

4. ENVIRONMENTAL CONSEQUENCES

Discussed below are some of the potential impacts of implementing the development plan. For a complete presentation of impacts see the Final Environmental Impact Statement for the Rocky Mountain Arsenal National Wildlife Refuge (USFWS 1996).

PHYSICAL ENVIRONMENT

Geology and Soils

Implementation of the Comprehensive Management Plan would result in several actions. Restoration activities on First Creek would result in temporary disturbance to the stream channel and banks. Excavation for channel realignment, bank stabilization and revegetation would result in erosion and soil loss during construction. Improvements to First Creek are expected to provide long-term benefits. Stabilized channels and banks and increased diversity of vegetation would improve the quality of habitat for wildlife, and protect soil and water resources from excessive erosion and sedimentation.

Construction of the visitor center, administrative offices, the education center, parking lots, and other facilities would require soil excavation and grading. It is anticipated that topsoil would be removed and stockpiled before construction for subsequent use in revegetation. Temporary increases in soil erosion from disturbed soils is possible during construction. Stormwater flow from buildings and parking areas might contribute very small amounts of sediment. The use of best management practices to control erosion and runoff would minimize potential impacts.

Construction of support facilities, such as roads, interpretive and environmental education areas, and perimeter development, would result in localized disturbance to soil resources. Revegetation of disturbed sites and implementation of erosion and drainage control measures would minimize soil erosion. Unpaved foot trails are often a source of erosion in heavily used recreation areas. Proper trail construction and maintenance would be necessary to prevent



Figure 4.1 Cleanup is currently underway at the Refuge.

excessive soil loss, particularly on steeper slopes, around lake shores, and other sites susceptible to erosion.

Resource development would occur primarily in the south central portion of the Refuge. Trail construction would occur principally on the Bresser soil series, which is a medium to coarse textured soil with low to moderate erosion hazard. The revegetation potential for this soil is moderate to high and should assist in stabilizing the site following construction. Some trails may cross areas of the Truckton soil series, a sandy soil susceptible to wind erosion. Trail stabilization with aggregates or pavement may be necessary at some locations.

The northern tram route, interpretive and environmental education areas, and perimeter developments occur on several soil types. Most of the planned developments disturb relatively small areas and would not significantly impact soil resources. Periodic monitoring, especially at popular locations or sensitive sites, would minimize visitor-related impacts to soil resources.

Remediation activities to clean up contaminated areas on the Refuge (Figure 4.1) will require disturbance to soils. The excavation, remediation, and capping of contaminated soils is expected to

affect sections in the central portion of the Refuge. The location and extent of disturbance has not been finalized. There is potential for wind and water erosion during cleanup and revegetation, although it is likely that extensive erosion control measures would be used to prevent soil losses. The area of disturbance is not known at this time.

Other reasonably foreseeable activities involve off-site developments that would not impact Refuge soil resources directly. Increases in stormwater runoff potentially could cause erosion in First Creek and other drainages.

Climate and Air Quality

Implementing the plan would result in insignificant changes to regional air quality. Ground-disturbing activities associated with facility, trail, or tram construction would have minor potential for generating suspended particulates from soil susceptible to wind erosion. Any effects would be minimal and short-term with revegetation of disturbed areas.

Prescribed burning is a management tool that is being considered for use in maintaining the long-term health of the grassland ecosystem. The periodic use of fire would cause a localized increase in particulates and a reduction in visibility. (See Figure 4.2.) Controlled fires would be conducted



Figure 4.2 The Refuge is in close proximity to a large urban area and controlled fires will have to be carried out with great care.

only under optimum weather conditions to minimize air quality degradation and possible effects at Denver International Airport (DIA). Annual prescribed burning plans would be developed with public involvement and adherence to state air quality regulations and DIA requirements. Impacts to air quality from prairie maintenance would be temporary and unlikely to cause significant air quality impacts.

Soil disturbance from tram road construction, trails, buildings, and other facilities could increase dust due to wind erosion. Best management plans would be used to minimize potential impacts. The increase in vehicles traveling to the Refuge would be relatively small in comparison to current average traffic volumes. Additional traffic would introduce air pollutants from vehicle emissions including carbon monoxide, nitrogen oxide, and sulfur dioxide. During peak weekdays, traffic to the Refuge is estimated at only 150 vehicles per day compared to current traffic volumes on Quebec Street of 35,000 vehicles per day. The small additional increase in vehicle traffic to the Refuge is not anticipated to significantly affect air quality in the area.

Excavation and incineration of contaminated soils during cleanup may introduce contaminants into the air including suspended particulates, metals, organic compounds, and pesticides. Air quality impacts from remediation activities will be temporary.

Off-site development surrounding the Refuge, such as redevelopment of Stapleton Airport, Gateway near Denver International Airport, and growth and development in Commerce City, are likely to influence local air quality. Increasing commercial, industrial, and residential growth is anticipated to increase traffic on the roads surrounding the Refuge. The incremental increase in

air pollutants from off-site vehicle emissions would be considerably greater than the amount generated by additional vehicle traffic to the Refuge.

Water Resources

The Service would like to maintain and manage existing Refuge lakes and wetlands, partially fill Upper Derby Lake (after contaminated sediments have been removed), and maintain a small base flow in First Creek. The First Creek channel would be improved by returning it, as much as possible, to its presettlement condition by increasing channel stability and restoring meanders to control erosion (Figure 4.3). In addition, the creek would be designed to handle increased flows associated with upstream development of the First Creek watershed. The restoration of the First Creek channel may increase erosion and sedimentation in the short term, but these would decrease from existing conditions over the long term.

The Refuge may have a surplus of water, at least after storm events, due to development in watersheds upstream. Stormwater detention and conveyance facilities would be constructed or modified to handle the increased runoff onto the



Figure 4.3 First Creek has been channelized and dammed since this area was settled.

Refuge in accordance with an intergovernmental agreement between affected jurisdictions. Trash racks and/or settling ponds could be constructed to remove debris, suspended sediment, and floatables from ditches and streams entering the Refuge. These structures could be located in the perimeter buffer zone for easier access and maintenance. The Refuge might create an interpretive and environmental education area to create public awareness of urban pollution problems.

Impacts to surface and ground water flows and water quality would probably be insignificant for each of the action alternatives. Increases in surface flows, which might also affect ground water flows, would be expected due to off-site development. On-site changes would not result in significant changes in surface flows. Similarly, increased off-site runoff of poor quality water could affect water quality at the Refuge. Refuge development, which might contribute very small amounts of non-point source pollution, would not significantly affect surface or ground water quality. The relationship between surface water management and ground water flow would be closely monitored by the U.S. Army to ensure that contaminant plumes continue toward the boundary containment and treatment systems. Restoration of First Creek could affect contaminant control due to changes in surface water flow. Channel improvements in First Creek would reduce flow rates and possible flooding. The creation of new wetlands along First Creek or in other areas could improve water quality.

Water resources would be managed to maintain wildlife habitat and recreational and educational opportunities for the public. Implementing the plan could possibly result in minor impacts to surface and ground water. Construction of new facilities and other ground disturbing activities

could increase sedimentation to surface water temporarily. New trail construction and increased trail usage along some of the lakes and in the southeast wetlands area could increase sedimentation to surface water. Implementation of best management practices to control runoff and erosion would minimize these impacts. Most roads within the Refuge would be reclaimed and revegetated; those remaining would be for staff use. This would reduce erosion and sedimentation to surface water. Impacts to water resources would not be significant.

