

# URBAN FOREST RESOURCE MANAGEMENT AT HILL AIR FORCE BASE, OGDEN, UTAH

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**Abstract.** Most military bases can be thought of as good-sized communities, containing all of the important resources that non-military communities contain including urban forests. These military urban forests have similarities and differences with urban forests in non-military communities, and their management is in some ways different. In this paper we describe the urban forest situation at Hill Air Force Base in northern Utah, an example of a military base still in the early stages of urban forest management, but with an improving and expanding urban forestry program. The base, in cooperation with Utah State University's Department of Forest Resources, began an assessment of its program and conducted a complete tree inventory in 1993. Inventory results and a qualitative assessment led to development of a plan with management goals and implementation strategies, which became part of an overall Natural Resources Management Plan for the Base. Besides increasing tree numbers and overall urban forest quality and tree management, the plan calls for increased emphasis on community participation as the key to a successful urban forestry program.

## Introduction: An Urban Forest in a Military Community

Military bases usually meet all of the requirements to be called "communities." Hill Air Force Base near Ogden, Utah is a typical large military community that is a work place for 22,000 military and civilian employees, is home to over 3,400 residents, and provides additional employment opportunities for the surrounding area through construction activities and contract services with local area businesses. Like any community, Hill contains recreational and commercial facilities, a hospital, homes, streets and highways, wildlife habitat, and nearby schools. And like any community, Hill AFB contains an important urban forest that is similar in some ways and different in other ways from urban forests in non-military communities. Military urban forests provide typical benefits like improved appearance, potentially increased property values (especially surrounding the base), shade, evaporative cooling, and wind protection to reduce cooling and heating costs. Less typical benefits of the urban forest at Hill AFB are visual screening for unsightly industrial areas or security-sensitive facilities,

highlighted base entrances, more attractive visitor facilities, and windbreaks that control snow deposition to keep runways clear and reduce wind erosion to protect dust-sensitive equipment. Urban forest concerns somewhat peculiar to military bases include the need to keep high security zones and weapons testing areas fairly free of woody vegetation, and provision of a clear zone surrounding runways to decrease the possibility of aircraft bird strikes.

In non-military communities the urban forest has a great effect on community image. "Green" cities look and feel good, pleasing residents and visitors alike. Image and appearance also are important on military bases like Hill AFB, which competes with other bases or even private facilities for military contracts, similar to the way a city tries to attract businesses from other areas. Upper level managers who consider moving a business or contract to a base usually are making a decision that involves moving many personnel and their families, and a good base image and overall appearance indicates a pleasant working and living atmosphere. This also positively affects morale of current employees and their dependents. Despite their relatively short-term residency, many base residents and employees take pride in their surroundings, actively planting trees and maintaining common areas near their residences and work places.

Military bases usually are communities within communities, having a large impact on surrounding cities and towns. Although Hill's urban forests are managed and maintained for the people who live or work on base, relations with the surrounding community can be improved by having the base look attractive. This is especially important along base boundaries and major travel corridors.

Like many communities, Hill AFB's urban forest resources had a low priority in the past. Urban forestry-related work took place, but it was not

**Table 1. Occurrence of various land uses (indicated by an X) by management area at Hill Air Force Base. Dominant uses for an area are indicated by XX.**

Area #	Land Use							
	Industrial	Transportation Corridor	Residential	Recreation	Open	Office	Munitions Storage	Commercial
1 (dispersed industrial)	XX	X			XX		XX	X
2 (open, industrial)	XX	X	XX		XX	XX	XX	
3 (residential, light industry)	X	X	XX	XX				X
4 (dense industrial)	XX	X	X	X		XX		X
5 (open, residential)	X	X	XX	X	XX			
6 (golf course)				XX				

governed by any plan or set of guidelines. Some maintenance occurred, but other areas needed attention. Trees were planted on occasion, but not according to a plan and often without the knowledge of persons responsible for the resource. This lack of planning was leading to an urban forest resource that was little understood, generally in poor shape, and inadequate to meet the needs or desires of base employees, residents, visitors, and neighbors.

