Programmatic Environmental Assessment: Nationwide Differential Global Positioning System

Prepared for:

Federal Highway Administration

In cooperation with:

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Federal Railroad Administration

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ABSTRACT

As required under the National Environmental Policy Act of 1969 (NEPA), the Federal Highway Administration has prepared this Programmatic Environmental Assessment (PEA) to evaluate the potential environmental effects of a proposed U.S. Department of Transportation Nationwide Differential Global Positioning System (NDGPS). This PEA evaluates potential individual and cumulative impacts of the proposed action and alternatives on environmental, land-use, and socioeconomic resource areas. This PEA represents the first tier of environmental impact analysis. Subsequent NEPA analyses tiered to this PEA may be prepared when site-specific impacts cannot be avoided or mitigated as specified herein.

To expand existing Differential Global Positioning System (DGPS) capabilities nationwide, the installation of at least 67 additional reference stations with low-frequency transmit antennas is required. Three NDGPS deployment alternatives were considered. Alternative A would consist of the conversion of 32 Ground Wave Emergency Network (GWEN) relay nodes to NDGPS reference stations, transfer of GWEN equipment from remaining GWEN relay nodes or spare GWEN equipment sets to 28 new NDGPS site locations, and installation of 7 additional NDGPS sites using new equipment, for a total of 67 NDGPS sites. Alternative B would consist of installation of new equipment at 32 existing GWEN relay node sites and at 35 new sites; each reference station would be physically similar to those described under Alternative A. Alternative C would consist of installation of 80 to 100 new reference station sites using equipment similar to that at U.S. Coast Guard local area DGPS stations. The environmental impact of the no-action alternative was also considered.

The potential for significant environmental impacts has been identified for each deployment alternative, including the no-action alternative. Under any of the proposed action alternatives, no significant environmental impacts will result provided that specific site-selection criteria and, if necessary, mitigation measures discussed in this PEA, are applied to each site proposed for installation of an NDGPS reference station. If, for some unforeseen reason, mitigation to reduce potentially significant impacts cannot be implemented at a specific site or a type of impact was not anticipated and addressed in this PEA, then additional NEPA analysis and documentation will be prepared for installation of an NDGPS facility at that specific site.

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EXECUTIVE SUMMARY

The U.S. Department of Transportation (DOT) has been authorized under Section 346 of Public Law 105-66 to select, install, and operate a Nationwide Differential Global Positioning System (NDGPS) for public and private applications. The proposed project would augment existing satellite-based Standard Positioning Service (SPS) Global Positioning System (GPS) range information with a differential correction broadcast from a network of ground-based reference stations transmitting from known positions. GPS users receiving both the differential correction signal and the SPS range information will be able to more precisely determine their location. Federal agencies that would implement the proposed NDGPS service are the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), DOT Office of the Secretary of Transportation (OST), U.S. Coast Guard (USCG), U.S. Army Corps of Engineers, U.S. Air Force (USAF), and the National Oceanic and Atmospheric Administration. A draft Memorandum of Agreement (MOA) among these agencies has been prepared for the establishment and operation of the NDGPS (see Appendix A).

The purpose of an NDGPS network is to provide government and civilian users with augmented radionavigation and positioning capabilities for use in public safety applications. Other uses include a wide range of transportation, scientific, and agricultural applications. Key uses include public safety and traffic management and control functions for vehicle and railroad transportation, inland waterway navigation, notification of emergency conditions, natural resource and emergency infrastructure mapping, and agricultural crop management.

The method for achieving an NDGPS service that best meets user requirements for accuracy, availability, and reliability is the expansion of the existing USCG local area Differential Global Positioning System (DGPS) network of reference stations. The existing system provides DGPS coverage to the Atlantic and Pacific Ocean coastal regions, the Gulf coast, the Great Lakes region, and major inland waterways. Under the preferred alternative, system expansion would utilize existing Ground Wave Emergency Network (GWEN) relay-node sites and equipment. These relay nodes consist of low and medium frequency transmission antennas and associated equipment that have been decommissioned by the USAF, Air Combat Command. In addition to the reuse of selected GWEN sites, new site locations will be acquired to provide a nationwide network of differential correction broadcasts. Under Phase I of the proposed expansion, at least one reference station would provide a usable NDGPS transmission to a GPS user located anywhere in the continental U.S. and portions of Alaska by the year 2000. Under Phase II, differential corrections from at least two reference stations (dual coverage) would be available anywhere in the continental U.S. by 2002.

The FHWA is the lead agency, and the USCG, FRA, and OST are cooperating agencies in the implementation of the National Environmental Policy Act of 1969 (NEPA) requirements for

the NDGPS program. A draft MOA among these agencies has been prepared for compliance with NEPA (see Appendix B). This draft Programmatic Environmental Assessment (PEA) provides a basis for the FHWA and the cooperating agencies to determine whether a Programmatic Environmental Impact Statement (PEIS) is required or if a Finding of No Significant Impact (FONSI) is appropriate for implementation of the proposed or alternative actions. This draft PEA analyzes the potential for significant environmental effects in the following issue areas: geology and soils, water quality, ecologically sensitive areas, air quality, noise, visual resources, flora and fauna, cultural resources, recreation, land use, hazardous materials, socioeconomics, environmental justice, and radiofrequency (RF) environment and human exposure. Reference station operation and maintenance are also considered during the 15-year life of NDGPS, as are actions that occur during decommissioning. Comments on the December 1998 draft PEA will be solicited from federal, state, and local agencies and the public, and addressed in a final PEA.

Several technologies used in combination are required for NDGPS. All the technology combinations considered for suitable NDGPS service to government and civilian users require expansion of existing USCG local area DGPS. The existing USCG service provides single coverage to approximately 45 percent of the continental U.S. For nationwide service, the deployment of NDGPS reference stations via any one of three alternatives was considered. Alternative A consists of conversion of 32 GWEN sites to NDGPS reference station use and the transfer of GWEN equipment from remaining GWEN sites to, or the installation of spare GWEN equipment sets at, 28 new NDGPS site locations. Seven additional sites would receive similar new equipment, for a total of 67 NDGPS reference stations. Transmit antennas would use 299 ft-tall guyed towers and operate at an effective radiated power (ERP) of no more than 500 W. Alternative B would require installation of new equipment at 32 existing GWEN relay node sites as well as at 35 new sites. The resulting NDGPS reference stations would be physically similar to the reference stations of Alternative A. Alternative C would utilize all new sites and equipment similar to existing USCG local area DGPS stations. The Alternative C reference stations would utilize either 90 ft- or 120 ft-tall towers and operate at an ERP of no more than 170 W. Approximately 80 to 100 reference stations would be required for an NDGPS service under this alternative. This PEA also examines the environmental impact of not implementing NDGPS under the no-action alternative. The affected environment under each action alternative includes the use of existing GWEN sites and equipment and/or the use of other minimally developed or undeveloped 11-acre land parcels located principally in the interior portions of the continental U.S. and Alaska. Sites will typically be on level ground and away from tall objects or structures.

During the selection of sites for NDGPS reference stations, the FHWA and cooperating agencies are committed to avoiding potentially significant environmental impacts by applying environmental siting criteria and, where necessary, the use of appropriate mitigation measures. If necessary, the following methods will be applied in sequence to mitigate impacts:

- Avoid the impact altogether by not undertaking the action or parts of the action

- Minimize the impact by limiting the degree or magnitude of the action and its implementation
- Rectify the impact by repairing, rehabilitating, or restoring the affected environment
- Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action
- Compensate for the impact by replacing or providing substitute resources or environments.

The FHWA and cooperating agencies will consult with key regulatory agencies and apply environmental site-selection criteria to avoid potentially significant impacts at new (non-GWEN) sites selected for NDGPS. If a potentially significant environmental impact is unavoidable during the selection of sites for NDGPS reference stations, specific mitigation measures will be implemented to decrease the impact to a less than significant level. If environmental site-selection criteria and specific mitigation measures identified in Table 11 (section 7) are implemented during the selection of NDGPS reference station locations, no significant environmental impacts will occur under any of the proposed action alternatives. If, for some unforeseen reason, planned mitigation measures for potentially significant impacts cannot be implemented at a specific site, or a site-specific impact is encountered that was not anticipated and addressed in this PEA, then additional appropriate NEPA analysis and documentation will be prepared by the FHWA for that specific reference station.

For each alternative, electromagnetic interference (EMI) with nearby Federal Aviation Administration radiobeacons operating in the same frequency band may occur. This EMI impact, however, can be mitigated by reassigning the operating frequency of one of the interfering sources of RF or, in some cases, altering the ERP.

Implementation of the mitigation measures identified in this PEA, including agency consultation and acquisition of required permits, should prevent significant environmental impacts from conversion of GWEN relay nodes to NDGPS reference stations.

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LIST OF ABBREVIATIONS

µg	microgram
A	ampere
ACHP	Advisory Council on Historic Preservation
ACTS	Advanced Communications Technology Satellite
AGL	above ground level
AM	amplitude modulated
A/m	amperes per meter
ANSI	American National Standards Institute
AST	aboveground storage tank
ASTM	American Society of Testing and Materials
ATU	antenna tuning unit
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
BUPG	backup power group
CAT	Category of Aircraft
CCC	Criteria Continuous Concentration
CE	Categorical Exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMC	Criteria Maximum Concentration
CO	carbon monoxide
CONUS	Continental United States
CORS	Continuously Operating Reference Station
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Plan
dB	decibel
DGPS	Differential Global Positioning System
DOC	Department of Commerce
DOD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
EDDA	environmental due diligence assessment
EIS	Environmental Impact Statement
EMC	electromagnetic compatibility
EMD	Electronics Maintenance Detachment
EMI	Electromagnetic interference
EPA	Environmental Protection Agency
ER	en route
ERP	effective radiated power

FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	frequency modulation
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
FRA	Federal Railroad Administration
g	gram
GLONASS	Global Orbiting Navigation Satellite System
GPS	Global Positioning System
GWEN	Ground Wave Emergency Network
HC	hydrocarbon
IEEE	Institute of Electrical and Electronic Engineers
INS	Inertial Navigational System
IOC	Initial Operational Capability
IRPA	International Radiation Protection Association
ITS	Intelligent Transportation System
kHz	kilohertz
km	kilometer
kW	kilowatt
l	liter
LF	Low frequency
m	meter
MBTA	Migratory Bird Treaty Act
mg	milligram
MF	medium frequency
mi	statute mile
MOA	Memorandum of Agreement
MPE	maximum permissible exposure
NAAQS	National Ambient Air Quality Standards
NCSHPO	National Conference of State Historic Preservation Officers
NDGPS	Nationwide Differential Global Positioning System
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resource Conservation Service

NRHP	National Register of Historic Places
NSTC	National Science and Technology Committee
NTIA	National Telecommunications and Information Administration
O_3	ozone
OMB	Office of Management and Budget
OST	Office of the Secretary of Transportation
Pb	lead
PCB	polychlorinated biphenyl
PDD	Presidential Decision Directive
PEA	Programmatic Environmental Assessment
PEIS	Programmatic Environmental Impact Statement
PIT	Policy and Implementation Team
PL	Public Law
ppm	parts per million
PPS	Precise Positioning Service
PSD	Prevention of Significant Deterioration
RF	radiofrequency
RFR	radiofrequency radiation
SHPO	State Historic Preservation Office
SO_2	sulphur dioxide
SPCC	Spill Prevention, Control, and Countermeasure
SPS	Standard Positioning Service
TEA-21	Transportation Equity Act for the 21st Century
TSP	total suspended particulates
UHF	ultra high frequency
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
V	volt
VLF	very low frequency
VMC	Visual Modification Class
VRM	Visual Resource Management
W	watt
WAAS	Wide Area Augmentation System
WAS	Wide Area System

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1 INTRODUCTION

1.1 FUNCTION OF NDGPS

Global Positioning System (GPS) satellite signals can be received around the world. The existing GPS uses 24 satellites to provide radio signals which allow persons on the ground, in flight, or at sea to determine their location (see Figure 1). GPS receivers, which are commercially available from a number of sources, receive the radio signals transmitted by these satellites and calculate the location of the receiver in widely used coordinate systems, such as latitude and longitude. Signals from at least four satellites should be received to obtain an accurate location estimate (see Figure 2). Two types of service quality are available, and the accuracy with which the receiver's location can be calculated depends on the type of service received. Precise Positioning Service (PPS) is available only to the U.S. military and other authorized users for national security reasons. It provides a horizontal accuracy of 22 m and a vertical accuracy of 27.2 m. Standard Positioning Service (SPS) is available to all members of the public and provides a horizontal accuracy of 100 m and a vertical accuracy of 156 m.

The Nationwide Differential Global Positioning System (NDGPS) will augment the existing satellite system with ground-based radio transmitters, known as reference stations. The reference stations will broadcast a signal from a transmitter located at a known fixed location on the ground. Users who receive the ground-based signal in addition to the normal satellite signals will be able to determine their position with an accuracy of 1 to 3 m (see Figure 3). While the existing U.S. Coast Guard (USCG) local area Differential Global Positioning System (DGPS) provides this service near coastal areas and navigable waterways, NDGPS would serve the remaining 55 percent of the continental U.S. (CONUS) and Alaska. Under Phase I, NDGPS would provide single coverage (an NDGPS signal from at least one reference station reaching a GPS user anywhere in the CONUS and Alaska). After Phase II installation, the proposed NDGPS will provide dual coverage (an NDGPS signal from at least two reference stations reaching a GPS user anywhere in the CONUS and Alaska) with 99.999 percent availability. In addition, the reference stations will monitor the locations of satellites and notify system operators if a satellite is not performing within specified tolerances. Thus, the NDGPS augmentation will also help to ensure the reliability of the satellite radio signals.

1.2 DEPARTMENT OF TRANSPORTATION AUTHORIZATION

Under Section 346 of Public Law (PL) 105-66, the U.S. Department of Transportation (DOT) is authorized to design, install, and operate an NDGPS service (see Appendix A). The law directs the Secretary of Transportation to investigate improvements, to develop standards, to sponsor new applications, and to continually upgrade NDGPS to meet the needs of federal, state,

Figure 1 Space-based GPS Satellite Constellation

Figure 2 GPS Satellites Within NDGPS Reference Station Orbital Plane

Figure 3 Depiction of GPS Satellite Range and NDGPS Correction Signal Broadcasts

and local governments and the general public. The agencies within DOT and their responsibilities with respect to the proposed NDGPS are as shown in Table 1.

Table 1
NDGPS Participants and Responsibilities

Agency	Responsibility
Office of the Secretary of Transportation (OST)	Interagency coordination and policy guidance
Federal Railroad Administration (FRA)	System sponsor (funding)
Federal Highway Administration (FHWA)	Network design, radio signal coverage verification, environmental review
U.S. Coast Guard (USCG)	Installation, operation, maintenance, and long-term system improvement
U.S. Army Corps of Engineers (USACE)	Real estate services and management
U.S. Air Force (USAF)	Transfer of Ground Wave Emergency Network (GWEN) property and equipment for NDGPS use
National Oceanic and Atmospheric Administration (NOAA)	Establish and maintain coordinates for each reference station, integrate NDGPS into the Continuously Operating Reference Station (CORS) system, and coordinate the use of NDGPS in the Integrated Precipitable Water Vapor System.

A draft Memorandum of Agreement (MOA) among the agencies listed in Table 1 identifies the respective role of each agency in the implementation of NDGPS (see Appendix A). A number of other federal agencies will be major users of NDGPS service. These include the Department of Interior (National Park Service [NPS] and Bureau of Land Management [BLM]), the Department of Energy, the Department of Justice, the Department of Commerce (DOC), the Department of Agriculture, and the Environmental Protection Agency (EPA). Use of NDGPS service by many local and state governmental agencies is also anticipated.

This Programmatic Environmental Assessment (PEA) evaluates the anticipated environmental consequences of the DOT effort to deploy reference stations nationwide that will provide DGPS service for both government and commercial applications. When fully implemented, this service will provide accurate navigation and positioning information across the nation, promoting safety and efficiency in transportation and other fields.

1.3 SELECTING AN NDGPS ARCHITECTURE

The need to select and implement a single radionavigation system that meets diverse user requirements was recognized in the early 1990s. In December 1993, the U.S. Department of Defense (DOD) and DOT published a Joint Task Force report entitled *The Global Positioning System: Management and Operation of a Dual Use System* (Joint DOD/DOT Task Force, 1993). The report considered both military and civilian requirements for accuracy, reliability, coverage, integrity, and cost while eliminating unnecessary duplication of facilities and services. The satellite-based GPS was identified as the system most capable of meeting the full range of military and civilian navigation and positioning requirements.

During the early 1990s, several government agencies were independently planning to develop an augmented GPS service for various uses. The Joint Task Force report concluded that a study of all augmentation alternatives was required to develop an optimum integrated system. In December 1994, a study entitled *A Technical Report to the Secretary of Transportation on a National Approach to Augmented GPS Services* was published (DOC National Telecommunications and Information Administration [NTIA], 1994). The study evaluated the capabilities of the various augmented GPS technologies and determined the optimum technology mix for DGPS.

Nineteen existing and proposed federal, private, and foreign augmented GPS technologies were considered in the Joint Task Force report. Of these, seven were identified as being technically feasible and potentially capable of meeting user requirements in the near future (however, no single existing or planned augmented GPS technology was found to be capable of meeting all user requirements). From these, six potential composite system architectures (i.e., combinations of feasible technologies) were proposed to satisfy as many user requirements as possible. The baseline architecture is the existing USCG local area DGPS, which does not provide nationwide coverage. All of the other architectures considered would also involve the expansion of the existing USCG local area DGPS service to a nationwide network.

Expansion of the USCG system required additional analysis to ensure it was technically feasible. The proposed expansion would provide service to the 55 percent of the contiguous U.S. and parts of Alaska not currently covered by the existing USCG local area DGPS system. Of principal concerns were the availability of frequency spectrum, and the number and distribution of reference stations. A frequency analysis was performed to design a nationwide network of reference stations that would minimize the potential for electromagnetic interference (Lemmon and Ketchum, 1998).

A Presidential Decision Directive (PDD) dated March 28, 1996, was issued based on a National Science and Technology Committee (NSTC) document identified as NSTC-6. It provided federal agencies with specific goals and direction for further implementation of an NDGPS service. The goals expressed in the PDD include: strengthen national security, integrate GPS into nonmilitary applications, encourage private sector investment in GPS, and promote

safety and efficiency in transportation and other disciplines. The PDD directed the DOT to serve as the lead agency within the U.S. Government for all federal civil GPS matters and to develop and implement U.S. Government augmentations to the basic GPS technology for transportation applications.

In January 1997, the DOT formed an interagency NDGPS Executive Steering Group consisting of senior management from each participating agency, and an NDGPS Policy and Implementation Team (PIT) to lead the implementation of the nationwide system. The NDGPS PIT documented the requirements of many federal and state agencies, evaluated alternative methods of providing differential corrections, documented benefits, and developed a cost benefit analysis in accordance with the Office of Management and Budget (OMB) Circular A-94. This work is documented in the team's *Nationwide DGPS Report* (NDGPS PIT, 1998). Seventeen Executive Steering Group members and 27 PIT members from the public and private sectors contributed to the formulation of the NDGPS report. Many public safety applications are identified in the report, including saving lives on the railroads and highways.

1.4 NEPA POLICY AND ENVIRONMENTAL DOCUMENTATION

The NDGPS MOA identifies the FHWA as the lead federal agency, as defined in 40 *Code of Federal Regulations* (CFR) 1501.5, for NDGPS program compliance with the National Environmental Policy Act (NEPA). As allowed by 40 CFR 1505.1(a), the parties to the MOA agree that FHWA NEPA regulations (23 CFR 771) will provide primary direction for environmental impact analysis and procedural compliance with NEPA. A separate MOA for the implementation of NEPA has been prepared which identifies the roles of the USCG, FRA, and OST as cooperating agencies in this process (see Appendix B).

During project planning and the preparation of NEPA documents, the FHWA has followed technical advisory T6640.8A, "Guidance for Preparing and Processing Environmental and Section 4(f) Documents," dated October 30, 1987, and the FHWA's Environmental Policy Statement, first issued in 1990 and revised in 1994. Based on this policy, the FHWA is committed to incorporating environmental stewardship into its planning procedures, project development, and decision making. Social, economic, and environmental goals are considered equally with engineering, safety, and mobility issues in reaching project decisions. This includes the preparation of an NDGPS PEA that captures and fully describes options to avoid, minimize, and mitigate adverse impacts and, where possible, enhance the natural and human environment. The FHWA's policy, ensuring that environmental commitments made during planning and project development and identified in NEPA documents, will be implemented during facility site selection, construction, maintenance, and operation.

This draft PEA analyzes the potential for the proposed installation and operation of the NDGPS to result in significant effects on the quality of the environment. The scope of the analysis is consistent with requirements set forth in FHWA regulations for environmental assessments (23 CFR 771.119). When necessary, measures to mitigate adverse impacts (both significant and

nonsignificant) have been incorporated into the proposed action, per FHWA policy described in 23 CFR 771.105(d). As required under NEPA regulations, the effectiveness and possible environmental effects of a range of alternative actions and the no-action alternative are analyzed. This document also specifies the use of environmental site-selection criteria and planned mitigation measures to be used to avoid or reduce potentially significant impacts that may occur during implementation of NDGPS. Where local conditions at proposed NDGPS reference stations warrant, the government intends to conduct follow-up environmental analyses at a site-specific level. Those analyses may include additional NEPA impact analysis and documentation.

The scope of this PEA focuses on the installation, operation, and eventual decommissioning of reference stations to supplement the existing USCG local area DGPS. Installation and operation of existing USCG local area DGPS reference stations are not included in this analysis. The FHWA is the lead agency under NEPA, however, other participating agencies have been given the opportunity to review this PEA. Copies of the draft PEA will be made available to the public and government agencies for comment during a 30-day period. For areas where considerable local concern is expressed, the FHWA may conduct a public meeting to describe the proposed project and discuss any project-related concerns.

The general size and layout of existing equipment and infrastructure at USAF GWEN sites are very similar to that proposed for NDGPS reference stations. Both the existing GWEN stations and NDGPS reference stations use the low frequency (LF) portion (~300 kHz) of the radiofrequency (RF) spectrum. Much of the analysis presented in the GWEN Final Environmental Impact Statement (EIS) applies to the FHWA proposal to install DGPS service at GWEN sites or use identical or similar equipment at new sites. Portions of this PEA are based on applicable information contained in the GWEN Final EIS (USAF, 1987). However, that information has been updated to account for changes in regulations and the physical environment. The GWEN Final EIS may be obtained by contacting: HQ Air Combat Command/CEVP, Langley Air Force Base, Virginia 23665.

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2 PURPOSE AND NEED

The NDGPS is a proposed nationwide radionavigation system that would use ground-based reference stations to broadcast radio signals for DGPS users to obtain greater positioning accuracy than is possible using only the existing satellite GPS signals. The proposed NDGPS would provide positioning accuracy, availability, integrity, and coverage sufficient to meet numerous government and civilian GPS navigation requirements, and would represent a significant improvement over traditional positioning technologies used in land and marine applications.

