
Federal Aviation Administration

# Draft Environmental Assessment for Issuing an Experimental Permit to SpaceX for Operation of the Grasshopper Vehicle at the McGregor Test Site, Texas

September 2011

**Draft Environmental Assessment for Issuing an Experimental Permit to SpaceX for Operation of the Grasshopper Vehicle at the McGregor Test Site, Texas**

**AGENCY**: Federal Aviation Administration (FAA)

**ABSTRACT**: This Draft Environmental Assessment (EA) addresses the potential environmental impacts of FAA's Proposed Action of issuing an experimental permit to Space Exploration Technologies Corporation (SpaceX) for operation of the Grasshopper reusable launch vehicle (RLV) at the McGregor, Texas test site. This Draft EA evaluates the potential impacts of the operation of the Grasshopper RLV as well as construction of a launch pad and related infrastructure.

Potential environmental impacts of the Proposed Action and the No Action Alternative analyzed in detail in this Draft EA include impacts to air quality; biological resources (fish, wildlife, and plants); hazardous materials, pollution prevention, and solid waste; historical, architectural, archaeological, and cultural resources; land use (including Department of Transportation Section 4(f) resources); noise and compatible land use; light emissions and visual resources; natural resources and energy supply; socioeconomics, environmental justice, and children's environmental health and safety; and water resources (surface waters and wetlands, groundwater, floodplains, and water quality). Potential cumulative impacts of the Proposed Action and the No Action Alternative are also addressed in this Draft EA.

**PUBLIC REVIEW PROCESS:** In accordance with the National Environmental Policy Act of 1969, as amended (NEPA; 42 United States Code [U.S.C.] 4321, et seq.), Council on Environmental Quality NEPA implementing regulations (40 CFR Parts 1500 to 1508), and FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1*, the FAA has initiated a public review and comment period for this Draft EA. Interested parties are invited to submit comments on environmental issues and concerns, preferably in writing, on or before October 26, 2011, or 30 days from the date of publication of the Notice of Availability in the *Federal Register*, whichever is later. When submitting comments, it is critical to be as specific as possible and clarify concerns or recommendations as they relate to the issues addressed in this Draft EA.

**CONTACT INFORMATION**: To request copies of the Draft EA or provide comments, please contact Daniel Czelusniak, Environmental Program Lead, Federal Aviation Administration, 800 Independence Ave., SW, Suite 325, Washington, DC 20591; e-mail Daniel.Czelusniak@faa.gov; or phone (202) 267-5924.

This Draft EA becomes a Federal document when evaluated, signed, and dated by the responsible FAA official.

Issued in Washington, DC on: 9/22/11

Dr. George C. Nield
Associate Administrator for
Commercial Space Transportation

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# LIST OF EXHIBITS

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AST | Office of Commercial Space Transportation |
| AGL | above ground level |
| CFR | Code of Federal Regulations |
| CEQ | Council on Environmental Quality |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| COPV | carbon overwrapped pressure vehicle |
| CWA | Clean Water Act |
| dB | decibel |
| dBA | A-weighted sound level |
| DNL | day-night average sound level |
| DOT | U.S. Department of Transportation |
| EA | Environmental Assessment |
| EO | Executive Order |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| FAA | Federal Aviation Administration |
| FEMA | Federal Emergency Management Agency |
| FR | Federal Register |
| GCD | groundwater conservation district |
| GWP | global warming potential |
| $H_2$ | hydrogen |
| $H_2O$ | water |
| HABS | historic American building survey |
| LOX | liquid oxygen |
| MOA | Memorandum of Agreement |
| $N_2$ | nitrogen |
| $N_2O$ | nitrous oxide |
| NAAQS | National Ambient Air Quality Standards |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |

| | |
|---|---|
| NMFS | National Marine Fisheries Service |
| $NO_2$ | nitrogen dioxide |
| $NO_x$ | nitrogen oxides |
| NPDES | National Pollutant Discharge Elimination System |
| NRHP | National Register of Historic Places |
| NWI | National Wetland Inventory |
| NWIRP | Naval Weapons Industrial Reserve Plant |
| $O_3$ | ozone |
| OSHA | Occupational Safety and Health Administration |
| Pb | lead |
| PEIS | Programmatic Environmental Impact Statement |
| PM | particulate matter |
| $PM_{2.5}$ | particulate matter 2.5 microns or less in diameter |
| $PM_{10}$ | particulate matter 10 microns or less in diameter |
| RCRA | Resource Conservation and Recovery Act |
| RLV | reusable launch vehicle |
| ROI | Region of Influence |
| SHPO | State Historic Preservation Officer |
| $SO_2$ | sulfur dioxide |
| $SO_x$ | sulfur oxides |
| TCEQ | Texas Commission on Environmental Quality |
| TPDES | Texas Pollutant Discharge Elimination System |
| TPWD | Texas Parks and Wildlife Department |
| TWDB | Texas Water Development Board |
| U.S.C. | United States Code |
| USACE | U.S. Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| VOC | volatile organic compound |
| VTVL | vertical takeoff and vertical landing |

# 1. INTRODUCTION

The Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) proposes to issue an experimental permit to Space Exploration Technologies Corporation (SpaceX) to conduct suborbital launches and landings of the Grasshopper reusable launch vehicle (RLV) at the McGregor, Texas test site.

Issuing an experimental permit is considered a major Federal action subject to environmental review under the National Environmental Policy Act of 1969, as amended (NEPA; 42 United States Code [U.S.C.] 4321, et seq.). The FAA/AST has prepared this Draft Environmental Assessment (EA) in accordance with NEPA, Council on Environmental Quality (CEQ) NEPA implementing regulations (40 CFR Parts 1500 to 1508), and FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1* to evaluate the potential environmental impacts of activities associated with FAA/AST's Proposed Action (see Section 2.1).

## 1.1 Background

Under the FAA's Experimental Permit Program (implemented by 14 Code of Federal Regulations [CFR] Part 437), the FAA may issue experimental permits[1] to launch developmental reusable suborbital rockets on suborbital trajectories. In September 2009, the FAA/AST issued the Final Programmatic Environmental Impact Statement for Streamlining the Processing of Experimental Permit Applications (PEIS) (FAA 2009) to facilitate compliance with NEPA when making decisions about whether to issue experimental permits to individual launch operators. The PEIS provides information and analyses common to a variety of reusable suborbital rocket types and analyzes the environmental impacts of the use of such rockets at specified facilities, so future environmental documents can tier from the PEIS. However, due to the following circumstances associated with the FAA/AST's Proposed Action of issuing an experimental permit to SpaceX to conduct suborbital launches and landings of the Grasshopper RLV at the McGregor, Texas test site, this Draft EA does not tier from the PEIS:

- the thrust generated by the Grasshopper RLV (122,000 pounds) is much greater than the maximum thrust analyzed in the PEIS for vertical launches (2,000 pounds); and
- SpaceX's proposed test site in McGregor, Texas is not a launch site included in the PEIS.

The McGregor test site is a 650-acre engine test site that has been leased by SpaceX from the City of McGregor since 2003. The test site is a portion of a larger area of property (approximately 9,700 acres) that was previously owned by the U.S. Navy and was the site of a Naval Weapons Industrial Reserve Plant (NWIRP) from 1966 to 1995. From 1966 to 1995 the property comprising the NWIRP was used for the development of naval weapons and solid-propellant rocket engines, and rocket engine testing. The U.S. Navy closed the NWIRP in 1995 and began transferring portions of the property to the City of McGregor. By 2006, the U.S. Navy had transferred ownership of the entire 9,700-acre property to the City of McGregor, which now uses the area as an industrial park. The 650-acre McGregor test site that SpaceX leases from the city includes administrative, storage, and support buildings, as well as stands to conduct engine testing. Currently, SpaceX uses the site to test engines that are used in other SpaceX

[1] An experimental permit is valid for one year and authorizes an unlimited number of launches and reentries of a specified reusable suborbital rocket from a specified site. An applicant can renew the permit by submitting an application to the FAA at least 60 days before the permit expires.

launch vehicles (see Section 2.2 for additional information on SpaceX's existing activities at the McGregor test site).

## 1.2 Purpose and Need for Agency Action

The purpose of the FAA's Proposed Action of issuing an experimental permit to SpaceX to conduct suborbital launches and landings of the Grasshopper RLV is to fulfill the FAA/AST's responsibilities under the Commercial Space Launch Act, 51 U.S.C. Ch. 509, §§ 50901-23 (2011) for oversight of experimental permit activities. The need for the action results from the statutory direction from Congress under the Commercial Space Launch Act to encourage commercial rocket developers' research and development associated with testing new design concepts, new equipment, or new operating techniques; compliance and requirements; and training of flight crews. The FAA/AST has received an application for an experimental permit from SpaceX to conduct launches of the Grasshopper RLV at the McGregor test site. The FAA/AST must review the application and determine whether to issue the experimental permit.

## 1.3 Request for Comments on the Draft EA

In accordance with NEPA, CEQ NEPA implementing regulations (40 CFR Parts 1500 to 1508), and FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1*, the FAA has initiated a public review and comment period for this Draft EA. Interested parties are invited to submit comments on environmental issues and concerns, preferably in writing, on or before October 26, 2011, or 30 days from the date of publication of the Notice of Availability in the *Federal Register*, whichever is later.

