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Evaluation of Options for Overseas Combat Support Basing

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Summary

Background

The geopolitical divide that once defined the U.S. military policy collapsed as the Soviet Union disintegrated and was replaced by the rise of regional hegemons, producing an evolving security environment that is driven not only by regional powers but also by a persistent global insurgency and counterinsurgency. The ability of U.S. forces to provide swift and tailored responses to a multitude of threats across the globe is a crucial component of security in today's complex political environment. The Air Force, like the other services, has responded by transforming itself into a more expeditionary force. In order for the Air Force to realize its goals of global strike and persistent dominance, it is vital that the Air Force support the warfighter seamlessly and efficiently in all phases of deployment, employment, and redeployment. One of the major pillars for achieving these objectives is a global combat support basing architecture.

This report focuses on an analytic framework for evaluating options for overseas combat support basing (or forward support locations). The presentation of this framework is important because it addresses how to assess these options in terms of the relevant programming costs while considering a novel approach to scenario planning. This formulation minimizes the costs of operating and constructing facilities and transporting WRM, costs that are associ-

ated with meeting the training and deterrent exercises needed to demonstrate U.S. global power projection capability and thereby deter aggression, while maintaining the necessary storage capacity and system throughput to engage in major combat operations should deterrence fail.

This framework is based on the notion that U.S. interests are not only global but dynamic as well, particularly when the United States is confronted with emerging anti-access and area denial threats. Consequently, the U.S. Air Force must be ready to deploy forces quickly across a wide range of potential scenarios.

The Tenets of Deployment Scenarios

As recently as a few years ago, the focus of contingency planners was on individual deliberate threat-based deployments. This led to supporting the warfighter by developing *optimal* combat support networks, which were designed to support known threats. An unfortunate characteristic of this type of designed network is that it often performs poorly if the set of demands (locations and quantities) differs from the plan. The new planning environment, with its broad (and unclear) set of potential adversaries, calls for *robust* and *efficient* combat support networks that, while not necessarily optimal for any one deliberate plan, meet operational requirements at reasonable costs over a wide range of contingencies. We have developed a new framework that integrates the traditional threat-based assessments concept with capability-based planning. This framework relies on a sequenced, potentially simultaneous set of deployment scenarios, which we call the Multi-Period–Multi-Scenario (MPMS) concept.

In keeping with this security paradigm and the concept of MPMS, we constructed a deployment framework using the following tenets:

- The combat support basing architecture should be developed using a global perspective and not centered on a few disconnected areas.

- A wide range of plausible deployment scenarios should be considered.
- Deployments should be sequenced in time and space.
- Different sets of deployment scenarios or "streams of reality" should be used to hedge against uncertainty.

Analysis Approach

To evaluate and select alternative forward basing options, we developed an analytic framework that uses an optimization model to assess the cost and capability of various portfolios of overseas combat support basing or forward support locations (FSLs) for meeting a wide variety of global force projections.

We have taken two complementary approaches in developing the optimization model: The primary approach attempts to minimize the overall system cost while meeting operational requirements; the other approach focuses on maximizing the support capability (e.g., reducing the time to initial operating capability). Examining the costs of alternative support basing options, for a constant level of performance against a variety of deployments, is an important process in the development of suitable programming and budgeting plans. In this approach, we are careful to ensure that adequate capacity is maintained to meet requirements as specified in the Defense Planning Scenarios.

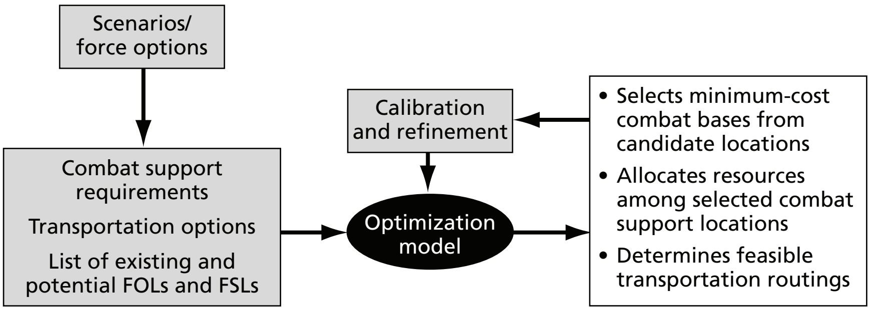
Our analyses show the costs and deployment timelines for various FSL options under different degrees of stress on combat support while taking into account infrastructure richness, basing characteristics, deployment distances, strategic warning, transportation constraints, dynamic requirements, and reconstitution conditions. We developed several sets of deployment scenarios using the MPMS concept, with each including training exercises, deterrent missions, and major combat operations. These so-called "streams of reality" allow our model to measure the effect of timing, location, and intensity of operational requirements on combat support—and vice versa. We develop several of these streams (or *timelines*) to account for the inherent uncertainties in future planning associated with each timeline.