Current GPS assets are managed by the DOD. Neither of the available two levels of GPS service, PPS and SPS, are sufficient to meet the existing and anticipated needs of GPS users for nationwide navigation and positioning.

The purpose of the proposed NDGPS is to provide government and civilian users with augmented SPS radionavigation and positioning capabilities through use of range-correction information broadcast by the reference stations. This will enable greater position accuracy in public safety, transportation, scientific, and agricultural applications.

An NDGPS is the most effective and efficient use of existing technologies that will meet the navigation and positioning requirements of land and marine GPS users. Under the preferred action alternative, an economic benefit of $10.4 billion is estimated (NDGPS PIT, 1998). A key NDGPS land transportation need is to support the Intelligent Transportation Systems (ITS) initiative under the Transportation Equity Act for the 21st Century (TEA-21). The ITS initiative will result in development of programs in the areas of traffic management, traveler information, vehicle control, public transportation, rural transportation, and commercial vehicle operations.

An NDGPS is also needed to provide train location and speed information to support public safety elements of advanced train control systems, such as positive train control. This will permit dynamic supervision of multiple trains, including positive train separation, when coupled with input from railway sensors and data communication networks that manage railroad traffic. These systems will increase train safety and improve the operating efficiency of the railroad system saving over $60 million per year (Allen, 1998).

Currently, USCG local area DGPS reference stations serve a variety of maritime navigation applications, including harbor, coastal, and ocean navigation for vessels of all sizes. An NDGPS would increase the reliability of these services and provide navigation reference points for inland waterways not currently served by the existing local area DGPS network.

Many other public safety applications that would benefit from an NDGPS have been identified (NDGPS PIT, 1998). These include tracking law enforcement assets, monitoring natural resources, monitoring groundwater contamination, abating hazardous material

contamination, and mapping safety infrastructure. Agencies at all levels of government will use the NDGPS to locate and track the movement of personnel and assets; to map natural and man-made features of concern; to receive automatic notification of accidents and emergencies; and to assist in emergency response. These applications will provide considerable benefits by enhancing public safety and fostering economic development.

3 DESCRIPTION OF PROPOSED ACTION

3.1 PROPOSED NDGPS SERVICE

Under the preferred action alternative, expansion of existing USCG local area DGPS service to an NDGPS will require the following:

- Acquiring or leasing 32 GWEN relay node sites
- Acquiring 53 previously built and 6 spare GWEN equipment sets
- Converting 32 GWEN relay nodes into NDGPS reference stations
- Selecting candidate sites for NDGPS reference stations using technical and environmental siting criteria
- Consulting with appropriate agencies regarding all prospective sites as described in 23 CFR 771.133 including agencies implementing the Endangered Species Act, the Migratory Bird Treaty Act, the National Historic Preservation Act, and 47 CFR 80 requirements relative to the DOC's Manual of Regulations and Procedures for Federal Radio Frequency Management
- Acquiring or leasing 35 new properties for NDGPS reference stations
- Acquiring new NDGPS reference station equipment
- Transferring and installing GWEN equipment and new equipment at 35 acquired sites
- Testing and calibrating NDGPS and other equipment at each reference station
- Operating and maintaining 67 NDGPS reference stations
- Installing new equipment to expand the capacity of existing USCG control stations at Alexandria, Virginia, and Petaluma, California
- Decommissioning the NDGPS reference stations, including environmental evaluations and audits, removal of equipment, restoration of property, as necessary, and the cessation of leases and agreements or transfer of land to the General Services Administration.

Phase I will allow users in most of the U.S. to obtain a DGPS correction signal from at least one reference station by 2000. Phase II will allow users in most of the U.S. to obtain a DGPS correction signal from at least two reference stations (dual coverage) by 2002.

3.2 EXISTING USCG DGPS SERVICE

The USCG operates a series of ground-based reference stations which provide local area DGPS service to GPS users along the Atlantic and Pacific coasts, near the Mississippi River, in the Great

Lakes region, and in portions of Alaska and Hawaii. Fifty-four existing local area DGPS reference stations exist in the CONUS and Alaska as shown in Figures 4 and 5. The local area DGPS currently provides dual coverage for the State of Hawaii. The areas covered by the existing DGPS service in the lower 48 states and Alaska are shown on Figures 6 and 7, respectively.

The proposed NDGPS would provide DGPS service to the 55 percent of the area of the U.S. not currently served by the USCG system. Under the preferred action (Alternative A) described in Section 4.2.1, this will require the installation of 67 additional reference stations, mostly in the interior regions of the continental U.S. and Alaska. As proof of concept, one reference station has been installed at a former GWEN station at Appleton, Washington.

3.3 PROPOSED REUSE OF GWEN FACILITIES AND EQUIPMENT AND INSTALLATION OF NEW NDGPS REFERENCE STATIONS

Until recently, the USAF operated a series of unmanned GWEN relay node stations around the country. The GWEN system was decommissioned by the USAF Air Combat Command in 1998. Because of their similarities to the NDGPS system, the existing GWEN relay nodes are well suited for reuse as NDGPS reference stations. The government will be able to reuse all 53 GWEN relay nodes and 6 spare GWEN equipment sets for its NDGPS reference stations.

Phase I will include the installation of NDGPS reference stations at 22 GWEN stations (including the existing NDGPS reference station at Appleton, Washington), using surplus GWEN equipment at 10 new locations, and using new equipment at 5 new locations (see Figures 8 and 9). Estimated Phase I coverage from sites in the CONUS and Alaska are shown in Figures 10 and 11, respectively. Under Phase II (dual coverage) an additional 10 reference stations will be installed at former GWEN sites, 18 new reference stations will be installed using surplus GWEN equipment, and 2 additional reference stations will be installed using new equipment (see Figures 12 and 13). A list of GWEN relay nodes and other (non-GWEN) sites proposed for NDGPS use is provided in Appendix C. Estimated dual coverage from this proposed system is shown in Figures 14 and 15.

A typical GWEN relay node station contains a 299 ft-tall tower, radio equipment shelter, antenna tuning unit (ATU) shelter, copper ground plane, and security fences (see Figures 16 and 17). Six GWEN towers are 310 ft tall. A copper ground plane, buried one foot below the ground surface, consists of 50 to 150 copper wires (0.128 inches in diameter) extending in a radial pattern from the base of the 299 ft-tall tower. Photographs of a typical GWEN relay node and associated equipment are shown in Figures 18 through 20. The GWEN relay nodes formerly broadcast a low-frequency radio signal for military use. The 299 ft antenna tower, electrical equipment shelters, security fencing, ground plane, access road, standby power generator, and utility connections at existing GWEN facilities are all suitable for reuse at an NDGPS reference station. The installation of two 30 ft-tall antennas, and electronic equipment will be required to convert a GWEN relay node to an NDGPS reference station.

Figure 4 Locations of Existing USCG Local Area DGPS Reference Stations (CONUS)

Figure 5 Locations of Existing USCG Local Area DGPS Reference Stations (Alaska)

Figure 6 Existing USCG Local Area DGPS Coverage (CONUS)

Figure 7 Existing USCG Local Area DGPS Coverage (Alaska)

Figure 8 Existing USCG DGPS and Proposed NDGPS Reference Station Locations—Phase I CONUS (Preferred Action Alternative)

Figure 9 Existing USCG DGPS and Proposed NDGPS Reference Station Locations—Phase I Alaska (Preferred Action Alternative)

Figure 10 Estimated Phase I NDGPS Coverage (CONUS)

Figure 11 Estimated Phase I NDGPS Coverage (Alaska)

Figure 12 Existing USCG DGPS and Proposed NDGPS Reference Station Locations—Phase I and II CONUS

Figure 13 Existing USCG DGPS and Proposed NDGPS Reference Station Locations—Phase I and II Alaska

Figure 14 Estimated Phase II NDGPS Coverage and Remaining (Shaded) Phase I Coverage (CONUS)

Figure 15 Estimated Phase II NDGPS Coverage (Alaska) Including Both Single and Dual Coverage Areas

Figure 16 Typical GWEN Relay Node

Figure 17 Plan View of Typical GWEN Relay Node

Figure 18 Photograph: Representative GWEN Relay Node (Savannah Beach, Georgia)

Figure 19 Photograph: GWEN Antenna Tuning Unit Shelter and Security Fence (Savannah Beach, Georgia)

Figure 20 Photograph: GWEN Equipment Area (with 30 ft Tall UHF Antenna, Radio Equipment and Backup Power Group Shelters)

3.4 DESCRIPTION OF TYPICAL NDGPS REFERENCE STATION

An NDGPS reference station is an unmanned facility that continuously broadcasts a radio signal at an operating frequency within the range 285 to 325 kilohertz (kHz). The signal has an effective range of up to 250 statute miles (mi) or approximately 400 kilometers (km).

Each reference station will require no more than 11.2 acres of land. A conceptual NDGPS reference station layout is shown in Figure 21. The most prominent feature will be a guyed steel-lattice tower located near the center of the property, which supports an LF broadcast antenna. The tower will be 299 ft in height and equipped with red warning lights and/or a strobe beacon to reduce hazards to aircraft. At the base of the tower will be an ATU shelter. A metallic ground plane or matting one foot below the ground surface will be required for transmission of the ~300 kHz signal. Similar to a GWEN relay node, this ground plane will consist of 50 to 150 buried copper wires (aka radials), each up to 330 ft in length, extending outwards in all directions from a buried ground mat centered near the base of the tower.

The FHWA will use property and/or GWEN equipment available from 53 GWEN sites and 6 spare GWEN equipment sets. The 299 ft GWEN LF antenna, backup power group (BUPG), and ATU and radio equipment shelters will be retained. Since there is not enough GWEN equipment, new concrete equipment shelters, BUPG shelters (or batteries), and LF antennas will also be used. A typical equipment shelter is shown in Figure 22. An 8 ft-tall chain-link fence topped with barbed wire will surround the tower and adjacent equipment shelter. In some locations, a shorter fence will surround the copper ground plane. An area near the entrance to the facility will also be fenced and will contain the radio equipment shelter and a BUPG shelter. Shelters at all NDGPS reference stations will use new, nonfreon air-conditioning units. These units contain R-22 (Refrigerant #22), a Class II refrigerant that has a recognized Ozone Depleting Potential. This product is scheduled for production phase-out but is appropriate for use until alternatives are available.

At each NDGPS facility a reference station antenna and an integrity monitor receive antenna will be mounted on each of two approximately 30 ft-tall masts located outside the ground plane and near the equipment shelter. The 25 kilowatt (kW) BUPG will provide electricity in case of primary power failure.

The NDGPS reference station will require 3-phase electric power and telephone service. Primary commercial electric power with 120/208 V alternating current and a service connection of 100 A will be needed. One telephone voice line and one telecommunications data line will be needed to meet telecommunications needs. No staff will be stationed at the reference station, which will be automated. Water service is not needed, and no wastewater will be generated. An all-weather driveway will be required for construction and long-term access for maintenance and repair.

Figure 21 Conceptual NDGPS Reference Station Layout

Figure 22 Proposed NDGPS Equipment Shelter for Reference Stations Not Using GWEN Equipment

3.5 NDGPS REFERENCE STATION MAINTENANCE

NDGPS reference stations will be maintained by the USCG. The USCG uses a three-tier maintenance support structure. First response and routine maintenance is the primary function of the local group office or "organizational unit." Primary support for the local group office is supplied at the district level or "support unit." These units provide maintenance only and carry out quarterly visits using inspection and maintenance procedures found in the USCG Index of Maintenance Procedures and various GPS operator drawings, manuals, and guides. Key functions of the maintenance team, typically consisting of two technicians, are cleaning and inspection of electronic and physical components, testing of electronic subsystems and components, and tests on various power and environment support systems, such as batteries, fire suppression units, and airflow equipment. Areawide support is provided by the regional Electronics Maintenance Detachment (EMD) to resolve significant technical problems.

3.6 USCG CONTROL STATION

NDGPS will require the installation of more sophisticated electronic monitoring equipment at USCG DGPS control stations in Alexandria, Virginia, and Petaluma, California. The Alexandria and Petaluma stations currently have eight and four staff members, respectively. These control stations continuously monitor critical parameters at each USCG local area DGPS reference station. With the addition of more efficient equipment, the stations will be able to monitor and control the full network of planned NDGPS reference stations, including the USCG local area DGPS reference stations. Nine additional DGPS operators will be stationed at those control stations.

4 ALTERNATIVES

4.1 REASONABLE ALTERNATIVE TECHNOLOGIES

4.1.1 Screening GPS Technologies

Augmentation of existing GPS is the most effective means of meeting government and civilian user requirements for nationwide positioning and navigation. A unique mix of technologies will be used for the NDGPS system architecture chosen to meet user requirements. Nineteen GPS technologies were considered for the development of an NDGPS architecture (see Table 2). These include GPS augmentation technologies that are in operation, likely to be put into operation, or are conceptual, and that individually or in combination with other technologies are likely to meet user requirements. Of the 19 technologies considered, 8 technologies were rejected because of lack of technical feasibility, inability to meet user requirements, and/or an insufficient development. Four other technologies were excluded because they lack key elements required to meet one or more of the user requirements (e.g., coverage over coastal or ocean areas or high failure notification time). Seven were determined to be suitable for augmenting existing GPS service (DOC NTIA, 1994).

A review of these suitable technologies concluded that no single one would meet all federal DGPS user requirements. Except for the extremely high accuracy and availability requirements of a highway collision avoidance application, all other user requirements can be met through a combination of technologies. During evaluation of the seven remaining technologies, a key consideration was that an NDGPS will need to be integrated into the existing USCG local area DGPS and the National Geodetic Survey's CORS system to attain the accuracy needed for ground-based GPS users.

4.1.2 Selection of a System Architecture

In devising a multiple-technology architecture that best meets the requirements for all anticipated uses, at least two GPS augmentation technologies will be required: one primarily for users operating on the earth's surface, and one primarily for aviation users. Using combinations of the seven accepted technologies, six system architectures were identified which maximized commonality and the sharing of resources while reducing duplication of effort. Table 3 describes these six architectures.

Architecture 1 includes the use of the existing USCG local area DGPS in conjunction with the planned Federal Aviation Administration (FAA) technologies; however, this system does not provide nationwide coverage. This architecture was rejected because it would not meet user requirements or security needs.

Table 2
Proposed or Developed Augmented GPS Systems

No.	Augmented GPS Technology	Responsible Entity	Proposed System	Operating System
1*	Low Frequency (LF)/Medium Frequency (MF) Radiobeacon System (over waterways)	USCG		X
2*	LF/MF Radiobeacon System (nationwide)	DOT	X	
3	Commercial Frequency Modulation (FM) Subcarrier System	Private	X	
4*	Wide Area Augmentation System (WAAS) 1 and FAA local area DGPS	FAA	X	
5*	WAAS 2	FAA	X	
6*	WAAS 3	FAA	X	
7*	WAAS 4	FAA	X	
8	WAAS 5	FAA	X	
9	WAAS 6	FAA	X	
10*	CORS System	DOC		X
11	Loran-C System	USCG		X
12	Advanced Communications Technology Satellite (ACTS)	NASA	X	
13	Global Orbiting Navigation Satellite System (GLONASS)	Russia		X
14	Expanded GPS Constellation	DOD	X	
15	Inertial Navigation System (INS)	Various		X
16	Sign Post System	Unknown	X	
17	Pseudolite System	Unknown	X	
18	Dead Reckoning and Map Matching System	Unknown	X	
19	Omega System (existing network of very low frequency [VLF] transmitters used for military and civil navigation, positioning, and timing)	DOD		X

*7 GPS systems considered for system architecture based on technical feasibility, potential for meeting user requirements, and level of development.

Table 3
System Architectures Versus User Requirements

Architecture	Technologies	Nationwide Coverage	Aviation Requirements (ER, CAT I, II, III) Satisfied	CORS Standard Compliant	IOC	Comments
1	USCG local area DGPS FAA WAAS FAA local area DGPS	No	Yes	Yes	1997	No nationwide service
2	Expanded USCG local area DGPS FAA WAAS FAA local area DGPS	Yes	Yes	Yes	1997	High performance; intermediate IOC
3	Expanded USCG local area DGPS Variant of FAA WAAS FAA local area DGPS	Yes	Yes	Yes	>1998	High performance; later IOC
4	Expanded USCG local area DGPS Modified FAA WAAS FAA local area DGPS	Yes	Yes	Yes	>1998	Moderate performance; later IOC
5	Expanded USCG local area DGPS Modified FAA WAAS FAA local area DGPS	Yes	Yes	Yes	>1998	Moderate performance; high security; high infrastructure cost
6	Expanded USCG local area DGPS Variant of FAA WAAS	Yes	Yes	Yes	>1998	Signal interference may occur (eliminated from consideration)

	FAA local area DGPS

ER=en route; CORS=Continuously Operating Reference Station; CAT=Category of Aircraft; IOC=Initial Operational Capability

Architectures 2 and 3 were deemed the top two candidate architectures for the NDGPS based on system performance, cost, and security factors. Architecture 2, a nationwide system of USCG-like DGPS reference stations, ranked highest overall, unless system security is an overriding factor, in which case Architecture 3 would be selected. Architectures 4 and 5 ranked lower in performance than Architectures 2 and 3. Architecture 6 was rejected because of concerns about signal interference to aviation users, which was deemed unacceptable.

Security was not determined to be an overriding factor by the DOT. Therefore, Architecture 2 was identified as the most advantageous architecture for NDGPS (DOC NTIA, 1994).

Architecture 2 was therefore selected to meet land-based user requirements. The DOT is proposing to deploy NDGPS reference stations at strategic locations in two phases. Under Phase I, a GPS user anywhere in the CONUS and Alaska will receive a differential correction signal from at least one NDGPS reference station. Dual or redundant coverage, in which a user would receive a signal from at least two reference stations, will be available to GPS users in Phase II.

Because of the availability of former GWEN sites and equipment for the expansion of local area DGPS, three possible deployment alternatives, and the no-action alternative, are under consideration. Alternative A, the preferred alternative, entails the use of GWEN sites and equipment plus obtaining new sites and then relocating the remaining surplus equipment from other GWEN facilities to some of these new sites. Alternative B entails the use of GWEN sites and new sites using new equipment similar to the GWEN equipment. Alternative C is the selection of all new sites using new equipment similar to that now used for local area service. For each alternative, a 1,000 W LF transmit antenna is proposed. New NDGPS facilities under Alternatives A and B will operate at 50 percent efficiency, or a maximum of 500 W effective radiated power (ERP). USCG-like equipment used under Alternative C will operate at 17 percent efficiency or 170 W ERP. Alternative D is the no-action alternative and would entail no future installation of NDGPS reference stations.

4.2 DESCRIPTION OF ALTERNATIVES ANALYZED IN DETAIL

4.2.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Alternative A, the preferred action for NDGPS service, would use a combination of GWEN relay node sites and newly acquired (non-GWEN) sites as locations for NDGPS facilities. By

Phase II of the NDGPS program, 32 existing GWEN sites will have been identified for reuse, and 35 new (non-GWEN) sites would be acquired to complete the system. Ownership of all GWEN properties selected for NDGPS development will be transferred from the USAF to either the USCG or the USACE for administration as NDGPS properties.

Existing GWEN sites are typically 700 ft × 700 ft, or slightly over 11 acres. A short access and utilities corridor connects the GWEN site with an existing public access road. Newly acquired properties for NDGPS reference stations would also be about 11 acres in size and require access and utilities corridors. Approximately 75 percent of the area at a typical site would be used for the NDGPS facilities. The remaining area would be used for staging and construction, and utilities and road access to the sites. Conversion of existing GWEN relay nodes to NDGPS use would not require new ground disturbance outside of the current site boundaries.

Thirty-two selected GWEN relay nodes would be converted for reuse as NDGPS facilities. Equipment from GWEN relay nodes and surplus GWEN equipment would be installed at 28 newly acquired (non-GWEN) sites. Newly manufactured DGPS equipment shelters and antennas would be installed at seven additional (non-GWEN) sites, which would have the same general size and layout configuration as a GWEN relay node.

A typical GWEN relay node with the 299 ft tower and ATU shelter is described in Section 6 and presented in Figure 16. Conversion of the existing GWEN facilities into NDGPS reference stations involves the following actions:

- Installation of two approximately 30 ft-tall masts (towers) and antenna equipment
- Installation of two 4 ft × 4 ft × 6 ft concrete mast foundations located at the outer edge of the existing ground plane
- Installation of a pull box at each mast location
- Installation of a 1 sq ft DGPS junction box near the existing equipment enclosure
- Installation of a 4-inch underground conduit between pull boxes and to the DGPS junction box
- Hardwire connection of the DGPS mast ground to the existing ground plane
- Removal or modification of other existing USAF equipment for compatibility with DGPS operation.

The 28 new NDGPS reference stations that would use GWEN equipment will have a standard GWEN layout, including the 299 ft guyed tower, ground plane, and BUPG and antenna equipment shelters. DGPS equipment as described above will be installed. The transmitter equipment shelter and BUPG (with a 500-gallon diesel fuel tank) will be installed near the perimeter of the site, and security fencing will be placed in a manner similar to the GWEN facilities. The 12 ft-wide access driveway will connect to an existing public road and lead to the

base of the transmit antenna tower. Aboveground 3-phase commercial power and telephone lines will be brought onto the site along the 12 ft-wide access road.

At the remaining seven new sites, NDGPS equipment having the same configuration as GWEN equipment will be installed, including the 299 ft tower. Site layout and equipment installation would be as described above for the NDGPS reference stations using GWEN equipment. For easier reference, Table 4 breaks out the types and number of properties required for each alternative.

Table 4
Number of Properties to be Acquired Under Each Alternative at Full Buildout

Type of Components	Alternative A	Alternative B	Alternative C	Alternative D
GWEN relay node sites with reuse of GWEN equipment (299 ft tower)	32	–	–	0
GWEN relay node sites with new equipment (299 ft tower)	–	32	–	0
Non-GWEN sites with GWEN equipment (299 ft tower)	28	–	–	0
Non-GWEN sites with new equipment (299 ft tower)	7	35	–	0
Non-GWEN sites with USCG equipment (120 ft tower)	–	–	80–100	0

Construction equipment used to install NDGPS includes a backhoe for trenching and ground plane installation, a front-loading tractor, and a large forklift to unload shelters. The tower can be erected in several ways: with a single crane; with a winch truck and gin pole; with a crane for the first 100 ft followed by use of a winch truck; or with a heavy-lift helicopter (Pugh, 1998). Other vehicles to be used at the construction site include up to four equipment delivery trucks and private commute vehicles for construction workers.

Installation of the proposed facilities at existing GWEN sites would require a maximum of 10 workers over a 30- to 45-day construction period. For construction at new, non-GWEN sites, a maximum of 15 workers over a 2- to 3-month construction period would be needed (Pugh, 1998).