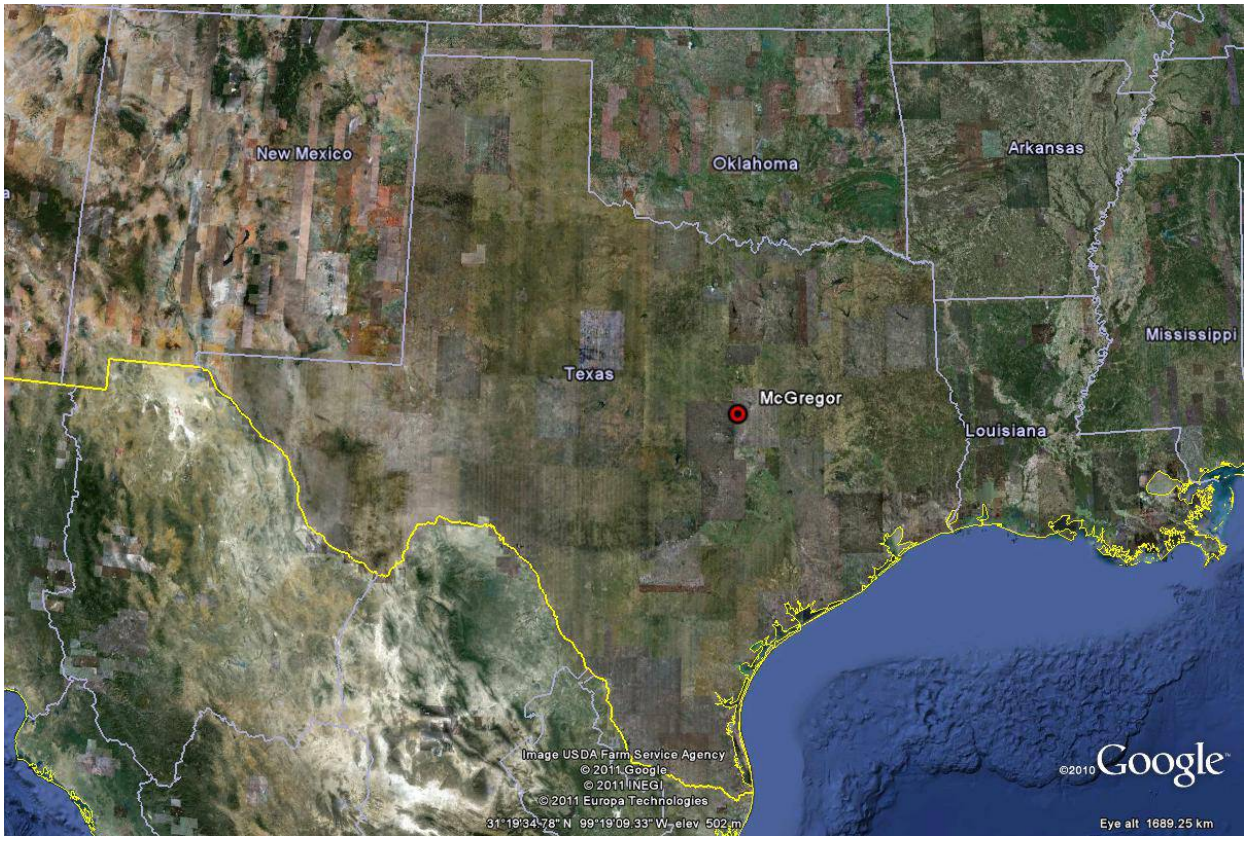
The FAA invites interested agencies, organizations, Native American tribes, and members of the public to submit comments on all aspects of this Draft EA. The FAA will consider all comments on this Draft EA in preparing a Final EA. To facilitate FAA consideration and response to comments, it is critical that comments be as specific as possible and clearly state concerns or recommendations related to the issues addressed in this Draft EA.

# 2. DESCRIPTION OF THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

## 2.1 Proposed Action

The Proposed Action (preferred alternative) is for the FAA/AST to issue an experimental permit to SpaceX, which would authorize SpaceX to conduct suborbital launches and landings of the Grasshopper RLV from the McGregor test site in McGregor, Texas (see Exhibits 2-1 and 2-2 below). SpaceX has determined that to support the Grasshopper RLV activities under the experimental permit, it would be necessary to construct a launch pad and additional support infrastructure. Therefore, the Proposed Action analyzed in this Draft EA includes the activities that would be authorized by the experimental permit (i.e., the operation of the launch vehicle) as well as the construction of the launch pad and related infrastructure. The experimental permit would be valid for one year and would authorize an unlimited number of launches[2]. The FAA/AST could renew the experimental permit if requested, in writing, by SpaceX at least 60 days before the permit expires. SpaceX anticipates that the Grasshopper RLV program would require up to 3 years to complete. Therefore, the Proposed Action considers one new permit and two potential permit renewals.

**Exhibit 2-1. McGregor, Texas**




Source: Google Earth 2011a

[2] See 14 CFR § 401.5 for the definition of a launch.

**Exhibit 2-2. McGregor Test Site[a]**


Source: Google Earth 2011b
a. Red line indicates the approximate boundary of the SpaceX-leased property.

According to FAA regulations, an experimental permit applicant must provide enough information for the FAA to analyze the potential environmental impacts associated with the proposed suborbital RLV launches. The information provided by an applicant must be sufficient to enable the FAA to comply with the requirements of NEPA. This Draft EA is intended to fulfill NEPA requirements for issuing or renewing an experimental permit to SpaceX for suborbital launches of the Grasshopper RLV. The successful completion of the environmental review process does not guarantee that the FAA/AST would issue an experimental permit to SpaceX. The Proposed Action also must meet all FAA safety, risk, and financial responsibility requirements per 14 CFR Part 400. Additional environmental analyses would be required for future SpaceX-proposed activities not addressed in this Draft EA or in previous environmental documentation.

The Grasshopper RLV is a vertical takeoff and vertical landing (VTVL) vehicle. The highest altitude which the Grasshopper RLV would reach during launches conducted under an experimental permit is 11,500 feet above ground level (AGL). SpaceX would need to obtain a Letter of Authorization from the Robert Gray Army Radar Approach Control at Fort Hood to operate the Grasshopper RLV in the proposed airspace before any launches could commence.

Operations associated with the Proposed Action would include pre-flight; launch, flight, and landing; and post-flight activities as defined in 14 CFR § 437.7, Scope of an Experimental Permit. Section 2.1.1 below provides information about the Grasshopper RLV, pre- and post-flight activities, and the flight profile.

Although an experimental permit would authorize an unlimited number of launches, the FAA/AST must estimate the number of launches in order to analyze potential environmental impacts. In conjunction with SpaceX, the FAA/AST developed a conservative set of assumptions regarding the possible number of launches that could be conducted under any one experimental permit for the Grasshopper RLV at the McGregor test site. The FAA/AST has assumed that SpaceX would conduct up to 70 annual suborbital launches of the Grasshopper RLV under an experimental permit at the McGregor test site. This estimation is a conservative number and considers potential multiple launches per day and potential launch failures.

To support the Grasshopper RLV operations, SpaceX proposes to construct a launch pad and additional support infrastructure at the McGregor test site (see Exhibit 2-2 for the general location); this construction is discussed in Section 2.1.2.

### 2.1.1 Grasshopper RLV

#### *2.1.1.1 Description*

The Grasshopper RLV consists of a Falcon 9 Stage 1 tank, a Merlin-1D engine, four steel landing legs, and a steel support structure. Carbon overwrapped pressure vessels (COPVs), which are filled with either nitrogen or helium, are attached to the support structure. The Merlin-1D engine has a maximum thrust of 122,000 pounds. The overall height of the Grasshopper RLV is 106 feet, and the tank height is 85 feet.

The propellants used in the Grasshopper RLV include a highly refined kerosene fuel, called RP-1, and liquid oxygen (LOX) as the oxidizer. The Grasshopper RLV has a maximum operational propellant load of approximately 6,900 gallons; however, the propellant loads for any one test would often be lower than the maximum propellant load. Even when the maximum propellant load is used, the majority of the propellant would remain unburned and would serve as ballast to keep the thrust-to-weight ratio low.

#### *2.1.1.2 Pre-flight and Post-flight Activities*

***Pre-flight activities*** include preparing the Grasshopper RLV for launch and providing ground operations support for launch and landing. Preparing the Grasshopper RLV would begin when the vehicle is transported from its storage location at the McGregor test site to the launch pad. The Grasshopper RLV would be transported to the launch pad via a truck or tractor-trailer. Similarly, trucks would be used to transport the propellants from the propellant storage area to the launch pad.

Standard safety precautions, such as clearing the area of unnecessary personnel and ignition (including spark) sources, would be implemented. The Grasshopper RLV would be fueled with the appropriate amount of propellant for the proposed type of test (see Section 2.1.1.3 below for a description of tests). In the event of a spill or release, propellant-loading operations would be halted. Any spills would be cleaned up according to the McGregor test site's Spill Response Procedure. Following the propellant transfer, the propellant-loading equipment would be removed from the launch area.

During preparations for launch, the electrical and mechanical connections would be inspected, and flight control diagnostics and health checks would be completed to ensure proper operation of electrical systems and moving parts. The Grasshopper RLV would initiate its formal launch

sequence (i.e., ignition of its propulsion system) after all preparation and pre-flight operations were completed.

***Post-flight activities*** include Grasshopper RLV landing and safing[3]. During a nominal launch, the vehicle would land on the launch pad. Safing activities would begin upon completion of all launch and landing activities and engine shutdown. The LOX oxidizer system would be purged, and the fuel lines would be drained into a suitable container. Any remaining pressurants (i.e., helium or nitrogen) would be vented prior to declaring the Grasshopper RLV safe and moving the vehicle to its transport vehicle and staging area. A ground crew would perform and supervise all pre-flight, flight, and landing operations and would be familiar with the operating protocol for the specific launch.

#### *2.1.1.3 Flight Profile (Takeoff, Flight, and Landing)*

The Grasshopper test program expected to be conducted under an experimental permit would consist of three phases of test launches, which would be performed in the sequence detailed below. SpaceX would repeat tests under each phase as necessary until SpaceX is ready to proceed to the next phase. Multiple test launches could occur each day during daytime hours only, and would be consistent with SpaceX's lease with the City of McGregor. For example, SpaceX is prohibited from conducting engine tests between the hours of 12:00 a.m. and 7:00 a.m. per SpaceX's lease with the City of McGregor.

**Launch Phases 1 and 2: Below-controlled-airspace VTVL**

The goal of Phase 1 is to verify the Grasshopper RLV's overall ability to perform a VTVL mission. During a Phase 1 test, the Grasshopper RLV would be launched and ascend to 240 feet AGL and then throttle down in order to descend, landing back on the pad approximately 45 seconds after liftoff. The Grasshopper RLV would stay below Class E Airspace (700 feet AGL). In Phase 2, there would be slightly less propellant loaded, a different thrust profile, and the maximum altitude would be increased to 670 feet, still below Class E Airspace. The mission duration during Phase 2 is again approximately 45 seconds.

**Launch Phase 3: Controlled-airspace VTVL (maximum altitude)**

The goal of Phase 3 is to verify the Grasshopper RLV's ability to perform a VTVL mission at higher altitudes and higher ascent speeds and descent speeds. To achieve this, the maximum mission altitude would be increased from 670 feet incrementally up to 11,500 feet. The altitude test sequence likely would be 1,200 feet; 2,500 feet; 5,000 feet; 7,500 feet; and 11,500 feet. The maximum test duration would be approximately 160 seconds. The Grasshopper RLV would land back on the launch pad.