Reasonably foreseeable activities

Reasonably foreseeable activities could have minor to major effects within the Refuge on surface and ground water flows and water quality. These include Stapleton redevelopment, development of the Gateway area southeast of the Refuge, and Commerce City and Adams County developments. Other reasonably foreseeable activities that are not likely to affect surface or ground water at the Refuge are "The Emerald Strands" plan, part of the *Airport Environs Plan* to link the Refuge to Barr Lake State Park, and other area parks and open space. It is likely that all off-site residential, commercial, and industrial development located upstream from the Refuge would increase runoff to the Refuge, which could alter current water management practices, cause local flooding, erosion, and damage infrastructure. The potential impact could be serious, since ground water flow direction could be altered, thus diverting contaminant plumes away from containment and treatment systems, resulting in flows that also could exceed treatment system capacity. The Army and Shell Oil Company would be responsible for managing impacts caused by changes in ground

water flows. Proposed Irondale Gulch stormwater management structures along 56th Avenue could intercept increased urban runoff and improve both quality and quantity aspects of Irondale water entering the Refuge.

Stapleton Redevelopment

The redevelopment of the former Stapleton International Airport (Figure 4.4) south of the Refuge could affect some surface water flows on the Refuge. Flows in the Havana interceptor from Montbello runoff currently discharge to Havana pond on the Refuge. However, much of the flow may be used to supply surface water features on the Stapleton property leaving only a small amount to fill Havana pond.



Figure 4.4 The redevelopment of the former Stapleton International Airport, south of the Refuge could affect some surface water flows on the Refuge.

Gateway Development

The Gateway Development area in the City of Denver would be located largely within the Irondale Gulch, First Creek, and Second Creek drainage basins upstream and southeast of the Refuge. Additional development also would occur along the Highline Canal and elsewhere within the Irondale Gulch basin. Several thousand acres of undeveloped land would become residential, commercial, and industrial areas likely to yield much greater peak flows during precipitation events and base flows from irrigation of lawns and parks.

Full urbanization of the First Creek watershed upstream of the Refuge would increase the annual base flow of the creek by an estimated 261 per-

cent, from 720 acre-feet to 2,600 acre-feet (McLaughlin Water Engineers 1994). The largest flow increases typically would be in the summer months when high intensity storm events occur. Future alterations in the First Creek channel would have to be completed to accommodate increased runoff from off-site. Plans include the possible construction of a detention reservoir upstream from the Bald Eagle Roost Exclusion Area to control

peak flows and erosion through the roost area.

Since First Creek loses water due to infiltration, ground water flow would also increase in the First Creek basin within the Refuge. The increased flows of both surface and ground water would likely change water quality constituents and concentrations within the basin. Greater amounts of contaminated runoff from developed areas upstream might be carried onto the

Refuge. If the Highline Canal were to capture runoff from newly developed areas adjacent to it, the increased flow in the Highline Canal could benefit the Refuge, which often does not get much of its water supply from this source. However, this is not a primary conduit for storm runoff, and would contain higher levels of contaminants than water diverted from the South Platte. Increased flows in Second Creek would have little or no impact on the Refuge, since less than 1,000 feet of the creek crosses the Refuge at its very north-east corner.

Commerce City Development

The Refuge Act of 1992 mandates that approximately 815 acres on the western boundary of the

Refuge be sold. The most likely effect of development on water resources would be increased runoff and sedimentation. Future development in this area may include the visitor center and primary parking area for the Refuge, and likely would increase runoff to the South Platte. Soil erosion and sedimentation during construction should cause only insignificant, short-term impacts to water quality. Commerce City also has plans to develop lands that are in the Second Creek drainage basin east of the Refuge; this probably would have little effect on the Refuge since only 0.6 square mile (3 percent) of the drainage is within the northeast corner of the Refuge.

Adams County Development

Adams County development plans that could impact the hydrology of the Refuge are the same areas described under the *Commerce City Development* section. Impacts, such as increased runoff, could occur to the Sand Creek and Second Creek drainages.

Noise

Noise levels on the Refuge would vary somewhat from existing conditions with the implementation of the plan. Prairie maintenance activities would require the periodic use of farm equipment. Restoration of First Creek also would require the use of heavy equipment and machinery during construction and revegetation. The reclamation of existing roads on the Refuge also would result in a temporary increase in noise levels. Construction of buildings, the tram road, trails, and other facilities would generate localized short-term noise above background levels. Completion of cleanup activities, closure of most internal roads, and a

decrease in vehicle traffic would result in an overall long-term reduction of noise levels.

A variety of features including trails, a tram route, interpretive and environmental education areas and buildings will be constructed. These are temporary increases in noise that would be spread over a period of time, and would be scheduled to minimize the potential impact to wildlife and visitors. Following construction of primary facilities, noise on the Refuge would be generated primarily from the tram and visitors. Noise levels on the Refuge should be low in relation to surrounding urban areas.

Cleanup operations are expected to require the use of heavy machinery for excavation of contaminated areas and demolition of buildings. There would be a temporary increase in noise while these activities are in progress. Increasing development around the Refuge may increase off-site noise contributions from traffic, industrial facilities, and residential and commercial development.

Biological Environment

Refuge management of specific habitats, biological communities, and individual species would not cause significant adverse environmental impacts. The proposed biological components of the Comprehensive Management Plan are designed to produce long-term benefits to the Refuge. Biological components consist of a variety of management activities that address management of habitat, individual species, the reintroduction of native species not presently found at the Refuge, and the management of human activities and biological resources.

These activities would affect and alter the current and post-cleanup landscape of the Refuge. Most actions would have net environmental bene-

fits. When an existing landscape is altered and managed to benefit and perpetuate preferred biological communities, the alteration often comes at the expense of some biological resources. Additionally, some proposed actions could create potential resource conflicts.

The Comprehensive Management Plan has specific biological components:

- Grassland management;
- Tree replacement and relocation;
- Management of Upper Derby Lake;
- Restoration of First Creek;
- Management of special species (deer, prairie dogs, ferruginous hawks, burrowing owls, migratory birds, and bald eagles); and
- Reintroduction of species native to the short-grass prairie, but not currently occurring on the Refuge (pronghorn antelope, bison, plains sharp-tailed grouse, and greater prairie chicken).

Significant effects to the biological environment include those beneficial or adverse effects anticipated to have regional, statewide, or national significance, substantially affect federally-listed species or management of the Refuge, or both. None of the biological components (listed above) would have significant adverse effects.

The management and reintroduction of certain species would likely have the following significant beneficial effects on the biological environment:

- The bald eagle is a federally-listed species, and the maintenance of a regionally important winter-

ing habitat for the bald eagle could be a significant factor in this species' recovery.

- Prairie dog colonies are declining along the Front Range and over their entire range; this is a keystone species essential to other species such as eagles, burrowing owls, and other raptors, which are also in decline.
- Management of deer populations is significant for the Refuge; a deer population that exceeds the Refuge's carrying capacity could significantly degrade habitat for other species. (See Figure 4.5)



Figure 4.5 A deer population that exceeds the Refuge's carrying capacity could degrade the Refuge for other species.

- Introduction of plains sharp-tailed grouse and the establishment of a self-sustaining population is of statewide significance as

this species is a Colorado state listed endangered species.