No unusual infrastructure or utility requirements will be needed for installation of this alternative. The cost of equipment acquisition and installation for 67 sites under this alternative is expected to be $30.3 million. Annual operating costs are estimated to be $2.5 million, and annual maintenance costs are expected to be $2.1 million (NDGPS PIT, 1998). The FRA would pay for

costs of installing, operating, and maintaining NDGPS, although operation and maintenance would actually be carried out by USCG personnel (see Appendix A).

4.2.2 Alternative B—Mix of GWEN sites and new sites using new equipment

Alternative B involves the use of existing GWEN sites and new (non-GWEN) sites as locations for NDGPS facilities. As described above for the preferred action, 32 GWEN relay node sites will be required for use and 35 newly acquired non-GWEN sites would need to be identified and acquired to achieve dual coverage under Phase II of the NDGPS program (see Table 4, above).

Except for the ground plane, no GWEN equipment would be reused or relocated for NDGPS facilities at any of the existing GWEN sites or newly acquired non-GWEN sites. Instead, new DGPS equipment would be acquired and installed at all 67 sites. The ground plane at 32 existing GWEN sites would be reused. Equipment installation, utilities, and access road installation would be as described above for newly acquired sites in Alternative A, except new DGPS equipment would be installed. A 299 ft-tall tower would be used at all sites (see Table 4, above). Project information in terms of land acquisition and property ownership, site size, and required construction equipment is identical to Alternative A.

Installation of the proposed facilities at existing GWEN sites would employ a maximum of 10 persons over a 30- to 45-day construction period. For construction at new sites, a maximum of 15 persons over a 2- to 3-month construction period would be needed. Although new equipment will be installed at all sites, the number of days needed for installation at existing GWEN sites is reduced because of the reuse of the existing ground plane.

No unusual infrastructure or utility extensions will be needed for installation of Alternative B. The cost of equipment acquisition and installation for 67 sites under this alternative is expected to be about $37.2 million. Likewise, annual operating and maintenance costs are $2.5 million and $2.1 million per year, respectively. The FRA would pay for costs of installing, operating, and maintaining NDGPS. USCG personnel would install, operate, and maintain the NDGPS equipment (see Appendix A).

4.2.3 Alternative C—All new sites using standard USCG equipment

Alternative C for the deployment of an NDGPS service involves the identification and development of new site locations for facilities very similar in size and capability to the existing USCG local area DGPS stations now in use. Approximately 80 to 100 new sites ranging in size between 2 and 11 acres would be required to expand the existing local area DGPS service to a nationwide dual coverage system using the current standard USCG equipment (see Table 4, above). Standard USGS local area DGPS reference stations use a single transmit antenna ranging between 90 and 120 ft in height, including a copper ground radial plane.

Site acquisition would be undertaken by the USACE, and as with Alternatives A and B, the USCG and USACE would administer the properties. Construction equipment needs would also be the same as described for Alternatives A and B. Installation of the proposed facilities at all site locations would require a maximum of 15 persons over a 2- to 3-month construction period (Pugh, 1998).

The cost of equipment acquisition and installation is expected to be $44 million. Annual operating costs are estimated at $3.6 million and annual maintenance costs are estimated at $3.1 million (NDGPS PIT, 1998). As with Alternatives A and B, the FRA would pay for the cost of installation, operation, and maintenance, and USCG personnel would carry out operation and maintenance responsibilities (see Appendix A).

4.2.4 Alternative D—No-action alternative

Under the no-action alternative, the existing GWEN system of facilities would continue to be decommissioned by the USAF. In this case, the USAF will continue to cease operations and intends to remove equipment at all GWEN properties (USAF, 1995). An environmental assessment for each of these actions will be prepared by the USAF. Those GWEN facilities located on leased property would be returned to private use. Properties purchased by the USAF for GWEN relay nodes would revert to the General Services Administration for possible reuse by another federal agency or resale out of federal ownership (USAF, 1987). The USCG would continue to operate its local area DGPS reference stations. No undeveloped or previously developed properties would be altered for use as NDGPS reference stations. The current accuracy, reliability, and availability of existing SPS service would remain unchanged.

5 AFFECTED ENVIRONMENT

The proposed NDGPS reference stations will be located in the interior portions of the CONUS and Alaska. Nearly level property away from tall objects and structures is preferred for installation of reference stations. There is a relatively large area within which candidate sites for a reference station may be located. Given this flexibility, the government intends to select locations for reference stations so as to minimize the potential effect on the environment. This section discusses the range of conditions that may be present at candidate sites, sources of site-specific resource information, and the regulatory setting within which the resource is managed or protected.

The proposed NDGPS network of reference stations will use existing GWEN sites and equipment, and/or deploy similar equipment at new sites. Given the similarity of these two programs, portions of the GWEN Final EIS have been used in this section when appropriate.

5.1 GEOLOGY AND SOILS

5.1.1 Resources Affected

Geological resources consist of soil and bedrock including unconsolidated and consolidated earth materials. Resources include the construction engineering properties of the materials, economic mineral deposits, significant or unique landforms, and paleontological (fossil) remains. The NDGPS program may affect or be affected by the geological environment. Major potential geological constraints to the project include seismic shaking and soil instability. The United States has been subdivided into six seismic zones and classified according to the potential for seismic hazard within that zone. Zones range from 0 to 4 (0, 1, 2A, 2B, 3, and 4) with the higher number indicating increasing potential for damage (International Conference of Building Officials, 1997). Zones 0 through 2 are found throughout the United States, while Zones 3 and 4 occur in the western and Rocky Mountain states and Alaska.

Soil instability is found on steep slopes of 5 percent or greater or in areas with highly erodible soil. These conditions can be found in all regions of the United States.

Mineral resources are widely distributed and include all types of rock and rock-derived material which has some economic use including fossil fuels, construction and building materials, metals, gemstones, and nonmetallic raw materials. Sand and rock quarries are the most common type of economic mineral deposit, and extraction sites may occur throughout the U.S. Oil and gas reserves are located throughout the U.S. Oil and gas production wells are typically spaced at one well per every 40 to 640 acres.

Paleontological resources are also present throughout the U.S. and may occur where bedrock is exposed on the surface, typically where erosion has exposed subsurface features or in mountainous terrain, and also in alluvial and lacustrine deposits.

5.1.2 Data Sources

Data on geological conditions and related resources, such as flooding, soil characteristics, terrain and paleontological resources, are available from the U.S. Geological Survey (USGS), the Natural Resource Conservation Service (NRCS), the U.S. Forest Service (USFS) and the USACE. Information on paleontological resources located on lands administered by the BLM or Bureau of Reclamation (BOR) is available from those federal agencies. Information on seismic zones is contained in the International Conference of Building Officials *Uniform Building Code* (1997). Sources of data at the state level include state offices of geology, natural resources, environmental conservation, emergency management, and oil and gas regulation, among others. Other independent sources include research and review by land development and resource extraction industries, and independent clubs and organizations.

5.1.3 Regulatory Setting

The code governing construction and design of NDGPS facilities within an assigned seismic hazard zone is contained in the 1997 *Uniform Building Code*. Procedures and guidelines developed by the USFS, BLM, or BOR for the protection, survey, and excavation of paleontological resources located on lands under their jurisdiction reside with those agencies. State regulations and management practices may also apply.

5.2 WATER QUALITY

5.2.1 Resources Affected

Water resources include surface water and groundwater and their physical, chemical, and biological conditions. The anticipated physical and chemical factors that influence local water quality and surface water runoff, including the effects of erosion and sedimentation, are discussed below. Floodplain and wetland resources are discussed separately in Section 5.3, Ecologically Sensitive Areas.

Water resources such as lakes, rivers, streams, canals, and drainage ditches make up the surface hydrology of a given watershed. Groundwater resources consist of subsurface hydrology in which one or more aquifers may be present. Aquifers perched near the ground surface may significantly influence local surface water levels, flow rates, salinity, and chemistry.

The buried copper radials used for the NDGPS (or former GWEN) antenna may be subject to corrosion, potentially resulting in increased copper concentration near the antenna ground plane. This aspect of NDGPS development on water quality depends on baseline copper concentrations, depth to groundwater, soil acidity, and water hardness ($CaCO_3$). Increased

hardness is associated with greater buffering capacity and reduced toxicity of copper (USAF, 1987). Except in acidic soils, copper mobility is generally limited because of insolubility, adsorption, and/or complexation (USAF, 1987). For the protection of aquatic life, the 1997 EPA standards for copper concentrating in water contained in 40 CFR 131 are dependent on water hardness. Table 5 indicates the allowable maximum and continuous concentrations of dissolved copper in freshwater depending on water hardness or $CaCO_3$ content.

Table 5
Freshwater Toxics Criteria for Dissolved Copper (40 CFR 131.36) July 1, 1997

Hardness[1] $CaCO_3$ (mg/l)	Criterion Maximum Concentration[2] (µg/l)	Criterion Continuous Concentration[3] (µg/l)
25	5	3
50	9	6
75	13	9
100	17	11
150	25	16
200	33	21
300	48	29
400	63	37

[1]The hardness level used for calculations must be no less than 25 and no greater than 400, regardless of the actual hardness value at the site (40 CFR 131.36 c(4)).

[2]Criterion Maximum Concentration (CMC) = the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-hour average) without deleterious effects.

[3]Criterion Continuous Concentration (CCC) = the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects.

5.2.2 Data Sources

Data on the location and condition of regional watershed resources is available from both the EPA and USGS water programs and resource maps. The USGS publishes the National Water Summary for water resources nationwide, and their National Water Quality Assessment Program provides water quality information for specific "study units." The EPA STORET environmental data system, which provides additional water quality and other descriptive information, is available via the Internet. Finally, the *Groundwater Atlas of the United States* (USGS, 1998) is another source of water resource information.

The potential for erosion and sedimentation can be identified by soil type from soil surveys prepared by the NRCS for each county or portion of a county. Soil classifications are ranked by several criteria, including their potential for severe erosion. The universal soil loss equation prepared from NRCS data is a standard method for quantifying anticipated losses of soil by erosion. This quantitative assessment of whether significant erosion would occur is typically applied on a site-by-site basis if a potential for severe erosion exists. For some locations, quantification of water runoff may be required for state or county project review requirements. Water runoff is typically a concern in low-lying areas near sea level, such as the coastal Gulf states and in mountain valleys. It is a concern when large impervious areas replace exposed soils that formerly promoted infiltration of standing water.

Typically, sources of data at the state level include state and county departments of water quality, environmental conservation, and environmental protection. Other independent sources include municipal water treatment data and independent sampling by private health, scientific and environmental organizations.

5.2.3 Regulatory Setting

The Clean Water Act of 1977 (as amended) is the primary law regulating water pollution and gives the EPA the authority to set water quality standards for contaminants in surface waters. The EPA publishes surface water quality standards and toxic pollutant criteria at 40 CFR Part 131. In 1997, the EPA updated its standards based on water hardness to protect aquatic life from excessive copper concentrations (40 CFR 131.36).

5.3 ECOLOGICALLY SENSITIVE AREAS

5.3.1 Resources Affected

Ecologically sensitive areas include jurisdictional wetlands and the 100-year floodplain. According to the USACE definition of wetlands contained in 33 CFR 328, three necessary conditions must be met in order for an area to be classified as jurisdictional wetlands: the area must contain hydric soils; it must support hydrophilic vegetation; and it must have an appropriate hydrologic regime. Typical wetland areas include marshes, swamps, and bogs, and, in general, are transitional zones between terrestrial and aquatic ecosystems. Wetlands are of prime importance to waterfowl and provide critical habitat for numerous other wildlife. Wetlands occur throughout the U.S. and are delineated based on regional or local criteria determined by the USACE. Where the presence or absence of jurisdictional wetlands is not known, delineation of wetland boundaries using criteria accepted by the USACE may be required.

Floodplains are lowlands and "relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year" (President, 1977). A 100-year floodplain is an area subject to flooding on average more than once every 100 years. The 100-year

floodplain may be present in low-lying regions throughout the U.S., particularly in the Midwest and Gulf states, and in mountain valleys and coastal areas.

5.3.2 Data Sources

The locations of known wetlands are available from the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory maps. NRCS soil surveys and separate soil listings delineate areas that may contain hydric soils or hydrophilic vegetation. Field studies may be required to confirm the presence or absence of jurisdictional wetlands. Flood Insurance Rate Maps indicating the boundary of the 100-year floodplain are available from the Federal Emergency Management Agency (FEMA).

5.3.3 Regulatory Setting

Section 404 of the Clean Water Act of 1977 (as amended) regulates development in wetlands and surface water bodies, and requires agencies to obtain a permit from the USACE to dredge or fill in U.S. waters. Executive Order 11990—Protection of Wetlands, directs federal agencies to avoid to the extent possible adverse impacts associated with the destruction or modification of wetlands. Executive Order 11988—Floodplain Management and Protection, directs federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.

5.4 AIR QUALITY

Air quality for a given location is characterized by the concentration of various key pollutants in the atmosphere. Parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$) are typical units for atmospheric pollutants. A significant impact on air quality may occur for incidents in which federal and state air quality standards are exceeded or where hazardous air pollutants may adversely affect public health. Short-term air emissions would occur during construction and decommissioning activities, principally from site clearing activities, if any, and the use of construction equipment and related vehicles. Long-term air emissions would occur during operation of the NDGPS reference station because of infrequent use of the BUPG during disruption of commercial power.

5.4.1 Resources Affected

The National Ambient Air Quality Standards (NAAQS) specify allowable pollutant concentrations at which public health and welfare are protected with a reasonable margin of safety. The criteria pollutants under federal and state standards are ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), total suspended particulates (TSP), particulate matter under 10 microns (PM10), and lead (Pb). Key factors affecting air quality conditions for a location or region are pollutant emission rates, emission parameters, topographic features, chemical reactions, cumulative effects from other emission sources, and meteorological

conditions. If criteria pollutant standards are exceeded more than once per year, that area is designated as being in nonattainment. For nonattainment areas, each state submits for approval a State Implementation Plan that will bring the affected air basin into attainment with the NAAQS. Air emission regulations are more stringent in nonattainment areas and vary from air basin to air basin.

Areas with very clean air are required to adhere to Prevention of Significant Deterioration (PSD) requirements concerning major new emission sources. Areas in which PSD requirements apply include federal wilderness areas and other settings possessing pristine air quality.

5.4.2 Data Sources

The Council on Environmental Quality (CEQ) annually summarizes the nation's air quality. Data from the annual reports are gathered by the EPA from national, state, and local air-quality monitoring sites, typically located in urban or industrial areas. Data for specifically designated air basins within the U.S. are also available.

Data on air quality standards and air basin conditions are available from state and regional air pollution control agencies and air quality management district offices. Whether a proposed action is in compliance with rules and regulations for a particular air basin is determined on a site-by-site basis. Areas in attainment and not subject to PSD requirements are not expected to require site-specific air quality analysis.

5.4.3 Regulatory Setting

The Clean Air Act Amendments of 1990 (as amended) set the NAAQS, while State Implementation Plans for areas in nonattainment with NAAQS are prepared by each state and the appropriate regional air quality management district.

5.5 NOISE

5.5.1 Resources Affected

Noise is unwanted sound heard by people or wildlife in the vicinity of the project area because of activities related to the construction, operation, and maintenance of the proposed facilities. Noise can be intermittent or continuous, steady or impulsive, and may involve any number of sources and frequencies. It may be readily identifiable or generally nondescript. Human response may vary depending on the source, listener sensitivity and expectations, the time of day, and the distance from the source. Noise is measured in decibels (dB), usually adjusted to the A-scale. Affected receptors are specific or areawide locales in which occasional or persistent sensitivity to noise above ambient levels exists, such as at or near hospitals, amphitheaters, nursing homes, and certain locally designated districts.

NDGPS reference stations will be located in a variety of local environments. While no land-use type can be eliminated from selection, dense urban environments having the highest ambient

noise levels are less likely to be selected. Wilderness areas, parks, and rural communities possess low ambient noise. This last setting is typical for many GWEN relay nodes. Suburban areas may have the greatest amount of noise-sensitive receptor locations.

5.5.2 Data Sources

Published data on anticipated noise levels of typical construction equipment are available in Bolt et al. (1971). Published federal, state, or local laws, ordinances, regulations, and standards can be obtained for comparison with anticipated noise emissions.

5.5.3 Regulatory Setting

The EPA administers the Noise Control Act of 1972, and has identified 55 dB (A-scale) as a desirable noise level for residential use. This level is not regarded as a noise standard, but simply a basis for state and local governments to set appropriate standards that should also factor in local considerations and issues. The FHWA has established long-term peak hourly noise level standards for the design of highway projects in various types of land-use settings.

The 1982 FHWA Federal Highway Program Manual 7-7-3 was used to assess the relative effects of noise. It establishes long-term average peak hourly noise levels for various land-use categories. For the most highly sensitive receptor areas, such as hospitals and parks, exterior noise levels of 57 dB (A-scale) or less are recommended. For areas containing moderately sensitive land uses, such as residences, hotels, and schools, an exterior noise level of 67 dB (A-scale) or less is recommended. For other developed lands, an exterior noise level of 72 dB (A-scale) or less is recommended.

5.6 VISUAL RESOURCES

5.6.1 Resources Affected

Visual resources comprise the natural and man-made features that give a particular environment its aesthetic qualities. These features form the overall impression that a viewer has of an area or its landscape character. Landforms, water surfaces, vegetation, and man-made features are considered characteristic of an area if they are inherent to the composition and function of the landscape. The landscape character is studied to determine whether a new element would appear compatible with the affected setting or would noticeably contrast in such a way as to diminish its character or aesthetic quality (USAF, 1987).

Methods to assess visual resources based on public values, goals, awareness, and concern have been developed by the BLM (BLM, 1986). The Visual Resource Management (VRM) system helps to define the visual sensitivity of an area and the degree of potential effect on a visual resource. Of particular concern are state and locally designated scenic highways and recognized visual settings governed by local comprehensive plans and ordinances, which are common within coastal, recreation, and open space areas, and historic properties or districts. These are of

moderate sensitivity. Areas of national significance, such as national parks, wild and scenic rivers, monuments, and landmarks are areas of potentially high visual sensitivity.

Four broadly defined landscapes would occur within the potential settings of the proposed project. These four landscapes consist of natural, rural, urban, and transitional landscapes (USAF, 1987) and are briefly described below.

Natural landscapes are those in which natural-appearing landforms and vegetation predominate, and signs of human activity are not readily apparent. Coastlines, water bodies, mountainous landforms and areas of varied relief are the most striking and tend to be the most conspicuous. More sparsely vegetated mountainous areas in the western U.S. are dominated by their landform, such as rock outcroppings, ridges, escarpments, and plateaus. Natural areas within the eastern third of the continental U.S. are typically heavily forested. Even where there is substantial relief, the heavily forested landforms are undistinguished and tend to confine a viewer's attention to the immediate foreground. Tower facilities would be least compatible within a natural landscape; however, for areas in which a forested area offers a diverse skyline or visual screening, the conspicuity of the structure would tend to be lower.

Rural landscapes include features such as croplands, orchards, fields, fences, and farm-related structures. Agricultural areas are predominantly flat or gently rolling hills. Native vegetation is present in confined areas where land is steep or soils are unproductive. Views may extend for some distance, with typically vertical elements consisting of relatively low farm buildings, silos, water towers, utility poles and trees. Distinct geometric patterns are often observed, such as rectangular or circular fields and property boundaries divided by section lines. Towns are small and contain a relatively low skyline profile. In general, structures are relatively few but can be of aesthetic interest and the landscape is noticeably influenced by agricultural practices. Other rural areas are forested or desert in character and are influenced by roadways, towns, and land-clearing actions such as timber harvesting, strip mining, ski areas, and large reservoirs.

Urban landscapes represent only a fraction of the nation's entire land area, but it is the dominant visual environment of roughly three-quarters of the U.S. population. Residential and suburban areas represent much of the urban landscape, with a centralized primary commercial center and business district defining the most dominant visual setting. Heavy and light industry tend to be scattered and located within specific zones or districts, such as along permanent roadways and waterfronts or near airports. The scale of development in major urban areas is large, dominated by structures, freeways, infrastructure and trees. Urban landscapes can absorb the greatest degree of visual change because of the dominant visual features contained within it. For tower structures, the presence of other similar towers in the region, the complexity and relief of the skyline, and the screening of view by structures and trees will lessen the potential for significant visual impact.

Transitional landscapes are those that contain common features of two or more of the dominant landscapes mentioned above. They represent a gradual change from one landscape type

to another. Visual landscapes between urban and rural areas are generally the most capable of absorbing visual change.

5.6.2 Data Sources

Data on visual resources and landforms are available from USGS topographic maps, road maps, regional transportation and planning maps, and from field investigations by experienced observers. Observation and analysis of visual effects are effectively categorized using the BLM VRM system. This method is simplified for use during NDGPS site-selection activities and can be applied to non-BLM lands.

Significance of impact should be based on visual dominance and visual sensitivity. The extent to which a project element is visually dominant relative to the affected landscape can be classified according to the BLM VRM classifications in Table 6.

Table 6
BLM VRM Classifications

Class	Dominance	Description
I	Not noticeable	The change would generally be overlooked
II	Noticeable	Visually subordinate; change is subtle but noticed by most without being pointed out
III	Distracting	Visually codominant; change competes strongly for attention and is equally conspicuous with other features
IV	Dominant	Demands attention; change to landscape is the focus of attention and becomes the primary focus of the viewer

Visual sensitivity reflects the level of viewer awareness and value placed on a particular scene or setting. Highly sensitive areas are typically designated as being of significant importance to the general public. These include national and state parks, designated wild and scenic rivers, historic sites, memorials, recreational areas, scenic roadways, overlooks, trails and rivers, wilderness areas, and other areas designated for special outdoor public use. Some travel routes, including roads, trails, bicycle paths, and equestrian trails at or leading to areas known for their unique scenic quality, are also considered to be highly sensitive. Medium sensitivity areas are affected areas or travel routes having no specific designation but lead to areas of special interest. Undesignated, but protected or popularly used areas of aesthetic, recreational, cultural, or scientific significance are present and are often identified by local, state, or county jurisdictions. Low sensitivity areas are those in which the general public is expected to have no more than a minor concern about changes in the landscape. Views in these areas are not unlike others in the general vicinity, and sensitivity remains low when viewed from any viewpoint or travel route not considered to be either medium or high in sensitivity.

5.6.3 Regulatory Setting

Regulations and planning documents that address potential effects to visual resources include federal management policies for public lands, particularly lands managed by the BLM and the USFS. Specific regulations containing federal requirements for visual resource assessment include the National Forest Management Act of 1976 (as amended), the Federal Land Policy and Management Act of 1976 (as amended), the Wild and Scenic Rivers Act of 1968, and the resource management policies of the BLM and USFS.