### 2.1.2 Grasshopper Launch Pad and Infrastructure

In order to support the proposed launches of the Grasshopper RLV under an experimental permit, SpaceX also proposes to construct a concrete launch pad and water lines.

The launch pad would be located to the southwest of the main portion of the McGregor test site (see Exhibit 2-2) and would encompass a total area of approximately 20,734 square feet (0.475

[3] Safing refers to shutting down the launch vehicle and ensuring the vehicle is in a safe condition before transporting the launch vehicle to its storage facility.

acre). The pad would be constructed at the end of an existing access road and would be built to comply with Texas code requirements for constructing on black clay. The launch pad would require approximately 6,534 cubic feet (242 cubic yards) of concrete, which would be supplied to the McGregor test site by approximately 27 concrete trucks in batches of 9 cubic yards. Construction of the launch pad would be expected to take 1–2 weeks.

Additional support infrastructure that would be installed includes water lines, which would tap off of the main water lines approximately 500 feet from the proposed location of the launch pad. All tanks, with the possible exception of a 10,000 gallon water tank for fire suppression and washing the launch pad, would be mobile. The launch pad would be powered by portable generators. A typical Grasshopper RLV launch would use 50 kilowatt hours of energy at the launch pad.

## 2.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue an experimental permit to SpaceX for operation of the Grasshopper RLV at the McGregor test site. Existing SpaceX activities would continue at the McGregor test site, which include engine testing for the Falcon 9 launch vehicle. SpaceX averages approximately five Merlin-1D tests per week as well as six Falcon 9 Stage 1 tests per year. The Falcon 9 is an expendable launch vehicle that uses RP-1 and LOX for propellants. Stage 1 of the Falcon 9 holds approximately 38,700 gallons of LOX and 24,900 gallons of RP-1, for a total of approximately 63,600 gallons of propellant. Stage 1 is powered by nine Merlin-1C engines, with each Merlin-1C engine producing 90,000 pounds of thrust. The Falcon 9 stage testing occurs on the tripod stand located at the site (see Exhibit 2-2 for general location). Additionally, SpaceX conducts hypergolic testing at the site, which occurs in an enclosed vacuum chamber.

NEPA requires agencies to consider a "no action" alternative in their NEPA analyses and to compare the effects of not taking action with the effects of the action alternative(s). Thus, the No Action Alternative serves as a baseline to compare the impacts of the Proposed Action. The No Action Alternative would not satisfy the purpose and need for the Proposed Action as stated above in Section 1.2.

## 2.3 Alternatives Considered but Dismissed

In conjunction with SpaceX, the FAA/AST considered alternative sites to conduct test launches of the Grasshopper RLV. However, due to the following reasons, alternative sites were dismissed from consideration:

- SpaceX's current lease with the City of McGregor,
- SpaceX's ongoing engine testing at the McGregor test site,
- The previously disturbed environment of the McGregor test site,
- The general uninhabited or sparse population surrounding the McGregor test site, and
- The generally "uncrowded" airspace.

Within the McGregor test site, the launch pad location was selected based on the separation distance from SpaceX's existing major infrastructure and control center.

## 2.4 Impacts and Resources Not Analyzed in Detail

This Draft EA does not analyze potential impacts to the following environmental resource areas in detail, for the reasons explained below:

- **Coastal Resources** – There are no coastal resources within the proposed construction and operating areas, because proposed construction and operations would occur inland.
- **Wild and Scenic Rivers** – There are no wild and scenic rivers as designated by the Wild and Scenic Rivers Act located within or near the proposed construction or operating area. The nearest wild and scenic river, the Saline Bayou River, is approximately 270 miles east of the McGregor test site in Louisiana (Wild and Scenic Rivers Council 2011).
- **Farmlands** – There are no prime or unique farmlands as defined by the Farmland Protection Policy Act located at the McGregor test site (NRCS 2011). The Natural Resources Conservation Service considers the soils at the McGregor test site "prior converted" to urban uses (NRCS 2011).

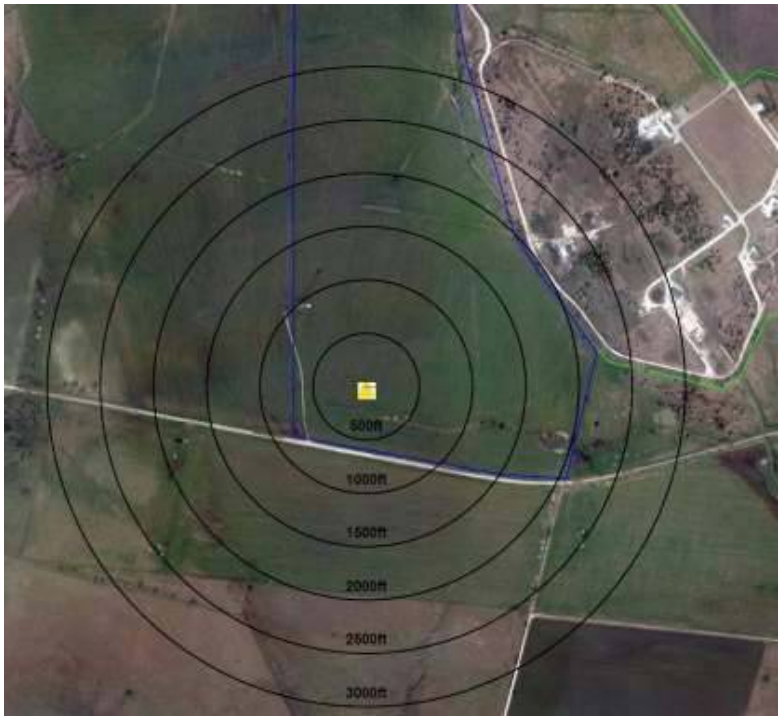
# 3. AFFECTED ENVIRONMENT

The McGregor test site is located within the City of McGregor's industrial park, which is approximately 20 miles southwest of Waco, Texas. The majority of the test site lies in McLennan County, with a small part located in Coryell County, including the proposed location for the Grasshopper RLV launch pad (see Exhibit 2-2). The closest populated areas to the McGregor test site include the Cities of McGregor and Oglesby.

The Region of Influence (ROI) is the area where potential environmental impacts could occur, and is different for each resource area as described in more detail in this chapter. For all resource areas, the ROI is centered on the proposed launch pad location and operating area, and extends out depending on the resource area. For example, the ROI is largest for air quality, noise, and visual resources because the ROI includes the areas that could receive air emissions, experience noise, and view Grasshopper RLV launches.

The operating area for Grasshopper RLV launches is defined as the area within 3,000 feet from the point of liftoff (see Exhibit 3-1). The operating area is uninhabited with the exception of SpaceX employees. A nominal mission includes taking off from and landing on the launch pad.

**Exhibit 3-1. Operating Area**




The following sections in this chapter present the existing conditions at the McGregor test site for air quality; noise and compatible land use; land use (including U.S. Department of Transportation (DOT) Section 4(f) properties); biological resources (fish, wildlife, and plants); historical, architectural, archaeological, and cultural resources; hazardous materials, pollution prevention, and solid waste; light emissions and visual resources; natural resources and energy supply; water resources (surface waters and wetlands, groundwater, floodplains, and water quality); and socioeconomics, environmental justice, and children's environmental health and safety. FAA/AST environmental specialists conducted a site visit in August 2011 to verify

existing conditions. The description of the existing conditions provides a baseline from which potential impacts under the Proposed Action and the No Action Alternative are evaluated.

## 3.1 Air Quality

Under the authority of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has established nationwide air quality standards, known as the National Ambient Air Quality Standards (NAAQS) (see Exhibit 3-2). The NAAQS represent the maximum allowable atmospheric concentrations of six "criteria pollutants," including ozone ($O_3$); carbon monoxide (CO); nitrogen dioxide ($NO_2$); sulfur dioxide ($SO_2$); particulate matter (PM) less than 10 microns in diameter ($PM_{10}$) and PM less than 2.5 microns in diameter ($PM_{2.5}$); and lead (Pb). The primary NAAQS are set at a level to protect public health with an adequate margin of safety; the secondary NAAQS are set at a level to protect the public welfare from any known or anticipated adverse effects of a pollutant (e.g., damage to crops and materials). Under the Clean Air Act, State and local agencies may establish their own Ambient Air Quality Standards, provided these standards are at least as stringent as the Federal requirements. The State of Texas has not established its own Ambient Air Quality Standards (TCEQ 2011a).

**Exhibit 3-2. National Ambient Air Quality Standards (NAAQS)**

| Pollutant[a] | Averaging Time[b] | Primary Standards[c] | Secondary Standards[c] |
|---|---|---|---|
| $O_3$ | 8 Hours | 0.075 ppm (147 µg/m$^3$) [d] | 0.075 ppm (147 µg/m$^3$) |
| CO | 8 Hours | 9.0 ppm (10,000 µg/m$^3$) | – |
| | 1 Hour | 35 ppm (40,000 µg/m$^3$) | – |
| $NO_2$ | Annual Arithmetic Mean | 0.053 ppm (100 µg/m$^3$) | 0.053 ppm (100 µg/m$^3$) |
| | 1 Hour | 0.100 ppm (200 µg/m$^3$) | – |
| $SO_2$ | 3 Hours | – | 0.5 ppm (1,300 µg/m$^3$) |
| | 1 Hour | 0.075 ppm (200 µg/m$^3$) | – |
| $PM_{10}$ | 24 Hours | 150 µg/m$^3$ | 150 µg/m$^3$ |
| $PM_{2.5}$ | Annual Arithmetic Mean | 15 µg/m$^3$ | 15 µg/m$^3$ |
| | 24 Hours | 35 µg/m$^3$ | 35 µg/m$^3$ |
| Pb | Rolling 3-Month Average | 0.15 µg/m$^3$ | 0.15 µg/m$^3$ |

Source: EPA 2011a

a. $O_3$ = ozone; CO = carbon monoxide; $NO_2$ = nitrogen dioxide; $SO_2$ = sulfur dioxide; $PM_{10}$ = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; Pb = lead

b. National standards other than $O_3$ and those based on annual averages or annual arithmetic means are not to be exceeded more than once a year. The $O_3$ standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standards, averaged over three years, is equal to or less than one. The 1-hour $NO_2$ standard is attained when the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area does not exceed 0.100 ppm. The 24-hour $PM_{10}$ standard is attained when the 24-hour concentrations does not exceed 150 µg/m$^3$ more than once per year on average over 3 years. The annual $PM_{2.5}$ standard is attained when the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors does not exceed 15 µg/m$^3$. The 24-hour $PM_{2.5}$ standard is attained when the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area does not exceed 35 µg/m$^3$. The rolling 3-month Pb standard is not to be exceeded over a 3-year period. The 1-hour $SO_2$ standard is attained when the 3-year average of the 99th percentile of the daily maximum 1-hour average concentrations does not exceed 0.075 ppm.

c. ppm = part per million; µg/m$^3$ = microgram per cubic meter

d. EPA has proposed to reduce the 8-hour ozone standard to a value between 0.060 and 0.070 ppm. EPA has not announced a date by which it intends to issue the revised standard.