After we determine the desired requirements in terms of combat support resources, our optimization model, the *RAND Overseas Basing Optimization Tool* (*ROBOT*), selects a set of FSL locations that would minimize the costs of supporting these various deterrence and training exercises while maintaining the capability to support major regional conflicts should deterrence fail. This tool essentially allows for the analysis of various "what-if" questions and assesses the solution set in terms of resource costs for differing levels of combat support capability.

Our analytic approach has several steps (see Figure S.1):

1. We first select a diverse set of deployment scenarios that would stress the combat support system. These deployments include small-scale humanitarian operations, continuous force presentation to deter aggression, and major combat operations.
2. The deployments and the force options drive the requirements for combat support, such as base operating support equipment, vehicles, and munitions.

Figure S.1
Overview of the Analytic Process for the Optimization Model



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3. These requirements, the set of potential FSLs and forward operating locations (FOLs), and the transportation options (e.g., allowing sealift or not) serve as the inputs to the optimization model.
4. The optimization model selects the FSL locations that minimize the costs of operating and constructing facilities and transporting WRM—costs associated with planned operations, training missions, and deterrent exercises that are scheduled to take place over an extended time horizon, satisfying time-phased demands for combat support commodities at FOLs. Major combat operations are included in this analysis to ensure that the resulting network has sufficient capability to allow for such operations should deterrence fail; however, the transportation costs associated with these operations are not considered in the model because of the different funding mechanisms for the execution of combat operations. The model also optimally allocates the programmed resources and commodities to those FSLs. It computes the type and the number of transportation vehicles required to move the materiel to the FOLs. The result is the creation of a robust transportation and allocation network that connects a set of disjointed FSL and FOL nodes.
5. The final step in our approach is to refine and recalibrate the solution set by applying political, geographical, and vulnerability constraints based on current expert judgments concerning the global environment. Because this step is applied postoptimally and may make additional iterations necessary, it enables reevalution and reassessment of the parameters and options chosen.

The end result of this analysis is a portfolio containing alternative sets of FSL postures, including allocations of WRM to the FSLs, which can then be presented to decisionmakers. This portfolio will allow policymakers to assess the merits of various options from a global perspective.

Combat Support Factors

Several major constraining and contributing factors affect the capability of FSLs to support the warfighter. Our analytic framework takes each of these parameters into account in its process of selecting an optimal set of combat support locations.

Base Access

This important issue deserves careful consideration and must be addressed before each conflict or operation. However, rather than eliminating some sites a priori because of potential political access problems, we allowed the model to select the most desirable sites based on other factors first. We then "forced" specific sites out of the solution set if we had reason to believe that these sites presented access issues—thereby providing the economic cost of restricting the solution to politically acceptable sites.

Forward Support Location Capability and Capacity

The parking space, the runway length and width, the fueling capability, and the capacity to load and offload equipment are all important factors in selecting an airfield to support an expeditionary operation.[1] Runway length and width are key planning factors and are commonly used as first criteria in assessing whether an airfield can be selected.

Airlift and Airfield Throughput Capacity

Timely delivery of combat support materiel is essential in an expeditionary operation. However, a mere increase in the aircraft fleet size may not improve the deployment timelines. The fleet size must always be determined with respect to the throughput capacity of an airfield. The maximum-on-ground (MOG) capability, for example, directly contributes to the diminishing return of deployment time as a function of available airlift.

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[1] In our analysis, some of these factors are computed parametrically in order to assess a minimum requirement of a potential field for meeting a certain capability.