In addition to these significant effects, the biological components of the Comprehensive Management Plan would have the following, less significant adverse and beneficial effects on the biological environment.

Grassland Management

The Army's restoration of degraded and weedy non-native grasslands to native grasslands during cleanup would result in a beneficial increase in native plant communities. Establishment of native prairie may reduce the existing plant and animal species diversity of the Refuge and preferentially provide habitat for species dependent on native grassland habitats. Over the short term, grassland restoration could temporarily increase the weed cover of restored sites until desirable native species eventually dominate. The conversion of existing weedy communities to native grasslands

also would reduce weedy habitats at the Refuge that help to support some species such as gold finches, juncos and many other species.

The restored grassland communities and existing native remnant grasslands would be managed primarily to benefit wildlife use by small mammals, prairie dogs, burrowing owls, raptors, and reintroduced native species. The Service would use grazing by wildlife as an important management tool for native grasslands. Other potential management methods include burning, biological, mechanical, and chemical controls. Burning may affect some biological resources in the short term. However, native wildlife have evolved with fire, and should respond favorably over the long term to burns that increase herbaceous plant production and reduce non-native species. Selective use of herbicides or pesticides could add minor amounts of toxic compound residues to vegetation, soils, and organisms, which could affect non-target species.

Tree Replacement and Relocation

Trees associated with old homesteads on the Refuge provide important wildlife habitat. The Service's goal is to maintain the habitat structure provided by trees. In the northern zone, dead trees would be left in place and new trees established along First Creek as an element of the First Creek restoration plan. In the southern zone, the goal would be to maintain a mix and distribution of vegetation similar to existing vegetation. Tree replacement would focus on the use of native species; however, in some instances, non-native species also may be established.

Tree replacement would result in long-term benefits to wildlife that rely on them for habitat (e.g., raptors, cavity-nesting wildlife and deer). The tree replacement program also would result in an

increase in native trees. In the northern zone, the replacement of trees in the First Creek riparian corridor eventually would result in a more natural appearing plains riparian woodland.

However, the shift in the distribution from homesteads to First Creek would result in the eventual loss of habitat where the trees now occur except in a few sites where homestead trees would be replaced. In the southern zone, tree replacement would be conducted to maintain the current diverse habitat structure.

Management of Upper Derby Lake

The Army plans to restore Upper Derby Lake during cleanup as a functioning shallow lake that would provide habitat for shorebirds and waterfowl. (See Figure 4.6.) The restoration of Upper Derby Lake would increase the amount of aquatic and waterfowl habitat at the Refuge about 40 percent. Upper Derby Lake would not be open to public fishing.

Restoration of First Creek

The restoration of First Creek, an intermittent stream and its associated wetlands and riparian areas, is an objective common to all action alternatives. Conceptual restoration plans (McLaughlin Water Engineers 1994) call for the restoration of the historical channel shape and length, while maintaining and enhancing existing habitat. The protection and maintenance of roost trees along



Figure 4.6 Geese and other waterfowl use the lakes extensively.



Figure 4.7 First Creek is a sensitive and important wildlife corridor.

First Creek is a critical component of the restoration plan. (See Figure 4.7). Over the long term, the restoration of First Creek and its associated habitats would result in a beneficial increase in habitat diversity, including an increase in wetland and aquatic habitats in the northern zone. There may be adverse impacts associated with restoration activities

including temporary increases in cover by weedy species due to disturbance, and an increase in the consumption of water from First Creek due to the establishment of additional wetlands and riparian vegetation (e.g., cottonwoods and willows), which in turn could have minor effects on downstream plant and animal communities.

Management of Special Species

Management of habitat within the Refuge would focus on several species, which due to either their legal status (federal listing under the Endangered Species Act), importance to a multitude of other species (keystone species), or because of their high profile and interest to the public, deserve special management considerations. Management of these species would remain constant for all action alternatives. These special species include white-tailed and mule deer, prairie dogs, and bald eagles. Many other important

species, such as burrowing owls, migratory birds, ferruginous hawks, and other threatened, endangered or candidate species, would benefit by managing and improving habitat at the Refuge.

Deer. The Refuge currently supports about 730 deer (530 mule deer and 200 white-tailed deer). Deer populations have increased dramatically over the last eight years due to fencing, minimal predation, good habitat, mild winters, and no hunting. (See Figure 4.8.) The Service would manage the deer population at or below the carrying capacity of the Refuge. This would require a variety of population control measures including female sterilization or contraception, hunting and culling of the herd. Additionally, it may be necessary to periodically introduce deer from outside the Refuge to increase genetic diversity. Over the short term, there likely would be reductions of suitable deer habitat due to cleanup. Long-term deer population goals would range from 325 to 550. Managing the deer population for a suitable carrying capacity would have the following long-term benefits:

- Maintenance of a healthy deer herd,
- Minimization of adverse effects to vegetation and habitat that support other species, and
- Maintenance of viewing opportunities for Refuge visitors.



Figure 4.8 Because of the protection the Refuge offers, there are some magnificent wildlife viewing opportunities.

Certain deer population management techniques may be unpopular with segments of the public. Additionally, in the near term, a reduced deer population may reduce public viewing opportunities.

However, over the long term,

a healthy deer population maintained at sustainable levels would offer Refuge visitors good deer viewing opportunities and promote other wildlife viewing.

Prairie Dogs. Prairie dogs are a keystone species and an essential prey base for raptors and coyotes. In addition, their burrows and associated habitat structure provide habitat for a variety of birds, mammals and herptiles. Currently, there are approximately 100 acres of active prairie dog colonies within the Refuge due to a 1995 plague event. The Service has set a target of managing 3,500 to 5,000 acres of prairie dog habitat for the Refuge. Management of prairie dog populations would include:

- Efforts to control sylvatic plague, a leading cause of prairie dog population fluctuations.
- Management of several small (50 acres or less), isolated prairie dog colonies as well as larger colonies. The smaller colonies could be used to repopulate plague-stricken colonies.

- A live trapping and relocation program to control prairie dog distribution and minimize colonization of areas beyond the Refuge, burrowing into capped cleanup areas, and disturbance to recently restored grasslands.

Successful implementation of the Service's prairie dog management plan would result in the following long-term benefits:

- Maintenance of a prairie dog population that would support a variety of other dependent species,
- Reduction in the fluctuations of prairie dog populations and secondary effects of such fluctuations on other species,
- Minimization of the spread of plague, and
- A potential reduction in nuisance prairie dog conflicts with Refuge neighbors.

Sylvatic plague is a disease transmissible to humans by infected fleas or direct contamination from infected animals. Efforts to minimize human contact with the plague would include:

- Public education,
- Use of designated trails,
- Dusting colonies in visitor use areas with an insecticide powder to control fleas, and
- Temporary closure of public access to areas with plague-infected prairie dogs.

The prairie dog population would be somewhat self-regulating due to periodic plague epizootics. Once cleanup has been completed, chemical lethal control of the prairie dog population would occur only as a last resort. Most wildlife and habitat management is adaptive (i.e., revisions are made to habitat and species management considering successes and failures). The following potential adverse effects could occur if components of the prairie dog management plan cannot be successfully implemented or fail to meet desired objectives:

- If plague cannot be controlled, and large fluctuations in prairie dog numbers occur, then the use of the Refuge by migratory raptor species (e.g., hawks and eagles) would likely decline during periods of low prairie dog numbers.
- If prairie dogs cannot be successfully contained within the Refuge, infected prairie dogs may spread the plague beyond the Refuge.
- If prairie dogs cannot be successfully contained within the Refuge, they may be considered a nuisance by neighbors.
- If prairie dogs cannot be controlled or excluded from newly restored grasslands, until such areas are vigorous enough to sustain prairie dog grazing, potential restoration areas could be lost or significantly set back in their succession toward sustainable native grasslands.