EPA designates areas of the U.S. having air quality equal to or better than the NAAQS as being in "attainment." Areas with air quality worse than the NAAQS are referred to as being in "non-attainment." The McGregor test site is located in McLennan and Coryell Counties. Both counties have been designated by the EPA to be in attainment for the NAAQS (TCEQ 2011b). Therefore, the FAA is not required to conduct a Clean Air Act General Conformity evaluation. The Texas Commission on Environmental Quality (TCEQ) measures ambient pollutant levels using a network of monitoring stations located throughout the State (TCEQ 2011c). Exhibit 3-3 presents the most recent three years of available data measured at the monitoring stations located nearest to the McGregor test site. For some pollutants, the nearest station with three full years of data is located many miles away from the McGregor test site (e.g., the nearest $PM_{10}$ and lead stations are located about 100 miles away). Data from those stations are illustrative of general attainment conditions in northeastern Texas rather than of local air quality in the area around the McGregor test site. Exhibit 3-3 shows that ground-level concentrations of criteria pollutants in the region around the McGregor test site are within the NAAQS.

**Exhibit 3-3. Measured Ambient Air Concentrations of Criteria Pollutants in the Region**

| Pollutant[a] | Averaging Time | Nearest Monitoring Station[b] | Maximum Measured Concentration (ppb, except CO in ppm and PM in µg/m$^3$) | | |
|---|---|---|---|---|---|
| | | | 2008 | 2009 | 2010 |
| $O_3$ | 8 Hours | Waco Mazanec | 71 (4th max.) | 74 (4th max.) | 66 (4th max.) |
| CO | 8 Hours | Waco Mazanec | –[d] | –[d] | –[d] |
| | 1 Hour | Waco Mazanec | 0.8 | 0.7 | .05 |
| $NO_2$ | Annual | Waco Mazanec | 3.1 | 2.1 | 2.8 |
| | 1 Hour | Waco Mazanec | 36.0 | 36.9 | 36.3 |
| $SO_2$ | 1 Hour | Waco Mazanec | 8.3 | 9.9 | 9.5 |
| $PM_{10}$ | 24 Hours | –[c] | – | – | – |
| $PM_{2.5}$ | Annual | Waco Mazanec | 9.69 | 8.80 | 8.29 |
| | 24 Hours | Waco Mazanec | –[d] | –[d] | –[d] |
| Pb | 3-Month Average | –[c] | – | – | – |

Source: TCEQ 2011c

a. $O_3$ = ozone; CO = carbon monoxide; $NO_2$ = nitrogen dioxide; $SO_2$ = sulfur dioxide; $PM_{10}$ = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; Pb = lead.

b. The Waco Mazanec monitoring station is approximately 29 miles from the McGregor test site.

c. No monitoring station is located within approximately 100 miles of the McGregor test site.

d. Data not reported by TCEQ.

Stationary point sources of air emissions at the McGregor test site include launch vehicle processing, fueling, and other point sources such as generators and storage tanks. Mobile sources of air emissions include support equipment, commercial transport vehicles, and personal motor vehicles. The McGregor test site operates under a TCEQ air quality permit (TCEQ 2007). This permit covers construction and operation of five rocket engine test stands, five new fuel storage tanks, and associated piping and equipment at the McGregor test site. It is a Permit by Rule, which TCEQ issues to facilities that produce more than a *de minimis* level of emissions but do not require a standard (i.e., New Source Review) TCEQ air quality permit, are not major sources as defined by the U.S. Clean Air Act, and that meet several TCEQ criteria including emissions limits. To meet these limits the facility's emissions must be less than 250 tons per year of CO or nitrogen oxides, 25 tons per year of $SO_2$ or volatile organic compounds, 15 tons per year of $PM_{10}$, and 10 tons per year of $PM_{2.5}$.

## 3.2 Noise and Compatible Land Use

Noise is considered unwanted sound that disturbs routine activities and peace and quiet, and can cause annoyance. Common metrics for quantifying noise include A-weighted decibels (dBA), which simulates the frequency response of the human ear, and day-night average noise level (DNL), which is a 24-hour average of noise levels with a 10 dBA penalty for noise occurring at night. The 10 dBA adjustment accounts for increased human sensitivity to noise at night.

Occupational Safety and Health Administration (OSHA) regulation 1910.95 establishes a maximum noise level of 90 dBA for a continuous 8-hour exposure during a working day and higher levels for shorter exposure time in the workplace. The EPA has recommended an average equivalent noise level of 70 dBA as the maximum 24-hour exposure necessary to protect hearing, and 75 dBA as a protective level for 8 hours (EPA 1981). OSHA regulation 1910.95 also establishes a maximum level for impulse (very short term) noise, which should not exceed 140 dBA. The 140 dBA threshold is considered advisory rather than mandatory.

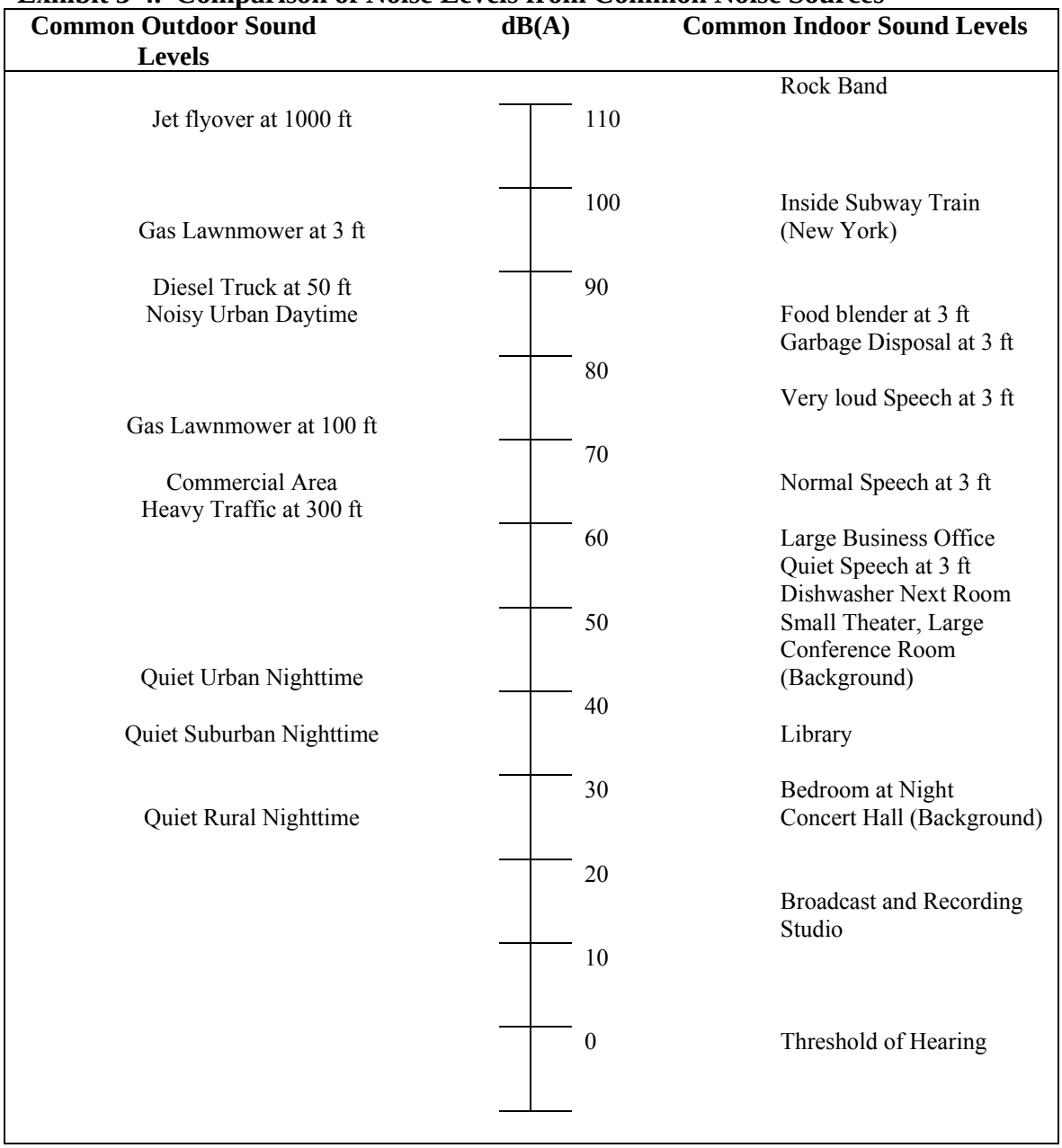
The McGregor test site is a relatively isolated facility, surrounded by agricultural land. The closest residential communities to the proposed launch pad location are the City of McGregor, located approximately 5 miles to the northeast, and the City of Oglesby, located approximately 3 miles to the northwest. The City of McGregor has a small industrial park, which is where the McGregor test site is located. However, many of the buildings comprising the industrial park are vacant (City of McGregor 2011). The majority of the industrial park is used for agricultural purposes.

Daily or weekly single engine testing at the McGregor test site increases noise levels for short periods of time. Approximately 5 single engine tests are conducted per week. An average single engine test lasts approximately 100 seconds and produces noise levels approximately 138 dBA within the test site boundary and approximately 97 dBA within 3 miles of the test site. Also, infrequent Falcon 9 Stage 1 tests (9 engines firing simultaneously) increase noise levels for short periods of time. SpaceX conducts Falcon 9 Stage 1 tests approximately six times a year, and each test lasts up to 3 minutes. Noise levels produced by the Stage 1 tests would be approximately 148 dBA at the test site and approximately 107 dBA 3 miles from the test site.