Forward Operating Location Distance

Distance from FSLs to FOLs can impede expeditionary operations. As the number of airlift aircraft increases, the difference in deployment time caused by distance becomes less pronounced. Adding more airlifters to the system will reduce the deployment time, albeit at a diminishing rate, until the deployment time levels off as a result of MOG constraints.

Modes of Transportation

There are several advantages to using sealift or ground transportation in place of, or in addition to, airlift. Allowing for alterative modes of transportation might bring some FSLs into the solution set that otherwise may have been deemed infeasible or too costly. Ships have a higher hauling capacity than do aircraft and can easily carry outsized or super-heavy equipment. In addition, ships do not require overflight rights from any foreign government.

Afloat Prepositioning

We examined the potential for storing combat support resources (munitions and nonmunitions) aboard an afloat preposition fleet (APF). Although afloat prepositioning does offer additional flexibility and reduced vulnerability versus land-based storage, the APF is much more expensive than land-based storage and presents a serious risk with regard to deployment time. Even if a generous advance warning is assumed to allow for steaming toward a scenario's geographic region, it can be difficult to find a port that is capable of handling these large cargo ships. The requirements placed on the port, including preemption of other cargo movement, also restrict the available ports that can be used by an APF.

Cost

The main objective of the model is to reduce the total cost of exercises and deterrent missions while meeting the time-phased operational demand for combat support resources (for those missions as well as for major combat operations). These costs include construction and/or expansion of facilities, operations and maintenance

(O&M), and transportation for peacetime and training missions. Incorporated in each of these costs is the effect of differences in regional cost-of-living or country cost factors.

Results

We focused on three of the most important combat support resources: Basic Expeditionary Airfield Resources (BEAR), munitions, and rolling stock (e.g., trucks).[2] These resources comprise the bulk of many of the consumable and repairable items in the combat support package; and, in the case of munitions, they pose storage and transport complexities.

From the outset of the study, we attempted to answer two basic questions: How capable are the Air Force's current overseas combat support bases of managing the future environment? And what are the costs and benefits of using additional or alternative overseas combat support bases for storing heavy combat support materiel?

To answer these questions, we devised five different *streams of reality*—or deployment timelines—to represent a wide range of possible future Air Force deployments across the globe (see Table S.1).

The base scenario, or the "most likely global deterrent scenario," places the focus on supporting a number of deployments in the Persian Gulf region, Asian littoral, and North Africa over a time horizon of six years, in keeping with the Future Years Defense Program (FYDP) convention. Figure S.2 represents the size, in terms of combat support requirements, and the timing of each deployment for the base scenario. The sizes of recent deployments are given on the y-axis as a reference. Notice that we have "scheduled" the MCOs in each scenario for execution at the end of the FYDP period. This approach

[2] BEAR provides the required airfield operational capability (such as housekeeping or industrial operations) to open an austere or semi-austere airbase.

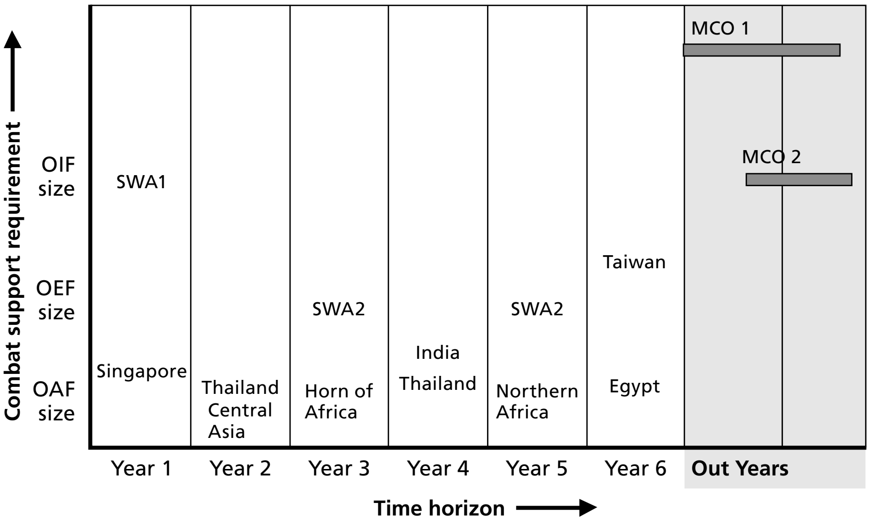
Table S.1
Sequencing of Scenarios by Timeline

