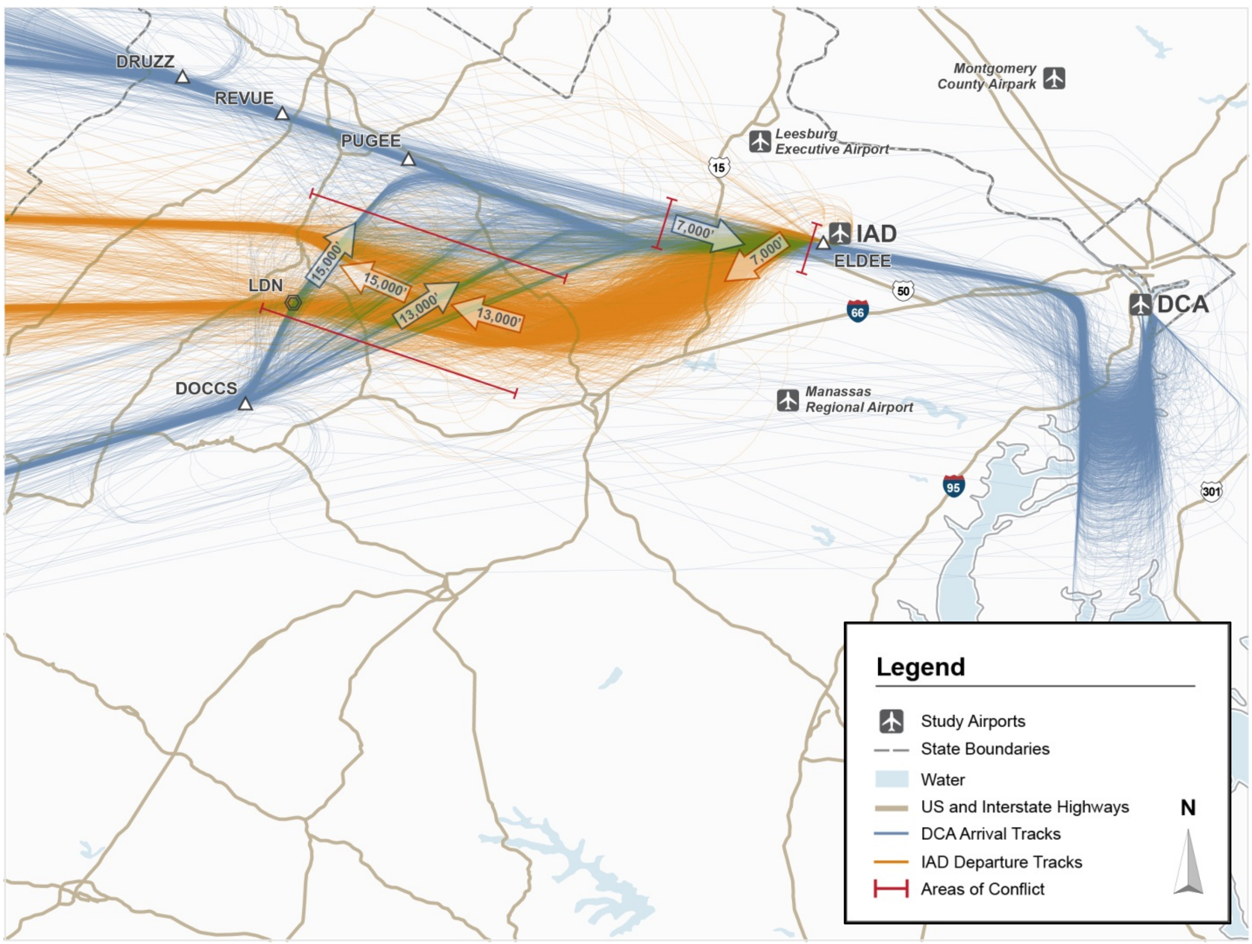
All the scenarios described above require additional verbal communication between controllers or between controllers and pilots. This can take extra time resulting in unnecessary system complexity and increased pilot and controller workload. In addition, vectoring and level-offs can reduce airspace efficiency and flight efficiency by adding time and distance to flights as aircraft enter/exit to/from the terminal airspace.