Other noise sources at or near the McGregor test site include sources that are typical to a rural/agricultural setting, including farm machinery, automobiles, trains, and commercial vehicles (e.g., waste management trucks). Historically, the NWIRP produced high-intensity noise while engaging in activities associated with manufacturing and ordnance and rocket motor testing (U.S. Navy 1998).

To provide context, Exhibit 3-4 provides a comparison of noise levels from common noise sources.

**Exhibit 3-4. Comparison of Noise Levels from Common Noise Sources**




Source: Coate 2011

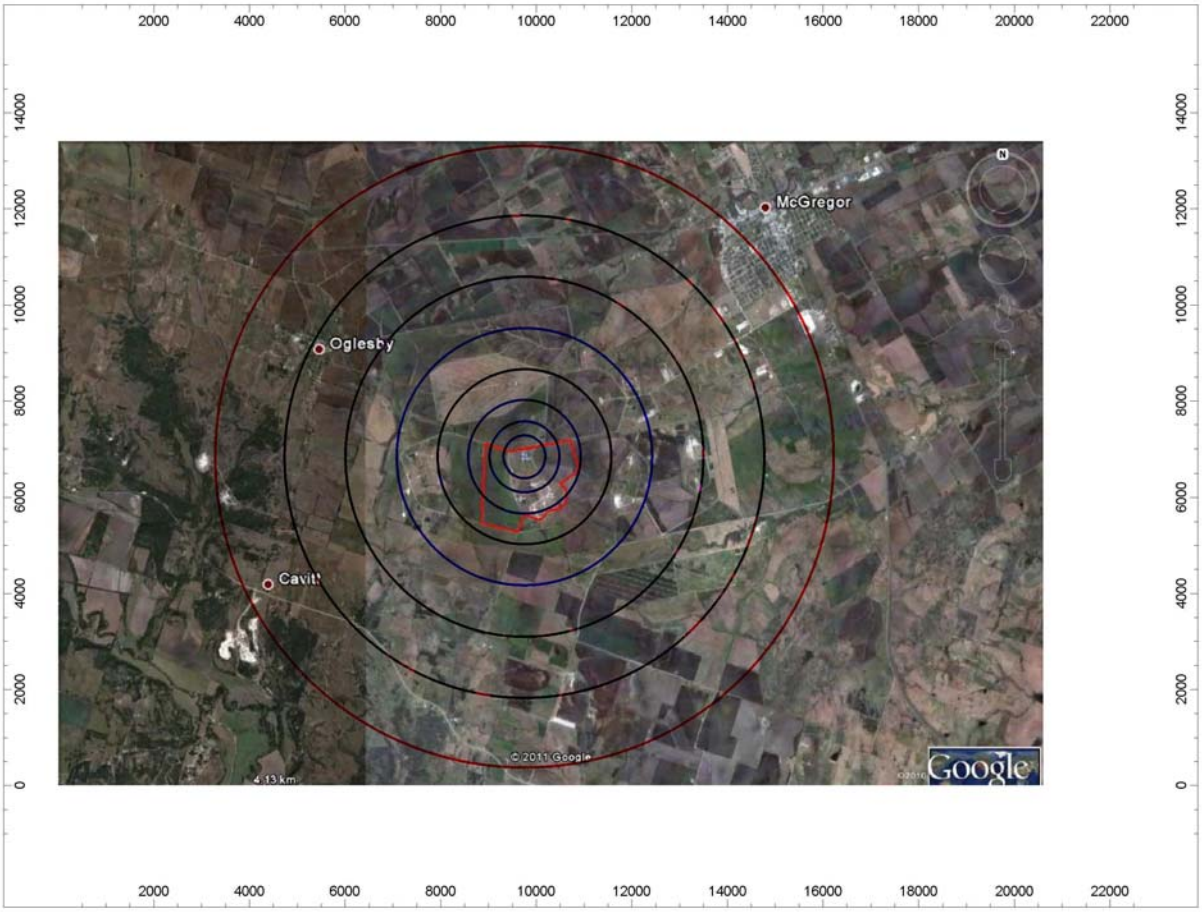
A noise sensitive area is an area where noise interferes with normal activities associated with its use. Examples of noise sensitive areas include, but are not limited to, residential, educational, health, and religious structures and sites, parks, recreational areas (including areas with wilderness characteristics), wildlife refuges, and cultural and/or historical sites where a quiet setting is a generally recognized feature or attribute. In addition to the residential communities of McGregor and Oglesby, noise sensitive areas near the proposed launch pad location include the Oglesby School, located approximately 3.4 miles northwest of the proposed launch pad location, and the McGregor High School, located approximately 4.5 miles northeast of the proposed launch pad location. The closest business is the Crosslink Powder Company, located

approximately 2.8 miles from the proposed launch pad location. The nearest residence is approximately 1.3 miles from the proposed launch pad location.

SpaceX is subject to noise limitations as stated in the property lease with the City of McGregor. The lease states that noise levels from engine (single or multiple) testing cannot exceed 115 dBA at 3 miles in any direction from the tripod test stand located at the McGregor test site. SpaceX is prohibited from conducting engine testing between the hours of 12:00 a.m. and 7:00 a.m.

Based on the existing engine test noise levels and durations previously discussed, and for the purposes of this estimate of existing conditions, assuming no nighttime tests, the 65 DNL contour line would be approximately 4 miles from the test site (see Exhibit 3-5). The 65 DNL contour line is selected for display, because according to FAA policy, a significant noise impact would occur if analysis shows that the Proposed Action would cause a noise sensitive area to experience an increase in noise of DNL 1.5 dB or more at or above the DNL 65 dB noise exposure level when compared to existing conditions. Exhibit 3-5 shows this noise contour (outermost circle) with each successive interior contour increasing by 5 dBA increments. According to Exhibit 3-5, residential areas in the City of McGregor and Oglesby are already exposed to 65 DNL or greater, due primarily to engine testing activities.

**Exhibit 3-5. Estimated Existing Noise Contours (DNL)[a]**




a. Units for axes are meters. Red line indicates McGregor test site boundary. The outermost circle is the 65 DNL contour line and is approximately 4 miles from the McGregor test site. Each successive interior contour increases by 5 dBA.

Compatible land use means the use of the land is normally compatible with the outdoor noise environment at the location. The concept of land use compatibility corresponds to the objective of achieving a balance or harmony between the project site and the surrounding environment. As mentioned previously, the McGregor test site is located within the City of McGregor industrial park and is largely surrounded by agricultural land. Exhibit 3-6 provides Federal compatible land use guidelines for residential, commercial, and manufacturing and production uses as a function of DNL values. Compatible or non-compatible land use is determined by comparing the predicted or measured DNL values of the Proposed Action to the values listed in Exhibit 3-6. According to Exhibit 3-6, residential areas in the City of McGregor and Oglesby that are already exposed to 65 DNL or greater are incompatible for residential use.

**Exhibit 3-6. Land-Use Compatibility with Yearly Day-Night Average Sound Levels[a]**

| | Yearly DNL Sound Level (decibels)[b] | | | | | |
|---|---|---|---|---|---|---|
| **Land Use** | **<65** | **65-70** | **70-75** | **75-80** | **80-85** | **>80** |
| **Residential** | | | | | | |
| Residential, other than mobile homes and transient lodgings<br>Mobile home parks<br>Transient lodgings | Y | N[c] | N[c] | N | N | N |
| **Commercial Use** | | | | | | |
| Offices, business and professional | Y | Y | 25 | 30 | N | N |
| Wholesale and retail – building materials, hardware, and farm equipment | Y | Y | Y[d] | Y[e] | Y[f] | N |
| Retail trade, general | Y | Y | 25 | 30 | N | N |
| Utilities | Y | Y | Y[d] | Y[e] | Y[f] | N |
| Communication | Y | Y | 25 | 30 | N | N |
| **Manufacturing and Production** | | | | | | |
| Manufacturing, general | Y | Y | Y[d] | Y[e] | Y[f] | N |
| Photographic and optical | Y | Y | 25 | 30 | N | N |
| Agriculture (except livestock) and forestry | Y | Y[g] | Y[h] | Y[i] | Y[i] | Y[i] |
| Livestock farming and breeding | Y | Y[g] | Y[h] | N | N | N |
| Mining and fishing, resource production and extraction | Y | Y | Y | Y | Y | Y |

Source: 14 CFR Part 150, Appendix A

a. The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under 14 CFR Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

b. 25 or 30 = Land use and related structures generally compatible; measures to achieve Noise Level Reduction of 25 or 30 dBA must be incorporated into design and construction of structure. Noise Level Reduction is the amount of noise reduction in decibels achieved through incorporation of building sound insulation treatments (between outdoor and indoor levels) in the design and construction of a structure (14 CFR § 150.7). Building sound insulation treatments typically consist of acoustical replacement windows and doors.
Y = Land use and related structures compatible without restrictions; N = Land use and related structures are not compatible and should be prohibited

c. Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor noise level reduction of at least 25 dBA and 30 dBA should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a noise level reduction of 20 dBA, thus, the reduction requirements are often stated as 5, 10 or 15 dBA over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of noise level reduction criteria will not eliminate outdoor noise problems.

d. Measures to achieve noise level reduction of 25 dBA must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

e. Measures to achieve noise level reduction of 30 dBA must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

f. Measures to achieve noise level reduction of 35 dBA must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

g. Residential buildings require noise level reduction of 25 dBA.

h. Residential buildings require noise level reduction of 30 dBA.

i. Residential buildings not permitted.

## 3.3 Land Use (Including U.S. Department of Transportation Section 4(f) Properties)

The EPA defines land use as "the way land is developed and used in terms of the kinds of anthropogenic activities that occur (e.g., agriculture, residential areas, and industrial areas)" (EPA 2011c). Land use is a critical element in understanding the context in which the Proposed Action would occur and potential impacts to land use are considered by the FAA/AST.