Year	Base Scenario	Stream 1	Stream 2	Stream 3	Stream 4
1	SWA 1 Singapore	SWA 3 Southern Africa East Timor	SWA 1 Horn of Africa	South America 2 Cameroon Singapore	Spratleys Chad
2	Central Asia Thailand	Thailand Sierra Leone	Central Asia Liberia	SWA 3 Thailand Haiti	South America 1 Horn of Africa
3	Horn of Africa SWA 2	Spratleys Haiti Chad	Balkans Rwanda	Taiwan S. Africa	SWA 2 Singapore
4	Thailand India	Balkans Egypt	Singapore Cameroon India	Spratleys Egypt	Taiwan Haiti
5	SWA 2 North Africa	SWA 1 North Africa Liberia	SWA 2 Taiwan Sierra Leone	SWA 1 Rwanda East Timor	SWA 2 East Timor
6	Egypt Taiwan	Central Asia India Cameroon	Spratleys Chad Thailand	Central Asia North Africa Singapore	SWA 1 Rwanda
7+	MCO 1 MCO 2	MCO 1 MCO 2	MCO 1 MCO 2	MCO 1 MCO 2	MCO 1 MCO 2

NOTE: SWA = Southwest Asia; MCO = major combat operation.

focuses attention on providing resources to support deterrent deployments. It ensures their funding while also placing major combat operation requirements in the planning, programming, budgeting, and execution (PPBE) process.

Figure S.2
"Most Likely" or Baseline Scenario



NOTE: OAF = Operation Allied Force; OEF = Operation Enduring Freedom; OIF = Operation Iraqi Freedom.
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Selection of Existing Combat Support Bases

We solved the problem (i.e., we found the least-cost bases that would satisfy operational requirements) using existing forward support locations (e.g., Ramstein Air Base [AB]). The model selected 11 FSLs (see Table S.2). These locations represent the optimal locations to support the baseline scenario. Although the model was allowed to select from the four existing munitions preposition ships, none was chosen unless infrastructure expansion at the existing land-based FSLs was excluded from the solution. In that case, a single APF ship assigned to the Arabian Sea was used to compensate for the lack of storage space at the land-based FSLs.

We assessed the capabilities of the selected FSLs (see Table S.2) against the remaining four timelines. These FSLs, along with an additional site at Eielson Air Force Base (AFB), were able to meet the demand for three of the four additional streams, although with

Table S.2
Optimal Existing FSLs to Support the Baseline Scenario

Ramstein AB, Germany	Seeb, Oman
Sigonella AB and Camp Darby, Italy	Thumrait, Oman
RAF Mildenhall and Welford, UK	Kadena, Japan
Al Udeid AB, Qatar	Andersen AB, Guam[a]
Sheik Isa, Bahrain	Diego Garcia, UK
Masirah Island, Oman	

[a] The model did not select Andersen AB directly, mainly because of its remoteness and cost. However, the postoptimality analysis (Andersen is a "bomber island" with a large quantity of combat support resources) led to its selection.

increased transportation requirements and costs. However, for Stream 4, the 10-day initial operating capability (IOC) requirement had to be relaxed to 12 days for the South American deployment, and a single munitions ship (with Guam as its home base) appeared in the solution (see page 67).