Base personnel recognized the need for and importance of a management plan to help them make informed decisions concerning species selection, tree placement, and maintenance priorities while reducing replacement and maintenance costs. Therefore, in 1993 an inventory and evaluation of the overall condition of Hill's urban forest resource was commissioned to assess current demands and future needs, and to address management issues leading to an action plan. An urban forestry plan also was written to prioritize goals and to set forth strategies for managing the urban forest as part of an overall Natural Resources Management Plan for the Base. An overview of this project is presented here as an example of urban forest management problems and solutions on a military base.

### Description of Resources

Preliminary inventory work began in spring 1993, with the base being divided into six logical and practical management areas. These units were located on the ground, delineated on maps, used to organize the inventory, and will be used for future resource management activities by base personnel and contractors. Land uses of these areas include a mix of base housing/residential, office complexes, commercial, industrial, munitions testing and storage, transportation corridors, recreation, and unmanaged areas (Table 1). Urban forest needs, priorities, and maintenance levels vary by land use, complicating management planning for each area. Unmanaged areas and relatively open areas like those used for munitions storage require little planting, minimal management of mostly native trees and shrubs, and little maintenance. Office, residential, recreation, and commercial areas are much more intensively maintained. Industrial areas and travel corridors vary considerably in the level of management needed, depending on location and intensity of use.

### Tree Inventory

A tree inventory was conducted for the base during a three month period in the summer of 1993

**Table 2. Numbers of trees and numbers of species inventoried by management area at Hill Air Force Base, Utah.**

	Area 1 Dispersed Industrial	Area 2 Mixed Open, Industrial	Area 3 Residential, Light Industrial	Area 4 Dense Industrial	Area 5 Mixed Open, Residential	Area 6 Golf Course	Entire Base
<b>Number of Trees Inventoried</b>	774	2,759	3,910	3,590	1,168	1,297	13,498
<b>Number of Species Inventoried<sup>1</sup></b>	33	56	61	66	36	25	85

<sup>1</sup>Nineteen species were represented by less than 5 individual trees and 39 species by less than 20 individual trees.

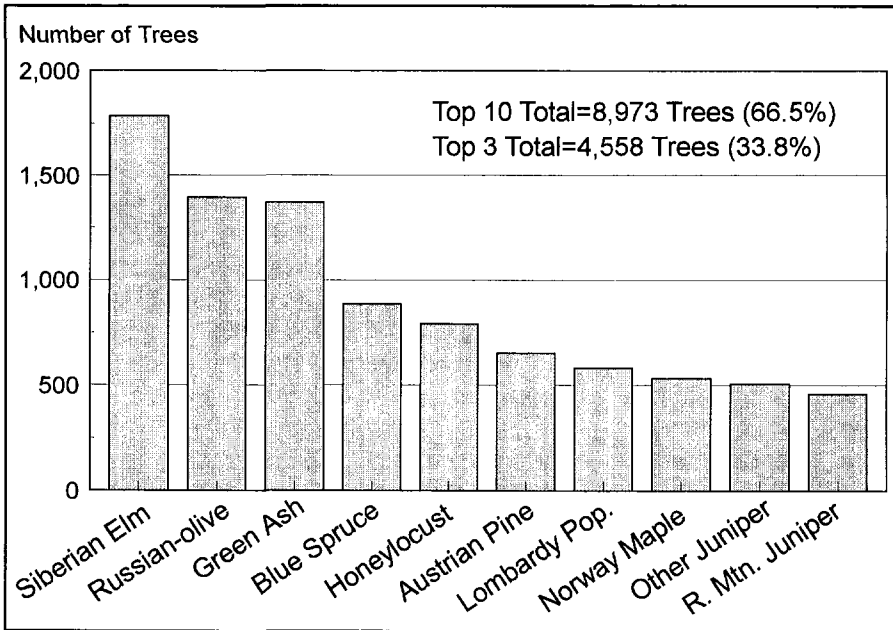
by a crew from Utah State University's Department of Forest Resources. All landscape trees were numbered and measured and every fifth tree was tagged to aid in future identification. Individual tree records included species, location, diameter at breast height, condition class (excellent, good, fair, poor, or dead-or-dying), presence of utility lines within or above the crown, and comments. Clumps of native, unmanaged trees, mostly in the less-intensively managed northern portions of the base, were not included in the inventory. Data

were entered into a computerized tree inventory database system, and reports were produced by area and base-wide, summarizing tree species diversity and quality, tree size, tree condition, tree value, and powerline interference.