The following sections provide two specific examples of how these interactions function within the DC Metroplex area.

West DCA Arrivals (ELDEE 5) and West IAD Departures (CAPITAL 8)

Exhibit 2-5 shows how current arrival routes for DCA (blue flight tracks) cross with several westbound IAD departure routes (orange flight tracks). Due to the altitudes at which aircraft on these routes cross there are several issues that prevent optimized approaches to the airport, including crossing restrictions and leveling off requirements. These issues can result in extended flight time and distance.

Exhibit 2-5 DCA Departures – IAD Arrivals Conflicts



Notes:
IAD – Washington Dulles International Airport
DCA – Ronald Reagan Washington National Airport

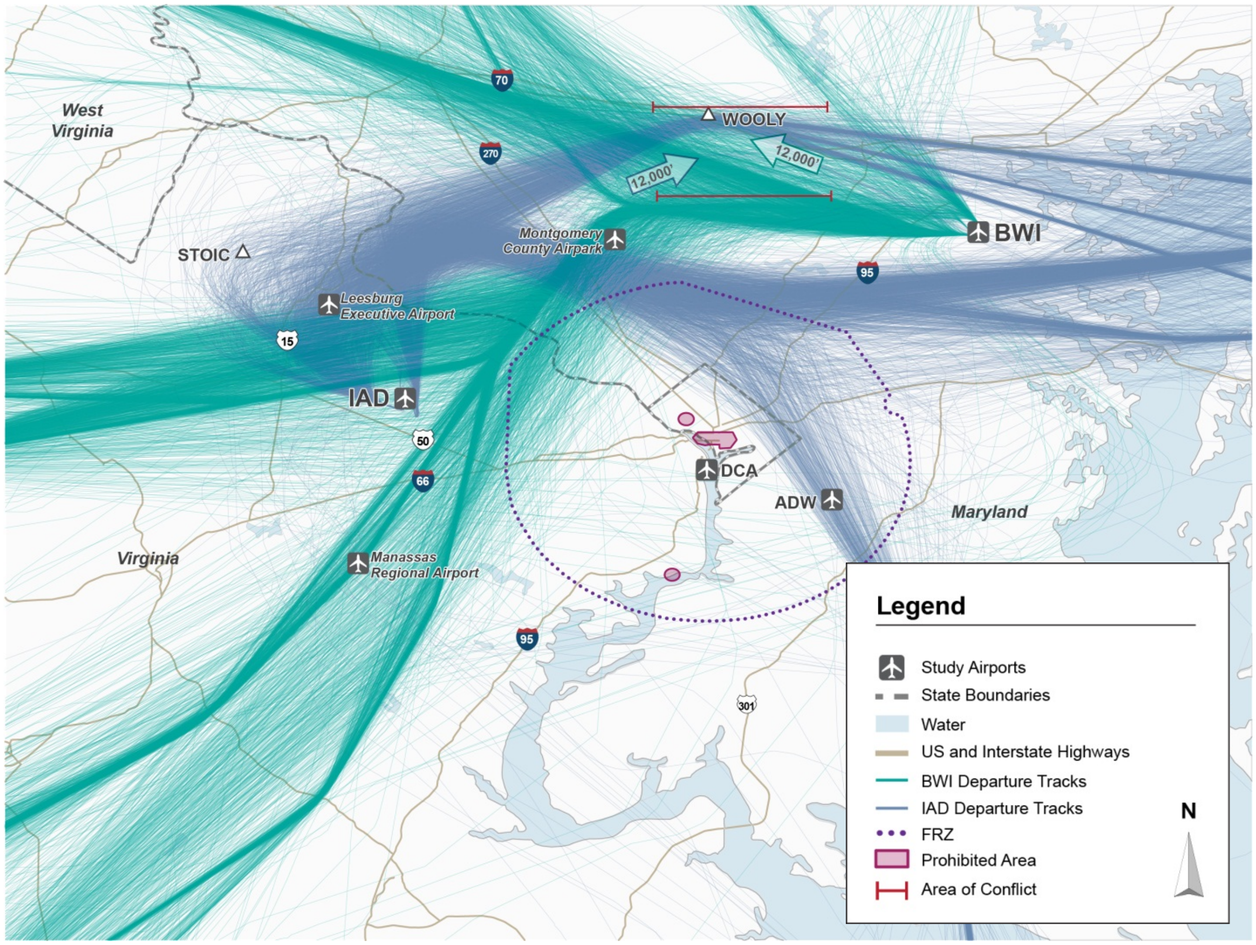
Source: ATAC (PDARS radar data), June 2011.
Prepared by: ATAC Corporation, March 2013.