Bald Eagles. Bald eagles roost and feed on the Refuge from approximately November through March each year. The number of roosting eagles can vary significantly during the winter and between years. However, the Refuge is considered to consistently have the largest population of roosting bald eagles along the Front Range. It is believed that the eagles are attracted to the large population of prairie dogs for prey, in combination with suitable nearby roost sites with minimal disturbance and development. A 7,000-acre bald eagle management area has been established to protect and buffer important hunting and roosting habitat for the eagles. Bald eagles are known to use habitat throughout the entire Refuge. The First Creek roost observation blind (Eagle Watch Area) has been a popular public education program at the Refuge. As desirable winter habitat for the bald eagle continues to decline in the region, management of bald eagle habitat at the Refuge would become increasingly important. The protection and enhancement of winter habitat for the bald eagle at the Refuge could contribute to its recovery. Protection of the bald eagle management area may have minor effects to public uses such as the seasonal exclusion of Refuge visitors from important eagle habitats. However, public use programs are adapted so that people may still visit and view bald eagles and other winter wildlife. Current bald eagle management allows for both protection of eagle habitat, and visitor observation via tour buses and at viewing blinds. (See Figure 4.9)



Figure 4.9 Special events provide visitors with unique opportunities to learn more about the Refuge

Reintroduction of Native Species

The comprehensive management plan includes the potential reintroduction of species that do not currently occur on the Refuge but were once components of the plains ecosystem. The four species considered for reintroduction are:

- Bison,
- Pronghorn antelope,
- Greater prairie chicken, and
- Plains sharp-tailed grouse.

The following adverse effects may be associated with the reintroduction of bison and pronghorn antelope:

- Populations may require artificial control.
 - There are safety concerns for Refuge visitors and neighbors.
- Pronghorn antelope are notorious fence walkers and may escape from the Refuge at gates. Perimeter fencing as well as internal fencing would need to be strong enough to control bison; such fencing may be an aesthetic distraction to Refuge visitors.
- Bison and pronghorn antelope would compete with other wildlife grazers.
 - Exclusion fencing of the First Creek riparian and wetland habitats may be required.
 - Bison may damage signs, trees and shrubs by their daily activities (e.g., rubbing, horning and wallowing).
 - Deer and pronghorn antelope are more susceptible to predation if enclosed within bison fence systems.

Establishment of bison and pronghorn antelope would provide a visual attraction to Refuge visi-

tors. The reintroduction of these native species provides an educational opportunity to demonstrate and explain the prairie ecosystem. Bison and pronghorn would also supply an additional tool for management of restored shortgrass prairie.

The reintroduction and management of greater prairie chicken and plains sharp-tailed grouse is expected to increase wildlife viewing and interpretive opportunities and would increase biological diversity. The plains sharp-tailed grouse is a Colorado state-listed endangered species, with only one known self-sustaining population in Colorado. The establishment of a protected self-sustaining population of plains sharp-tailed grouse at the Refuge would be a beneficial effect of statewide significance.

Increased development of the Refuge to accommodate public access and increases in visitor use could adversely affect portions of the biological environment.

Public education and access to wildlife habitat is a major component of the Refuge's program. Access facilities can be located and constructed and the public managed in ways that minimize adverse impacts to the biological environment. For example, seasonal and temporary interpretive and environmental education sites would restrict visitor access at times and locations that avoid or minimize impacts to wildlife.

Presently, visitation at the Refuge is primarily limited to the lakes area and eagle watch, with about 35,000 to 45,000 visitors annually. (See Figure 4.10.) The Comprehensive Management Plan anticipates an increase in annual visitation to



Figure 4.10 The Eagle Watch allows observation of bald eagles with minimal disturbance.

100,000 to 150,000 visitors, and concentrates public use and access primarily around the lakes area in the southern zone. Most of the southern zone occurs within the bald eagle management area and much of the lakes area occurs within high use principal bald eagle habitat.

All the tram loops occur within or pass through portions of the bald eagle management area and the northern loop would pass through the prairie dog management area in Sections 29, 30 and 32, as well as known burrowing owl locations.

A one- to three-fold increase in visitor use, relative to present conditions, that concentrates visitors in the lakes area may increase eagle use of off-Refuge habitat. Service-controlled use of trails, interpretive and environmental education areas, and tram routes would control visitor access in the Bald Eagle Management Area to minimize potential conflicts. It is not anticipated that there would be a substantial shift in bald eagle use on the Refuge. Eagle use would be monitored closely to minimize any potential impacts.

Portions of some of the proposed trails and overlooks are located near important biological resources (e.g., migratory bird nesting habitat, raptor nest locations, or remnant native vegetation). Direct impacts to important biological resources due to construction of public access facilities would be insignificant because these areas would be avoided.

The disruption and division of once continuous habitat into smaller units is called "habitat fragmentation." The public facilities combined with public use, particularly the proposed trails and

tram in the southern zone and lakes area, would divide habitat into smaller units. Visitor education, trail signage and seasonal closure of trails would help to minimize impacts to wildlife. The closure and reclamation of most of the roads on the Refuge would reduce existing habitat fragmentation.

Visitor activities can adversely disrupt wildlife habits and movements. Some species, such as mule deer, become habituated to the presence of humans, while others avoid or minimize contact. Some displacement of wildlife is likely in areas of greatest visitation, particularly in the southern zone. The plan would maintain extensive habitat in the northern zone, which would have only limited public access and only minimal disturbance to wildlife.

Cumulative effects result from the incremental impact of the Comprehensive Management Plan when added to other past, present and reasonably foreseeable future actions. Management of the Refuge for wildlife would result in significant beneficial effects to the biological environment when considering past, present and reasonably foreseeable future actions. Past actions on the Refuge and surrounding area include use of the Refuge for the manufacture of toxic chemical compounds and the subsequent contamination of portions of the Refuge. In addition, the southern part of the Refuge was influenced by activities at Stapleton Airport.

Implementation of the Comprehensive Management Plan would occur in phases, with the majority of development occurring after Refuge cleanup. Portions of the Refuge, particularly in the northern zone, may be disturbed during cleanup activities. The Service would work cooperatively with the parties responsible for cleanup to revegetate disturbed areas. Revegetation of the sites

would benefit the Refuge by providing habitat and minimizing erosion of disturbed areas. Provided that wildlife can be excluded from capped toxic material, the presence of properly contained toxic material would not adversely affect wildlife resources or public use of the Refuge. Cleanup activities may result in short-term habitat losses and changes in the present landscape, but contained contaminants would provide a significant net environmental benefit over the long term.

The Refuge occurs at what has historically been the edge of the urban Denver metro area. Residential and commercial development occurs on the east, west, and southern perimeters of the Refuge, with agricultural lands on the north and east sides. In the future, much of the currently undeveloped lands around the Refuge may be developed, especially due to the proximity to Denver International Airport. Increased development around the Refuge could affect the biological environment of the Refuge in the following ways:

- Increased runoff from surrounding urban lands would carry additional pollutants to the Refuge (e.g., nutrients, pesticides, sediments, and oil).
- Additional urban and industrial development around the Refuge would reduce wildlife habitat available to species that move between the Refuge and nearby habitats.
- Development around the Refuge could isolate the Refuge from nearby important wildlife habitats (e.g., South Platte River and Barr Lake).