**Inventory results.** Overall, the community forest inventoried at Hill Air Force Base resembles that of many other communities that do not have active urban forestry programs. Hill has an extensive urban tree resource with a value that is compromised by low species and age diversity,

low quality due to poor species selection, and maintenance problems. Herbicide and other maintenance-related damage is common and often severe. Maintenance and planting-related conflicts between residents, employees, and maintenance personnel are frequent. Adequate numbers of trees exist in some areas, while other areas have no trees or only a few low quality trees.

Hill has 13,498 trees on base (Table 2), not including the native



**Figure 1. Numbers of trees for ten most common species at Hill Air Force Base, Utah.**

clumps mentioned above. Predominantly residential/light industrial areas (Area 3) and dense industrial/office areas (Area 4) had the most trees, while the more dispersed industrial areas and the open northern area (Areas 1 and 5) had the fewest. This follows base development patterns, with more developed areas (parts of areas 2,3,4 and 5) having greater numbers of trees, and more intensive landscaping and maintenance. Area 1, with a low number of trees because of its dispersed, open-land nature, receives little attention other than at the base museum. The golf course, Area 6, is the most densely "wooded" and intensively managed of all six areas.

**Species diversity.** Though the base has 85 tree species (Table 2), 39 have fewer than twenty individual trees and 19 have fewer than five individual trees. Only 25 species have over 100 individual trees. Species abundance or diversity is highest where trees are most abundant, with Areas 2, 3, and 4 having a fairly high number of species, as well as the most trees. Area 6, the golf course, has the lowest number of tree species (25) and is dominated by blue spruce (*Picea pungens* Engelm.) and green ash (*Fraxinus pennsylvanica* Marsh.), which compose 61% of the trees. The ten most common tree species make up two-thirds of the trees on base, with the top 3 species (Siberian elm [*Ulmus pumila* L.], Russian-olive [*Elaeagnus angustifolia* L.], and green ash) totaling one-third of the trees on base (Figure 1).

**Tree size.** The base has many trees in the lower size classes with few large trees, especially above 35 to 43cm

(14 to 17 in) diameter (Figure 2). Only seven trees have diameters greater than 100 cm (40 in). About 58% of the trees on base are in the 2.5-20 cm (1-8 in) diameter category, while only 2.9% are 62 cm (25 in) or larger. These larger trees are mainly Siberian elms, with a few silver maples (*Acer saccharinum* L.), London planetrees (*Platanus x acerifolia* (Ait.) Willd.), Russian-olives, and cottonwoods (*Populus* spp.). Areas 1 (due to the presence of a fairly new museum), 2, and 4 have the largest proportions of 2.5-20 cm (1-8 in) trees, ranging from 62 to 70% of the total in those areas. Areas 3, 5, and 6 have the greatest percentage of 22-40 cm (9-16 in) diameter trees (older housing and the golf course), while Areas 1, 2, and 5 have the greatest percentage of 43+ cm (17+ in) trees (fewer trees present, but many are older, larger, and relatively undisturbed).