Selection of Additional Combat Support Bases

The next step was to evaluate existing and potential FSLs against the baseline scenario and the four alternative streams of reality. We generated a list of potential FSL locations around the globe that could support a wide range of deployments; as before, the model selected an optimal list for the baseline scenario (the "most likely" scenario). The earlier 11 existing sites presented in Table S.2 remained in the solution (i.e., the model selected them again), along with five new sites in Europe and Asia: Incirlik, Turkey; Clark AB, Philippines; Paya Lebar, Singapore; U-Tapao, Thailand; and Balad, Iraq. It should be noted, however, that the list in Table S.2 is by no means sacrosanct, and alternative sites may provide the same capability at a similar or marginally greater cost. In particular, Souda Bay, Greece; Akrotiri, Cyprus; Constanta, Romania; or Burgas, Bulgaria, may be suitable alternatives to Incirlik, Turkey. In addition, some realignment of existing sites may be more efficient and effective than current sites. For example, the port of Salalla in Oman could be used to meet some requirements met by Seeb or Thumreit with lower cost and less time than the current sites. The new combination of existing and potential FSLs offers about 30 percent savings in total cost by reducing the overall transportation cost to the system (see page 69).

Figure S.3 illustrates the final results from the combination of the baseline scenario and the four other streams of reality. This figure also shows the locations of the other candidate sites that were not selected by the model. It and the accompanying Table S.3 divide these locations into Tier 1 and Tier 2 categories. We use the label "Tier 2 FSLs" for a set of FSLs that require a more detailed consideration as potential sites. They may also have appeared in the solution as a result of one or two individual deployments, and therefore their role is closely fixed to the nature of those particular deployments. Additionally, all the Tier 2 FSLs (with the exception of Puerto Rico) have uncertain political futures or limited internal capabilities. Iraq, for example, falls in this category, but its location for support of many

Figure S.3
Supporting Global Deterrence Using a Global Set of Oveseas Bases

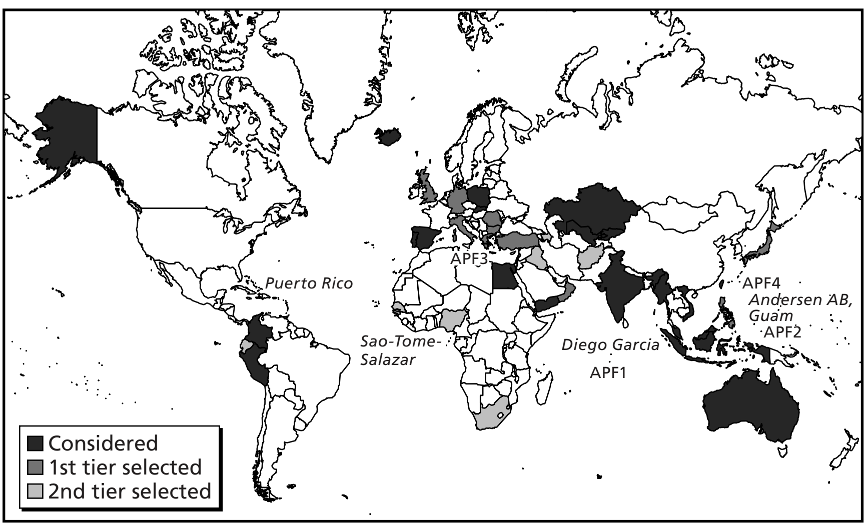

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Table S.3
Global Set of Overseas Bases

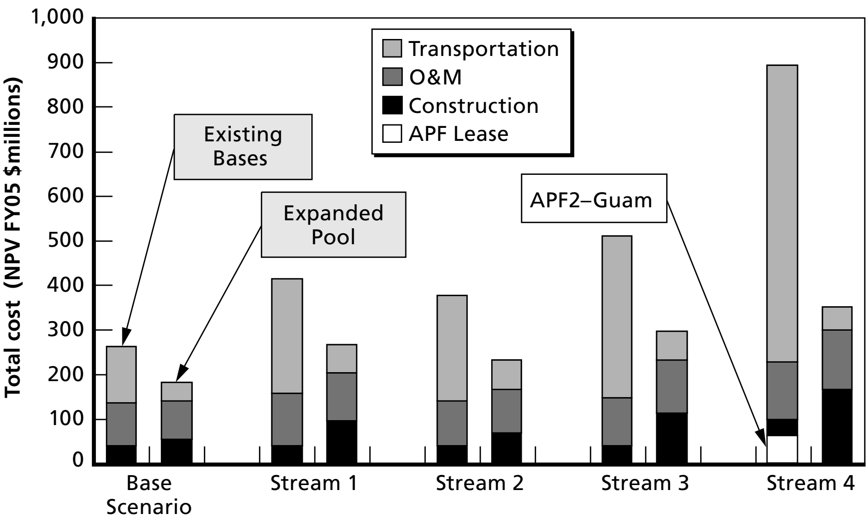
Tier 1	Tier 2
Al Udeid AB, Qatar	Louis Botha, South Africa
Andersen AB, Guam	Bagram, Afghanistan
Diego Garcia	Baku, Azerbaijan
Kadena, Japan	Roosevelt Roads, Puerto Rico
Masirah Island, Oman	Tocumen, Panama
Mildenhall and Welford, UK	Cotipaxi, Ecuador
Ramstein, Germany	Sao Tome/Salazar, Sao Tome
Seeb, Oman	Kaduna, Nigeria[b]
Sheik Isa, Bahrain	Balad, Iraq
Sigonella and Camp Darby, Italy	
Thumrait, Oman	
Clark AB, Philippines	
Incirlik, Turkey	
Paya Lebar, Singapore	
U-Tapao, Thailand	
Souda Bay, Greece[a]	