5.7 FLORA AND FAUNA

5.7.1 Resources Affected

Flora and fauna resources include native and exotic plant species (or vegetation) and indigenous or migratory animal species (or wildlife) and their habitats. These resources include plant populations and communities, and wildlife populations and their relationship to habitat, including aquatic, wetland, and riparian ecosystems. Of principal concern are direct or indirect effects upon state and federally protected species or their prime habitats. Lists of protected flora and fauna are prepared for each county and periodically updated by the regional or local field office of the USFWS. Current lists of state-listed species reside with the equivalent state-level agency and/or the natural heritage database.

There are numerous settings in which state- and federally listed plant and wildlife species may occur. Common, broadly classified ecosystems include deserts, grasslands, scrub, woodlands and forests, aquatic, wetlands, and riparian areas. In addition to threatened and endangered species, flora and fauna protected by other federal and state laws must be considered. This includes the potential for mortalities to indigenous and migratory birds because of tower strikes. Typically, the location of new, tall guyed towers between large migratory bird stopover and feeding areas within the Central, Pacific, and Atlantic Flyways should be chosen to avoid areas where low flyovers (below 300 ft) occur. Also, federal regulations for some areas may require the use of utility pole cross-arms designed to eliminate the potential for raptor electrocutions.

Other types of critical habitat occur in areas with broad, natural occurring ecosystems, such as old growth coniferous forests in the Pacific Northwest, long-leaf pine forests of the lower eastern seaboard, and undisturbed areas within the southwestern deserts. Numerous other types of valuable habitat areas are present and must be considered during site-specific investigations for suitable properties.

5.7.2 Data Sources

To effectively consider effects upon flora and fauna, site-specific information and regulatory agency input are required. USFWS Recovery Plans for federally protected species and species location information on state natural heritage database records are excellent sources. Any conflict between observed or documented ecosystems identified on-site and critical habitat required to

sustain protected species should be evaluated by a qualified botanist or wildlife biologist. Initial screening for conflicts with critical habitat can be made using on-site observations and published information.

5.7.3 Regulatory Setting

The principal federal statute pertaining to the protection of plants and animals is the Endangered Species Act of 1973 (as amended), which requires protection of federally listed threatened and endangered species and their habitats. Other federal statutes include the Migratory Bird Treaty Act of 1918 (as amended), the Fish and Wildlife Coordination Act of 1958 (as amended), and the Bald Eagle Protection Act of 1940. For coastal and marine locations, the Marine Mammal Protection Act of 1972 (as amended) and the Coastal Zone Management Act of 1972 (as amended) would apply. Various state laws protecting state-listed plant and animal species or habitat areas of special concern must also be considered during the siting and development of NDGPS facilities.

5.8 CULTURAL RESOURCES

5.8.1 Resources Affected

Cultural resources that could be affected by construction and operation of an NDGPS reference station include prehistoric-archaeological, historic, architectural, and Native American (American Indian and Native Alaskan) resources. Prehistoric-archaeological resources are defined as physical remnants of human occupation that predate the advent of written records in a particular culture and geographic region. These resources typically include archaeological sites, dwellings and structures, artifacts, midden heaps, and other evidence of prehistoric human activity. Historic resources consist of physical properties or locations postdating the advent of written records. In addition to the artifacts mentioned above, historic resources may also consist of written records and locations associated with events that have made a significant contribution to history or that are associated with the lives of historically significant persons. Architectural resources include historic/prehistoric structures, buildings, and other objects related to prior human occupation. American Indian and Native Alaskan cultural resources may be prehistoric archaeological sites, artifacts, burial grounds, areas of prior occupation and events, historic and contemporary sacred areas (traditional cultural properties), hunting and gathering areas, cultural landscapes, and other botanical, biological, and geological resources of importance to contemporary Native American groups. Traditional cultural properties can often be bounded areas defined by symbolic associations with religious or cultural practices, historic events, or other concepts and not necessarily manifested by physical remains.

Areas of potential impact to cultural resources include properties, structures, landscapes, or traditional cultural sites that qualify for listing in the National Register of Historic Places (NRHP). While typical locations of previously unknown cultural resources are subsurface artifacts and sites located on undeveloped properties, developed sites with structures greater than 50 years old may

be eligible for the NRHP. Historic districts, landscapes, or clusters of similar historic properties related to a common theme or locale may occur in prospective NDGPS site areas. Undocumented or unidentified traditional cultural sites or landscapes may also exist at or near prospective NDGPS sites. Visual, noise, atmospheric, and physical impacts must be considered during NDGPS site evaluations near these resources.

5.8.2 Data Sources

Data sources include those available from the State Historic Preservation Office (SHPO) and from NRHP-eligible properties and landmarks listed in the National Register Information System (NPS, 1998). Information from the SHPO or other databases on the presence of prior cultural resource studies in the vicinity of the project's site search area are also valuable. For some areas, regional prehistoric, historic, and ethnohistoric descriptions and accounts that summarize cultural properties and lifestyles found in the U.S. may be appropriate. Definitive information regarding the presence or absence of cultural resources is obtained from on-site cultural resource investigations by a qualified archaeologist or architectural historian. Ethnographic information, including information on traditional cultural properties, may be available from regional historians or must be obtained by ethnographic research and interviews with traditional cultural leaders from tribal groups or other Native Americans.

5.8.3 Regulatory Setting

Numerous federal laws govern the treatment of cultural resources on lands administered or managed by federal agencies or that may potentially be affected by proposed federal projects. The National Historic Preservation Act (NHPA) of 1966 (as amended) is the cornerstone of federal preservation law and establishes the current national historic preservation program. Section 106 of the NHPA requires federal agencies to consider the effects of their actions on historic properties and to seek comments from the Advisory Council on Historic Preservation (ACHP). The procedure for meeting Section 106 requirements is set forth in ACHP regulations at 36 CFR Part 800. Other statutes and regulations include: the Antiquities Act of 1906, Section 4(f) of the DOT Act of 1966, the Archaeological and Historic Preservation Act of 1974, the American Indian Religious Freedom Act of 1978 (as amended), the Archaeological Resources Protection Act of 1979 (as amended), the Native American Graves Protection and Repatriation Act of 1990, Section 101(d)(6)(A) and (B) of the NHPA, and other codes, plans, and programs that set forth actions and procedures for the protection of cultural resources.

Cultural resources derive their significance from the roles they have played in American history, architecture, archaeology, engineering, and culture. To be eligible for listing on the NRHP, resources must be evaluated for significance against standards established by the NPS. The criteria for evaluation listed below are those standards used for evaluating NRHP eligibility. The quality of significance is "present in districts, sites, buildings, structures, and objects that . . .:

(a) are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) are associated with the lives of persons significant in our past; or

(c) embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) have yielded, or may be likely to yield information important in prehistory or history"

(NPS, 1982).

To be eligible for listing on the NRHP, a property must meet at least one of the above criteria and possess "integrity of location, design, setting, materials, workmanship, feeling, and association. . ." (NPS, 1982). NRHP eligibility is determined in consultation with the SHPO.

Potential impacts to significant cultural resources occur when the proposed undertaking alters the characteristics of the resource that qualifies the resource for inclusion on the NRHP. To determine effect, potential alteration to features of a property's location, setting, or use should be considered. An undertaking is considered to have an adverse effect when the integrity of the property's location, design, setting, materials, workmanship, feeling, or association is diminished. Potential adverse effects include:

- physical destruction, damage, or alteration of all or part of the property;
- isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the National Register;
- introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;
- neglect of a property resulting in its deterioration or destruction; and
- transfer, lease, or sale of the property

(ACHP and GSA, 1991).

5.9 RECREATION

5.9.1 Resources Affected

Recreational resources include designated areas such as national and state parks, national and state recreation areas, national seashores, national monuments, national historic sites, state beaches, and state fishing areas. Other recreational resources potentially affected by construction and operation of the proposed facilities are regional, county, and municipal parks, reservoirs and beaches, and recreation areas used by the local populace. Potential concerns in these areas include increases in traffic and noise, alteration of scenic quality, increased access from the

installation of new roadways, and conversion of land uses to nonrecreational uses, both individually and cumulatively.

Recreational resources are those places or amenities set aside as parklands, beaches, trails (hiking, skiing, bicycling, equestrian), recreation fields, sport or recreational venues, open spaces, aesthetically pleasing landscapes, and many other locales. National, state, and local jurisdictions typically have designated land areas with defined boundaries for recreation. Other less structured activities—for example, hunting or cross-country skiing—are performed in broad, less defined locales. A recreational setting may consist of natural or man-made landscapes and can vary in size from a roadside monument to a multimillion-acre wilderness area.

5.9.2 Data Sources

Key national recreational resources can be identified from land-use maps prepared by numerous federal agencies, such as the NPS, USFS, BLM, USFWS, and other land management agencies. State recreational resources are found from state park, recreation, natural resource, fish and game, and historic preservation agencies. Local regional or county recreational amenities are found from maps prepared by the local governing jurisdiction, and local civic and athletic organizations.

5.9.3 Regulatory Setting

Recreational resources are provided varying levels of management and protection by several federal regulations. These include Section 4(f) of the DOT Act, the Land and Water Conservation Act of 1985 (36 CFR Part 59), the Wilderness Act of 1964, the Coastal Zone Management Act, the Wild and Scenic Rivers Act, and portions of other legislation enacted to create and maintain the resource areas mentioned in Section 5.9.1.

5.10 LAND USE

5.10.1 Resources Affected

Natural land uses and land uses that occur as a result of human modification are considered affected resources. Natural land uses may include forest, rangeland, desert, and other open or undeveloped areas. Human land uses include residential, commercial, industrial, and institutional, transportation corridors, communications and utilities rights-of-way, agriculture, and other activities. Recreational land use and wild and scenic rivers are addressed separately in Section 5.9, Recreational Resources, and Section 5.6, Visual Resources.

Land-use designations are typically made by the state or federal land management agency or by the local jurisdiction through management plans, policies, ordinances, and regulations. Federal policies that govern prime farmlands and coastal zones include the Farmland Protection Policy Act of 1984 (FPPA) (7 CFR 658) and the Coastal Zone Management Act (CZMA) of 1972 (as amended) (15 CFR 923). Prime farmland is land that has the best combination of physical and

chemical characteristics for the production of crops. The FPPA minimizes the extent to which federal programs contribute to the unnecessary and irreversible conversion of such farmlands to nonagricultural uses, and assures that federal programs are administered to be compatible with state or local governments and policies to protect farmland. Approximately 334 million acres of land in the U.S. are designated as prime farmland by the U.S. Department of Agriculture (USDA) (NRCS, 1994). Prime farmlands can occur throughout the U.S. but are more prevalent throughout the Great Plains, Midwest, and Western states.

Coastal zones are areas located along U.S. oceans and lakes that are regulated by state or local management plans developed under the authority of the CZMA. Coastal zone areas include islands, transitional and intertidal areas, salt marshes, wetlands, beaches, estuaries, bays, ponds, lagoons, bayous, dunes, barrier islands, reefs, and fish and wildlife habitat. The purpose of the act is to preserve, protect, develop, and restore or enhance the resources of the nation's coastal zones, and to assure that all federally supported activities that directly affect the coastal zone are consistent with approved state coastal management programs as much as possible.

Land-use designations are typically more restrictive in urban and suburban areas and can change frequently over a distance of just several hundreds of feet. Conversely, in rural areas, a single land-use designation may encompass several tens of acres, or more. These areas are typically zoned for agriculture and carry relatively few restrictions on the installation of communication towers, unmanned shelters, and the extension of utilities. However, because of the proliferation of numerous cellular and other communication antenna towers in urban, suburban, rural, and transitional landscapes, more stringent land-use approval procedures are becoming common.

The NDGPS program will require the long-term lease or acquisition of public or private lands to install towers and equipment within an approximately 11-acre area. A major issue is the potential for regulatory conflict between existing land uses and the proposed NDGPS action. Under the doctrine of federal supremacy, the federal government is not subject to local or state land-use and zoning regulations unless specifically consented to by Congress. Under the Public Building Amendments of 1988, the federal government does take land-use and zoning policies into consideration, and cooperates with state and local agencies to avoid conflicts when possible. The federal government will offer planning and design drawings for courtesy review, but will not formally apply for conditional use permits, variances, or similar land-use approvals related to local/regional zoning and land-use law.

5.10.2 Data Sources

Individual city and county planning agencies or regional planning boards are the most definitive sources of information regarding current land-use plans and zoning regulations. Lead planners can provide an indication of the potential for current and future land use. State agencies coordinating or assisting in regional development plans can also provide information on proposed development activities. State and/or local agencies would also provide coastal zone management

policies approved under the CZMA. NRCS soil surveys and separate soil listings delineate areas that may qualify as prime farmland.

5.10.3 Regulatory Setting

The Public Buildings Act of 1959 enables federal projects to proceed without local approvals. The Public Building Amendments of 1988 require federal agencies to consider local land use and zoning during their project planning and to accommodate local requirements whenever possible.

Executive Order 12372—*Intergovernmental Review of Federal Programs* directs federal agencies to "make efforts to accommodate state and local elected officials' concerns with proposed…direct federal development." This executive order requires federal agencies to provide state and local officials the opportunity to comment on action that could affect their jurisdictions, using state clearinghouses to facilitate the consultation process, when possible. Several states have elected to eliminate this process; however, efforts to coordinate with local planning and development reviewing agencies should be made at the earliest possible time.

The Land and Water Conservation Act of 1965 promulgated under 36 CFR Part 59 allows Congress to fund grants to state and local agencies for the acquisition of parkland. Agencies may purchase and develop land and water areas for recreational use with those funds but may not use the land for nonpark uses. The CZMA and FPPA are discussed above. Section 4(f) of the DOT Act states that a DOT action requiring the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance or land from a historic site of national, state, or local significance would only be approved if there is no feasible and prudent alternative to the use of such land, or the action includes all possible planning to minimize harm resulting from the use.

Other federal laws contain indirect land-use elements. The Federal Land Policy and Management Act of 1976 (as amended) requires projects on BLM land to coordinate with state and local land-use plans. The Federal Aviation Act of 1958 provides for FAA review of proposed towers over 200 ft, and smaller towers within 20,000 ft of major airport runways or within 10,000 ft of general aviation airports. This process is carried out through the review of FAA Form 7460-1—Notice of Proposed Construction or Alteration. Federal and state environmental regulations or programs mentioned in other sections of this document could prohibit development in some areas. Or, these regulations may not prohibit development, but could require extensive mitigation to protect or replace a particular resource. Also, local concerns may arise because of perceived conflicts between the project and existing land-use plans, zoning, and other development controls.

5.11 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

5.11.1 Resources Affected

Socioeconomics comprise such interrelated resources as population, employment, income, temporary living quarters (during construction), and public finance. Public finance pertains to the fiscal effect of a project on local governments—including such entities as counties, cities, schools, and special districts—and refers to local property revenues, expenditures, debt, and bonding and tax limitations. Socioeconomic issues and concerns are associated with a project's selection and use of construction contractors, available local labor and materials; the need for temporary housing and other services to support construction and maintenance personnel; the need for protective or public services, such as fire and police protection; and any special tax ramifications. Land use as applied to social and economic issues and concerns is addressed in Section 5.10.

Executive Order 12898—*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* was issued to ensure that disproportionately high and adverse human health or environmental effects on ethnic minority communities and low-income communities were identified and addressed (President, 1994). An ethnic minority is defined as an individual who is a member of one of the following population groups: American Indian or Native Alaskan, Asian or Pacific islander, Black (not of Hispanic origin), or Hispanic. Ethnic minority populations are identified when the minority population of a defined study area, or area of project effect, exceeds 50 percent, or the minority population percentage is meaningfully greater when compared with levels in other geographically defined units (e.g., neighborhoods, census tracts, county, state) (CEQ, 1997). Low-income populations are identified as those living at or below statistical poverty thresholds. Impacts on resource areas such as water and air quality could potentially be considered adverse to minority and low-income populations if they were found to significantly impact the environment. Executive Order 13045—*Protection of Children from Environmental Health Risks and Safety Risks*, addresses safety risks to children that may result from federal activities and requires each federal agency, when taking regulatory action, to identify and assess environmental health risks that may disproportionately affect children (President, 1997).

5.11.2 Data Sources

Demographic data such as area population, ethnic minority status, and income are available from the Bureau of the Census, as well as from federal, tribal, state, and local health, environmental, and economic agencies. Local employment and industry summaries prepared by local jurisdictions or the Chamber of Commerce, the county tax assessor's office, and listings of local construction contractors and existing hotel/motel accommodations should be examined.

5.11.3 Regulatory Setting

Executive Order 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs and activities on

minority communities and low-income populations. The CEQ Interagency Working Group, chaired by the EPA, finalized guidelines for incorporating environmental justice concerns into the NEPA compliance process in December 1997. DOT procedures to comply with Executive Order 12898 are set forth in the final DOT order issued on April 15, 1997, to address environmental justice (*Federal Register*, April 15, 1997). Executive Order 13045 provides policy guidance for possible effects on children from federal activities (President, 1997).

5.12 ENERGY

5.12.1 Resources Affected

Direct and indirect energy sources required for the installation and operation of each of the proposed NDGPS reference stations are considered. Direct energy sources include 3-phase electrical power from commercially available sources and fuels required to operate the NDGPS equipment, and construction and maintenance vehicles and equipment. Indirect energy sources are fuel resources consumed by others because of NDGPS installation and operation.

Public and cooperative energy providers are typically able to provide service in even remote areas throughout the continental U.S. Depending on the location, primary sources of energy may not be available for proposed NDGPS site locations in Alaska. Adequate fuel supplies for transportation and equipment are expected to be present in most areas.

Backup power will be provided by a BUPG equivalent to the same as the existing units serving the USAF GWEN facilities.

5.12.2 Data Sources

Site-specific information regarding available 3-phase power sources and their current service areas are available from the local electric power company. Some local government offices may also have this information.

5.12.3 Regulatory Setting

Specific state or local regulations may require consideration of energy expenditures and the availability of energy resources.

5.13 HAZARDOUS MATERIALS

5.13.1 Physical Setting

The reuse of existing GWEN relay node properties is contemplated by several of the alternative actions considered herein. In general, these facilities would be expected to contain minimal amounts of hazardous or regulated materials. During construction and maintenance of the GWEN facilities, it is likely that hazardous or regulated materials, such as petroleum fuels, paints, solvents and cleaners, sealants, herbicides and pesticides, and so on, were used in small

quantities. However, it is unlikely that the use of small amounts of those materials would have resulted in significant contamination of the property. Diesel fuel for the GWEN backup generator was stored at these properties in tanks with secondary containment, which should have prevented release of fuel and contamination of soil or groundwater.

The GWEN relay nodes were installed after the manufacture of polychlorinated biphenyls (PCBs) was banned, and it is unlikely that transformers or light ballasts at these facilities would contain PCBs. Use of lead paint in occupied structures was banned prior to construction of the GWEN relay nodes, and it is expected that lead paint would not have been used at the relay nodes (USAF, 1995). Similarly, because of the relatively recent construction of the GWEN relay nodes in the late 1980s or early 1990s, these facilities are not expected to contain asbestos (USAF, 1995).

The GWEN copper ground plane is composed of unshielded copper wire and may have corroded during the years since its installation. If so, it is possible that the level of copper in soil or groundwater at the GWEN property may have reached action levels of regulatory significance. According to the GWEN Final EIS, that result is only possible in areas of acidic soil and constantly or seasonally shallow groundwater. For the most part, such areas were avoided during selection of locations for GWEN relay nodes, thus significant levels of copper in soil or groundwater is considered unlikely at GWEN properties. Recent tests of four soil samples taken at depths of 1 to 3 ft below the ground surface at the GWEN relay node at Savannah Beach, Georgia, which has acidic soils and may be subject to a seasonally shallow water table, found copper levels ranging up to 11 ppm. The measured copper levels are far below the 1,500 ppm action level for copper in soil established by the Georgia Department of Natural Resources (EMC Engineering Services, Inc., August 21, 1998).

5.13.2 Regulatory Setting

The Resource Conservation and Recovery Act of 1976 governs the handling, treatment, and disposal of solid wastes, which are defined as garbage, refuse, or sludge from a waste treatment facility and other discarded materials including solids, semi-solids, liquids, and contained gases. In general, land disposal of solid wastes is allowed only at properly permitted facilities which are located, constructed, and operated so as to prevent release of contaminants to the environment. Hazardous wastes are those solid wastes which are hazardous to human health or the environment because of an inherent characteristic of being reactive, ignitable, corrosive, or toxic. Petroleum products are not considered hazardous materials or wastes but their storage, transport, use, and disposal is regulated by several laws, most notably the Oil Pollution Act of 1990.

The Comprehensive Environmental Response, Compensation, and Liability Act assigns physical and fiscal responsibility for the removal or neutralization of hazardous waste. In general, the owner and operator of facilities or land at the time at which disposal of hazardous waste occurs is responsible for the cost of remedial actions. In some situations, such as when the prior owner or operator cannot be found or is financially insolvent, landowners who acquire a property

with pre-existing contamination may be liable for clean-up costs. Landowners in the latter situation can be relieved of liability if they can show that they diligently conducted studies to ascertain the presence or absence of contamination prior to acquiring the property (i.e., the innocent landowner defense). The most common means for establishing this defense is to conduct an environmental due diligence study meeting recognized standards, such as the American Society of Testing and Materials (ASTM) E-1527-93 or E-1528-93 standards. Compliance with the ASTM due diligence standards requires investigation of past and existing uses of the target property, past and existing uses of nearby properties, search of government and private environmental databases for information on the target property and surrounding lands, physical inspection of the property and surroundings, and interview of individuals who may have knowledge about the target property and its past and present uses.

Under regulations contained in 40 CFR 112, newly installed storage tanks for fuel must meet certain performance standards including designs to minimize the likelihood of releases of fuel to the environment (e.g., double walls, secondary containment structures). In addition, a Spill Prevention, Control, and Countermeasure (SPCC) Plan must be prepared for facilities containing an individual above-ground storage tank with capacity of 660 gallons or more or multiple above-ground tanks with a total capacity of 1,320 gallons or more.

5.14 RADIOFREQUENCY ENVIRONMENT AND HUMAN EXPOSURE

The Communications Act of 1934 assigns responsibility for assignment of radio frequencies for non-government users to the Federal Communications Commission (FCC) and for government users to the President. Executive Order 12046 (March 26, 1978) delegated the President's authority over government radio users to Secretary of Commerce who designated the Administrator of NTIA as the appropriate party to carry out this function. NDGPS reference stations would be government radio stations and would require a frequency allocation from the NTIA.