**Tree condition.** Only one-third of the trees on base are in excellent or good condition, while two-thirds are in fair or poor condition, or are dead (Figure 3). Low tree condition can be explained by the predominance of low quality species and their tendency toward poor health. Only 9.7% of Siberian elms and 5.5% of Russian-olives were

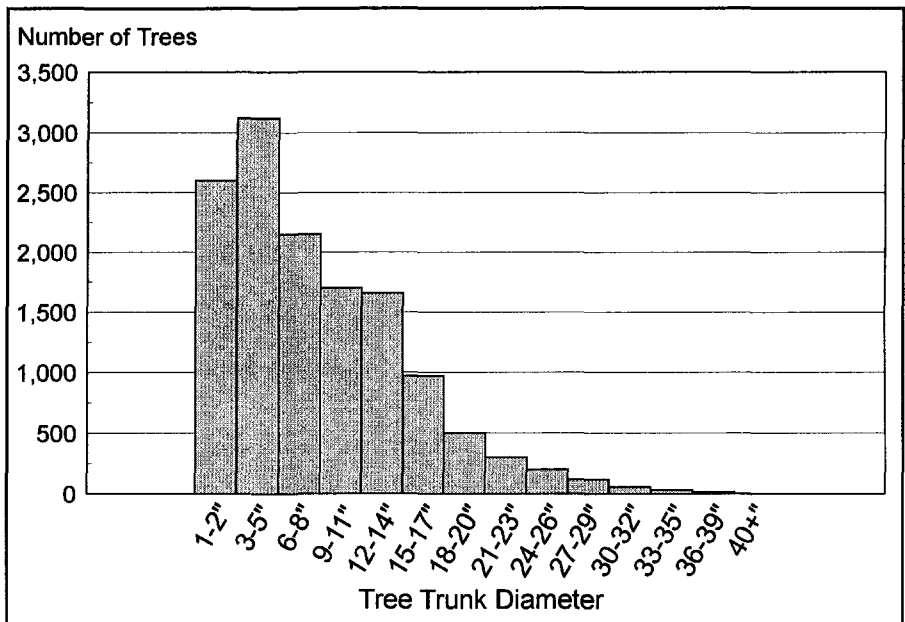


Figure 2. Number of trees by trunk diameter at Hill Air Force Base, Utah.

rated good or excellent, yet these trees are very common on base.

While hazard trees were not directly identified, the number of poor or dead-or-dying trees indicates a potentially serious hazard tree situation. Poor condition was defined as "having many problems, some of which are life-threatening, with moderate to high hazard potential;" and dead-or-dying trees as "dead or likely to die within one year, with low to high hazard potential depending on tree size and wood-soundness at death." Poor trees total 2,200 on the base, with over 1,000 of these in the 22-40 cm (9-16 in) and 43+ cm (17+ in) diameter classes, indicating significant hazard potential (Figure 4). Dead or dying trees totaled 261, with 69 having diameters greater than 20 cm (8 in) and likely to pose a significant hazard in the presence of a target if not removed promptly.

**Utility line interference.** A total of 927 (6.9%) of the trees on base were observed with all or parts of their crowns directly under or within utility lines. Over 60% of these trees are 1-8 inches diameter, while only about 10% are 43 cm (17 in) in diameter or larger. Although few trees are large

enough to pose major utility-related trouble at present, there are significant numbers of small trees that will likely interfere in the future. Most of the trees under utility lines are in fair or better condition, probably as a function of their small size, since smaller trees are less likely to have been severely topped or pruned in the past.

**Tree value.** Hill has a tree resource conservatively valued at \$11.9 million with the average per-tree value of \$882, varying from \$379 to \$1,459 per tree. Exact values were not determined for each tree; values are a rough approximation calculated by the inventory software using a simplified version of the International Society of Arboriculture/Council of Tree & Landscape Appraisers (ISA/CTLA) tree valuation formula (2):

$$\text{Tree Value} = \text{Stem Cross-Section Area} \times \text{Base Value} \times \text{Species Factor} \times \text{Location Factor} \times \text{Condition Factor}$$

A base value of \$37 per sq. inch (2.5 sq. cm) of stem area at breast height was used as established by the Rocky Mountain Chapter ISA (3). Species factors were developed using Rocky

Mountain Chapter ISA factors (3) modified to local conditions. Location factors were based on our assessment of the quality of each tree location on the base. Condition factor was based on the condition class we assigned to each tree, with Excellent = 100%, Good = 80%, Fair = 60%, Poor = 40%, and Dead or Dying = 0%.