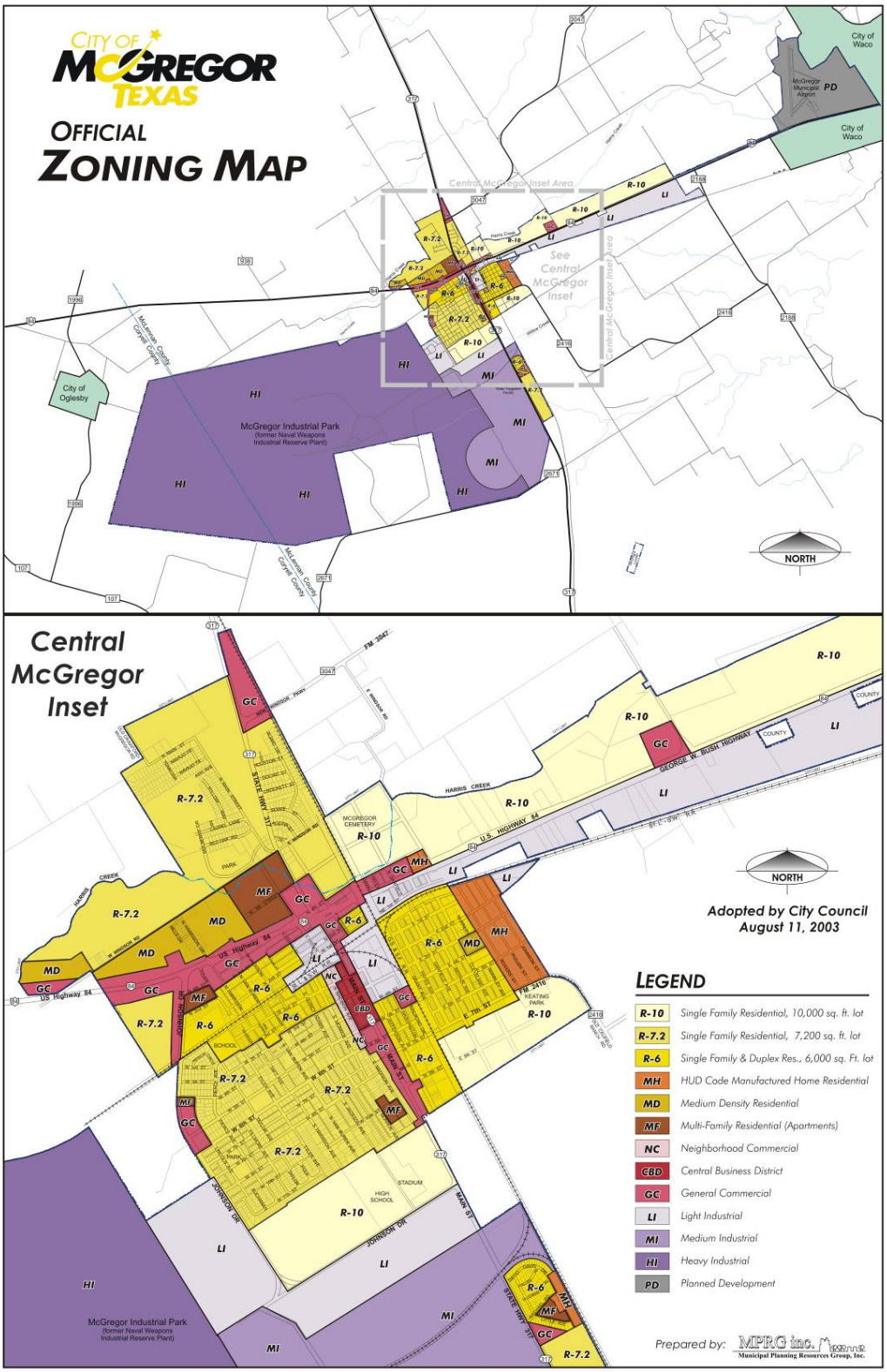
The FAA/AST must also consider impacts under Section 4(f) of the DOT Act, which was re-codified and renumbered as 49 U.S.C. Section 303(c). The FAA/AST will not approve any program or project that requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance or land from an historic site of national, State, or local significance as determined by the officials having jurisdiction thereof, unless no feasible and prudent alternative exists to the use of such land and such program, and the project includes all possible planning to minimize harm resulting from the use (FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1*).

The McGregor test site is a relatively isolated facility, surrounded predominantly by agricultural land. The closest residential communities to the proposed launch pad location are the City of McGregor, located approximately 5 miles to the northeast, and the City of Oglesby, located approximately 3 miles to the northwest (see Exhibit 2-2). The McGregor test site is located within the McGregor industrial park, located in land zoned by the city as "heavy industrial" (City of McGregor 2003a; see Exhibit 3-7).

The McGregor industrial park has been under the ownership of the City of McGregor since 1996. As mentioned previously, prior to 1996, the industrial park was known as the NWIRP. The NWIRP's mission included research, testing, and manufacture of weapons and solid fuel rocket propulsion systems. Since transfer of the property to the City of McGregor, a number of commercial tenants have leased space within the industrial park, including Dell Computer Corporation, Fergeson Plumbing Company, General Micrographics, In Situ Forms, McLennan County Electrical Corporation, Pace America, and SpaceX. In addition, the Central Texas Youth Rodeo Association indoor arena is located in the industrial park (EPA 2009).

Activities that occur within the McGregor industrial park include commercial activities, the recreational use of the rodeo arena, and agricultural cultivation. The majority of the land within the industrial park is used for agricultural production, including the area where the proposed launch pad would be constructed. As mentioned in Section 2.2, SpaceX currently conducts engine tests at the McGregor test site. SpaceX averages approximately five Merlin-1D tests per week as well as six Falcon 9 Stage 1 tests per year.

**Exhibit 3-7. McGregor, Texas Zoning Map**




Source: City of McGregor 2003a

A number of State and local recreational areas that may be considered Section 4(f) properties were identified within the general vicinity of the project area. These resources, as well as their distance and direction in relation to the McGregor test site are listed in Exhibit 3-8 below. Additionally, the Iron Bridge Wildlife Management Area is located approximately 5.5 miles south of the project area. None of these areas are located within the physical boundaries of the McGregor industrial park. Publicly and privately owned historic sites of significance may also be considered Section 4(f) properties. See Section 3.5 below for a discussion of historic properties.

**Exhibit 3-8. Recreational Facilities Near the McGregor Test Site**

| Resource Name | Distance from McGregor Test Site (miles) | Direction from Grasshopper Site |
|---|---|---|
| Amsler Park | 5.1 | Northeast |
| Bewley Park | 4.5 | Northeast |
| Bluebonnet Park | 4.1 | Northeast |
| Kasting Park | 5.6 | Northeast |
| Legacy Park | 5.1 | Northeast |
| Mother Neff State Park | 4.3 | South |
| Oglesby Park | 2.3 | Northwest |

Source: City of McGregor 2002

## 3.4 Biological Resources (Fish, Wildlife, and Plants)

### 3.4.1 Vegetation

The McGregor test site is located in the Cross Timbers and Prairies ecological region, which encompasses approximately 26,000 square miles in north and central Texas and is the primary ecological region of north central Texas (TPWD 2011a). Grasses, forbs, trees, and shrubs are the dominant plant types within the Cross Timbers and Prairies ecological region. These plant types provide forage for browsing wildlife species; nesting and roosting sites for birds; cover; and food in the form of seeds, nuts, and fruits. Common plant species found within the Cross Timbers and Prairies ecological region include little bluestem, bluebonnets, Texas ash, and coralberry (TPWD 2011a).

The McGregor test site is located in area that has been previously disturbed by industrial activity (e.g., the NWIRP) as well as agricultural practices (e.g., crop production and cattle grazing). The pastureland and rangeland areas at the McGregor test site are primarily open grasslands, vegetated with a variety of native grass species. Part of the test site is vegetated with a combination of bermuda grass, native grasses, and live oaks. The industrial areas have been maintained by mowing.

### 3.4.2 Wildlife

The McGregor test site and surrounding area contains a variety of wildlife, including species of birds, mammals, amphibians, and reptiles. Some of the more common species likely to be present at or near the test site include bobwhite quail, mourning dove, eastern cottontail, and whitetail deer. Habitat for fish species is limited primarily to the intermittent streams located at the test site (see Section 3.9.1 below for a description of surface waters).

### 3.4.3 Special Status Species

The Endangered Species Act (ESA) establishes protection and conservation of threatened and endangered species and the ecosystems upon which they depend. The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) administer the ESA and designate critical habitat for each species protected under the ESA. Section 7 of the ESA requires all Federal agencies to consult with the USFWS and/or NMFS, as applicable, before initiating any action that may affect a listed species or designated critical habitat. Candidate species, which may be listed as threatened or endangered in the near future, are not provided any statutory protection under the ESA.

The Texas legislature authorized the Texas Parks and Wildlife Department (TPWD) to establish a list of threatened and endangered plant and animal species, and to protect the species. TPWD regulations prohibit the taking, possession, transportation, or sale of any of the animal species designated by State law as endangered or threatened without a permit. Texas laws and regulations prohibit commerce in threatened and endangered plants and the collection of listed plant species from public land without a permit issued by TPWD.

See Exhibit 3-9 for a description of the 14 State-listed species and 3 federally listed species found in McLennan and Coryell counties. When the U.S. Navy was considering closing the NWIRP and transferring ownership of the property to the City of McGregor, the U.S. Navy prepared and published the *Environmental Assessment for the Disposal or Retention of the Naval Weapons Industrial Reserve Plant (NWIRP), McGregor, Texas* (hereafter referred to as the 1998 EA or cited throughout the EA as U.S. Navy 1998). In preparing the 1998 EA, the U.S. Navy contacted the Austin USFWS field office to determine if any protected species had been identified at or near the NWIRP. It was determined that there were no known occurrences of protected species at the NWIRP (U.S. Navy 1998). In preparing this Draft EA, the FAA/AST contacted the USFWS Ecological Services Field Office in Austin, TX, to determine if the USFWS is aware of any protected species occurring at or near the McGregor industrial park (USFWS 2011c). The Austin fish and wildlife biologist indicated he was not aware of any federally listed species occurring in the area. The potential for occurrence of any of the listed species in Exhibit 3-9 at the McGregor test site is unlikely due primarily to the absence of preferred habitat, on-going agricultural activities, and maintenance (e.g. mowing) and operation activities (e.g., engine testing).