[a] Alternatives to Souda Bay, Greece, are Akrotiri, Cyprus; Burgas, Bulgaria; or Constanta, Romania.
[b] An alternative to Kaduna, Nigeria, may be Dakar, Senegal.

operations makes it invaluable. However, we emphasize that the focus should not be on a particular latitude and longitude but rather on a particular region. Balad, Iraq, would be suitable if all the issues of security and long-term political amenities were resolved. If the uncertainties continue, then an alternative location in the region with similar capabilities should be considered (see page 75).

Figure S.4 presents the costs for the base scenario and all four streams. For each stream the expanded set of FSLs offers the same capability at a reduced overall cost to the Air Force. Note especially that the set of existing land-based FSLs could not support Stream 4 requirements and required that the IOC deadline be extended from 10 to 12 and also required the use of an APF munitions ship.

Figure S.4
Total Cost of Supporting All Scenarios Using Existing and Expanded Set of FSLs



NOTE: Existing land-based FSLs cannot support Stream 4 requirements; the IOC deadline must be extended from 10 days to 12. NPV = net present value.
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However, when we selected from the expanded set of land-based FSLs, the need for the afloat option disappeared. The advantage of the global basing option is not limited to cost and encompasses a more efficient use of multimodal transportation. For each stream, the model was able to make better use of trucks and high-speed sealift for the expanded pool of bases, yielding about 50 percent less airlift usage without compromising operational requirements (see page 77).

Recommendations

We make the following recommendations based on our analysis of overseas combat support basing options:

Using a global approach to select combat support basing locations is more effective and efficient than allocating resources on a

regional basis. One of the strengths of the analytic framework chosen is the lack of regional command boundaries. We are able to look at all regions of the world simultaneously with operations occurring in various locations at the same time, thereby extracting the most efficient solution without adversely compromising the capability needs of a particular region. Currently, the Air Force lacks a focal point for managing its investment in global infrastructure. Combatant Commanders influence their assigned warfighting units, which in turn influence Air Force investments on a regional basis, but there is no central organization that has the overall responsibility to investigate how these regional capabilities interact to provide global force projection capabilities. One option to overcome this shortfall would be the creation of a centralized Air Force planning and assessment group at the Air Staff. Because the potential scenarios impacting U.S. interests are constantly shifting, such a group needs to continually revise the model inputs and rerun these computer models, to ensure that the logistics posture is well suited to the current environment. This group might also have the budgeting and Programmed Objectives Memorandum preparation responsibilities associated with global logistics infrastructure (see page 83).

Political concerns need to be addressed in any decision about potential overseas basing locations. For instance, while an APF is much more expensive than alternative land-based storage options and may suffer from increased risk in deployment time, it may be necessary to consider the APF option because it offers more flexibility if access is denied. Additionally, countries like Iraq are continually selected by the model because cost and time are its major driving criteria. However, the uncertainty surrounding the future of Iraq (and similar countries) should force us to pause and consider alternative sites that may be less desirable mathematically but offer a higher probability of access and stability (see page 84).