**Current Urban Forest Utilization and Future Needs**

Hill's urban forest resource is very important as indicated by its

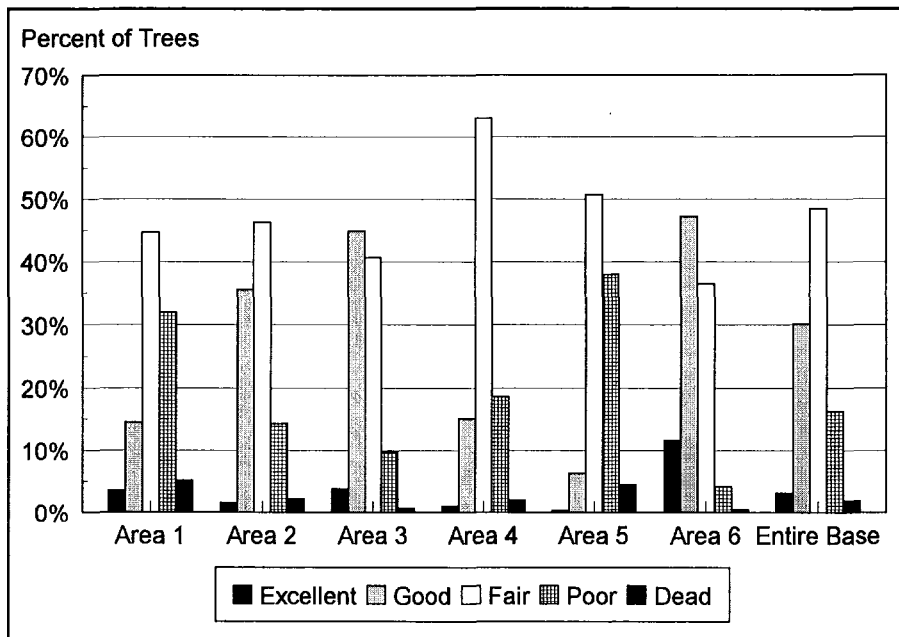


Figure 3. Percent of trees in each condition class by management area and for the entire base at Hill Air Force Base, Utah.

heavy use where large numbers of people and trees coincide. A densely developed office complex in Area 2 is a good example of a heavily used landscape where trees are important for shade and beauty. Small landscaped patches have been developed near many of the buildings, mostly by building occupants, typically consisting of a few trees, grass, shrubs, and flowers, with a picnic table, benches, and possibly a barbecue grill. Other common areas near these buildings without these amenities are rarely used, especially if they have no trees. The relative scarcity of these landscaped areas leads to over-use which could be reduced by developing more such areas.

Though trees are used in some locations on base explicitly for their environmental benefits, additional opportunities exist for such use. Hill is located in a dry area subjected to weather extremes. Noise and visual "pollution" also are problems. Trees could be used on base to control blowing dust and snow, to reduce building cooling and heating expenses, to increase storm water retention time, to provide visual and sound barriers, and to enhance wildlife habitat. Though the trees on base currently provide some of these amenities, little planning has been done to assure that they are used appropriately to provide maximum benefits.

As with urban forests in many other communities, an important need for the future of Hill AFB's urban forest is to replace older and less desirable trees with younger trees and more desirable species in better locations. These needs will largely be dictated by the future level of activity on the base. Areas will become more or less developed or populated due to changes in the military mission of the base,

creating new demands for landscapes and recreation resources. Planning and management guidelines are needed to assure good species selection, proper location, and good maintenance in these areas, increasing overall urban forest usability.

Hill and other communities must plan for an urban forest that may be less intensively maintained than in the past, with reduced use of fertilizers, pesticides, water, and labor as such resources and funding become more limited. Use of native and better-adapted non-native plants, as well as more efficient maintenance of existing landscapes, must be considered at Hill. A quality urban forest takes money and effort, however, and savings from increased efficiency that result in a better urban forest should not be mistaken for simple expenditure reduction that decreases forest quality.