Development plans for surrounding areas include potential open space, parks, and corridors, which may lessen the effects of the future development. Many of these developments could link trails and open space with the Refuge.

The future development of lands around the Refuge would increase the value of the Refuge as a regionally important wildlife habitat. The 27-square mile Refuge eventually would be the single largest area of undeveloped land in the Denver metro area.

Threatened and Endangered Species

The significance of an impact to a threatened or endangered (T&E) species depends on several factors: duration of the impact, effect on a species population or food source, modification of habitat, and most importantly, the effects on the continued existence of the species. Impacts to candidate species for federal listing also are addressed. An impact to a candidate species is considered significant if the action might cause the species to move toward federal T&E listing.

The Army will continue to manage the Arsenal until the Environmental Protection Agency certifies that cleanup is complete. The Army then will transfer most of the land area to the Service. In addition, following cleanup, the Army will transfer responsibility for lakes and wetlands to the Service. The timing for the transfer is unknown since the length of time for cleanup is undetermined. Until then, the Army will need water for fire control, irrigation of newly restored grasslands, dust suppression, containment and remediation of contaminants, and maintenance of existing lakes and wetlands.

The Army's contract with Denver Water for water from the Highline Canal extends until 2042 and may be renewed at that time. However, the

Army is searching for a more reliable water supply from surface water, ground water, treated wastewater, or a combination of sources. The Army currently is considering various alternatives to supply the water. If the Army's selected alternative requires water derived from the South Platte River, the Army will initiate Section 7 consultation with the U.S. Fish and Wildlife Service concerning threatened or endangered species in the Platte River system.

Bald Eagle

The plan incorporates several development and use features within the Bald Eagle Management Area (BEMA). The tram routes would extend into the BEMA, as would an optional route to the Eagle Watch Area. Several trails and interpretive and environmental education areas in the southern portion of the Refuge occur within the BEMA. The Eagle Watch Area on the east side of the Refuge would also be maintained. Most of the physical structures, improvements, or activities within the BEMA would be designated for seasonal use when eagles are not present. The northern tram route would run periodically and is not expected to affect bald eagles. Currently-operating bus tours at the Refuge and visitor activities near the lakes have not significantly affected bald eagle use in these areas. Additional visitor use, noise and activities on the Refuge may result in a shift in eagle habitat use; however, measurable change in bald eagle habitat use is not expected. Intrusions into bald eagle use areas would be closely monitored to minimize potential impacts. No significant adverse impacts to bald eagles are anticipated with the Comprehensive Management Plan.

The maintenance of the Refuge as a regionally important habitat for the bald eagle could be a

significant factor in this species recovery. Management activities that protect and support prairie dog populations also would have a significant beneficial impact on bald eagles. Restoration activities along First Creek would occur during the summer when eagles are not present, and would protect and enhance roost habitat.

Peregrine Falcon

Peregrine falcons are only occasionally sighted on the Refuge. Restoration and enhancement of First Creek and other areas of wetland habitat would improve the quality of songbird habitat, the primary prey for peregrine falcon. Due to the limited occurrence of peregrines on the Refuge, it is unlikely they would be affected adversely by the Comprehensive Management Plan. Long-term protection of lands at the Refuge constitutes a positive impact for this species.

Ute Ladies'-tresses Orchid

No Ute ladies'-tresses orchids have been found on the Refuge. No adverse impacts to the orchid are expected from activities planned.

Plains Sharp-tailed Grouse

There are currently no plains sharp-tailed grouse on the Refuge, but the Refuge would contain habitat suitable for their reintroduction. Establishment of a population of plains sharp-tailed grouse on the Refuge would be a significant benefit to its recovery.

Greater Prairie Chicken

This species is not presently found on the Refuge, but is being considered for reintroduction. Proposed habitat improvements would be beneficial to the establishment of this species.

Preble's Meadow Jumping Mouse

This species has not been observed on the Refuge. Restoration of First Creek could temporarily disturb potential jumping mouse habitat. Significant adverse impacts could likely be avoided. First Creek restoration could provide improved habitat for establishing a population of Preble's meadow jumping mouse.

Swift Fox

The presence of this species on the Refuge has not been confirmed. The maintenance of native vegetation on the Refuge would be beneficial to the swift fox if it is present or reintroduced.

Figure 4.11
Ferruginous Hawks
depend upon
prairie dogs as
one of their main
food sources.



Ferruginous Hawks

Several ferruginous hawk winter roosts are found within the vicinity of the proposed northern tram route. (See Figure 4.11.) Ferruginous hawks also hunt in the prairie dog towns bisected by the tram road. Displacement or shifting of ferruginous hawk use areas may occur from tram operation in this area. Maintenance of the prairie ecosystem and prairie dog towns would be an important beneficial effect. Development of the plan is not expected to impact ferruginous hawks adversely.

Baird's Sparrow

This species, which favors shortgrass prairie, is an occasional migrant to the Refuge. Maintenance of native grasslands should greatly improve the quality of habitat for this species.

Black Tern

Black terns are occasional migrants to Refuge lakes and wetland areas. Habitat improvements along First Creek and management of Upper Derby Lake for shorebirds would increase the available habitat for black terns. The plan would not adversely affect this species.

Mountain Plover

This species has been observed at the Refuge, but no nesting activity has been noted. Maintenance of grasslands and proactive management of prairie dog complexes would be a significant improvement in mountain plover habitat.

White-faced Ibis

The management of Upper Derby Lake for shorebirds and waterfowl would provide a beneficial increase in suitable habitat for this species. Overall, there would be a beneficial impact to this species.

Regal Fritillary Butterfly

This species has not been documented on the Refuge. Maintenance of native vegetation is likely to improve habitat suitability for the species.

Colorado Butterflyweed

No occurrence of this species has been documented on the Refuge. The restoration of First Creek and other wetland enhancement activities could affect potential butterflyweed habitat.

Discovered stands likely could be avoided. There would be no adverse impacts to this species.

Developments and activities off the Refuge may potentially affect threatened and endangered wildlife populations on the Refuge. In general, development such as the Gateway area, Commerce City, Adams County and E-470 road construction, would reduce the amount of habitat available for use by threatened and endangered species or their prey. This would likely increase the value of the Refuge to these species.

Regional bald eagle use occurs on approximately 140 square miles surrounding the Refuge (USFWS, et. al. 1992). Bald eagles use the Refuge for winter roosting, and Barr Lake, northeast of the Refuge, for nesting. Winter use of the Refuge by eagles has fluctuated, possibly from loss of prey base in surrounding lands. The management of the bald eagle winter roost and prey population habitat on the Refuge may become more important as surrounding lands are disturbed. Cleanup and remediation activities on the Refuge could potentially disturb bald eagle use. Cooperative agreements between the U.S. Army and the Service have developed long-range management plans for protection of bald eagles and other wildlife (USFWS 1992).

Other candidate species and state threatened species may rely on the Refuge to provide habitat due to potential habitat losses from surrounding developments. Species that are most likely to increase their reliance on the Refuge include ferruginous hawks, Baird's sparrow, mountain plover and, if reintroduced, the greater prairie chicken.