IAD and BWI Departure Conflicts

The IAD STOIC departure procedure requires that the initial fix be located 15 nmi from the runway complex to ensure avoidance of the Flight Restricted Zone (FRZ) surrounding DCA.

The BWI TERPZ2 departure route conflicts with the IAD STOIC departure route due to this IAD STOIC initial fix location. The DCA SKILS and CLIPR arrival routes also conflict with the IAD STOIC departure route. **Exhibit 2-6** shows where the IAD and BWI departures conflict. **Exhibit 2-7** shows where the DCA and IAD departures conflict. These conflicts can cause level-offs resulting in extended flight time and distance.

Exhibit 2-6 IAD Departure – BWI Departure Conflicts



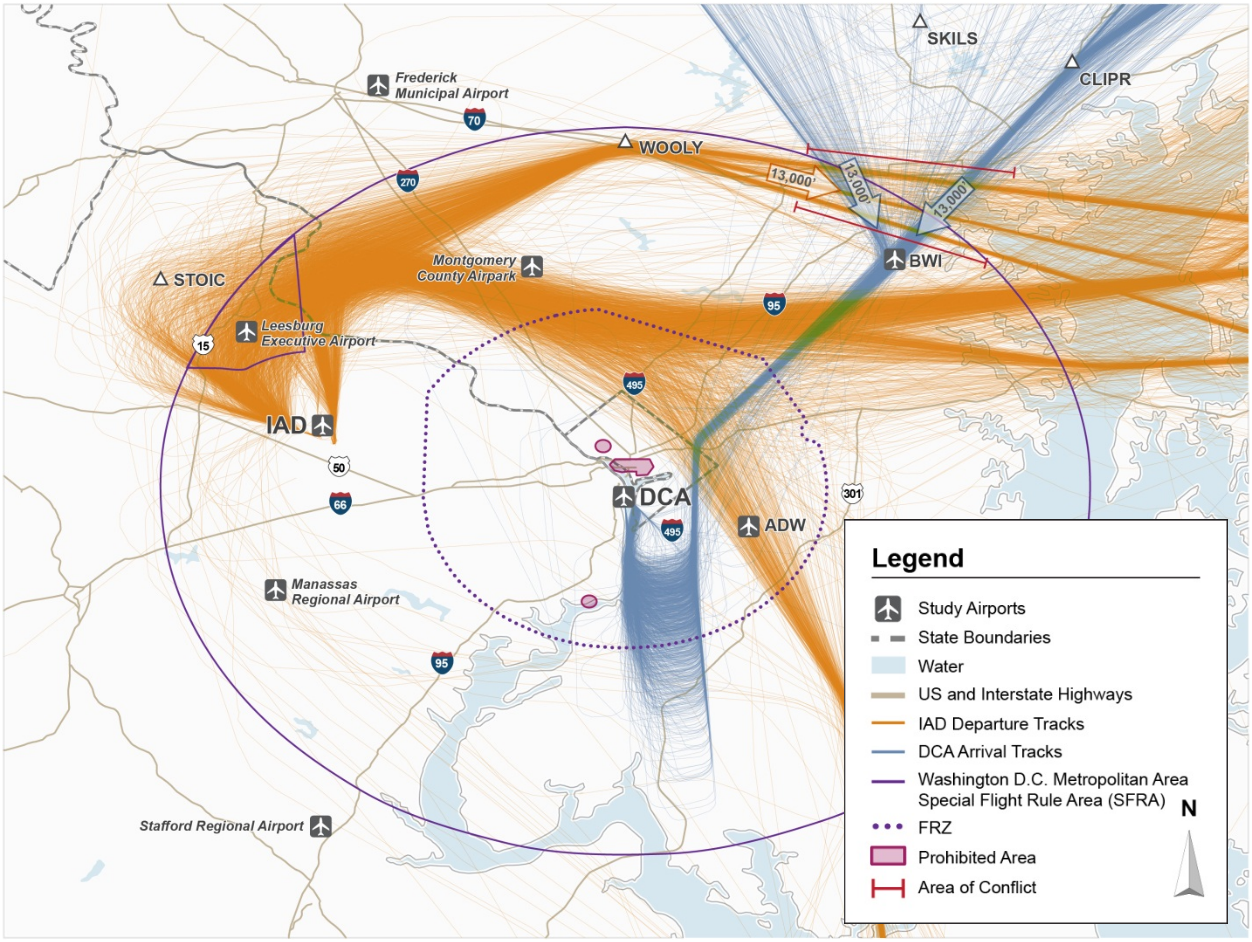
Notes:
ADW – Joint Base Andrews
BWI – Baltimore/Washington International Thurgood Marshall Airport
DCA – Ronald Reagan Washington National Airport
IAD – Washington Dulles International Airport