NDGPS reference stations include two receiving antennas for GPS signals and an antenna transmitting the DGPS correction signal. The receive antennas are mounted on twin masts at heights of about 30 ft above ground level (AGL). Under the preferred alternative, the transmit antenna typically consists of a 299 ft-tall steel lattice tower, similar to amplitude modulated (AM) broadcast towers commonly found throughout the U.S. At former GWEN sites, the existing transmit tower and antennas would be reused, and the GPS receive antennas and masts would be newly installed. The receive antennas only receive the existing GPS signals emitted by satellites in earth orbit; they do not generate any new RF emissions or add to the existing RF environment. The band between 285 and 315 kHz, which includes the operating frequencies of the NDGPS transmitters, is reserved for use in the Western Hemisphere (i.e., north, central, and south America) for maritime radiolocation and aeronautical radionavigation. DGPS stations are expressly authorized to operate in this band on a primary basis. In this band, the FCC may authorize operation by specific nongovernment navigation aids based on need and a lack of

government service. Radio frequency separation is attained by following the *Manual of Regulations and Procedures for Radio Frequency Management* (DOC NTIA, 1994). Additionally, government and nongovernment electric utility providers can operate power line carrier communications systems, which are transmitted along power lines, at frequencies below 490 kHz (NTIA, 1995).

In 1991, the FCC and the EPA measured the electric and magnetic fields at 1 m (3.28 ft) AGL at various locations near nine AM broadcast antennas in southern California. The towers ranged in height from 180 to 480 ft, which is comparable to the roughly 299 ft tower planned at a typical NDGPS reference station. The power levels of the transmissions from these towers ranged from 630 W to 50 kW, as compared with the 300 W to 500 W broadcast by the typical NDGPS reference station. Within 1 m of the base of these towers, the measured electric field ranged from 95 to 500 V/m. At a distance of 164 ft (50 m) from the base of the towers, the electric field had diminished considerably and ranged from 2.5 to 30 V/m. At a distance of 328 ft (100 m), the strength of the electric field ranged from 3.3 to 20 V/m. The local strength of the measured electric field was substantially reduced in the vicinity of conductive objects, such as a metal fence. The strength of the magnetic field measured at the base of the towers ranged from 0.1 to 1.5 A/m. At a distance of 164 ft (50 m), the strength of the magnetic field decreased considerably and ranged from 0.01 to 0.08 A/m. At a distance of 328 ft (100 m), the strength of the magnetic field ranged from 0.008 to 0.075 A/m.

The GWEN relay nodes that are proposed for conversion to NDGPS reference stations contain two types of radio transmitters, a 50 W transmitter operating in the 225 to 400 MHz band and a 5,000 W transmitter operating in the 150 to 175 kHz band. These transmitters would be removed during the conversion for NDGPS use. The Final EIS for the GWEN system examined the possible human health effects of exposure to the radio signals transmitted by the GWEN relay nodes. Possible effects of exposure to GWEN transmissions in the 150 to 175 kHz band, which is relatively close to the 300 kHz operating frequency of NDGPS, are of particular interest. The GWEN Final EIS found that the level of exposure to RF emissions during operation of GWEN relay nodes would comply with national and international safety guidelines (USAF, 1987). In 1993, at the request of the USAF, the National Research Council (NRC) of the National Academy of Sciences reviewed the findings of the GWEN Final EIS with respect to human exposure to RF fields. The NRC study investigated possible mechanisms of interactions between the GWEN fields and biological tissues and organisms; possible effects on cells and cellular components, organs, and tissue systems; and evidence from epidemiological studies and laboratory studies on animals and human volunteers. The NRC states, “The conclusions of this report reinforce those of the EIS, in that no evidence of adverse effects of GWEN fields on public health was found” (NRC, 1993).

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6 ENVIRONMENTAL CONSEQUENCES

This section provides a programmatic-level analysis of the environmental impacts (individual as well as cumulative) that could occur in specific issue areas as a result of implementation of the preferred action and alternatives. The general approach is to identify the impact and take specific mitigation measures that would reduce potential impacts below a level of significance. The following mitigation strategies are used in the order shown:

- Avoiding the impact altogether by not undertaking the action or parts of the action
- Minimizing the impact by limiting the degree or magnitude of the action and its implementation
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action
- Compensating for the impact by replacing or providing substitute resources or environments

It is the government's intention to avoid impacts to sensitive environmental conditions or resources through selection of locations for NDGPS reference stations. During the site-selection process, the presence or absence of sensitive environmental resources in the siting area will be ascertained. Sites for reference stations will be selected such that the proposed facilities will be compatible with nearby uses and will not cause adverse effects on environmental resources. For environmental impacts that cannot be avoided, specific mitigation will be performed to ensure an impact is less than significant. If for some unforeseeable reason planned mitigation measures cannot be undertaken, additional environmental analysis and documentation may be prepared by the FHWA.

The broadest range of anticipated environmental impacts are identified for each environmental resource/condition and project alternative. Information is presented to determine, at the programmatic level, whether the potential impact to the human environment will be significant or not significant.

The proposed NDGPS network of reference stations will consist of reuse of existing GWEN sites and/or equipment, and deployment of similar equipment at new sites. For that reason, information in the GWEN Final EIS has been used in this section when appropriate.

6.1 GEOLOGY

6.1.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Seismic shaking because of an earthquake could damage the proposed facilities. The GWEN towers, whether existing or transferred to a new location, are stabilized by guy wires. A very large earthquake could potentially result in damage on-site to the NDGPS transmission tower and associated facilities. The existing towers have been in place for many years without failure, indicating significant structural integrity. Even in the case of collapse, the tower would remain within the property boundary and there would be no impact on surrounding areas. On-site environmental impact would not be significant since GWEN sites were selected that do not contain environmental resources of critical concern and none are expected to have developed during the operation of GWEN. In the case of tower failure, it is expected that severely damaged towers would be replaced with new DGPS equipment by the USCG Maintenance and Logistics Command. The proposed 11 ft × 17 ft shelter at the base of the tower would be designed and constructed to withstand seismic shaking that may occur in seismic zone 4 (great damage) conditions.

Since ground-clearing activities are involved at new sites, the potential for erosion is highest during facility construction and decommissioning. Minimal ground disturbance is required for the conversion of GWEN sites to NDGPS reference stations. Because GWEN sites are located on relatively level terrain and only small areas of soil would be disturbed, erosion is not expected as a result of NDGPS equipment installation on those properties. The potential for significant impacts from soil erosion at new locations will be minimal since preferred locations for reference stations have relatively level terrain and are not located close to large drainage systems. Unless eroded or highly erodible soil is present at a new site area, the only erosion impacts would be insignificant. To reduce the effects of erosion, standard erosion control measures will be used, if feasible. These include the use of silt fences, mulch, siltation basins, and revegetation of disturbed areas to control short-term erosion. Steep slopes and eroded or highly erodible areas identified in NRCS soil surveys will be avoided during the selection of new NDGPS sites.

Mineral resources occur in widely spaced and diverse areas. Selection of new NDGPS sites will avoid areas of mineral extraction and known economic mineral sources. If avoiding these resources is not possible, it is unlikely that the small size of the proposed facilities, about 11 acres, would significantly restrict access to mineral deposits. No impacts on mineral resources would result from conversion of GWEN properties to NDGPS use.

Paleontological resources are found in widely scattered areas. The likelihood of encountering these resources is very low, and the resource can be avoided during selection of new sites for NDGPS reference stations through early consultation with the state geologist and other relevant agencies. For federal properties in certain fossil-rich areas, paleontological resource monitoring during construction may be prudent. Inquiries to the state geologist regarding known

paleontological resources are recommended when evaluating sites on undeveloped property. If the resource is encountered, the impact is likely to be minor provided that monitoring is performed whenever recommended by the state geologist. Extraction and recordation of the resource will be conducted, if feasible, should unforeseeable potentially significant impacts to paleontological resources arise. No significant impacts to geological or mineral resources will result.

6.1.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The use of new equipment instead of using GWEN equipment transferred from other locations would result in essentially the same effects on geological resources as discussed in Alternative A. Using a new USCG tower structure rather than a previously used GWEN tower may slightly reduce the potential for structural failure during seismic activity (or high wind loads); however, the potential for this impact to occur is remote. All other impacts are expected to be equivalent to Alternative A, discussed above. No significant impacts to geological or mineral resources will result.

6.1.3 Alternative C—All new sites using USCG-like equipment

Under this alternative, all NDGPS reference station sites will be located at new non-GWEN sites less than 11 acres. Furthermore, up to 35 more reference stations would be required than for Alternatives A and B. This alternative has the most potential for impacts because of the greater number of reference stations required and the expected location of reference stations on previously undeveloped property. While it is more likely that geological resources would be encountered under this alternative, avoiding significant geological hazards and resources will be possible. Mitigation measures discussed under Alternative A would reduce potential impacts to insignificant levels. No significant impacts to geological or mineral resources will result.

6.1.4 Alternative D—No-action alternative

The no-action alternative would not result in the impact on geological and mineral resources expected from implementation of the proposed NDGPS service. Decommissioned GWEN facilities would be dismantled and removed by the USAF. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated. This USAF action would involve removal of existing facilities and would be confined to previously disturbed areas. No significant impacts to geological or mineral resources will result.

6.2 WATER QUALITY

6.2.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Water resources may be affected by the proposed NDGPS facilities because of soil erosion promoted by land clearing and grading during construction, and subsequent entertainment and transport of eroded soil to surface waters. Also of interest is the potential for copper from the

ground plane to leach over time into the soil or to the nearest surface water or groundwater. Improper storage and handling of fuels for each proposed BUPG may also result in release to the environment and contamination of water resources.

The potential for copper from the NDGPS ground plane to enter water supplies depends on the rate of corrosion, the extent of leaching into the soil, and the distance for transport of copper via groundwater flow to the nearest water resource. The Final EIS for the GWEN Final Operational Capacity found that the rate of copper addition from a single ground plane to nonacidic, unsaturated soil would normally be less than 10 pounds per year and less than 1 pound per acre. The maximum rate of copper added to soil is estimated at 4.75 pounds per acre per year. This amount would not be expected to have adverse effects on water resources or on terrestrial or aquatic ecosystems. Ground planes at new NDGPS reference station locations would be very similar to the GWEN ground plane. No significant impact upon drinking water is expected for sites with nonacidic soils or that are not subject to seasonal saturation.

The mobility of copper in soil is relatively limited, except in acidic soils (pH less than 6.5) and where the seasonally high water table is within 1.3 m of the ground plane. During the selection of new NDGPS sites, it would be prudent to avoid locations that have both of these conditions; if these conditions are avoided, no significant impact in water quality would result. If these conditions cannot be avoided, a separation of 300 ft between the ground plane and the nearest surface water source (particularly those that support significant aquatic fauna) is planned. With that separation, the impact to water quality would not be significant. If under these conditions a 300 ft setback from surface water resources cannot be established, there exists the potential for significant impact to water resources containing sensitive aquatic organisms. A possible mitigation under these unlikely circumstances would be the application of lime to soil at the ground plane in order to raise the soil pH above 6.5. Unless the background copper concentration of the soil is known to be excessively high, no cumulative impacts would result.

There is potential for soil erosion at new NDGPS sites because of the installation of facilities on previously undeveloped land. Although the total site area would be about 11 acres, less than 8 acres would actually be cleared and disturbed. Construction would remove existing vegetation and organic soil horizons that normally limit erosion of soil. The potential for severe erosion from land-disturbing activities and the potential for impacts to water resources would be eliminated by avoiding eroded or highly erodible soils as identified by the NRCS soil survey, or by evaluating conditions and taking appropriate erosion control measures based on consultation with the local NRCS soil scientist. Erosive soils will be avoided during site selection, or, if avoidance is not possible, measures will be taken to prevent washing of soil and increased turbidity of surface waters. No significant impacts upon local water quality would result.

The converted GWEN sites and the newly constructed NDGPS reference stations would have aboveground storage tanks (ASTs) for diesel fuel for the standby generators. At converted GWEN sites, 1,000 gallons of storage capacity is available. At new sites, 500 gallons of capacity would be installed. EPA regulations at 40 CFR 112 require preparation of SPCC plans for

storage of more than 660 gallons in a single AST or more than 1,320 gallons in multiple ASTs at a single facility. The proposed NDGPS reference stations would not have capacity exceeding those thresholds and preparation of an SPCC would not be required. The ASTs for the reference stations would have secondary containment to prevent release of fuel to the environment. No significant impacts on water quality would result.

6.2.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The installation of USCG-like equipment at new NDGPS sites, instead of transferring decommissioned GWEN equipment, would not be expected to alter the anticipated level of impact to water resources described for Alternative A. The physical specifications and site-selection criteria would essentially be equivalent for Alternatives A and B. No significant impacts on water quality would result.

6.2.3 Alternative C—All new sites using USCG-like equipment

Under Alternative C, individual NDGPS sites are likely to be smaller in size (and broadcast coverage area). For this reason, additional sites would be required nationwide, and the ability to avoid certain locales with sloped terrain, acidic or highly erodible soil, or areas within 300 ft of a surface water body may decrease. Under this alternative, there is a slightly higher potential for impacts to water resources because of the greater number of reference stations. Mitigation measures mentioned above for Alternative A for impacts to water resources apply for this alternative action. Potentially significant impacts can be avoided or mitigated under this alternative. Because of the smaller size of each project area, cumulative effects to water resources when combined with other nearby land uses will be negligible. No significant impacts on water quality would result.

6.2.4 Alternative D—No-action alternative

The no-action alternative would prevent the occurrence of water resource impacts that may result from the installation of NDGPS reference stations. Water quality would remain unchanged.

Potential indirect environmental benefits provided by the proposed NDGPS service would not occur. These include increased accuracy in the positioning of water sample collection points and greater precision when applying fertilizers and pesticides, minimizing adverse impact on adjacent water resources. No improvement in water quality would result under the no-action alternative. Other local area positioning methods may be able to substitute for NDGPS and provide benefits to water resources.

Under this alternative GWEN facilities would be dismantled and removed after decommissioning. This activity would not affect water resources. No significant impact on water quality would result under the no-action alternative.

6.3 ECOLOGICALLY SENSITIVE AREAS

6.3.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Ecologically sensitive areas contain resources that are particularly susceptible to impacts from new development. Of specific regulatory concern are wetlands and floodplain resources. A site-specific wetlands delineation survey may be required to determine whether jurisdictional wetlands would be affected. Areas with hydric soil, hydrophylic vegetation, and seasonally standing water meet the criteria for jurisdictional wetlands. Projects resulting in dredge or fill deposition into wetlands would require a nationwide or individual permit from the USACE, in accordance with Section 404 of the Clean Water Act. To obtain a USACE permit, it must be demonstrated that no upland site alternatives are feasible. Nationwide permits are available in some states for relatively small actions, such as road crossings, utility corridors, and relatively small land disturbing activities (i.e., less than 10 acres) and may apply to NDGPS reference stations where available.

Wetlands will be avoided when selecting prospective sites for NDGPS reference stations. Wetland inventory maps prepared by the USFWS can be used to identify known wetlands resources. Avoiding areas containing hydric soil, as identified by the NRCS, will eliminate conflicts with suspected wetlands resources. If jurisdictional wetlands are present, a delineation survey will be performed and, if necessary, nationwide or individual permits for dredge and fill in wetlands will be obtained from the USACE. For developments that require an individual USACE permit for dredge or fill in wetlands, mitigation may be necessary. These may include the enhancement or creation of wetlands on other portions of the property or in designated areas off-site. Some states offer the mitigation option of contributing restoration funds to a "wetlands bank." It is the intention of the FHWA and participating agencies to first avoid jurisdictional wetlands. If avoidance is not feasible, the impact will be rendered to an insignificant level by minimizing the affected area and performing mitigation measures agreed upon by the FHWA and the USACE during Section 404 permit process. Since either resource avoidance or appropriate mitigation (pursuant to a USACE permit) will be achieved, no significant impacts will result.

Similarly, developments involving placement of new dwellings or assets must be outside of the 100-year floodplain, as designated by the FEMA (unless no reasonable alternative exists). FEMA Flood Insurance Rate Maps identify these areas. If no other alternative exists, the ground elevation for the proposed facilities must be raised above the 100-year floodplain to protect life and property, or critical facilities must be floodproofed. For the NDGPS program, this would include the equipment shelters, BUPG unit, and transmit and receive antenna towers. Unless unforeseeable circumstances arise, the 100-year floodplain will be avoided during the siting process for each NDGPS reference station.

No significant impacts will result.

6.3.2 Alternative B—Mix of GWEN sites and new sites using new equipment

For Alternative B, the installation of new equipment at newly proposed NDGPS sites (instead of transferring decommissioned GWEN equipment) would have an equivalent level of impact to environmentally sensitive resources as anticipated under Alternative A. The physical specifications and site-selection criteria under this alternative are equivalent to those for Alternative A. No significant impacts will result.

6.3.3 Alternative C—All new sites using USCG-like equipment

Under Alternative C, a greater number of NDGPS reference stations would be required nationwide and the ability to avoid some environmentally sensitive locales could decrease. Under this alternative, there is a slightly greater likelihood that environmentally sensitive resources could not be avoided during the siting process. Mitigation measures mentioned above for Alternative A for impacts to environmentally sensitive resources would apply for this alternative action. Because of the relatively small size of each project area, nationwide dredge and fill permits from the USACE are likely to be appropriate in the unlikely case that jurisdictional wetlands are affected. In general, significant impacts to environmentally sensitive resources under this alternative will be avoided during site selection or by applying mitigation measures. No significant impacts will result.

6.3.4 Alternative D—No-action alternative

The no-action alternative would not result in resource impacts anticipated to result from the implementation of the proposed NDGPS service. Environmentally sensitive resources would remain unchanged. Enhancements in water (wetland) quality monitoring methods expected to result from an NDGPS would not be realized. Decommissioned GWEN facilities would be dismantled and removed. Based on the siting criteria identified in the GWEN Final EIS and applied during GWEN site selection, no sensitive water resources are expected to be affected. No significant impact upon this resource will result during GWEN decommissioning.

6.4 AIR QUALITY

6.4.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

For this resource, short-term impacts are associated with construction-related air emissions. Long-term impacts are associated with operation and maintenance activities, such as use of the BUPG diesel generator, and project-related vehicle emissions. Most construction-related emissions are exempt from regulatory review provided that NAAQS would not be exceeded. For the NDGPS program, qualitative (versus quantitative air quality) modeling is sufficient to demonstrate continued adherence to air quality standards. The construction period for the conversion of GWEN sites will last between 4 and 6 weeks and the installation of equipment at new sites approximately 2 and 3 months. Except for dust, emission of criteria pollutants by

project-related vehicles and equipment during the construction period will be minor. Changes in local air quality resulting from these sources would not be a significant impact. Cumulative effects would also not be significant.

During installation of the ground plane and guy-wire anchors at new sites, ground surface disturbance will occur over approximately three-quarters of the 11-acre site. In areas where wind erosion is a concern, dust suppression techniques (e.g., periodic watering or using low-impact ditching equipment) will be used as necessary to reduce airborne emissions. Dust emissions would not result from the conversion of GWEN sites to NDGPS reference stations.

NDGPS reference stations would not be classified as major emission sources. The emission of minor amounts of air pollution would be unavoidable; however, the individual and cumulative impacts during construction will be insignificant. Long-term impacts from hydrocarbon (HC) and oxides of nitrogen (NO_x) emissions during monthly testing and infrequent use of the BUPG and from quarterly equipment maintenance visits will be negligible. For each NDGPS reference station in a nonattainment area, the FHWA will adhere to the approved applicable State Implementation Plan (SIP). In some areas, a local permit to construct and/or operate a BUPG is required. In these cases, the FHWA will ensure that necessary permits are obtained by the operator of a reference station. No hazardous air pollutants specifically listed in the Clean Air Act Amendments (42 USC 7412) will be generated by the proposed facilities. No significant impacts on air quality will result.

6.4.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The level of local air quality impacts resulting from the construction and operation of NDGPS reference stations using USCG-like equipment at new sites will be the same as that discussed for Alternative A, above. No significant impacts on air quality will result.

6.4.3 Alternative C—All new sites using USCG-like equipment

The level of short-term, local air quality impact associated with the construction of a typical NDGPS reference station using current USCG equipment at new sites will be less than that discussed for Alternative A, above. Individual site size will be less than 11 acres; hence, land disturbance associated with a smaller copper ground plane will create proportionately less dust (depending on local site conditions and climate). Operation and maintenance practices will be the same as Alternative A; hence, long-term air quality impacts under this alternative will also be insignificant. Emission of criteria pollutants at any proposed reference station site will be negligible. No significant impacts on air quality will result.

6.4.4 Alternative D—No-action alternative

The no-action alternative would not result in the air quality impacts expected to result from implementation of the proposed NDGPS. Decommissioned GWEN facilities would be dismantled and removed creating minor, short-term emissions of dust, HC, and NO_X. The absence of

NDGPS capabilities would have no foreseeable direct or indirect effects on air quality. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated. No significant impacts on air quality will result.

6.5 NOISE

6.5.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Short-term noise impacts associated with site clearing and preparation and the installation of facilities would occur. Noise would also be associated with dismantling the facility upon decommissioning of the reference stations. Except for the use of specific equipment during brief segments of the construction (and dismantling) periods, average project-related noise is expected to be well below recommended levels for human exposure. Average noise levels 50 ft from the source can reach 84 dB for ground clearing activities, 78 dB for foundations, and 85 dB for steel erection. Considering noise attenuation by both distance and terrain, noise generated during NDGPS installation and dismantling would be considered a short-term, daytime nuisance rather than a health concern. Potentially significant impacts because of noise generated during the construction period would be prevented by limiting construction to normal working hours and shutting off equipment when not in use. Noise impacts due to the conversion of GWEN facilities to NDGPS reference stations will not be significant.

No noise sources are present during NDGPS operation, except for the rare use of the BUPG during power failure. Noise levels generated by the BUPG will be below significant levels provided that a manufacturer's silencer is installed and operating. The government plans to include this feature as a standard practice. No significant long-term change to the average ambient noise level will occur because of the proposed project. Likewise, no significant cumulative impacts will occur regardless of other adjacent noise sources. During operation of the NDGPS facility, even the most sensitive noise receptors would not be significantly affected. No significant noise impacts will result from facility operation and maintenance.

6.5.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The levels of unavoidable, short-term noise associated with the construction of a new NDGPS reference station would be roughly equivalent to that discussed for Alternative A, above. Use of construction equipment would be similar as for Alternative A. Any potentially significant impacts because of noise generated during the construction period would be prevented by limiting construction to normal working hours and shutting off equipment when not in use. The government plans to include this action as a standard practice. No significant cumulative noise effects will occur. Project-related noise sources will generally be absent during the operation of NDGPS reference stations. Installing a silencer on the BUPG will ensure noise emissions are below levels of significance. No significant noise impacts will result from facility operation and maintenance.

6.5.3 Alternative C—All new sites using USCG-like equipment

The level of short-term, local noise generated during the construction of a typical NDGPS reference station using current USCG equipment at new sites will be roughly the same as that discussed for Alternative A, above. Land-clearing activity associated with a smaller site area will generate similar noise levels, but for a slightly shorter construction period. No significant noise impacts will result from facility operation and maintenance.

6.5.4 Alternative D—No-action alternative

Ambient noise levels at new reference station sites would remain unchanged. Decommissioned GWEN facilities would be dismantled and removed creating noise levels similar to those discussed for Alternative A. This impact would be minor and short term. The absence of NDGPS service would have no foreseeable direct or indirect effect on ambient noise. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated. No significant noise impacts will result.