Closer attention should be paid to Africa both as a source of instability and as a possible location for combat support bases. Africa, with its potential as a future source of oil combined with the uncertain future of many of its nation states, requires a great deal of attention from policymakers. Northern and sub-Saharan Africa continue to be plagued by civil wars, ethnic or clan-based conflicts, and/or severe economic disasters. There is a greater likelihood that terrorists may seek haven in the remote areas of Africa because of the continued U.S. military presence in the Middle East and Southwest Asia. Also, the geopolitical importance of the region, with its high levels of oil production, makes it an area of interest to the United States. If deployments to the region increased in the future, the current set of bases would not support those operations. Possible FSL locations in Africa could support operations across the entire southern half of the globe. Although the initial construction costs for these bases would be high, the costs would be quickly offset by the reductions in transportation costs. As an initial phase, we recommend closely evaluating western regions of Africa, with particular attention to Nigeria, Sao Tome/Salazar, South Africa, and Senegal. The development of African FSLs could be tied into other foreign policy and outreach initiatives in Africa, such as the NATO Mediterranean Dialogue country relationships with Algeria, Mauritania, Morocco, and Tunisia (see page 84).

Some Eastern European nations should be considered as serious candidates for future overseas bases. The potential for continued conflicts in central Asia and the Near East has made many of the countries in the eastern part of Europe very attractive as potential storage locations for WRM. The appeal of this region has been further heightened by the inclusion of some of these countries in the European Union (EU) and NATO, combined with the lower cost of living and the relatively high professional labor market. Romania and Bulgaria in Eastern Europe, along with Mediterranean locations such as Greece and Cyprus, form an appealing region that would allow easy access to both the U.S. Central Command (CENTCOM) and the U.S. European Command (EUCOM). These locations are especially attractive because they allow for multimodal transport options, using Black Sea ports for Romania and Bulgaria (assuming passage through the Bosporus Strait in Turkey to the Mediterranean). Poland and the Czech Republic, although very accommodating to U.S. efforts in the current operations, are located relatively far from the potential deployments that were considered in this report. Also, the

Czech Republic is a landlocked state, and while Poland has significant coastline on the Baltic Sea, these ports do not allow for rapid transport to the regions of U.S. Air Force (USAF) interest. In terms of transportation time and cost, neither Poland nor the Czech Republic offers savings versus the existing installations in Germany, and either would require a substantial investment in transportation infrastructure to attain the current capability levels in Germany.

Southeast Asia offers several robust options for allocation of combat support resources. The remoteness of Guam and Diego Garcia from most potential conflicts in the region requires the consideration of other locations in the Pacific. The geographical characteristics of the U.S. Pacific Command (PACOM) put a heavy reliance on airlift and possibly fast sealift. Most of the current U.S. bases are located in Japan and the Korean Peninsula with the main purpose of supporting the Korean deliberate plan. To support other possible contingencies, we propose a closer examination of three locations: Thailand, Singapore, and the Philippines. Each of these locations offers a host of options for the Air Force, including storage space, adequate runway facilities, proximity to ports, and strategic location. Darwin, Australia, has many of the desired attributes for an overseas combat support base, but its remoteness to any potential conflict makes it a comparatively poor choice.

Potential future operations in South America may be greatly constrained unless additional infrastructure in the region is obtained. In our analysis, a large South American scenario obtained from the Defense Planning Scenarios overstressed the system of existing facility locations, preventing the satisfaction of a 10-day IOC deadline, even with the use of APF ships. While the states of South America are relatively stable, the recent difficulties in Ecuador, Bolivia, and Venezuela demonstrate the potential volatility of the region. As with Africa, future U.S. intervention cannot be discounted owing to significant U.S. interests in the region's oil supply. Although the current combat support infrastructure is sufficient for small-scale operations such as drug interdiction, an expanded combat support presence would facilitate larger-scale operations in the region (see page 86).

A multimodal transportation option is the key to rapid logistics response. RAND has shown in several earlier reports (Amouzegar et al., 2004; Vick et al., 2002) that overreliance on airlift may in fact reduce response capability because of throughput constraints and lack of airlift. A comprehensive mobility plan should include a combination of air, land, and sealift. Judicious use of trucks and high-speed sealift in fact may offer a faster and less expensive way to meet the Air Force's mobility needs (see page 86).