Source: ATAC (PDARS radar data), June 2011.
Prepared by: ATAC Corporation, March 2013.

2.1.2.3 Lack of Predictable Standard Procedures to/from and in Enroute Airspace

Predictability provides pilots and controllers the ability to know ahead of time how, where, and when an aircraft should be operated along a defined route allowing them to better plan airspace use and the control of aircraft in the given volume of airspace. A predictable route may include expected locations (where), altitudes (where and how high), and speeds (how

Exhibit 2-7 IAD Departure – DCA Departure Conflicts



Notes:
ADW – Joint Base Andrews
BWI – Baltimore/Washington International Thurgood Marshall Airport
DCA – Ronald Reagan Washington National Airport
IAD – Washington Dulles International Airport

Source: ATAC (PDARS radar data), June 2011.
Prepared by: ATAC Corporation, March 2013.

fast and when) at key points. A procedure that provides these elements results in a more predictable route for the pilot and controller.

Aircraft performance and/or piloting technique can vary, and as a result, may also play a factor in reducing predictability. Because conventional procedures are less precise than RNAV procedures and less predictable, controllers will use vectoring as well as instructions governing speed and altitude level-offs to ensure safe vertical and lateral separation between aircraft. As discussed in Section 1.2.6.1, RNAV procedures enable aircraft to follow more accurate and better defined, direct flight routes in areas covered by GPS-based navigational aids. This allows for predictable routes with fixed locations and altitudes that can be planned ahead of time by the pilot and air traffic control. Fixed routes help maintain segregation between aircraft by allowing defined vertical and horizontal separation of traffic. As a result, some routes can be shortened and the need for level-offs can be eliminated. This allows for improved use of the airspace. Therefore, the greater the number of RNAV procedures in a Metroplex the greater the degree of predictability.

Table 2-4 summarizes current availability of conventional and RNAV-based procedures for the four major study airports as of December 2011.

The following sections describe the three areas - ground path, vertical path, and runway transitions - in which conventional procedures in the DC Metroplex result in less predictable air traffic management as compared to RNAV-based procedures. The following sections describe the conditions that reduce predictable air traffic management.