**Exhibit 3-9. State and Federally Listed Species in McLennan and Coryell Counties, Texas (page 1 of 2)**

| Species | State Status[a] | Federal Status[a] | Habitat Requirements |
|---|---|---|---|
| Golden-cheeked warbler | E | E | Juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs. |
| Peregrine falcon | T | Delisted | Meadows, mudflats, beaches, marshes, and lakes where birds are abundant. Migrate through the State. |

**Exhibit 3-9. State and Federally Listed Species in McLennan and Coryell Counties, Texas (page 2 of 2)**

| Species | State Status[a] | Federal Status[a] | Habitat Requirements |
|---|---|---|---|
| Whooping crane | E | E | Migrate through Texas to Gulf Coast. During migration, croplands are used for feeding, and large wetland areas are used for feeding and roosting. |
| Bald eagle | T | Delisted[d] | Quiet coastal areas, rivers, or lakeshores with large, tall trees. |
| Black-capped vireo | E[b] | E | Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover. |
| Wood stork | T[c] | Not listed | Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds. |
| White-faced ibis | T[c] | Not listed | Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats. |
| Interior least tern | E[c] | Not listed | Nests along sand and gravel bars within braided streams and rivers. |
| Red wolf | E | Not listed | Extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies. |
| Smooth pimpleback | T | Not listed | Small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel substrate, tolerates very slow to moderate flow rates. |
| False spike mussel | T | Not listed | Possibly extirpated in Texas; medium to large rivers; substrates vary from mud through mixtures of sand, gravel, and cobble. |
| Texas fawnsfoot | T | Not listed | Little known about habitat; possibly rivers and larger streams; intolerant of impoundments; flowing rice irrigation canals, possibly sand, gravel, and sandy-mud bottoms in moderate flows. |
| Timber/canebrake rattlesnake | T | Not listed | Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland, limestone bluffs, sand soil or black clay; prefers dense ground cover. |
| Texas horned lizard | T | Not listed | Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive. |

Source: TPWD 2011b; TPWD 2011c; USFWS 2011a

a. E = endangered; T = threatened;
b. Listed only in Coryell County
c. Listed only in McLennan County
d. Bald and golden eagles are protected by the Bald and Golden Eagle Protection Act, which is administered by the USFWS. The Act prohibits unauthorized capture, purchase, or transportation of the birds, their nests, or their eggs. Any action that might disturb these species requires a permit from the USFWS.

## 3.5 Historical, Architectural, Archaeological, and Cultural Resources

Cultural resources include prehistoric and historic archaeological sites, buildings, districts, structures, landscapes, or objects having historical, architectural, archaeological, cultural, or scientific importance. Section 106 of the National Historic Preservation Act (NHPA) requires a Federal agency to consider the effects of its undertaking (or action) on properties listed or eligible for listing on the National Register of Historic Places (NRHP). Compliance with Section 106 requires consultation with the State Historic Preservation Officer (SHPO) if there is a potential adverse effect to historic properties listed or eligible for listing on the NRHP.

During the development of the 1998 EA, the U.S. Navy consulted the SHPO pursuant to Section 106 of the NHPA to identify historic properties listed or eligible for listing on the NRHP. A historic resources survey was conducted at the NWIRP between August 1995 and February 1996 (U.S. Navy 1998) in accordance with the standards and guidelines of the SHPO and the National Park Service. The survey identified 191 existing properties located at the NWIRP that were potentially eligible for listing on the NRHP. Of these 191 historic properties, all were military-related property types, including:

- administrative facilities,
- production facilities,
- research and development facilities,
- utilities and infrastructure facilities,
- operational support facilities,
- shipping and storage facilities, and
- landscape elements.

The survey evaluated the relative significance and integrity of each of the 191 properties for their contributions to the major historical themes, events, and trends that affected the development of the NWIRP. Based on this assessment, the survey identified four individual properties (Buildings 105, 300, 603, and 1201) and a historic district (Buildings 8001 through 8064) that might have been eligible for listing in the NRHP (U.S. Navy 1998). The SHPO reviewed the historic resources survey and concurred with its principle recommendations, but further determined that the following properties were also eligible for listing in the NRHP, due to their part in the make-up of the physical plant: Buildings 106, 404, 601, 602, 711, 712, 1237, 2301, 2308, and 2309.

The SHPO recommended that a Memorandum of Agreement (MOA) be prepared to address the potential adverse effects on historic properties at the NWIRP, as a result of the U.S. Navy closing and/or transferring the site to the City of McGregor. An MOA was prepared and signed in 1998 by the U.S. Navy, SHPO, City of McGregor, and Advisory Council on Historic Preservation. The MOA includes appropriate deed covenants requiring SHPO review of character alterations to the eligible buildings that could potentially be transferred from the U.S. Navy to the City of McGregor.

The SHPO recommended that prior to any demolition or transfer of property, the Navy complete and submit Historic American Buildings Survey (HABS) Level III documentation for each property type. The HABS Level III documentation was completed in September 1997 and was accepted by the SHPO as completion of the Section 106 process (U.S. Navy 1998).

In addition to surveying for historic properties, a reconnaissance survey to identify archeological resources was conducted in October and November 1995 (U.S. Navy 1998). The field reconnaissance survey identified 28 archeological sites: 24 historic sites, 3 sites containing both historic and prehistoric materials, and 1 entirely prehistoric site. The site that was entirely prehistoric and 13 of the 27 historic components (for a total of 14 archeological sites) were recommended as being potentially eligible for listing on the NRHP (U.S. Navy 1998). The SHPO reviewed the archeological survey report and recommended that, if the property was transferred, the U.S. Navy and the acquiring entity agree to transfer the NWIRP property with a protective covenant that includes adequate conditions to ensure the preservation of the property's significant historic features. The U.S. Navy incorporated protective covenants for both historic and archeological resources into the MOA (U.S. Navy 1998). FAA/AST contacted the SHPO and confirmed that none of the 14 archeological sites that might be eligible for listing on the NRHP that are referred to in the MOA are located within the operating area (THC 2011).

Of all the historic properties that were considered to be eligible for listing on the NRHP, only Building 300 is occupied. Building 300 houses the McGregor Volunteer Fire Department. All other historic properties/buildings are either vacant or have been demolished. Buildings 1201 and 1237 were the only historic properties that were located on property currently leased by SpaceX. Building 1201 was built in 1944 and was used as an administrative office for the Navy (U.S. Navy 1998). Building 1237 was also built in 1944 and was used for storing chemicals and rocket propellants (U.S. Navy 1998). Both buildings were demolished prior to SpaceX leasing the property in 2003. Also, a recent search of the NRHP for Coryell and McLennan Counties resulted in no listed historic properties located near the proposed launch pad location (NPS 2011). There are no other known historical, archaeological, or cultural resources, or resources of architectural importance, located at the McGregor test site.

## 3.6 Hazardous Materials, Pollution Prevention, and Solid Waste

The storage, handling, and use of hazardous materials at the McGregor test site are governed by multiple Federal and State regulations, including the Comprehensive Environmental Response, Compensation, and Liability Act, and the Resource Conservation and Recovery Act (RCRA). Hazardous materials are those substances that pose potential threats to humans and the environment because of their quantity, concentration, or physical, chemical, or infectious characteristics. Texas regulates hazardous wastes under Texas Administrative Code, Title 30, Chapter 335, Industrial Solid and Municipal Hazardous Waste, which is administered by the TCEQ.

SpaceX produces approximately 10,000 pounds of hazardous waste annually at the McGregor test site. Hazardous waste is generally produced by engine testing and cleaning or dismantling of the engines. Hazardous wastes produced at the McGregor test site include acetone, oily rags, paint-related wastes, and hypergol waste in the form of water mixed with either monomethylhydrazine or nitrogen tetroxide in small amounts. Additional wastes include used oil and batteries from maintenance activities. Disposal of hazardous waste at the McGregor test site is currently handled through an independent contractor. The waste is removed from the site by the contractor and taken to a 90-day storage area. The waste is then transported to an environmentally approved landfill in Deer Park, Texas, where it is incinerated or treated before proper disposal. There is no treatment or disposal of hazardous waste onsite at the McGregor test site.

Solid waste generated at the McGregor test site is contracted for pickup and transport to the City of Waco landfill. SpaceX maintains three dumpsters (2 cubic yards each) for solid waste ranging from food containers to cardboard packaging and plastic. These dumpsters are emptied by the contractor three times each week. Additionally, the site maintains two construction roll-off dumpsters (30 cubic yards each), which are emptied when necessary.

The production of hazardous and solid waste at the McGregor test site and adjacent areas has been occurring for several decades. From 1942 through the close of the NWIRP in 1995, materials for military applications, shells and airplane bombs, munitions grade and fertilizer grade ammonium nitrate, and production of components for various weapons were manufactured and produced at the site (U.S. Navy 1998). Hazardous materials that were stored on-site prior to 1995 included waste explosives, propellants, solvents, and other solid wastes (U.S. Navy 1998).

When the U.S. Navy closed the NWIRP, site investigations were conducted regarding past hazardous waste releases from the NWIRP operations, per RCRA requirements and the Texas Administrative Code. In 2001, the U.S. Navy issued a Finding of Suitability to Transfer study as part of the U.S. Navy's lease agreement with the City of McGregor (U.S. Navy 2001). The study found that groundwater in the adjacent land parcel to the east of the proposed launch pad area (which is currently leased by SpaceX) was contaminated from past use of the NWIRP as a naval weapons production facility, but not at concentrations requiring remedial action. The adjacent land parcel to the west of the proposed launch pad area was found to have groundwater and soil contaminated with perchlorate from past use of the NWIRP. The remediation for this land parcel is ongoing, and by 2023 all areas of the former NWIRP contaminated with perchlorate are expected to be remediated (U.S. Navy 2008). In the immediate area of the proposed launch pad, sampling results from two groundwater wells showed no migration of contaminants into the area from either the parcel to the east or west (U.S. Navy 2001).

## 3.7 Light Emissions and Visual Resources

The FAA considers the extent to which any lighting associated with an action would create an annoyance among people in the vicinity or interfere with their normal activities. Visual and aesthetic resources refer to natural or developed landscapes that provide information for an individual to develop their perceptions of the area. Areas such as coastlines, national parks, and recreation or wilderness areas are usually considered to have high visual sensitivity. Heavily industrialized urban areas tend to be the areas of the lowest visual sensitivity.

The existing conditions at the McGregor test site are characterized as having low visual sensitivity, because the site is currently an industrialized area that supports engine testing. SpaceX conducts general engine tests and Falcon 9 Stage 1 tests, which produce noise and flames. Notable visual structures include the existing tripod test stand, which is used to conduct Falcon 9 Stage 1 tests. Due to the flat topography and the height of the tripod test stand (approximately 235 feet), the test stand and Falcon 9 Stage 1 engine tests can be seen several miles away. Existing light sources at the McGregor test site include nighttime security lighting at the test stands and buildings, and safety lighting at the tripod test stand.