Social and Economic Environment

Visitor Projections

Current annual visitation is 40,000 persons. The Refuge could accommodate 60,000 visitors by the year 2000 (Phase I) as additional environmental and interpretive sites are developed.

By the end of cleanup, with the development associated with Phase II, visitation could grow to 100,000-150,000, of which 40,000-50,000 would be participants in environmental education programs. (See Table 4.1.)

Five to ten years beyond the completion of environmental cleanup (Phase III), the Service could accommodate 360,000 visitors per year on the Refuge itself. Approximately 60,000 of these visitors would be participating in environmental education programs.

Most of the land in the western zone, where the Visitor Learning Center will be located, will not be owned by the Service. Its level and rate of development cannot be determined by the Service. (The Service seeks to work in partnerships with Commerce City, Denver, and businesses in developing the western zone.) Visitation to the Visitor Learning Center could reasonably be 512,000 persons per year. That figure could range widely depending on the scope of development in the western zone.

Land Use

Development of the plan will not have an adverse impact on land use surrounding the Refuge.

A higher concentration of commercial land use, especially businesses that provide goods and services, like gasoline and convenience items, may develop near the entrances to the Refuge. Access points to the Refuge would include the visitor cen-

Table 4.1 Annual and daily visitation forecasts (upper range of visitation, Phase II).

Period	Plan Forecast (Phase II)	Current
Total Annual	150,000	45,000
Average Daily		
Weekday	260	80
Weekend	790	240
Peak Daily		
Weekday	650	200
Weekend [†]	1,960	590
Special Events		
Daily	9,800	4,000

[†] Peak months have historically been December through February for bald eagle viewing.



ter and Eagle Watch. Commercial development probably would occur off Quebec Street or 56th Avenue near the visitor center, and off Peña Boulevard near the Eagle Watch. Land use in the southwest corner of the Refuge would be partially devoted to primary facilities.

About 815 acres would be eliminated from the Refuge as mandated by the Refuge Act. This land in the southwest corner of the Refuge and along the western edge would be auctioned by the General Services Administration to the highest bidder. Future land use on the Refuge currently is not known. However, no residential development will be allowed.

Social and Economic Conditions

Community

The character and population of the community surrounding the Refuge would not change significantly. The proposed management emphasis of the Refuge would be the conservation and enhancement of wildlife and natural resources, and opportunities for compatible public use, research, and education. No residential, commercial, or industrial development would occur on the Refuge. There is potential for a small amount of commercial development as an indirect result of the Refuge. This development would be concentrated in services. Effects to community services and infrastructure would be insignificant.

The Refuge would not have significant effects on the local population. No residential development would occur on the Refuge. Plans for lands around the Refuge, including Gateway, Stapleton, Adams County, and New Lands in Commerce City, have been developed. The Refuge could make these areas more desirable places to live, and indirectly attract additional residential development in combination with other factors. The establishment of the Refuge and cleanup of the Arsenal also may alter the public's perception of the Refuge. The public may associate this area more with natural resources, wildlife, and outdoor recreation, and less with environmental degradation and the associated cleanup.

Employment and Income

Staffing levels at the Refuge would increase to 75. Currently, there are 51 positions allotted for the operation and management of the Refuge. A total of 32 positions are filled and 19 are vacant. Based on current salaries for vacant and filled

positions, approximately \$2.8 million would be needed for the 75 staff positions.

Average salaries for positions at the Refuge may decrease compared to current levels when the Refuge is fully developed and established. Additional temporary employment would be associated with the construction of Refuge facilities, including the visitor center.

Local employment in Commerce City and Adams County may change as a result of the Refuge. However these changes are not expected to be significant. Employment in the Denver metro area would be affected slightly from employment created at the Refuge. For each job at the Refuge, a maximum of 0.5 indirect jobs would be created in the Denver metro area (Colorado Division of Local Governments 1995).

Employment and income impacts would have very minor effects on employment opportunities and income in the Denver metro area. The effects would be positive.

Increased indirect income also would occur with Refuge development. Indirect income results when dollars from the initial purchase of goods and services are spent again. For example, for every paycheck dollar spent on local gasoline or groceries, a portion is spent again by the receiver for other goods and services. It is unlikely that a significant portion of the income earned by employees at the Refuge would be spent on goods and services in Adams County. While much of it would be spent in the Denver area economy, the net effect would be very small.

Visitors to the Refuge may impact existing retail corridors slightly and increase commercial development near the Refuge. Refuge visitors would travel through existing or future retail corridors and may alter their spending patterns slightly.

With the development of the new Denver International Airport and the closing and proposed redevelopment of Stapleton Airport, several plans for the area surrounding the Refuge have been created. These plans and others include aspects of residential, commercial, and open space development.

Sites of residential communities planned for the area include Gateway, Stapleton, and Commerce City New Lands. Open Space and trails are planned in and around these communities. More opportunities for public use in and around the Refuge would mean an increased quality of life for residents of the surrounding communities, both existing and planned. The Refuge and its facilities could become a center of community recreation, and thus provide an important link for coordinating community programs and recreational opportunities.

The establishment of the Refuge and cleanup of the Arsenal also may alter the public's perception of the northern metro area communities, including Commerce City. The public may come to associate this area with natural resources, wildlife and outdoor recreation.

Once the communities planned for Gateway, Stapleton, and Commerce City New Lands are developed, more of the indirect jobs and income created by the Refuge may remain in these communities rather than being more widely distributed in the entire Denver metro area. Currently, there are few retail corridors near the Refuge. As the planned mixed use and commercial areas develop, visitors to the Refuge may stimulate additional growth in these corridors. Commercial development near the proposed Refuge entrances, especially the proposed entrance off Peña Boulevard, where commercial development already is planned, may increase with development.

The indirect employment that the Refuge would generate would be a portion of an overall increase in employment in the northern metro area. This area may become an employment center with the concentration of the Refuge, DIA, Stapleton, and Gateway.

Environmental Justice

This section provides an analysis of the effects of implementing the plan on minority populations and low-income populations.

The Refuge would be an urban Refuge, with potential users coming primarily from the Denver metro area. Portions of the Denver metro area consist of minority and low-income populations. The public use proposed would have a beneficial effect on minority and low-income populations. The Service would seek partnerships with area schools to provide free environmental education. The Service also proposes periodic "free days" where the admission fee would not be charged. These free days would provide an additional opportunity for low-income populations to visit the Refuge. The perimeter trail would provide increased recreational opportunity to any minority and low-income populations in the area surrounding the Refuge.

The increased traffic would have an adverse effect on any minority and low-income populations in the area surrounding the Refuge. The effects would not be significant, however.

Recreation

Many types of recreational opportunities would exist at the Refuge. Interpretive and environmental education areas, presentations, and special events allow the public to learn more about the Refuge, its wildlife, natural resources, history, and



Figure 4.12 Catch-and-release fishing can be enjoyed by all age groups.

cleanup. Eagle watching, bird watching, and wildlife tours provide the public with a better understanding of wildlife.

Considering current visitation and participation in public programs, many programs seem to be gaining popularity, especially participation in environ-

mental education, interpretive programs, and nature walks. Participation in fishing, presentations, eagle watching, and special events has increased markedly. (See Figure 4.12.) It is expected that the popularity of these programs would continue, and growth in participation would level out as the Refuge is developed and becomes an established outdoor recreation site. Expected visitation levels would be higher than current levels and, therefore, would provide more opportunities for the public to participate in these and other programs.