Ground Path

Airports with a significant volume of aircraft operating under Instrument Flight Rules (IFR) need SID and STAR procedures to direct air traffic flows and various runway configurations to achieve optimal efficiency. The intention of SID and STAR procedures is to maintain a predictable flow of aircraft to/from an airport. This is achieved by establishing consistent flight route expectations, reducing the need for communications between controllers and pilots. These procedures also reduce the need to hold aircraft on the ground or in the air, or to make use of other aircraft management tools and coordination techniques to satisfy aircraft separation requirements.

Several STAR and SID procedure designs use ground-based NAVAIDs. As discussed in Section 2.1.1, navigation based on ground-based NAVAIDs can be hindered by line-of-site issues and signal degradation that limits where conventional procedure routes can be located. In addition, because they are less precise, conventional procedures require additional lateral airspace to protect aircraft flying on neighboring routes. Due to these factors, it can be difficult for a non-RNAV equipped aircraft to follow an accurate ground path. The ground path is the track or trace along the surface of the earth directly below the aircraft which represents where the aircraft should be flying. Because these procedures cannot provide more predictable controls such as specific speeds or altitudes, controllers use vectoring and speed adjustments to manage traffic. This leads to increased controller and pilot workload. **Table 2-4** shows the current number of procedures for the five major study airports as of December 2011.

Table 2-4 Existing STAR and SID Procedures for ADW, BWI, DCA, IAD, and RIC (1 of 2)

	Current Procedures			
	Conventional		RNAV	
Airport	STAR	SID	STAR	SID
KADW	IRONS FOUR	ANDREWS ONE, CAMP SPRINGS ONE, MORNINGSIDE ONE	None	None
KBWI	NOTTINGHAM SIX, WESTMINSTER FIVE	PALEO THREE, SWANN THREE	RAVNN THREE	TERPZ TWO
KDCA	IRONS FOUR	NATIONAL TWO	BILIT ONE, CLIPR ONE, ELDEE FIVE, OJAAY ONE, SKILS TWO	LAZIR THREE

Table 2-4 Existing STAR and SID Procedures for ADW, BWI, DCA, IAD, and RIC (2 of 2)

	Current Procedures			
	Conventional		RNAV	
Airport	**STAR**	**SID**	**STAR**	**SID**
KIAD	COATT FOUR, DELRO TWO, PHILIPSBURG TWO, ROYIL TWO, SELINSGROVE THREE	CAPITAL EIGHT	BARIN ONE, HYPER FOUR, LEGGO TWO, PRTZL THREE, SHNON TWO	STOIC TWO
KRIC	NONE	COLIN FIVE, YEAST ONE	NONE	NONE

Table Notes:
Procedures listed in table include RNAV SIDs and STARs implemented in 2012.

Source: NFDC, accessed May 31, 2012, April 17, 2013.
Prepared By: ATAC Corporation, April 2013.