6.6 VISUAL RESOURCES

6.6.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

The principal visual element of the proposed NDGPS reference station will be the 299 ft-tall steel-lattice antenna tower and associated guy wires and top-loading elements. The proposed shelters at the base of the tower, the two shelters near the perimeter of the property, and the twin 30 ft antenna masts will not be visually dominant from the most direct viewpoints more than 500 ft from the site boundary. For the conversion of GWEN facilities to NDGPS reference stations, no change in the existing visual quality of the affected area would result. The proposed twin antenna masts would essentially replace the existing UHF (ultra high frequency) antenna located on a number of existing GWEN sites. The number (three), size, and location of electronic equipment and BUPG shelters will essentially be the same as that of the existing GWEN site.

The 299 ft tower and land clearing will be the primary elements affecting visual quality at new sites. The method used to assess the visual impact of similar GWEN tower facilities may be applied to determine the visual impact of proposed NDGPS facilities at new sites. This method uses the BLM VRM classifications described in Section 5.6.2. As with GWEN, the visual analysis for newly proposed NDGPS reference station sites will consider the following factors: the distance from which an element is viewed, focal-point sensitivity, skyline complexity, competing feature interest, and physical screening.

Distance affects the degree of contrast an object will have within the surrounding landscape. An object loses much of its identity with greater distance. For GWEN relay nodes, views from less than 0.5 mi (foreground) and greater than about 1.5 mi (distant) are most strongly affected by this factor alone (USAF, 1987). Foreground views of the transmit tower tend to dominate at

these distances; however, the 60 ft- or 150 ft-tall GWEN UHF tower contributes strongly to the assignment of Class IV (dominant) within 0.5 mi. For NDGPS, the twin 30 ft-tall masts would not be as conspicuous at this distance; hence, a Class III (codominant) assignment would be appropriate for NDGPS locations with a competing interest or a complex skyline. When viewed from 0.5 mi to 3 mi away, the GWEN LF tower could be discerned and in rare circumstances would compete for, or be the object of attention (USAF, 1987). The screening effect of vegetation and terrain proved effective in making the structure appear relatively distant, subordinate, and less obtrusive. For many conditions, the tower would fall into Class I: it could not be noticed unless specifically pointed out. When viewed from beyond 3 mi, the tower could not be discerned. Clearing of vegetation or surface soil would create a marked contrast to the surrounding environment. For a clearing of approximately 11 acres performed on nearly level terrain, this would usually not be a concern beyond 0.75 mi.

For distances within 3 mi, relative amounts of skyline complexity, focal-point sensitivity, and competing features would affect whether a Visual Modification Class (VMC) rating of II, III or IV is assigned (USAF, 1987). Focal-sensitivity considers focal points directing viewer attention, particularly in areas that receive public attention. These focal points occur with abrupt changes in a sequence or pattern of landscape or when a sudden shift in viewing direction is encountered. Skyline complexity is the relative degree of irregularity created at the horizon by masses of vegetation, topography, or structures. Irregularity can be created by the vertical difference between the highest and lowest point along the skyline. Irregular skylines are more complex and tend to mask the appearance of an added element, such as a GWEN or NDGPS transmit tower. Competing interest is when a feature of strong visual interest is included within the view of the tower. Such features are commonly farm buildings, dominant mountain crests, and lakes. These features of added interest tend to draw attention away from other elements, such as a GWEN or NDGPS tower structure. Focal-point sensitivity and skyline complexity are generally given relative assignments of low, moderate, and high, while competing interest is either present or absent. Table 7 indicates the appropriate assignment of a VMC rating used for GWEN relay node facilities based on varying conditions.

In summary, the primary visual elements would be the 299 ft-tall NDGPS transmit tower and the contrast created by the clearing of the ground surface. The visual modification from these features would tend to be dominant (Class IV) when viewed from less than 0.5 mi, except when a competing feature and moderate-to-high skyline complexity is present to provide a codominant visual feature (Class III). A high skyline complexity with no focal-point sensitivity could render the visual modification as simply noticeable (Class II). Between 0.5 mi and 1.5 mi, the tower would appear visually dominant (Class IV) only if the skyline complexity were low and there were no other competing features of interest. Beyond 1.5 mi, the tower would be barely noticeable or, at worst, very subordinate.

Table 7
VMC Ratings for Various Conditions

FACTORS	VMC RATING						
	Less than 0.5 mi*			0.5 to 1.5 mi*			1.5 to 3.0 mi*
Focal Point Sensitivity/ Competing Feature Interest	Relative Skyline Complexity			Relative Skyline Complexity			Relative Skyline Complexity
	High	Moderate	Low	High	Moderate	Low	Not a Factor
No focal point sensitivity No competing feature interest	IV	IV	IV	II or III	II or III	III or IV	I or II
Focal point sensitivity No competing feature interest	IV	IV	IV	III or IV	III or IV	IV	I or II
Focal point sensitivity Competing feature interest	III	III or IV	III or IV	II or III	III	III	I or II
No focal point sensitivity Competing feature interest	II or III	III	III or IV	II	II or III	II or III	I or II

*Distance is that between observer position and NDGPS facilities.

Potentially significant long-term visual impacts would occur if a medium- to high-sensitivity view were affected by a Class IV VMC, and if a high-sensitivity view were affected by a Class III VRM. Medium-sensitivity views affected by a Class III VRM would result in a moderate (less than significant) visual impact. To eliminate this potential for significant visual impact during site selection, proposed NDGPS reference stations will be located at least 1.5 mi from areas designated for their visual sensitivity (e.g., scenic roads, rivers, national parks and monuments, scenic vistas within national and state forests, and open space districts) whenever feasible. With this siting, no significant impacts would result.

6.6.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The analysis for Alternative A applies to Alternative B. No significant impacts would result.

6.6.3 Alternative C—All new sites using USCG-like equipment

Assuming 120 ft towers are to be used, visual resource impacts would likely be less than significant for all sites except those within 0.5 mi of the most sensitive areas. Proposed NDGPS reference stations with towers 120 ft tall or less will be located 0.5 mi or more from a sensitive visual resource area, as identified in Section 6.6.1. Screening of fences and shelters using vegetation would reduce visual impacts. No significant impacts would result.

6.6.4 Alternative D—No-action alternative

The no-action alternative would not result in visual impacts. The existing visual environment at non-GWEN site locations would remain unchanged. The decommissioned GWEN facilities would not be reused, and the USAF would dismantle and remove those facilities including the 299 ft tower. This would result in a marginal enhancement of the existing visual conditions at and near those sites. The absence of NDGPS service would have no foreseeable direct or indirect effect on visual quality. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated. Benefits of more accurate NDGPS service to users would not be realized under this alternative. No significant impacts would result.

6.7 FLORA AND FAUNA

6.7.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

The proposed conversion of GWEN sites to NDGPS reference stations is unlikely to result in a significant impact to flora and fauna, including federal- and state-listed threatened and endangered species. The potential does exist for protected species to occur at a GWEN site converted to DGPS use; however, based on the environmental siting criteria established in the GWEN Final EIS and applied during individual site selection for GWEN relay nodes, it is unlikely that listed species occur at GWEN properties. No significant impacts to protected species would result from the installation and operation of NDGPS at former GWEN properties. To ensure that protected species will not be significantly affected by the conversion of GWEN sites to NDGPS reference stations, the FHWA will obtain current listings of federal and state-protected species per Section 7 of the Endangered Species Act. Based on information regarding these protected species, the FWHA will determine whether the potential to effect any of these species exists because of the proposed project and will consult with regulatory agencies regarding its determination. The USFWS field office will be contacted regarding federally listed species, and, for state-listed species, the responsible state agency (e.g., departments of fish and game) will be contacted.

If the FHWA determines that no effect upon protected species will result and the regulatory agency concurs, no further action is necessary. If a "may effect" determination is made for protected species, formal consultation and, if necessary, a biological assessment will be performed to determine the level of impact to protected flora or fauna. Should the potential for significant impact exist, the FHWA plans to apply appropriate mitigation measures to reduce this potential impact to insignificant levels. The specific mitigation measures to be taken will be determined during consultation with appropriate regulatory agencies prior to site acquisition. Mitigation measures planned by the FHWA include not undertaking all or portions of the proposed action at the affected GWEN location or compensating for any critical loss of species or their habitat by resource conservation, management or replacement methods agreed upon with the appropriate regulatory agency.

For NDGPS reference stations proposed on new (non-GWEN) properties, project related ground disturbance may occur anywhere within the approximately 11-acre property boundary. For previously undeveloped properties, ground clearing to install the proposed towers, copper ground plane, shelters, and access drive would displace habitat for common plant and animal species. Unless protected species are jeopardized, this amount of common habitat displacement would not result in a significant biological impact.

During the evaluation and selection of candidate sites for new NDGPS reference stations, the government will comply with the Endangered Species Act and other regulatory requirements previously cited in Section 5.7. During the evaluation of candidate sites, the FHWA plans to consult with appropriate regulatory agencies, as discussed above, to determine whether protected species may be adversely affected. In cases where protected species may be adversely affected, additional consultation will be performed and, if necessary, a biological assessment will be prepared to determine the level of potential impact. Should the potential for significant impact exist, the FHWA plans to apply appropriate mitigation measures to reduce this potential to less than significant levels. The specific mitigation measures to be taken will be determined during consultation with appropriate regulatory agencies prior to site acquisition. Mitigation measures planned by the FHWA include not undertaking all or portions of the proposed action at the selected site location or compensating for any critical loss of species or their habitat by resource conservation, management, or replacement methods agreed upon with the appropriate regulatory agency.

In general, habitat areas likely to support protected species will be avoided, such as wetlands, riparian habitat, diverse native plant communities, and areas with large, contiguous native old-growth forest habitat. In addition to on-site project activities, the potential effects from off-site activities, such as the additional infrastructure, should be considered. For example, where appropriate, new overhead power lines should be designed to prevent the electrocution of raptors, and traffic through some remote areas may jeopardize protected species that use existing/proposed access routes. Given that avoidance of protected species and their habitats can be achieved or that consultation with federal and state regulatory agencies will result in a no adverse effect determination, no significant impacts to flora or fauna will occur. If for unforeseeable reasons the FHWA and federal or state regulatory agencies find that a potentially significant adverse impact will occur, additional analysis will be performed to determine what mitigation measures are necessary to reduce the impact to less than significant levels.

The proposed 299 ft-tall tower may represent a hazard to birds in flight. Collisions with the tower or its guy wires and top-loading elements may result in bird mortality. As discussed in the GWEN Final EIS and in other literature, the most common episodes of avian mortality involve migrating songbirds, or passerines, that have become disoriented during stormy or overcast conditions (USAF, 1987). While birds have been killed from strikes on shorter, 100 ft-tall towers, the majority of bird mortality incidences are associated with towers over 300 ft in height. Indeed, the greatest risk to birds in flight involves towers over 500 ft tall, which are typical for radio and

television broadcast antennas. Raptors and waterfowl appear to be less susceptible to collisions with towers or guy wires. Raptors are agile species with keen eyesight and are adept at avoiding tall structures; however, nest sites within 1.5 mi can be disturbed by construction-related noise and activity. By consulting with local and regional USFWS offices, known nest sites and other critical habitat could be avoided during nesting and rearing seasons. Low flights by migratory birds such as waterfowl are more common between wetland areas and adjacent or nearby open feeding areas. For proposed NDGPS tower facilities planned in or near major migratory corridors such as the Pacific, Atlantic, and Central flyways, prospective sites between adjacent, local stopover locations (broad wetlands habitat) and feeding areas (typically open fields) will be avoided. By locating NDGPS reference stations more than 3 mi from critical avian habitat within major flyways, the potential for avian mortality to migratory birds is reduced to an insignificant impact. In addition, consultation with the USFWS will be performed to confirm that the location of the proposed facilities is consistent with policies of the Migratory Bird Treaty Act.

The proposed action is expected to result in approximately the same level of copper leaching into the soil as anticipated for the existing GWEN facilities. As discussed in the GWEN Final EIS (p. 4.4–7), the addition of copper is "unlikely to have any detrimental effect on resident land plants" as long as "soil pH were above 6.5 and cation exchange capacity were above 15 milli-equivalent per 100 grams (m_{eq}/100 g)." If these conditions cannot be met, significant impacts would only occur to plant species of "special concern." Animal species consuming such plants are not expected to be affected in any case (USAF, 1987).

The potential for significant impact upon aquatic biota depends on the water hardness of a given resource. The GWEN Final EIS states that concentrations in excess of 10 µg/l may generate a variety of adverse effects. For the GWEN ground plane located 1 ft beneath the ground surface, aquatic habitat within 300 ft would not be exposed to adverse levels of project-related copper unless the soil pH is below 6.5, the seasonally high water table was within 1.3 m of the surface, and the subsurface flow is directed toward the aquatic resource. If these conditions cannot be avoided, surface water concentrations for copper could exceed acceptable standards and a very localized but long-term adverse impact would arise. Depending on concern registered by USFWS, state agencies, and scientific organizations, this impact could be significant (USAF, 1987). In the unlikely circumstance in which areas with acidic soils, a high water table, and nearby aquatic resources cannot be avoided, an effective mitigation measure is to add lime to the soil to raise its pH above 6.5. This action would eliminate the potential for significant impacts to aquatic flora and fauna caused by the amount of copper released into the environment.

Upon decommissioning, the government plans to evaluate and restore NDGPS sites so that environmental impacts because of copper leached into the soil and any hazardous materials in the environment are removed or reduced to insignificant levels. These actions will eliminate the potential for significant long-term impacts to subsequent users of the property.

Cumulative effects may occur because of NDGPS reference station facilities located at either new sites or existing GWEN properties. New sites near existing tower structures located within a

major avian flyway could result in a significant cumulative impact; however, these areas would be avoided during the siting process. Because of the widely spaced siting requirements of adjacent NDGPS reference stations, no significant cumulative or individual impacts to flora and fauna will result.

6.7.2 Alternative B—Mix of GWEN sites and new sites using new equipment

This alternative would have similar impacts as described for Alternative A, above. No significant impacts will result.

6.7.3 Alternative C—All new sites using USCG-like equipment

This alternative would be less likely to result in bird strikes at any one reference station because of the use of shorter towers. However, a greater number of towers is required and may result in siting near wetlands and other waterfowl habitat. The same magnitude of impact is expected for this alternative as that described for Alternative A. Environmental siting criteria previously discussed will be applied, including agency consultation and mitigation, performed in accordance with the Endangered Species Act and the Migratory Bird Treaty Act. No significant impacts will result.

6.7.4 Alternative D—No-action alternative

The no-action alternative would eliminate any resource impacts anticipated from the implementation of the proposed NDGPS service. Habitat values and existing flora and fauna at new (non-GWEN) NDGPS reference station locations would remain unchanged. Decommissioned GWEN facilities would be dismantled and removed, potentially adding habitat value to some former GWEN locations. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated. The absence of NDGPS service would not have a foreseeable direct or indirect impact on flora and fauna resources. No significant impacts will result.

6.8 CULTURAL RESOURCES

6.8.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Under Alternative A, 32 GWEN relay nodes would be converted to NDGPS reference stations. During implementation of the GWEN project and the associated NEPA compliance process, those sites underwent Section 106 review with SHPOs and, in some cases, additional review with the ACHP. Because new ground-disturbing activities would be confined to the existing project area that has received SHPO and ACHP clearance, no impacts to cultural resources would occur at those sites. To comply with Section 106, however, the FHWA would submit project information for review to the SHPO as required by 36 CFR Part 800.4.

Implementation of Alternative A would result in the identification and land acquisition of 35 new sites. Potentially significant long-term impacts include the following:

- Partial or full physical destruction of archaeological or architectural resources, traditional cultural properties, or other Native American resources during site preparation and ground-disturbing activities
- Visual impacts from the 299 ft tower or utility lines on historic structures or their settings, historic districts, historic or cultural landscapes, and traditional cultural properties
- Restricted access to traditional-use areas by members of an ethnic minority group
- Increased public access to traditional cultural sites by the general public because of installation of new roadways.

Potentially significant short-term impacts include noise impacts on nearby traditional cultural properties caused by construction activities.

Cumulative impacts on cultural resources could occur from installation of an NDGPS reference station within a particular area when added to other projects being undertaken in the vicinity. Cumulative impacts of this nature will be determined by obtaining current and future development plans from local planning agencies and during consultation with the SHPO.

The most effective means of avoiding significant impacts to cultural resources would be through the site-selection process. Environmental siting criteria that will be used by the government to avoid significant impacts to cultural resources include the following:

- Avoid known cultural resources listed or eligible for listing on the NRHP
- Avoid siting within 1.5 mi of a known significant cultural resource with high visual sensitivity (see Section 5.6)
- Avoid traditional cultural properties and other resources and use areas that are known to have significance for Native Americans
- Avoid siting at or near historic resources of state or local importance that are not listed or eligible for listing on the NRHP.

Although adherence to the environmental siting criteria would avoid significant adverse effects to cultural resources in most instances, it may be necessary to proceed with site-specific analysis under specific unusual conditions. In some cases, it may be necessary to conduct an archaeological or historic structure survey or consult with appropriate Native American traditional cultural leaders or other ethnic minority groups before sufficient information is known about the location and types of resources that may be present in the area of potential effect. It may also not be possible to avoid affecting particular cultural resources such as historic structures or archaeological sites during the site-selection process because of technical, operational, or cost considerations. Should this occur, the following measures would be taken to ensure that a mitigation strategy would be followed. These measures would be carried out in consultation with

the SHPO and would follow procedures established under 36 CFR Part 800 to comply with Section 106 of the NHPA and any state standards that may apply to cultural resources investigations.

- In consultation with the SHPO, identify and evaluate cultural resources that are present in the area of potential effect and determine project effects.
- Develop procedures in consultation with the SHPO to avoid or mitigate adverse effects through data recovery (for both archaeological and historic architectural resources) in accordance with federal, state, and local regulations.
- Develop a strategy to ensure that previously unidentified archaeological resources encountered during site preparation and construction are protected and afforded appropriate management treatment.
- If human remains or items of cultural patrimony are encountered, consult with the appropriate state or federal agencies or Native American group. Exhumation, study, and disposition of any human remains would comply with all federal, state, and local laws.
- Properly analyze, report on, and curate all recovered archaeological resources.
- Request the comments of the ACHP.

Based on the site selection and mitigation strategies outlined above, no significant impacts will result.

6.8.2 Alternative B—Mix of GWEN sites and new sites using new equipment

Implementation of Alternative B would result in the same level of potential impacts to cultural resources as those described above under Alternative A, and the same environmental siting criteria and all mitigation measures apply to Alternative B. No significant impacts will result.

6.8.3 Alternative C—All new sites using USCG-like equipment

Under Alternative C, a greater number of NDGPS reference stations will be required nationwide, and the potential for encountering cultural resources would increase. The ability to avoid known significant cultural resources may be slightly more difficult to accomplish, but adherence to the environmental siting criteria is achievable with similar limitations as described under Alternative A. The potential for encountering archaeological resources at prospective sites or during construction of the NDGPS facilities would also increase slightly under this alternative; however, the environmental siting criteria and mitigation strategy described above would apply. No significant impacts will result.

6.8.4 Alternative D—No-action alternative

The no-action alternative would eliminate direct resource impacts anticipated from the implementation of the proposed NDGPS. Cultural resources existing at new (non-GWEN) NDGPS reference station locations would remain unaffected. Decommissioned GWEN facilities would be dismantled and removed. Based on the environmental site-selection criteria contained in the GWEN Final EIS and applied during site selection, cultural resources are not present at existing GWEN properties. No cultural resources would be affected at decommissioned GWEN relay node sites during removal of GWEN facilities and no additional ground disturbance would occur outside of the GWEN relay node; thus, no archaeological resources would be affected by removal of the facilities. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated. In the absence of NDGPS service, no direct impacts to cultural resources would occur. Indirect benefits of NDGPS related to new methods to locate and reestablish cultural resources survey locations would not be achieved. No significant impacts will result.

6.8.5 Statement of Compliance with Section 4(f) of the DOT Act

Section 4(f) of the DOT Act (40 U.S. Code 303) requires analysis of possible impacts arising from FHWA actions on historic properties and stipulates that DOT projects may not be sited on land from a historic site of national, state, or local significance as determined by the officials having jurisdiction thereof, unless no other prudent and feasible alternative is possible and all possible planning is taken to minimize harm to the historic site to be used.

As described above, no significant unavoidable impacts would result from conversion of existing GWEN sites to NDGPS reference stations, construction and operation of NDGPS reference stations at newly acquired site locations, or decommissioning of NDGPS as long as the proposed environmental siting criteria are adhered to or appropriate mitigation is applied. Implementation of the proposed action would not result in significant impacts on cultural resources and would be consistent with policies in Section 4(f) of the DOT Act.

6.9 RECREATION

6.9.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Potentially significant long-term impacts on recreational resources could occur if proposed NDGPS reference stations are located within areas designated as wilderness areas, national and state parks, national and state recreation areas, national seashores, and other designated recreational areas listed in Section 5.9.1. Those areas are normally regulated by general management plans that identify management zones and prohibit incompatible uses. Potentially significant long-term visual effects could also result from siting an NDGPS facility too close to designated scenic vistas within national and state forests. Potential adverse effects could occur to locally designated or undesignated recreational areas where recreational activities would be

impeded or diminished as a result of installation of an NDGPS facility. Although the probability is low, the potential also exists for impacts to result from increased access to resources from the construction of new roadways. However, should this occur, it would result in a beneficial effect since the recreational resource would be more accessible to the public. Potential short-term effects on recreational resources could result from temporary increases in traffic and noise during the construction period.

Under Alternative A, potential impacts on recreational resources could occur from installation of NDGPS facilities at newly acquired sites. Existing GWEN relay nodes that would be converted to NDGPS reference stations would not result in impacts on recreational resources. The most effective means of avoiding impacts to recreational resources is through the site-selection process. Environmental siting criteria that will be used to avoid significant impacts include the following:

- Avoid wilderness areas and wilderness study areas designated in accordance with the Wilderness Act
- Avoid national and state parks, national and state recreation areas, national sea shores, national monuments, national historic sites, state beaches, and state fishing areas designated by the Department of Interior or state agencies with jurisdiction over recreational areas
- Avoid national natural landmarks in accordance with the National Natural Landmarks Program
- Avoid locally designated or undesignated local recreational areas where recreational activities would be impeded or lost, such as county and municipal parks, reservoirs, county beaches, and other recreational areas used by the populace.

Adherence to these environmental siting criteria would ensure that significant impacts on recreational land use would not result. Potentially significant impacts on visually sensitive recreational areas could be avoided by siting the NDGPS facilities at least 1.5 mi away from the resource. This site-selection criteria is based on the visual analysis that was conducted for resources with medium- to high-sensitivity views (see Sections 5.6 and 6.6, Visual Resources). Project related traffic volumes on existing roadways during construction would be low and temporary. Long-term traffic would be infrequent, approximately one or two vehicles per month. This effect on recreation would be insignificant.