An environmental education facility would be built near the visitor center or combined with it. Specific interpretive and environmental education areas would be designated at various sites.

Refuge populations of bald eagles, waterfowl, deer, and other wildlife species would enhance public opportunities for wildlife observation, environmental education, and interpretation. The plan will offer the public more opportunities to partici-

pate in Refuge programs. More visitors and opportunities for public use would mean an increased quality of life for residents of the surrounding communities (both existing and planned), and for Refuge visitors from the Denver metro area.

The visitor center and other primary structures will benefit the public recreational experience by providing facilities for environmental education and interpretive programs. There would be an increased availability of environmental education programs for local and regional schools and the public. The placement of such facilities in the area would enhance interpretation of other local features and provide an important link for coordinating community programs and recreational opportunities. The recreational and environmental education opportunities of the region would be enhanced by the Refuge. The perimeter regional trail around the Refuge would connect with many of the natural resource amenities of northeast metro Denver.

Other outdoor recreation sites that may offer similar opportunities to the Refuge include Barr Lake State Park and Recreation Area, Cherry Creek and Chatfield Reservoirs, Roxborough Park, and the Boulder Mountain Parks System. These areas may lose some of their total annual visitors to the Refuge. On the other hand, areas located near the Refuge, like Barr Lake, may attract more visitors due to an increased awareness of recreational opportunities in the area.

The Refuge would provide greater access and connection to regional trails, open space, and outdoor recreational opportunities. The development of recreational and educational facilities at the Refuge would enhance interpretation of other local features and provide an important link for coordinating community programs and recreational

opportunities. It also may stimulate greater awareness of recreational opportunities in Adams County and use of open space and outdoor recreation facilities. Populations of wildlife might increase in response to an increase in land area and corridors, and enhance public opportunities for wildlife observation, environmental education, and interpretation. Linking on-site open space to regional, community, and neighborhood open space and parks systems and trails would contribute to the structure and organization of land use and development, provide more pedestrian and bicycle links, and create a greater amenity.

Cultural Resources

Historic properties on the Refuge may be subject to direct and indirect impacts as a result of implementation of the Comprehensive Management Plan. Direct impacts are primarily the effects related to project construction, operation and maintenance. Indirect impacts are usually attributable to factors such as better access, increased traffic and visual intrusions. Better access and increased traffic can lead to increased vandalism, while visual intrusions may impair the ability to see and interpret a historic property in its original setting.

Implementation of the plan is not expected to significantly affect cultural resources. The specific location of facilities and improvements have not been determined and the status and location of historic sites is still under investigation.

No cumulative effects are expected to cultural resources from foreseeable off-Refuge development. Cleanup operations on the Refuge could potentially affect several cultural resource sites.

Table 4.2 Traffic volume forecasts to the Refuge with development (Phase II).

Average Weekday Traffic	
Auto	60
Bus	4
Average Weekend Traffic	
Auto	330
Peak Weekday Traffic	
Auto	140
Bus	10
Peak Weekend Traffic	
Auto	830
Special Event Traffic	
Auto	4,110



Transportation

Estimates of vehicle traffic to the Refuge were based on current visitation patterns as well as several assumptions on future visitor use. (See Table 4.2.) It was assumed that on weekends, essentially all visitors would arrive by automobile, but that during the week, half of the visitors are school children who would arrive by bus. The average occupancy of autos is assumed to be 2.37, the average family size for the Denver area. It is also anticipated that the average visitor stay would be one-half day. Primary access to the Refuge would be through the Visitor Learning Center. Visitors would park their automobiles here and either walk or ride trams into the Refuge.

Based on projected visitation of 150,000 by the end of Phase II, traffic volumes would be projected at 60 cars and four buses on an average week-day. Weekend traffic is estimated at 330 vehicles per day, which is about three times the current weekend traffic. Peak visitor month traffic volumes for the weekend is estimated at 830 vehicles. Special event traffic volume is estimated at 4,110 vehicles.

Future traffic levels (year 2015) were estimated by increasing current (1995) volumes by 2 percent per year, the general rate of growth in the Denver metro area. Current average weekday volumes on Quebec Street, the primary road accessing the Refuge, is approximately 35,000 vehicles per day. The maximum weekday volume forecasted for the Refuge would be 140 vehicles per day. This moderate increase in traffic volume may be difficult to distinguish from background traffic volumes and would not be considered significant.

Winter peak event Saturday volumes including Refuge traffic have been forecasted (year 2015) for nearby roadways. As with weekday volumes, the traffic generated by the Refuge on peak event Saturdays would be relatively small in relation to the normal volumes. The peak season Saturday volumes that include the Refuge are less than the normal weekday volumes. This is because both Saturday and Sunday normally have less traffic than during the week. Traffic safety would not be reduced if adequate turn lanes are provided at the main entrance to the visitor center. Special events may require additional traffic control to facilitate traffic flow.

If the Visitor Learning Center or other features of the western zone become major attractions, this would affect traffic projections significantly.

Development of lands surrounding the Refuge for residential, commercial and industrial activities

is expected to increase the amount of traffic on roads adjacent to the Refuge. The closure of Stapleton Airport has reduced traffic on Quebec Street, but redevelopment of these lands may increase future traffic volumes. In addition, development of the 815-acre parcel of land to be sold along the west side of the Refuge would generate traffic along Quebec. Gateway development on lands to the south and east of the Refuge would increase traffic volumes along Buckley Road, Peñon Boulevard, and proposed E-470. Cleanup operations would continue to generate traffic from Army personnel, equipment operators, and contractors for the next ten years or more. Traffic from cleanup operations would occur both on and off the Refuge. Following cleanup, on-Refuge traffic would decrease significantly.

Visual Resources

The Visitor Center off the Refuge to the southwest would reduce the visual impact of the new primary facilities. They would be absorbed into the adjacent urban fabric of that area. It is anticipated that the existing on-site maintenance and research facilities would be reused by the Service. Other improvements to the Refuge would result in satellite interpretive and environmental education areas with outdoor classroom structures and associated loop trails, interpretive trails, and a tram route; the trails would consist of crushed stone and the tram route would be paved. It is anticipated that all of the existing roads would eventually be removed, with the exception of the two track perimeter road inside the fence, several internal two-track roads, and a paved service road for management access.

The trails would be designed to avoid sensitive wildlife areas and would be integrated into natur-

al land forms. The satellite interpretive and environmental education areas would be constructed of native materials and designed to blend into the surrounding landscape. Because of the more vegetated nature of the southern portion of the Refuge, and its greater wealth of natural resources, most of the facilities for public use would be located there. Public access to the Refuge would be controlled and confined to the tram route and designated trails. The visual intrusiveness of these facilities would be in direct proportion to their quantity, since their nature would remain unchanged between alternatives.

Resource Commitments

Federal funding for staff and operations would be an irretrievable commitment of resources. These resources would not be available for other federal programs or projects.

The transfer of land from the Department of Defense to the Service (Department of Interior) would be retained as "public lands" and would be unavailable for private use or development, with the exception of about 815 acres of land, which would be sold under all alternatives. These changes would be an irretrievable commitment of resources.