Vertical Path

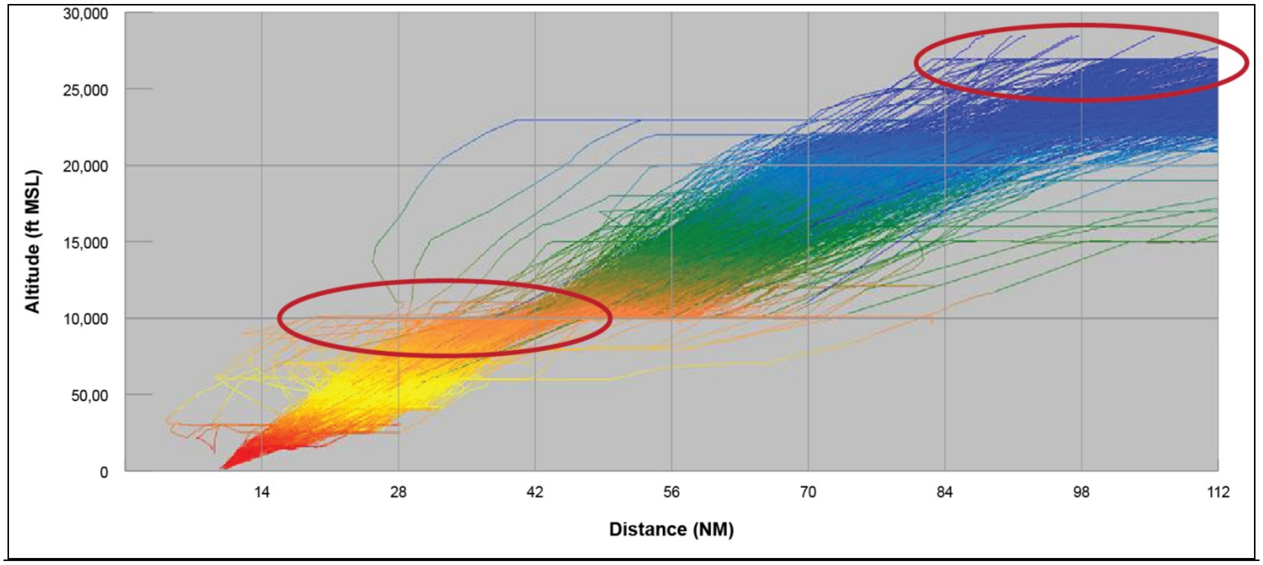
Aircraft climb or descend when instructed by a controller. The point when an aircraft reaches an assigned altitude may vary depending upon a combination of factors, including aircraft performance, weather conditions, and/or piloting technique. Aircraft arriving to or departing from the Study Airports are frequently required to level off during descent/climb to maintain vertical separation from other arriving and departing aircraft. Flight time and distance can be increased for traffic flows with interrupted climbs and descents as the aircraft exit/enter the terminal airspace or transition to/from the runway approach environment. Unpredictable vertical guidance resulting from conflicting traffic leads to increased controller workload and inefficient aircraft operation.

There are routes in the DC Metroplex that require climbing or descending aircraft to level-off to accommodate aircraft crossing above or below. In these instances, aircraft efficiency suffers due to: 1) power variability during leveling-off; 2) power variability in reinitiating the climb or descent; and 3) increased fuel consumption. The level-off in the climb phase typically results in aircraft taking longer to reach the altitude necessary to exit the terminal airspace. During the descent phase, the level-off requires application of thrust for aircraft preparing to land to maintain appropriate approach speeds and altitude. This results in extended fuel burn.

Exhibit 2-8 shows the vertical profile for current DCA/IAD departure flight tracks. Once over the PALEO fix, departures in this area must level-off at 23,000 feet MSL. This location is referred to as “flight level” 230 and abbreviated FL230. The extended level-off is noted by the collection of dark blue flight tracks circled in red. An additional level-off can also be noted at 9,000 feet MSL by the collection of orange flight tracks circled in red. This situation involves additional controller-pilot communications, including additional point-outs.[37] This adds to complexity (e.g., higher controller workload, the number of times controller-to-pilot communication occurs, and inefficient use of aircraft performance capabilities during a descent or climb) and reduces airspace efficiency. Accordingly, the STAR or SID does not offer a predictable route. The procedure does not take full advantage of RNAV capabilities,

[37] While the aircraft is in a climb or descent, controllers may need to alert adjacent aircraft or another controller, who is responsible for a nearby airspace sector, of the proximity of a nearby aircraft. This notification is called a “point-out” and adds to the airspace complexity, because of the communication requirement and time taken to provide the point-out and receive confirmation from the recipient. Reducing point-outs improves efficiency in communications.

Exhibit 2-8 Vertical Arrival Flow Profile Example (DCA/IAD Departures)



Source: ATAC (PDARS radar data), June 2011.
Prepared by: ATAC Corporation, 2012.

including the ability to use the current technology to reduce the complexity of the terminal airspace system and allow for more efficient use of the airspace.