**Management Issues, Goals, and Strategies**

Inventory results and an overall qualitative assessment of Hill AFB's urban forest resources point out a number of issues that need to be addressed. In the past there has been almost no planning regarding the base's urban forest.

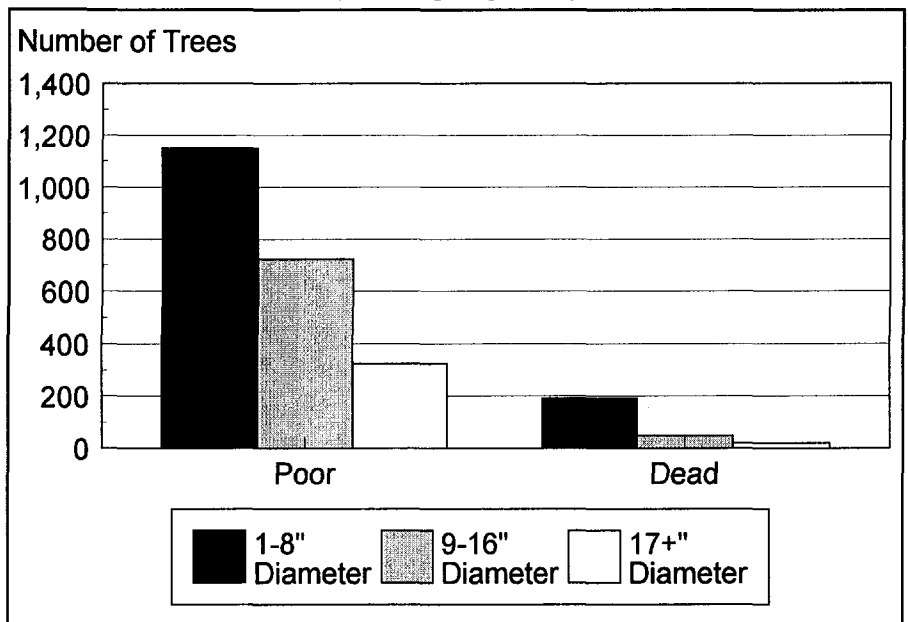


Figure 4. Number of poor and dead trees for three diameter classes at Hill Air Force Base, Utah.

Planting and maintenance were handled as needed with little prioritization. Level and quality of maintenance has been fairly low, leading to trees that are in poorer condition than they should be. There has been inadequate coordination between all of the entities that affect the urban forest resources on base, including base housing, civil engineering, environmental management, and base residents and workers. However, Hill has residents and employees who are interested and involved with the urban forest on the base, and this important resource should be acknowledged and encouraged in the future.

To address these issues, a plan was developed for the management of Hill's urban forest that includes four goals, and strategies for achieving these goals:

**Goal 1.** Improve Hill's urban forest resource quality. Strategy: Train maintenance crews, residents, and employees through workshops, brochures/fact sheets, newsletters, and other means. Devise plans to govern establishment of trees and plantings, including approved or preferred species and locations of key plantings or individual specimen plants. Update the inventory database as trees are removed and new trees are added.

**Goal 2.** Increase tree numbers on the base. Strategy: Inventory and direct observation will determine where plantings are needed. Use incentives to encourage residents and employees to participate in planting projects. Existing, poor quality trees or poorly designed plantings may be removed to make way for new plantings.

**Goal 3.** Use trees more effectively to accomplish energy savings, erosion control, scenic beautification and screening, and to improve base image. Strategy: Identify, prioritize, and develop plans for sites where plantings can be used to improve environmental conditions or solve specific problems.

**Goal 4.** Increase involvement of base residents and employees in urban forest planning and implementation. Strategy: Encourage involvement of base residents and employees through educational and outreach programs, tree-planting and care programs, and by direct assessment of attitudes and desires involving the urban forest and its usage.