Short-term Uses of the Environment and Maintenance of Long-term Productivity

Historical uses of the Refuge, including early settlement, the manufacture of munitions and toxic chemicals, and cleanup of soil and ground water contamination have affected the long-term productivity of the ecological environment of the Refuge. These activities have altered the natural environment. Short-term uses of the refuge associ-

ated with implementing the Comprehensive Management Plan include the construction of facilities and modifications and enhancement of the natural environment. The effects of implementing the Comprehensive Management Plan would contribute to the maintenance and enhancement of long-term productivity of the Refuge environment.

Unavoidable Adverse Environmental Effects

Adverse environmental effects that would be associated with implementation of the Comprehensive Management Plan are short-term and minimal. During construction of additional facilities on the Refuge, wildlife would be disturbed and temporarily displaced. Facilities construction, enhancement of First Creek, and wetlands development would result in minor, short-term disturbance of soils and erosion. The long-term effects of implementing the Comprehensive Management Plan would be beneficial to the biological community and the diversity and productivity of the Refuge ecosystem.

How the Refuge will relate to its surroundings

Stapleton Redevelopment

The former site of Stapleton International Airport adjoins the Refuge on the southwest. Plans for Stapleton redevelopment are described in the *Stapleton Development Plan* (February 1995). Stapleton will be redeveloped during the next 30 to 40 years into a mixed-use community capable of supporting 30,000 jobs and 25,000 residents. The plan focuses on the sustainable integration of employment, housing, and public transportation; ties between Stapleton and the surrounding com-

munity; and opportunities for parks, open space, and recreation.

More than one-third of Stapleton (about 1,600 acres) will be managed for parks, open space, and recreation. The open space system will serve a major role in unifying Stapleton, making effective regional connections, and restoring the ecological health of natural systems on and off the site.

The Refuge borders the Stapleton property and connects through it to the Sand Creek waterway. Regional trails are anticipated along Sand Creek, Westerly Creek, and the open space corridor connecting Sand Creek with the Refuge.

DIA Gateway Development

In 1988, Denver annexed about 2,000 acres of land near Denver International Airport (DIA). A comprehensive plan for this land plus an additional 2,500 acres already in Denver was prepared (City and County of Denver 1991). These 4,500 acres, south and east of the Refuge and between DIA and Interstate-70, are known as Gateway. Most of the land presently is used for dryland farming. Gateway is expected to develop over the next 50 years due to its proximity to DIA. About 65,000 people are expected to reside at Gateway at buildout in 2045.

The eastern Refuge boundary will be separated from Gateway by Peña Boulevard. Residential and mixed uses will adjoin the Refuge south of 56th Avenue. A 90-acre urban park will be located south of the Refuge and east of the Montbello neighborhood, and a 180-acre golf-course will be located along First Creek southeast of the Refuge. Drainage from the golf course will flow towards the northwest into a drainage pond on the Refuge. First Creek is significant wildlife habitat and, therefore, the Gateway Plan proposes this

area remain undeveloped. Gateway will be linked to the surrounding areas by the Platte River Greenway and Highline Lateral hike and bike trails.

The Gateway Plan emphasizes economically successful development; distinctive, livable neighborhoods; mass transit, pedestrian and bicycle links; open space; and environmental protection.

The Refuge's perimeter greenbelt trail will feed into the Gateway neighborhoods.

New Lands in Commerce City

A series of intergovernmental agreements among Commerce City, Adams County, Aurora, and Brighton divided the land around Denver International Airport and identified 43 square miles as the Commerce City Annexation Area. This area is located north and east of the Refuge and is referred to as *New Lands*. The plan for this area is detailed in the *New Lands Comprehensive Plan* (City of Commerce City 1992).

Existing land use in this area is mostly agricultural with scattered residential properties. Small parcels of commercial and industrial uses are located less than a mile north, northeast, and east of the Refuge. The Burlington Northern Railroad, which runs along the northwest corner of the Refuge, is expected to draw additional industrial development. A storage facility and the Rocky Mountain Speedway adjoin the Refuge on the northeast. Tower Landfill, located about 1 mile east of the Refuge, is within the planning area.

Most of the New Lands in Commerce City are zoned by Adams County. Non-contiguous areas north and east of the Refuge are zoned by Commerce City. Most of the area surrounding the Refuge is zoned agricultural or planned unit development.

The plan proposes various land uses. The area north and east of the Refuge, between Tower Road and State Highway 2, is proposed for residential use. A small parcel adjoining the south half of Section 29 is proposed for office and distribution development. Proposed open space will be in the First Creek and Second Creek flood plains.

Significant transportation routes near the Refuge include I-76 to the northwest, 96th Avenue along the northern boundary, and Buckley and Tower roads to the east. The proposed E-470 highway will be located about 2 to 4 miles northeast of the Refuge. Significant development is expected to occur along the E-470 corridor.

Lands within 100-year flood plains are reserved for trails, parks, recreation areas, parking, and open space. Neighborhood parks are proposed for Sections 13, 17, and 18 north of the Refuge, and Section 21 east of the Refuge. The Parks and Open Space Frame Work Plan (BRW, Inc. April 1992) proposes to incorporate recreational opportunities from the Refuge, Barr Lake, the E-470 Corridor, and the Denver International Airport buffer zones.

Adams County Development

The *Adams County Comprehensive Plan* (1984, Amendments through 1990), includes several county development objectives: strong economic development, locating development on suitable soils, minimizing erosion, and conserving prime agricultural soils and subsurface resources.

The plan describes proposed land use for the areas adjoining the Refuge on the west, northwest, north, and northeast. The area along Quebec Street, from 56th Avenue to State Highway 2, is designated commercial mixed use. The area northwest of State Highway 2 is primari-

ly designated industrial, with some medium density residential and parks, open space, and flood plains. North and northeast of the Refuge along 96th Avenue, from Buckley Road to Peoria Street, is designated suburban residential, and parks, open space, and flood plains. A small portion of land east of the Refuge between 72nd and 88th Avenues is designated commercial mixed use.

Large portions of open space and natural areas (including agricultural lands) are located in Adams County, including the Refuge, an area west of Highway 86 from 88th Avenue to the County's northern boundary, around Barr Lake, and north and east of the DIA. The plan establishes buffer areas of 150 feet around lakes, 20 feet on either side of trails, and 1/2 mile around Barr Lake. Stated objectives in the plan are to protect and enhance Barr Lake, restore wildlife values along the South Platte River valley, and protect critical wildlife habitat.

Emerald Strands

The Emerald Strands (Adams County, et. al. 1990) is a network of existing and planned trails and open space from Cherry Creek Reservoir on the south to beyond Barr Lake State Park and Recreation Area on the north, and from the South Platte River on the west to Box Elder Creek on the east. Emerald Strands was developed as part of the *Airport Environs Plan*, which focused on controlling development around the Denver International Airport. The interjurisdictional plan addressed the following issues:

- The continuity of trails across city and county boundaries,
- The joint development of regional parks, and
- Consistent standards for trails and parks.

The Refuge is the largest and most concentrated area of open space in the Emerald Strands. On the south, the Refuge connects to trails and open space along First Creek, Sand Creek, the Highline Lateral, and E-470. On the North the Refuge connects to open space and trails along First and Second Creeks, E-470, I-76, the South Platte River, Barr Lake, Fulton Ditch, and the Brighton Lateral. Recreational opportunities include hiking, biking, fishing, bird watching, and picnicking.