Runway Transitions

As discussed in Section 1.4.3, Study Airports use different runway operating configurations based on factors like weather, wind direction, and the amount and type of air traffic. At a Study Airport with a high level of air traffic, particularly during peak periods, operational efficiency is improved by the availability of STARs for each runway that can be used for the various runway operating configurations. STARs with one or more runway transition route (i.e., the route that leads aircraft to a final approach that typically ends at an Initial Approach Fix) enhance efficiency by minimizing the need for controller-to-pilot communication when aircraft transition to the final approach to the runway from the enroute transition route. The enroute transition route begins in enroute airspace, converging into a single route that ends at a point prior to the runway transition route. Standard instrument arrival procedures also make it easier for controllers to monitor the flow of traffic to the runways and to maintain a constant and predictable routing of aircraft.

Of the 10 RNAV STARs for the major airports in the DC Metroplex, eight include runway transitions to the final approach to a runway end. Including runway transitions in the RNAV STARs can reduce pilot and controller workload, increase flight route predictability, and minimize the need for controller-to-pilot communication. After issuing control instructions to follow an RNAV STAR that contains a runway transition, the controller knows how the pilot will maneuver the aircraft to the final approach. Thus, there is no need for further controller-to-pilot communication unless unusual circumstances arise, such as the need to call out the proximity of other traffic.

Satellite Airports

In addition to issues with existing procedures, system efficiency is affected by the lack of more predictable STAR and SID procedures at DC Metroplex satellite Study Airports. These airports serve as reliever or alternate airports in the event destination airports are closed due to unexpected conditions such as bad weather. The existing procedures for the satellite Study Airports do not allow for predictable segregation of routes between air traffic arriving to or departing from these Study Airports and the major Study Airports in the DC Metroplex. Specifically, the need for predictable SID and STAR procedures to and from the satellite Study Airports are exemplified by interactions between IAD routes and departures from Leesburg Airport (JYO) and Frederick Municipal Airport (FDK), as well as DCA routes and operations at U.S. Air Force operated Joint Base Andrews (ADW).

2.2 Purpose of the Proposed Action

The purpose (goal) of the Proposed Action is to take advantage of the benefits of performance based navigation by implementing RNAV procedures that will help improve the efficiency of the airspace in the DC Metroplex. Implementing RNAV procedures will also comply with direction issued by Congress in the Modernization and Reform Act of 2012. To meet this goal, the Proposed Action would optimize procedures serving the DC Metroplex Study Airports while maintaining or enhancing safety in accordance with FAA's mandate under federal law. This would be achieved by reducing dependence on ground-based NAVAID technology in favor of more efficient satellite-based navigation, such as RNAV. Specifically, the objectives of the Proposed Action are as follows:

- Improve the flexibility in transitioning traffic between enroute and terminal area airspace and between terminal area airspace area and the runways;
- Improve the segregation of arrivals and departures in terminal area and enroute airspace; and
- Provide RNAV arrival and departure enroute transitional and terminal area airspace procedures for each individual runway with the intent to provide a more predictable ground and vertical path.

Air traffic controller workload and controller-to-pilot communication would be expected to decrease, reducing both workload and airspace complexity. Improvements in arrival and departure segregation among the DC Metroplex Study Airports would reduce the need for vectoring and level flight segments, resulting in shorter, more predictable flows.

Each objective of the Proposed Action is discussed in greater detail below.

2.2.1 Improve Flexibility in Transitioning Aircraft

As discussed in Section 2.1.2.1, the limited number of entry and exit points and associated procedures, constrain the efficiency of the air traffic routes in the terminal and enroute transitional airspace. This results from the need to merge multiple routes prior to arrival to and departure from terminal airspace. One objective of the Proposed Action is to minimize the need for merging by increasing the number of entry/exit points and procedures dedicated to specific Study Airports. This objective can be measured with the following criteria:

- Where possible, increase the number of entry and exit points compared with the No Action Alternative (measured by number of exit/entry points).
- Segregate major Study Airport traffic from other major Study Airport and/or satellite Study Airport traffic to/from Study Airports (measured by count of RNAV STARs and/or SIDs that can be used independently to/from Study Airports).