## Community Involvement

Effective community involvement in urban forestry programs is critical to program success. People often use landscaped areas and value natural resources in ways that are different than anticipated, and they often are the key to success or failure of a project. Therefore, their attitudes and desires must be known before effective planning and plan implementation can occur. Kuhns and others (2) detailed the steps that should be taken to ensure effective community involvement in urban forestry programs. Involvement should be both informational and participatory. Effective involvement is more than teaching people how to plant a tree or including them in a tree planting project. Community residents must participate early-on in deciding what is to be done and in implementing decisions.

A three-phase data collection/public involvement process has been designed for Hill AFB:

**Phase 1:** Town meeting focus groups will be held where invited residents and employees give their opinions and identify concerns.

**Phase 2:** Telephone survey of residents and employees will be used to record and analyze use of different areas of the base, knowledge of existing trees and tree conditions, attitudes toward existing trees, preferences for plantings, and perceived problems with existing trees and current forestry practices.

**Phase 3:** Resident input will be sought on tree planting and care practices, and on tree species and cultivar selection.

This method of using initial meetings to guide planning and identify concerns, refining knowledge through an opinion/attitude survey, and ensuring direct citizen involvement during planning and implementation can serve as a model public involvement process for urban forestry planning on other military bases and in other communities. This process helps meet the need for objective social data for improving plans, improves chances for successful plan implementation, and serves a political function by enhancing the support and cooperation of local residents.

## Conclusions

Hill Air Force Base is an example of a military base with an urban forestry program in its early stages that can serve as an example to other military communities. The need to identify problems, inventory and evaluate the forest and the overall situation, and develop a plan and implementation strategy is common to all communities, both military and non-military. The need for community involvement also is common to all communities and is a prerequisite for effective programs that meet community needs.

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**Résumé.** La plupart des bases militaires contiennent toutes les ressources importantes retrouvées sur les sites non militaires incluant une forêt urbaine. La forêt urbaine de la Base de l'Air Force de Hill dans le nord de l'Utah est un exemple de base militaire encore aux premiers stades de gestion de la forêt urbaine, mais avec un programme de foresterie urbaine en expansion et allant en s'améliorant. La Base, en coopération avec le Département des ressources forestières de l'Université de l'état de l'Utah, a entrepris une évaluation de son programme et effectué un inventaire complet de ses arbres en 1993. Les résultats de l'inventaire combinés à une évaluation qualitative ont permis de développer un plan avec des objectifs de gestion et des stratégies de réalisation, ce qui en a fait une composante importante d'un plan plus vaste de gestion des ressources naturelles pour cette base. En plus d'augmenter le nombre d'arbres, leur condition générale et d'améliorer la gestion arboricole, le plan a provoqué une emphase accrue vers la participation communautaire, ce qui constitue la clé d'un programme réussi de foresterie urbaine.

**Zusammenfassung.** Die meisten Militärbasen verfügen über alle wichtigen Ressourcen einschließlich von Forstgebieten, die zu auch nichtmilitärischen Basen gehören. Der Stadforst der Hill Air Force Basis im nördlichen Utah ist eine Beispiel für eine Militärbasis, die noch im Anfangsstadium einer Forstbewirtschaftung steckt, aber bereits ein Programm zur Verbesserung und Ausdehnung der forstlichen Nutzung einsetzt. In Kooperation mit der Abt. Forstwirtschaft der staatlichen Universität Utah startete die Basis eine komplette Baumbestandsaufnahme durchgeführt. Die Ergebnisse der Bauminventur und einer qualitativen Prüfung führten zur Entwicklung eines Konzepts mit einer Managementzielsetzung und Strategien zur Ausführung, die nun Teil eines allgemeinen Managementkonzepts für natürliche Ressourcen wurden. Abgesehen von einer Vergrößerung der Baumanzahl und der allgemeinen Forstqualität, ruft der Plan nach stärkerer Beteiligung der Kommunen. Das wird als Weg zur Durchführung eines erfolgreichen Forstprogramms gesehen.