Adhering to the environmental siting criteria will also minimize potential short-term impacts during the construction period. For proposed NDGPS reference stations sited at least 1.5 mi from national, state, or local recreational resources, increases in traffic because of construction-related activities or noise generated during construction would have little or no effect on resources. No significant impacts on recreational resources would result.

6.9.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The potential for recreational impacts associated with the construction and operation of NDGPS reference stations using USCG-like equipment would be comparable to those discussed for Alternative A, above, and the same environmental siting criteria would apply. No significant impacts on recreational resources would result.

6.9.3 Alternative C—All new sites using USCG-like equipment

Environmental siting criteria would apply to all new reference stations using USCG-like equipment proposed under Alternative C. Because no significant unavoidable impacts would result if the environmental siting criteria are adhered to, project effects under Alternative C would be the same as those discussed under Alternative A.

6.9.4 Alternative D—No-action alternative

The no-action alternative would eliminate direct resource impacts anticipated from the implementation of the proposed NDGPS service. Recreational resources at new (non-GWEN) NDGPS reference station locations would remain unaffected. Decommissioned GWEN facilities would be dismantled and removed, and GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated. No significant impacts on recreational resources would result.

6.9.5 Statement of Compliance with Section 4(f) of the DOT Act

Section 4(f) of the U.S. DOT Act of 1966 states that a DOT action requiring the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, state, or local significance or land from a historic site of national, state, or local significance will be approved only if there is no feasible and prudent alternative to the use of such land, and the action includes all possible planning to minimize harm resulting from the use.

Based on application of the environmental siting criteria, no NDGPS reference station site will be located within a designated recreational area of national, state, or local significance. No significant unavoidable impact would result from construction, operation, and decommissioning of NDGPS in conformance with the proposed environmental siting criteria.

Section 4(f) also applies to indirect use of recreation or conservation properties under the constructive use principle. Under this principle, Section 4(f) applies where the facts support the proposition that the proposed action would constitute “constructive use” of adjacent Section 4(f) property. For example, as defined in 23 CFR 771.135(p)(2) of the FHWA Regulations, constructive use:

> occurs when the transportation project does not incorporate land from a Section 4(f) source, but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify a resource for protection

under Section 4(f) are substantially impaired. Substantial impairment occurs only when the protected activities, features, or attributes of the resource are substantially diminished.

The regulations at 23 CFR 771.135 describe certain situations where constructive use would be found such as:

- Where there is excessive noise when the project is adjacent to a noise-sensitive facility
- Where the aesthetic features of the protected facility would be impaired or obstructed
- Where the proposed project would result in the restriction of access to the protected facility
- Where the vibration impact of the project would substantially impact the use of the protected facility
- Where the ecological intrusion of the project would substantially diminish the value of protected wildlife habitats adjacent to the project (23 CFR 771.135(4)).

Installation, operation, and decommissioning of NDGPS would not remove land from existing recreation or conservation use and would not cause constructive use of designated recreation or conservation properties. Therefore, no direct or constructive impacts on Section 4(f) properties would result.

6.10 LAND USE

6.10.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Under the Public Buildings Amendments of 1988, the federal government is not bound by local planning and zoning land-use requirements, but is directed to consider them in the project planning and decision-making process and accommodate state and local concerns to the extent practicable. Some rural areas are not officially zoned for a specific use and may or may not have specific restrictions or review processes for tower structures. Many areas with land-use guidelines and zoning regulations allow tower facilities outright and provide for a variance to stated zoning requirements or offer a conditional use permit to nonfederal applicants. In the latter case, height restrictions as well as public health and visual aesthetic concerns may need to be addressed with the local jurisdiction. With the proliferation nationwide of 30 to 100 ft-tall transceiver antenna towers for cellular and digital personal communication devices, many local jurisdictions have specified or plan to specify conditions on the location and design of some tower structures.

Land use concerns at the local level may also include the potential for effects upon regional landmarks, historic properties, heritage districts, and scenic viewsheds. Under the Public Building Amendments of 1988 and E.O. 12372, local area land-use and zoning considerations should be addressed during the NDGPS site-selection process. While unlikely, residential land use may be

affected by the proposed construction activities. These effects (typically noise and traffic) are expected to be short term, and insignificant. Long-term effects are not expected to be significant; however, concern by local residents over perceived inconsistencies with local zoning and land-use plans may arise. Areas zoned for heavy industrial or commercial uses are likely to be consistent with the proposed NDGPS project from a land-use perspective. Light-industrial use tends to be located in more aesthetically pleasing environs, often containing well-maintained landscapes and lawns, which could be a concern in some local jurisdictions.

Agricultural areas are typically able to absorb the conversion of 11 acres of property to nonagricultural use and are considered consistent with the proposed use of a tower structure. Whenever feasible, prime farmlands designated by both the state department of agriculture and the USDA NRCS should be avoided via consultation with these agencies. If prime, or locally important or unique, farmland cannot be avoided, a USDA Farmland Conversion Impact Rating form will be completed and a determination made as to whether the proposed conversion is consistent with the FPPA. Based on the small size of individual NDGPS sites, significant impact to prime farmland is highly unlikely; however, significant impacts can be mitigated by altering the NDGPS site size or design. Open or undeveloped areas may be affected if they are designated as conservation zones or open space districts. Unrestricted open or undeveloped areas would have no specific land-use conflicts; however, the future use of adjacent properties may be affected because of sensitivities concerning radiofrequency interference or aesthetic concerns.

State and federally managed lands typically have management plans that limit or restrict certain activities or facilities. After consultation with the land manager, areas incompatible with an NDGPS reference station should be avoided. If the incompatibility can be eliminated by an acceptable change in facility layout or design, this form of mitigation will be implemented.

For NDGPS reference station sites in states with approved state or local coastal zone management programs, a review of applicable management plans will be performed to determine federal consistency with the plan. Consultation with the state Coastal Zone Management Plan (CZMP) manager will be performed to establish a consistency determination. Conflicts with CZMP goals and objectives will be avoided during the siting of NDGPS reference stations.

Individual and cumulative impacts upon existing, local land-use designations would not be significant. Submittal of NDGPS development plans to local jurisdictions for courtesy review for up to 30 days is required under Public Law 100-618; and city and county planning offices should be consulted regarding the NDGPS project, its siting criteria, and the federal government's ability to voluntarily avoid potential conflicts with existing land-use designations, regulations, and requirements. The federal government is not required to pay fees or make changes recommended by the local agencies. The FHWA will avoid areas that conflict with parks, refuge areas, recreation areas, culturally significant properties, wilderness areas, and other resources discussed in Sections 5.8, Recreation, and 5.9, Cultural Resources.

Land use and other natural resource benefits are expected under the preferred action alternative. This alternative involves the maximum reuse of GWEN equipment and properties for NDGPS. This reduces the need for disposal of nonrenewable materials such as metals and earth materials.

6.10.2 Alternative B—Mix of GWEN sites and new sites using new equipment

This alternative would have an equivalent level of impact and the same potential for significant impact as that described for Alternative A, above. Land use conflicts, if any, would occur in a similar fashion, and the methods to avoid land-use conflicts would be the same. Conflicts with federal, state, and local land-use plans will be avoided during the siting process, and significant impacts will not occur. Direct environmental benefits in terms of reduction of waste and reuse of materials arise under Alternative B from the reuse of 32 GWEN sites (but not GWEN equipment).

6.10.3 Alternative C—All new sites using USCG-like equipment

This alternative would be less likely to result in land-use conflicts at any one site because of the use of a shorter tower and a smaller facility size. However, because of the greater number of sites required, some conflicts may result despite the smaller site size and lower tower height. Conflicts with existing land-use plans will be avoided in the site-selection process, and no significant impacts to land-use conditions would result.

6.10.4 Alternative D—No-action alternative

The no-action alternative would prevent impacts anticipated from the implementation of the proposed NDGPS service. Existing land uses would remain unchanged for areas where new (non-GWEN) NDGPS reference station locations were to be considered. Decommissioned GWEN facilities would be dismantled and removed, possibly resulting in a change in land-use designation or zoning for that specific land parcel. This would enable local jurisdictions to adjust land use to that which is more compatible with adjacent parcels. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated and new land uses considered by their owners. Benefits of more accurate NDGPS services to identify remote land-use boundaries would not be realized under this alternative. No significant impacts would result.

6.11 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

6.11.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

6.11.1.1 Socioeconomics

Adherence with the environmental siting criteria described in Section 6.10, Land Use, during site selection is achievable and would avoid land-use impacts associated with social and economic

issues. Adherence to these environmental siting criteria would also avoid local land-use concerns and issues that could potentially arise from local residents. No adverse impacts on land use are expected to occur. Direct economic impacts to the residents and residential areas would not occur, as direct impacts would be confined to the construction and staging area of the project sites. Should a fire, break-in, or other emergency occur at the NDGPS facilities, the services of local police and firefighter personnel may be needed. However, no undue increase in demand on public protective services would occur as a result of the operation and maintenance of the proposed NDGPS facilities.

It is not likely that installation of the NDGPS facilities will affect employment patterns on a permanent basis or induce substantial growth or growth-related impacts. The facilities will be unmanned, and no increase in population levels would result. Installation of the proposed facilities at existing GWEN sites would employ 10 workers over a 30- to 45-day construction period. For construction at new sites, 15 workers over a 2- or 3-month construction period would be needed. If the government employs local contractors to install the facilities, this would result in a short-term, positive impact to the local economy although it would not necessarily be a net addition to a region's economy. However, it is more likely that the government would bring in its own contractors to construct the proposed facilities (Pugh, 1998). If this is the case, temporary housing and other services to support the construction workers would be required, and local hotels and motels, restaurants, and other local businesses would benefit during the construction period. In addition, in either scenario, construction materials needed for installation of the facilities and available locally would be purchased from local suppliers.

In economies that rely heavily on tourism and recreation, significant short-term impacts could potentially occur on temporary housing. If the construction period occurs during the peak travel season in a given region when lodging is at or near capacity, guests needing temporary lodging could be displaced by construction workers and they may be unable to find accommodations. Should this be the case, the government plans to bring in temporary housing units, such as trailers, to house the workers, or the construction period can be shifted to avoid peak tourist periods. If either measure is implemented, no adverse impacts on temporary housing would result. Government personnel who would travel to the area periodically to perform routine maintenance on the NDGPS equipment would not adversely impact temporary housing.

Impacts of the preferred alternative on public finances would be insignificant. The government plans to acquire about 11 acres of land for new sites. Land acquisition would be either through a lease or direct purchase. If up to 11 acres of land were purchased for installation of an NDGPS facility, property tax revenues from that land would potentially be decreased and unavailable to local governments. Based on a study conducted by the USAF at the time the GWEN facilities were installed, the potential effect of removing 11 acres from the tax base would be insignificant (USAF, 1987). If the land were leased, no tax revenue would be lost. No significant impacts would result.

6.11.1.2 Environmental Justice and Protection of Children

Potential impacts on ethnic minority populations, low-income populations, and Native American groups may differ from impacts on the general population, depending on the make-up of the particular community and the community's distinct cultural practices. An example of this difference is found in the phrase, "differential patterns of consumption of natural resources." This term refers to differences in subsistence patterns, such as the dependence by a minority or low-income population on indigenous fish, vegetation, and wildlife as a principal part of their diet, and to differences in the rates and patterns of consumption as compared with rates and patterns of consumption of the general population (CEQ, 1997).

When determining whether disproportionately high and adverse human health effects would result on a minority or low-income population, agencies should consider the following three factors to the extent practicable (CEQ, 1997):

(1) Whether the health effects are significant (as employed by NEPA), or above generally accepted norms

(2) Whether the risk or rate of hazard exposure by a minority or low-income population to an environmental hazard is significant (as employed by NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group

(3) Whether health effects occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

When determining disproportionately high and adverse environmental effects on a minority or low-income population, agencies should consider the following to the extent practicable (CEQ, 1997):

(1) Whether there is or will be an impact on the natural or physical environment that significantly (as employed by NEPA) and adversely affects a minority or low-income population; such effects may include ecological, cultural, human health, economic, or social impacts when those impacts are interrelated to impacts on the natural and physical environment

(2) Whether environmental effects would be significant (as employed by NEPA) and may have an adverse impact on minority or low-income populations that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group

(3) Whether the environmental effects occur or would occur in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

Development of new site locations to support NDGPS will occur at up to 35 sites throughout CONUS and interior Alaska, therefore, it may not be possible to avoid areas that contain significant percentages of ethnic minority and low-income populations. However, no disproportionately high and adverse human health and environmental impacts on ethnic minority communities and low-income communities will result because of installation and operation of the proposed NDGPS. No significant short- or long-term impacts on water resources are expected to occur, as analyzed in Section 6.2. As long as the proposed mitigation measures are implemented at sites where soil and water table conditions are conducive to copper mobility, no adverse impacts to surface water, vegetation, or aquatic biota that may be consumed would occur. Individual and cumulative impacts on air quality and from noise would be minor, and land use and socioeconomic impacts would not be significant, as discussed, respectively, in Sections 6.4, 6.5, 6.10 and 6.11.1.1 A discussion of potential effects from exposure to radiofrequency radiation (RFR) and electromagnetic fields at the NDGPS operating frequency is presented in Section 6.13 of this PEA. The analysis concludes that it is unlikely that anyone would be harmed by RFR outside the 8 ft-high security fence surrounding the tower, and posted signs warning of the danger from RF exposure would provide additional security. It is also unlikely that anyone would suffer electric shock or burns from exposure to the NDGPS electric fields.

Executive Order 13045 addresses safety risks to children that may result from federal activities. This order requires each federal agency, when taking regulatory action, to identify and assess environmental health risks attributable to products or substances that children are likely to come into contact with and that may disproportionately affect children. The order also sets up a task force to coordinate federal research on safety risks to children. Installation of NDGPS to provide greater nationwide radionavigation and positioning capabilities is not a covered regulatory action, and Executive Order 13045 does not specifically apply to such an action. However, in keeping with the spirit and intent of Executive Order 13045, this PEA examines possible health and safety risks to those in the vicinity of NDGPS, including children, from exposure to RF signals emitted by NDGPS and to NDGPS electric and magnetic fields. It is unlikely that anyone, including children, would be harmed by RFR outside the 8 ft-high security fence surrounding the ATU, and posted signs warning of the danger from RF exposure would provide additional security. The high security fence, which would be locked unless maintenance personnel were present, would prevent small children from entering the fenced area. It is also unlikely that anyone, including children, would suffer electric shock or burns from exposure to the NDGPS electric fields. Installation of the NDGPS would be consistent with E.O. 13045. No significant impacts would result.

6.11.2 Alternative B—Mix of GWEN site and new sites using new equipment

Potential socioeconomic and environmental justice impacts and impacts on children under this alternative would be comparable to impacts described under Alternative A, and the same mitigation measures would apply. No significant impacts would result.

6.11.3 Alternative C—All new sites using USCG-like equipment

Under Alternative C, a greater number of new NDGPS reference station sites would be required nationwide, however, socioeconomic impacts would be equivalent to those described under Alternative A, and the same mitigation measures would apply. Although the increase in new sites from Alternatives A and B would increase the likelihood of siting an NDGPS within an area containing a high percentage of ethnic minority and low-income populations, the potential for disproportionately high and adverse human health and environmental effects would be low. The recommendation to involve the public and minority and low-income populations early in the NEPA process applies. The unlikely potential for environmental health and safety risks on children from installation of NDGPS is comparable to Alternative A. No significant impacts would result.

6.11.4 Alternative D—No-action alternative

The no-action alternative would not cause any direct, adverse resource impacts. Existing conditions within minority and low-income areas would remain unchanged in areas where new (non-GWEN) site locations were considered. Decommissioned GWEN facilities would be dismantled and removed, possibly resulting in a change in land use at locations where minority and low-income populations currently exist. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated and new land uses considered. No significant impacts would result.

6.12 ENERGY

6.12.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Based on the number of personnel and type of equipment required, the energy used for construction of an NDGPS reference station, both individually and cumulatively, is not expected to exceed the capacity of existing services or be difficult to obtain.

During operation, individual NDGPS reference stations would use commercial 3-phase power that can offer reasonably reliable service year-round. This level of service is expected to be available, or be extended, to most NDGPS siting areas within the CONUS. Some areas within the CONUS and the state of Alaska may not offer commercial service within a distance that would enable economically feasible extension of service lines. The use of generators, solar, or battery-powered equipment may be considered in these rare cases. Broadcast characteristics for each NDGPS transmitter have not been finalized; however, a 1,000 W capacity transmitter is currently planned at each site. The energy requirement for NDGPS reference stations would be consistent with other similar low-power, LF broadcast antennas operating within the U.S. Annual usage of commercial power and other energy resources for this type of facility and its proposed level of operation would not be significant for almost every area within the CONUS. For remote areas such as portions of Alaska, alternative sources of primary power may need to be considered, and

the appropriate state-level permits obtained, if necessary. No significant impact to national or local energy consumption would result based on these power requirements.

6.12.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The energy requirements under Alternative B are similar to those for Alternative A. No significant individual or cumulative impacts to energy sources would result.

6.12.3 Alternative C—All new sites using USCG-like equipment

The energy requirements under Alternative C are similar to those for Alternative A. No significant individual or cumulative impacts to energy sources would result.

6.12.4 Alternative D—No-action alternative

The no-action alternative would result in minor impacts. Existing energy use would remain unchanged for areas where new (non-GWEN) site locations were to be considered. Decommissioned GWEN facilities would be dismantled and removed, possibly resulting in a minor net reduction in energy use for that service area. BUPG energy requirements (e.g., the use of diesel fuel) would be eliminated. GWEN site leases with private landowners or land-use agreements with other federal land managers would be terminated and new land uses considered. No significant impacts would result.

6.13 HAZARDOUS MATERIALS

6.13.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

This alternative envisions the reuse of 32 GWEN properties as NDGPS reference stations and the relocation of certain GWEN equipment to new sites. In addition, a number of reference stations would be installed at newly acquired properties. Based on Environmental Baseline Survey reports prepared by the USAF for 32 GWEN relay nodes proposed for reuse, none of these properties contain significant amounts of hazardous materials or environmental contamination, however, additional review and analysis are recommended at Kirtland AFB, New Mexico, and Pueblo, Colorado. A list of Environmental Baseline Survey reports prepared by COMPA Industries, Inc., are listed in Table 8.

The relocation of GWEN equipment would not be expected to cause contamination of soil or water. However, to prevent the assumption of liability for existing contamination at new (non-GWEN) properties acquired by the government, the FHWA should perform environmental due diligence assessments (EDDAs) in conformance with ASTM standards prior to acquiring those properties.

NDGPS reference stations consist principally of electronic components, hardware and subassemblies, and generate little if any hazardous waste. During construction and operation of

the NDGPS reference stations, small amounts of hazardous or regulated materials, such as petroleum fuels, paints, solvents and cleaners, sealants, herbicides and pesticides, and so on, would likely be used at the reference station properties. The use and handling of these materials will be performed according to applicable regulations and manufacturer's recommendations. No contamination of the environment will result.

Table 8
Summary of GWEN Environmental Baseline Surveys

GWEN Site	Report Date	Field Survey Date	Ownership	On-Site Contamination Concerns	Adjacent Areas of Site Contamination or Concern Exist	Category Assignment*	Recommendation†	Comments
Appleton, WA	6/98	12/10/96	U.S. Govt.	No	No	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	
Austin, NV	7/98	11/14/96	U.S. Govt. (BLM)	No	No	BUPG: 2, all else: 1	Proceed	
Bakersfield, CA	6/98	12/5/96	Private	Yes	No	BUPG: 2, all else: 1	Proceed	Buried household waste at site.
Billings, MT	11/97	10/9/96	Private	No	No	BUPG: 2, all else: 1	Proceed	
Bobo, MS	7/98	2/10/97	U.S. Govt.	No	No	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	
Clark, SD	6/98	10/16/96	Private	No	No	BUPG: 2, all else: 1	Proceed	
Edinburg, SD	12/97	10/15/96	Private	No	No	BUPG: 2, all else: 1	Proceed	
Fenner, CA	6/98	12/3/97	U.S. Govt.	No	No	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	
Flagstaff, AZ	11/97	10/23/96	U.S. Govt.	No	Yes	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	
Gettysburg, PA	6/98	3/6/97	U.S. Govt.	Yes	Yes	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	NPL hazardous materials site 1 mi NW, could impact groundwater at GWEN site.
Goodland, KS	7/97	1/21/97	Private	No	No	BUPG: 2, all else: 1	Proceed	
Grady, AL	7/98	2/13/97	Private	No	No	BUPG: 2, all else: 1	Proceed	
Great Falls, MT	11/97	10/7/96	Private	No	No	BUPG: 2, all else: 1	Proceed	

Hackleburg, AL	7/98	2/12/97	Private	Yes	No	BUPG: 4, all else: 1	Proceed	A fuel leak occurred inside the BUPG shelter.
Hagerstown, MD	6/98	3/5/97	State of Maryland	Yes	No	BUPG: 2, all else: 1	Proceed	Buried trash in northwest part of GWEN facility.
Hawk Run, PA	6/98	3/9/97	Private	No	No	BUPG: 2, all else: 1	Proceed	

Table 8 (concluded)
Summary of GWEN Environmental Baseline Surveys

GWEN Site	Report Date	Field Survey Date	Ownership	On-Site Contamination Concerns	Adjacent Areas of Site Contamination or Concern Exist	Category Assignment*	Recommendation†	Comments
Kirtland AFB, NM	6/98	2/13/97	U.S. Govt.	Yes	Yes	BUPG: 2, storage building & undeveloped land: 7, all else: 1	Proceed	Storage building on site may have contained hazardous materials; past explosives testing and disposal of debris nearby may have contaminated site.
Klamath Falls, OR	6/98	11/19/96	Private	No	No	BUPG: 2, all else: 1	Proceed	
Macon, GA	6/98	2/19-20/97	Private	No	No	BUPG: 2, all else: 1	Proceed	
Medford, WI	6/98	6/17/97	U.S. Govt.	No	No	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	
Medora, SD	12/97	10/11/96	U.S. Govt.	No	No	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	Site is a portion of Little Missouri National Grassland.
Onandaga, MI	7/98	4/4/97	Private	No	No	BUPG: 2, all else: 1	Proceed	
Penobscot, ME	11/97	9/24/96	Private	No	No	BUPG: 2, all else: 1	Proceed	
Pueblo, CO	7/98	1/23/97	U.S. Army	No	Unknown	BUPG: 2, all else: 1	Proceed	The entire Army depot is considered a CERCLIS site.
Ronan, MT	11/97	10/4/96	U.S. Govt.	No	No	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	
Savannah Beach, GA	3/97 (Draft)	2/10-11/97	Private	Yes	No	BUPG: 3, all else: 1	Proceed	A minor fuel leak occurred in 1996. Reported to have been cleaned up.
Spokane, WA	6/98	12/5/96	U.S. Govt.	No	No	BUPG: 2, all else: 1	Proceed, with consideration of Deed Covenant & Reservation of Access	
Summerfield, TX	7/98	3/6/97	Private	No	No	BUPG: 2, all else: 1	Proceed	

Whitney, NE	11/97	10/21/96	Private	No	No	BUPG: 2, all else: 1	Proceed

*Definition of All Category Assignments:
1 = No storage, release, or disposal of hazardous materials has occurred and the area is not subject to migration from a release nearby.
2 = Only storage of hazardous materials occurred in this specific area.
3 = Contamination exists but is below the regulatory limit requiring action.
4 = Contamination existed but has been remediated to below the regulatory action level.
7 = Further evaluation required.