2.2.2 Segregate Arrivals and Departures

As discussed in Section 2.1.2.2, arrival and departure flight routes frequently cross, converge, or are located within close proximity of each other in some portions of the enroute and terminal airspace. This requires controllers to actively manage the traffic using the tools available to them to ensure that safe vertical and lateral separation between aircraft is maintained. Another objective of the Proposed Action is to implement procedures that would achieve better segregation of arrivals and departures within the terminal airspace. This objective can be measured with the following criterion:

- Where possible, increase the number of RNAV STARs and SIDs compared with the No Action Alternative (measured by total count of RNAV STARs and RNAV SIDs for the DC Metroplex.)

2.2.3 Improve the Predictability of Air Traffic Flow

As discussed in Section 2.1.2.3, current procedures in the DC Metroplex do not take full advantage of RNAV capabilities. RNAV procedures can increase predictability by taking better advantage of aircraft performance capabilities (e.g., speed control and altitude restrictions) and by designing procedures that reflect these capabilities. These enhancements would provide for more predictable, repeatable, and efficient routes than is currently possible with most conventional procedure designs.

In addition, RNAV procedures with runway transitions provide for a more predictable flow of air traffic through the airspace and require less controller-to-controller coordination and controller-to-pilot communications to manage air traffic flows. Additional runway transitions to and from each runway would provide controllers more flexibility to balance demand, maintain runway departure separations, and segregate routes without the need for controller intervention.

This objective can be measured with the following criteria:

- Ensure that the majority of STARs and SIDs to and from the Study Airports are based on RNAV technology (measured by count of RNAV STARs and SIDs for an individual Study Airport);
- Increase the number of runway transitions in the RNAV STARs and SIDs in comparison to the No Action Alternative. (measured by count of procedures that include runway transitions to/from runways); and,

2.3 Criteria Application

The Proposed Action is evaluated to determine how well it meets the purpose and need based on the measurable criteria for each objective described above. The evaluation of alternatives will include the No Action Alternative, under which the existing (2011) air traffic procedures serving the Study Airports would be maintained, along with approved procedure modifications already planned and approved for implementation. The criteria are intended to aid in comparing the Proposed Action Alternative with the No Action Alternative.

2.4 Description of the Proposed Action

The Proposed Action considered in this study would include the implementation of optimized RNAV SID and STAR procedures that would reduce reliance on conventional procedures. The primary components of the Proposed Action are to the extent possible, redesign standard instrument arrival and departure procedures to more efficiently serve the Study Airports and to improve the flexibility and predictability of air traffic routes. The Proposed Action is described in detail in Chapter 3, *Alternatives*.

Implementation of the Proposed Action would not result in an increase in the number of aircraft operations at the Study Airports. However, inefficiencies in the air traffic routes currently serving the Study Airports would be reduced. The Proposed Action does not involve physical construction of any facilities, such as additional runways or taxiways, and does not require any state or local actions. Therefore, the implementation of the proposed changes to procedures in the DC Metroplex would not require any physical alterations to environmental resources identified in FAA Order 1050.1E.

2.5 Required Federal Actions to Implement Proposed Action

Implementation of the Proposed Action requires the following actions to be taken by the FAA:

- Controller training; and,
- Publication of new or revised STARs, SIDs, and transitions.

2.6 Agency Coordination

On December 19, 2012, the FAA distributed an early notification letter to 437 federal, state, regional, and local officials as well as to 17 tribes. FAA sent the early notification letter to provide notice of the initiation of the EA; request background information related to the EA study area; and to gain an understanding of issues, concern, policies, and/or regulations that may affect the environmental analysis. A subsequent notification letter was sent to an additional 56 federal, state, and local officials on March 25, 2013. The FAA sent the early notification letter to:

1. To advise agencies and tribes of the initiation of the EA study;
2. To request background information regarding the study area established for the EA; and
3. To provide an opportunity to advise the FAA of any issues, concerns, policies or regulations regarding the environmental analysis that will be undertaken in the EA.

Appendix A, *Agency Coordination, Agency Consultation, and Public Involvement*, includes a copy of the early coordination letter (and attachments) as well as a list of the receiving agencies and tribes.