†Proceed=transfer of land is acceptable BUPG = backup power generator

The standby generator requires storage of diesel fuel and uses lubricating oil and antifreeze. The storage capacity for diesel fuel would be about 500 gallons in one AST or 1,000 gallons in two ASTs, which is below the SPCC threshold of 660 gallons in a single tank or 1,320 gallons in total; therefore, an SPCC Plan is not required by 40 CFR 112. The diesel fuel will be stored in ASTs with double walls or secondary containment, greatly reducing the potential for leaks to the environment. The amounts of lubricating oil and antifreeze used would be minor and would not present a significant risk to the environment.

The USCG-like reference stations may use batteries to provide backup power instead of a diesel fuel generator. Upon removal or replacement, these batteries will likely be considered a hazardous waste and would be sent to a waste facility that is licensed to accommodate this type of waste.

Based on existing information, the FHWA plans to conduct additional EDDAs for GWEN properties at Kirtland AFB, New Mexico, and Pueblo, Colorado. If those studies find a low risk of contamination at those properties, no significant hazards to construction or maintenance personnel would result. If the FHWA analysis finds potential for contamination at significant levels (i.e., regulatory action levels), those sites would not be used. No significant impacts will result.

6.13.2 Alternative B—Mix of GWEN sites and new sites using new equipment

The potential for the DGPS program to incur liabilities if this alternative is implemented would be similar to that for Alternative A. To prevent the assumption of liability for existing contamination at properties acquired by the NDGPS program, the FHWA should perform EDDAs in conformance with ASTM standards prior to acquiring those properties.

During construction and operation of the NDGPS reference stations, small amounts of hazardous or regulated materials, such as petroleum fuels, paints, solvents and cleaners, sealants, herbicides and pesticides, and so on, would likely be used at the reference station properties. If these materials are properly used in accordance with the manufacturer's instruction, no contamination of the environment will result.

The USCG-like reference stations would likely use batteries for backup power instead of a diesel-fuel generator. No diesel fuel would be stored on site. Upon removal or replacement, these batteries would likely be considered a hazardous waste and would be sent to a waste facility that is licensed to accommodate this type of waste. No significant impacts will result.

6.13.3 Alternative C—All new sites using USCG-like equipment

Implementation of this alternative would result in the installation of 80 to 100 USCG-like reference stations. The potential for the NDGPS program to incur liability because of the acquisition of contaminated property and the potential for construction or operation of NDGPS

reference stations to cause significant contamination would be the same as for Alternative B. No significant impacts will result.

6.13.4 Alternative D—No-action alternative

Under this alternative, the NDGPS program would not acquire any property or construct any facilities. There would be no potential for the program to incur liability for contaminated property or to cause contamination. No significant impacts will result.

6.14 RADIOFREQUENCY RADIATION ENVIRONMENT AND HUMAN EXPOSURE

6.14.1 Alternative A (Preferred Action)—Mix of GWEN sites and equipment plus new sites and equipment

Under this alternative, 32 existing GWEN relay nodes would be converted to GPS use, which would entail the removal of the GWEN transmitter and the installation of a new DGPS transmitter and two new receive antennas. Antennas, towers, and other equipment from 22 additional GWEN relay nodes and 6 spare GWEN sets would also be relocated and installed at newly constructed NDGPS reference stations. Finally, 7 NDGPS reference stations would be newly constructed without use of GWEN sites or equipment. In each of these cases, the NDGPS reference station would include one transmit antenna and two smaller receive antennas. In regard to the possible health effects of human exposure to RF radiation, only the transmit antenna is of concern.

The NDGPS reference station transmits a signal at an ERP of 500 W and an operating frequency of about 300 kHz. That signal generates electric and magnetic fields in the vicinity of the transmit antenna that generally decrease in field strength with increasing distance from the antenna. A number of national and international standard-setting bodies, including the American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE), International Radiation Protection Association (IRPA) of the World Health Organization, and the FCC, have developed or adopted frequency-specific standards for occupational and general public exposure to electromagnetic fields, such as those generated by NDGPS transmissions. In the NDGPS operating band, the safety standards define maximum permissible exposure (MPE) for both electric and magnetic fields. Table 9 lists those MPEs, which are based on a 6-minute averaging time. The ground-level electric and magnetic fields that would be generated by the NDGPS transmitter are shown in Table 10 (SRI International, 1998).

As shown by Tables 9 and 10, the NDGPS electric and magnetic fields would exceed the national and international occupational safety standards only within the inner 8 ft fence surrounding the transmit tower and antenna. It is expected that the height of the security fence and the barbed wire atop the fence would effectively discourage trespassing. Signs will be posted warning the public to stay out of this area. Authorized maintenance personnel will be instructed to make sure the reference station is not transmitting when they enter this area.

Table 9
Safety Standards for Human Exposure to RFR at an Operating Frequency of 300 kHz

	MPE Level	
Organization	**Electric Field (V/m)**	**Magnetic Field (A/m)**
ANSI/IEEE*		
Occupational	614	54.33
General Public	614	54.33
IRPA		
Occupational	614	5.3
General Public	87	2.5
FCC		
Occupational	614	1.63
General Public	614	1.63

*Adopted by the USAF as Occupational Safety and Health Standard 48-9 (August 1,1997) and the Department of Defense as DOD Instruction 605.11 (February 21, 1995).

Table 10
Ground Level Electric and Magnetic Fields at a Typical NDGPS Reference Station

Distance from base of tower (ft)	Electric Field (V/m)	Magnetic Field (A/m)
2	1,200	2.87
30 (8 ft security fence)	80	0.191
100	24	0.057
300 (40 ft perimeter fence)	8.0	0.0191
320 (equipment area)	7.5	0.0179
350 (boundary of site)	0.0164	0.0164

Source: SRI International, 1998

The NDGPS magnetic field would not exceed the national and international safety standards for exposure of the general public at any place outside the inner 8 ft security fence. As noted above, public entry into that fenced area is not expected. Outside the 8 ft security fence, the NDGPS electric and magnetic fields will not exceed the ANSI/IEEE, IRPA, or FCC safety standards for exposure of the general public to electric fields.

In addition to the possible health effects from absorption of RFR by the human body, electromagnetic fields at the NDGPS operating frequency can potentially shock an individual because of either: (1) flow of the received electric field through his or her body touch, or (2) contact with ungrounded metal objects within the field, thereby completing the ground circuit and cause flow of electricity through his or her body. The GWEN Final EIS identified a field strength of about 3,800 V/m as the level necessary to produce sufficient current flow within the body to cause discomfort to a person (USAF, 1987). At ground level, the NDGPS electric field would be far less (at least an order of magnitude) than one-tenth of that level and would not harm or cause discomfort to persons in the vicinity.

The GWEN Final EIS also examined the situation in which a child touches a van that has nonconducting rubber tires, causing flow of electricity through the child's body and a shock to the child (USAF, 1987). The NDGPS electric field would be sufficient to cause that shock only within about 50 ft of the tower base. The shock would be startling but not harmful to the child. To be harmed (i.e., burned) by current flow, the child would have to grab a firm hold of a portion of the vehicle while exposed to an electric field of 430 V/m or more (USAF, 1987). An electric field of that strength would not occur outside the 8 ft security fence. Adults are physically larger than children and would require a more intense electric field to create the same current flows as would occur in a child. The fences at the NDGPS reference stations would be grounded and would not present a shock or burn hazard.

The measurements by the EPA and FCC at typical AM radio stations showed that the electric and magnetic fields generated by such stations decrease to levels well below the safety levels established by the standards within a few hundred feet of the broadcast towers. The same occurs for NDGPS reference stations. The cumulative level of RFR exposure from an NDGPS reference station and another nearby radio transmitter, even if directly adjacent to the NDGPS reference station, would not create a health hazard in areas outside the inner fence of the NDGPS reference station.

To address the potential for NDGPS reference stations to cause electromagnetic interference (EMI) with other radio facilities using the same frequency band, or a nearby band, the NTIA conducted a study of EMI concerns (Lemmon and Ketchum, 1998). The coverage areas of NDGPS reference stations, and hence the locations and number of stations required to achieve nationwide coverage, depend on the ERPs of the sites. The assignments of operating frequencies and ERPs to the broadcast sites are constrained by the requirement that there be no interference problems among DGPS signals or between DGPS signals and the signals broadcast by other users

of the 285 to 325 kHz band. These other users include Canadian DGPS beacons, Canadian aviation beacons, Mexican aviation beacons, FAA beacons, and radiobeacons licensed by the FCC. In general, there would not be interference problems among DGPS beacons that do not have cochannel frequency assignments. During the selection of new sites for NDGPS reference stations, the government plans to avoid areas where EMI is likely to occur. On the other hand, potential interference problems do not appear to be entirely avoidable for any choice of the number of sites, power levels, and frequency assignments. Mutual EMI may result from operation of NDGPS reference stations and FAA beacons located in the same vicinity. Based on a preliminary NTIA analysis of possible locations for NDGPS reference stations having an ERP of 300 W, three FAA beacons would suffer EMI under Phase I. Seven FAA beacons may suffer EMI because of installation and operation of NDGPS reference stations under Phase II. The number of FAA beacons affected may change because of the proposed increase to 500 W ERP transmission and any future changes in the location of NDGPS reference stations. To prevent or minimize these EMI effects, the NTIA study recommends that the operating frequency of the FAA beacons be changed to provide frequency separation. Alternately, the ERP of the NDGPS reference stations and/or the FAA beacons could be reduced in some cases (Lemmon and Ketchum, 1998). Implementation of these measures to prevent EMI would require coordination with the NTIA *Manual of Regulations and Procedures for Federal Radio Frequency Management* (DOC NTIA, 1995), as well as the FAA and other RF emitters. No significant impacts on public health and no significant EMI with other systems would result.

6.14.2 Alternative B—Mix of GWEN sites and new sites using new equipment.

The installation of all USCG-like DGPS equipment at both GWEN and newly acquired NDGPS sites would not alter the anticipated level of impact from RFR or shock from electromagnetic fields described under Alternative A. Although Alternative A would use a mix of GWEN equipment and USCG-like DGPS equipment, both types use the same transmit antenna, which is the only component of concern with regard to possible health effects from RFR exposure. Maximum ERP level would be 500 W for each transmit antenna. No significant impacts on public health and no significant EMI with other systems would result.

6.14.3 Alternative C—All new sites using USCG-like equipment.

Under Alternative C, existing USCG equipment would be installed at all proposed NDGPS sites. The transmit antenna used with existing USCG equipment operates at a maximum 170 W ERP, resulting in a much lower exposure level than from the GWEN and USCG-like DGPS transmit antenna. Anticipated levels of impact, therefore, would be lower than those described under Alternatives A and B. No significant impacts on public health and no significant EMI with other systems would result.

6.14.4 Alternative D—No-action alternative

Under this alternative, no actions would be taken to convert existing GWEN relay nodes to NDGPS use, and no new NDGPS reference stations would be built. There would be no new RF emissions. Existing RF emissions from the existing GWEN relay nodes would occur in the future as long as the USAF continued to operate the GWEN system. Because the USAF plans to cease operation of the GWEN network in the near future, it is expected that GWEN RF transmissions would end shortly. In any case, the findings of the NRC study, which specifically addressed human exposure to RFR from GWEN, confirm that no adverse effects on human health will result from exposure to GWEN RFR (NRC, 1993). No significant impacts on public health and no significant EMI with other systems would result.

6.15 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

This section represents an assessment of whether significant irreversible or irretrievable commitment of resources would occur either on a long-term or short-term basis. Long-term resources are permanent in nature and include nonrenewable resources such as certain materials, human labor, commodities, and natural resources. Short-term resources are materials and labor used during construction. The following assessment considers commitments for any of the three project alternatives.

6.15.1 Acceptance of GWEN Sites and Equipment

The NDGPS program proposes to use existing materials, equipment, and infrastructure from the GWEN program upon decommissioning of those USAF assets. It allows the DOT to avoid committing resources to new equipment or properties. This arrangement results in efficiencies in capital expenditures, use of durable goods, and in human labor. Reuse of materials would result in a minor direct benefit to the environment. Useful materials would not be discarded prematurely to landfills, and new materials would be spared for other uses. Economic trade-off analyses indicate that the fiscal benefits over the life of the project would far outweigh the short- and long-term commitments of resources and capital to install, operate, and maintain an NDGPS service (NDGPS PIT, 1998).

6.15.2 Personnel and Materials

The proposed NDGPS reference stations are unmanned and can be monitored from a remote location for functional accuracy and reliability. Personnel used during construction would result in an irretrievable commitment; however, the number of workers and the expected duration of equipment installation do not represent a significant expenditure, regardless of the local or regional economy involved. Long-term use of materials for NDGPS sites using new equipment and property would involve the use of standard tower structures, electronic equipment, and construction materials available commercially. These materials have the potential for reuse, after NDGPS is decommissioned, for other purposes, if necessary.

Maintenance and quality assurance activities would require a commitment of human resources. Upon complete installation, only one or two technicians or grounds maintenance personnel will visit the facility per quarter. These visits typically involve inspection, cleaning, and preventive maintenance of NDGPS subsystems, components, and hardware. These activities are confined to the project area and do not require major physical changes to the reference station. Hence, the life-cycle effect of maintenance would not result in significant impacts to environmental, socioeconomic, or cultural resources. During operation, quality assurance monitoring would occur from remote locations using existing levels or minor increases in personnel and monitoring equipment.

6.15.3 Decommissioning

If used for the full project life of the NDGPS program, approximately 15 years, most or all of the resources committed to the project would be either obsolete or structurally inferior for reuse. Decommissioning would be performed according to applicable federal environmental regulations and established USCG protocols in force at that time. A commitment of human resources is required to decommission the facilities, remove materials and equipment, and restore the property. This commitment of resources, similar to project installation, is not considered significant.

7 MITIGATION MEASURES

For NDGPS reference stations proposed at new (non-GWEN) properties, no significant environmental impacts are anticipated from the implementation of either the preferred action or any of the alternative actions provided that sensitive environmental resources or conditions are avoided during site selection. Environmental site-selection criteria will be applied and agency consultation performed as part of the proposed action to ensure that unforeseeable, site-specific adverse impacts will not be significant. The environmental site selection criteria for new sites and agency consultation and mitigation measures to be taken for all NDGPS sites are summarized in Table 11 and discussed in Section 6. If impact avoidance cannot be achieved, specific mitigation measures including agency consultation will be taken by the FHWA to reduce any potentially significant impacts to less than significant levels.

For NDGPS reference stations proposed at existing GWEN properties, no environmental resources or conditions will be significantly affected; however, confirmation of this assessment at the site-specific level would be required for the following resources or conditions: flora and fauna, cultural resources, land use, and RF effects (see Table 11). To confirm that no potentially significant impact to these resources will occur, consultation with appropriate resource agencies, and possibly other mitigation measures, will be performed as necessary.

To the extent possible, FHWA plans to adhere to the environmental siting criteria and/or implement the mitigation measures identified herein in order to eliminate all significant adverse environmental effects. Only in the unlikely situation that planned mitigation measures cannot be undertaken or would not be effective, would additional site-specific NEPA analysis and mitigation be prepared by the FHWA.

Table 11 is designed to assist the FHWA in selecting sites for NDGPS reference stations and determining the proper level of environmental review for those sites. Avoidance during site selection is the primary means of preventing significant impacts. If avoidance through site selection is not possible, mitigation measures indicated herein will be implemented as needed at new sites or at GWEN sites proposed for use as NDGPS reference stations.

Table 11

Environmental Siting Criteria and Consultation and Mitigation Measures for NDGPS Facilities at New Locations and GWEN Locations

Resource	Environmental Siting Criteria for New Sites	Consultation and Mitigation	
		New Sites	GWEN Sites
Geology (see § 6.1)	Avoid unstable slopes and highly erodible or eroded soils	Apply standard erosion control measures	Apply standard erosion control measures
	Avoid conflicts with mineral rights and known mineral deposits (including oil and gas)	Compensate for loss of access to resource	None
	Avoid areas known or expected to contain paleontological resources	Monitor during construction using a qualified paleontologist	None
Water Quality (see §6.2)	Avoid areas with seasonally high ground water and acidic soils, or set back copper ground plane >300 ft from surface water	Apply lime to acidic soil; evaluate conditions at decommissioning	Evaluate conditions at decommissioning
Ecologically Sensitive Areas (see § 6.3)	Avoid federal-jurisdictional wetlands	Obtain USACE dredge and fill permit and/or compensate for loss of wetlands	None
	Avoid the 100-year floodplain	Raise facilities above 100-year flood level or flood-proof facilities	None
Air Quality (see § 6.4)	None	Obtain local permits for BUPG; suppress dust emissions during construction	Obtain local permits for BUPG; suppress dust emissions during construction
Noise (see § 6.5)	None	Equip the BUPG with silencer; limit construction to normal working hours and shut off equipment when not in use	Equip the BUPG with silencer; limit construction to normal working hours and shut off equipment when not in use

Table 11 (continued)

Environmental Siting Criteria and Consultation and Mitigation Measures for NDGPS Facilities at New Locations and GWEN Locations

Resource	Environmental Siting Criteria for New Sites	Consultation and Mitigation	
		New Sites	GWEN Sites
Visual Resources (see § 6.6)	Avoid areas within view of moderately to highly sensitive public use areas	None	None
	Avoid designated or candidate wild and scenic river areas	None	None
Flora and Fauna (see § 6.7)	Avoid critical habitat for threatened and endangered species	Consult with USFWS and state agencies regarding protected species; alter facility layout to reduce level of impact	Consult with USFWS and state agencies regarding protected species; alter facility layout to reduce level of impact
	Avoid critical avian habitats and vicinity within major flyways	Consult with USFWS regarding MBTA; mark tower, guy wires and overhead power lines	Consult with USFWS regarding MBTA; mark tower, guy wires and overhead power lines
	Avoid rare native plant communities	Consult with state agencies and natural heritage database; conduct survey and alter site layout to avoid rare plants	Consult with state agencies and natural heritage database; conduct survey and alter site layout to avoid rare plants
Cultural Resources (see § 6.8)	Avoid siting on properties listed or eligible for listing on the NRHP or within 1.5 mi of historic properties with high visual sensitivity	Consult with SHPO; perform data recovery per consultation with SHPO and ACHP	Consult with SHPO; perform data recovery per consultation with SHPO and ACHP
	Avoid resources or properties of significance to Native Americans	Consult with traditional cultural leaders on appropriate methods to reduce potential impacts	None
Recreation (see §6.9)	Avoid national, state, regional, and local parks and recreation areas	None	None

Table 11 (concluded)

Environmental Siting Criteria and Consultation and Mitigation Measures for NDGPS Facilities at New Locations and GWEN Locations

Resource	Environmental Siting Criteria for New Sites	Consultation and Mitigation	
		New Sites	GWEN Sites
Land Use (see § 6.10)	Avoid areas where NDGPS would conflict with land-use plans or local zoning	Consult with local planning jurisdiction; alter facility design to reduce or eliminate potential conflict	Consult with local planning jurisdiction; alter facility design to reduce or eliminate potential conflict
	Avoid designated prime, unique, or state- or local-importance farmland	Complete Farmland Conversion Impact Rating form	None
	Avoid state and federal lands where management plans are incompatible with NDGPS	Alter facility design to reduce or eliminate potential conflict	None
	Avoid conflicts with approved state and local coastal zone management plans	Alter facility design to reduce or eliminate potential conflict	None
Socioeconomics & Environmental Justice (see § 6.11)	None	Supply temporary housing for construction workers if needed	None
Energy (see § 6.12)	None	None	None
Hazardous Materials (see § 6.13)	None	Prepare EDDAs	Prepare EDDAs at Kirtland AFB, NM, and Pueblo, CO, GWEN relay nodes
Radiofrequency Effects (see § 6.14)	Avoid areas near other radio facilities where EMI is possible	Consult with NTIA; analyze assigned frequency for EMI/EMC; reassign operating frequencies; or reduce ERP	Consult with NTIA; analyze assigned frequency for EMI/EMC; reassign operating frequencies; or reduce ERP
	None	Maintain security fences and signs to warn of RF exposure hazard	Maintain security fences and signs to warn of RF exposure hazard

8 CONCLUSION

This PEA, prepared for a network of NDGPS reference stations, supports the conclusion that potentially significant environmental impacts can either be avoided during site selection or mitigated via appropriate mitigation measures. No significant site-specific environmental impacts will occur as a result of implementation of the preferred or alternative actions.

For NDGPS reference stations proposed at existing GWEN properties, no environmental resources or conditions will be significantly affected; however, confirmation of this assessment will be performed at the site-specific level for the following resources or conditions: flora and fauna, cultural resources, land use, and RF effects. To confirm that no potentially significant impacts to these resources will occur, consultation with appropriate resource agencies, and implementation of other mitigation measures, will be undertaken.

For proposed NDGPS reference stations proposed on other (non-GWEN) properties, it is anticipated that potentially significant impacts can be avoided during the selection of candidate sites. Specific environmental siting criteria are described in this document that will allow the FHWA to avoid potentially significant impacts. For environmental siting criteria that cannot be met during the site-selection phase, mitigation measures will be taken to reduce or eliminate any potentially significant environmental impact to an insignificant level. To confirm that no potentially significant impacts to these resources will occur, consultation with appropriate resource agencies, and implementation of mitigation measures, will be undertaken.

Implementing the preferred action or any of the alternative actions would not result in a direct taking or constructive use of lands protected by Section 4(f) of the DOT Act.

A Finding of No Significant Impact (FONSI) is recommended at the programmatic level for the deployment of NDGPS reference stations.

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APPENDIX A

DRAFT MEMORANDUM OF AGREEMENT
FOR THE ESTABLISHMENT AND OPERATION OF THE
NATIONWIDE DIFFERENTIAL GLOBAL POSITIONING SYSTEM (NDGPS)

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APPENDIX B

DRAFT MEMORANDUM OF AGREEMENT FOR COMPLIANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT FOR THE ESTABLISHMENT OF THE NATIONWIDE DIFFERENTIAL GLOBAL POSITIONING SYSTEM SERVICE

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APPENDIX C

GWEN RELAY NODES AND OTHER (NON-GWEN) SITES PROPOSED FOR NDGPS USE

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APPENDIX D

DISTRIBUTION LIST FOR THE NOTICE OF AVAILABILITY—NDGPS DRAFT PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

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