## 3.8 Natural Resources and Energy Supply

Executive Order (EO) 13123, *Greening the Government Through Efficient Energy Management*,[4] encourages Federal agencies to expand the use of renewable energy in their activities, while also reducing the use of petroleum, total energy, and water consumption. Similarly, FAA policy encourages the development of facilities that exemplify the highest standards of design, including principles of sustainability.

The energy supply for the McGregor test site consists of gas and electricity supplied by Hudson Energy Services, LLC in Irving, Texas. The facility currently uses approximately 200,000 kW-hr per month. Gasoline and other fuels and small batteries are used for facility vehicles. SpaceX also occasionally uses a diesel-powered generator to provide lighting for operations. Potable water is provided by the City of McGregor via water mains. The facility currently uses about 125,000 gallons of water per month to support its operations.

## 3.9 Water Resources (Surface Waters and Wetlands, Groundwater, Floodplains, and Water Quality)

At the Federal level, the Clean Water Act (CWA) is the primary statute governing water pollution and water quality in wetlands or other waters subject to U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (EPA) jurisdiction. Section 404 of the CWA regulates discharges of dredged or fill material into jurisdictional waters, known as waters of the United States. The USACE is authorized to issue permits for the discharge of dredged or fill materials into waters of the United States.

Sections 303(d), 401 and 402 of the CWA protect surface water quality. While the CWA is a Federal law, these sections of the CWA are delegated to and implemented by State, territory, or tribal authorities. In Texas, the Texas Commission on Environmental Quality (TCEQ) has been given the authority from the EPA for developing the impaired waters list and establishing total daily maximum loads under Section 303(d) of the CWA. The EPA has also approved the TCEQ to implement the Section 402 (National Pollutant Discharge Elimination System or NPDES) permit program and to issue Section 401 Water Quality Certifications.

The TCEQ also has the responsibility for the majority of the State's environmental water quality and regulatory programs. As the State lead agency for water resources and environmental protection, the TCEQ administers both State and federally mandated (as mentioned above) programs. The Texas Legislature has authorized the TCEQ, the Texas Water Development Board (TWDB), and the Texas Parks and Wildlife Department (TPWD) to study, identify and delineate priority groundwater management areas, and initiate the creation of Groundwater Conservation Districts (GCDs) within those areas, for the purpose of managing the State's groundwater resources in areas where critical groundwater problems exist or may exist in the future. The primary management of groundwater in Texas is found at the local level through GCDs. The proposed project falls within two separate GCDs: (1) Middle Trinity Groundwater Conservation District (Coryell County) and (2) Southern Trinity Groundwater Conservation District (McLennan County).

Under EO 11990, *Protection of Wetlands*, all Federal agencies are directed, to the extent practicable, to avoid adverse impacts associated with the destruction or modification of wetlands.

[4] 64 *FR* 30851, June 8, 1999.

Similarly under EO 11988, *Floodplain Management and Protection*, Federal agencies are required to evaluate potential effects of any project conducted within a floodplain. This includes, where possible, avoiding activity within a floodplain and avoiding and minimizing adverse impacts for projects sited within a floodplain. DOT implementation of these two EOs is carried out by DOT's Orders 5660.1a, *Preservation of the Nation's Wetlands*, and 5650.2, *Floodplain Management and Protection*.

The Safe Drinking Water Act was established to protect the quality of drinking water of the United States. The Act focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground. The EPA is responsible for establishing minimum standards to protect tap water and requires all owners or operators of public water systems to comply with these standards.

### 3.9.1 Surface Waters and Wetlands, and Water Quality

The McGregor test site is located within the Willow Creek-South Bosque River Watershed, part of the Waco Lake Watershed, a sub-drainage basin of the Bosque River Watershed. These watersheds are part of the larger Texas Gulf Region watershed, where all surface water flow discharges to the Gulf of Mexico. According to the EPA (2010), the Willow Creek-South Bosque River Watershed encompasses 33,143 acres. Land use in the watershed is dominated by row crops, followed by wood/range, and pasture. The remaining land use is dominated by urban and water areas (McFarland and Hauk 1999).

The proposed operating area is at a topographical high point and would generally drain toward the south and east. In the operating area, two streams are identified on the USFWS topography map: South Bosque River and Onion Creek. The headwaters of both streams are found in the operating area and are identified as intermittent streams. Further downstream, the streams turn into perennial waters. South Bosque River originates in an open field near the proposed launch pad location (approximately 370 feet from launch pad location) and flows southeast through two excavated ponds. From there the South Bosque River flows over 16 miles to the Bosque River. Onion Creek originates in an open field, approximately 2,200 feet southwest of the proposed launch pad location, and flows south out of the operating area through several excavated ponds until it reaches Station Creek approximately 3 miles downstream.

The National Wetland Inventory (NWI) map indicates one Palustrine Unconsolidated Bottom Semipermanently Flooded Diked/Impounded wetland in the operating area (USFWS 2010b). This wetland appears to be a stock pond for livestock. Another stock pond used for livestock is located upstream of the NWI mapped stock pond. The South Bosque River flows (intermittent in this area) through these two stock ponds. In addition, a drainage ditch runs along the east site of the field and drains southeast toward the NWI mapped stock pond.

None of the surface waters in the operating area are listed as 303(d) impaired waters. In addition, no Texas Parks and Wildlife Department Significant Rivers, as designated by the TWDB, are identified in the operating area. The McGregor test site currently operates under a Texas Pollutant Discharge Elimination System (TPDES) multi-sector general stormwater permit for stormwater discharge (permit #TXR05Z834). Coverage under this permit began November 3, 2010, and is currently active.

### 3.9.2 Floodplains

Floodplains are defined as "any land area susceptible to being inundated by waters from any source" (44 CFR Part 59). The Federal Emergency Management Agency (FEMA) identifies 100-year floodplains and 500-year floodplains. The 100-year floodplain has a 1-percent chance of flooding in any given year. Areas with a 0.2 percent chance of being flooded in any given year are identified as 500-year floodplains. Floodplains are important for attenuating floods, reducing stormwater runoff into waterbodies, and filtering out sediment and other pollutants from surface runoff.

In the United States, the National Flood Insurance Program regulates development in mapped 100-year floodplains for communities that participate in the program. The City of McGregor, and McLennan and Coryell Counties, are all participating communities in the program. According to FEMA mapping, the 100-year floodplain associated with the South Bosque River is mapped in the southeast portion of the operating area (Department of Homeland Security 2008, 2010). The proposed site for the launch pad is not located in the mapped 100-year floodplain.

### 3.9.3 Groundwater

The operating area is over the Trinity (subcrop) aquifer. The TCEQ has designated this area of the aquifer a Priority Groundwater Management Area. This designation is based on TCEQ's finding that indicates the decline in groundwater levels in the aquifer is a significant problem and that the decline in groundwater levels will cause groundwater availability and quality problems for the region. Withdrawals from the Trinity aquifer exceed the recharge and continued overdraft is resulting in water-level declines in the confined portion of the aquifer (Bradley 1999). Overall, groundwater quality throughout the aquifer is good (Bradley 1999). There are no active groundwater wells on the McGregor test site. No EPA designated Sole Source Aquifers are found at the McGregor test site.

In 2001, the U.S. Navy issued a Finding of Suitability to Transfer study as part of the U.S. Navy's lease agreement with the City of McGregor (U.S. Navy 2001). The study found that groundwater in the adjacent land parcel to the east of the proposed launch pad area was contaminated from past use of the facility as a naval weapons production facility, but not at concentrations requiring remedial action. Therefore, in accordance with Department of Defense Condition of Property Classification Guidance, the groundwater in the area was classified as Category 3 (areas where release, disposal, and/or migration of hazardous substances has occurred, but at concentrations that do not require removal or remedial response). The adjacent land parcel to the west of the proposed launch pad area was found to have groundwater and soil contaminated with perchlorate from past use of the naval facility. Over time this groundwater plume migrated southward. In 2002, remediation actions to remove the perchlorate began, and by 2008, greater than 50 percent of the perchlorate mass had been removed. By 2023, all off-site properties contaminated with perchlorate are expected to be remediated (U.S. Navy 2008). In the immediate area of the proposed launch pad, sampling results from two groundwater wells showed no migration of contaminants into the area from either the parcel to the east or west (U.S. Navy 2001).

# 3.10 Socioeconomics, Environmental Justice, and Children's Environmental Health and Safety

CEQ NEPA implementing regulations state that the *human environment* "shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment."[5] Regarding environmental justice, EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, directs each Federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Subsequent Orders at the State and Federal level, including DOT Order 5610.2, *Environmental Justice in Minority Populations and Low-Income Populations* (DOT 1997), have reinforced the directives outlined in EO 12898. CEQ, which oversees the Federal government's compliance with EO 12898 and NEPA, also developed guidelines (CEQ 1997a) to assist Federal agencies in incorporating the goals of EO 12898 into the NEPA process. EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, requires Federal agencies to identify disproportionately high and adverse impacts to children.

Affected environment descriptions in this section are categorized according to the following resource categories:

- Demographics and Housing
- Economy and Employment
- Environmental Justice
- Children's Environmental Health and Safety

The McGregor test site is located between Oglesby and McGregor, Texas, approximately 3.5 miles south of U.S. Route 84 (see Exhibit 2-2). From a socioeconomic, environmental justice, and children's environmental health and safety perspective, the ROI for the Proposed Action encompasses (1) the Cities of McGregor, Oglesby, and Waco; and (2) the Counties of McLennan and Coryell in which the McGregor test site and surrounding cities are located.

## 3.10.1 Demographics and Housing

Exhibit 3-10 provides an overview of long-term population trends in the area at the county and State level. The Cities of Waco and McGregor are located in McLennan County. They are substantially more populous than the City of Oglesby, which is located in Coryell County. Adding to this population disparity, from 2000 to 2009, the Cities of McGregor and Waco, and McLennan County, demonstrated an increase in population, while the City of Oglesby and Coryell County experienced a decline in population. Overall, as evidenced by population and housing statistics, the areas of potential impact at the City and County level in the vicinity of the McGregor test site have experienced slow growth or even population decline when compared to the same statistics for the State of Texas. All statistical areas also show a large percentage of vacant housing units (11 percent or greater).

[5] 40 CFR § 1508.14

**Exhibit 3-10. Current Population and Housing Data in the Region of Influence (2005–2009 Average)**

| Location | Total Population | Population Growth Rate (2000-2009) | Area (square miles) | Population Density (persons/ square mile) | Total Housing Units | Vacant Housing Units (Percent of Total) |
|---|---|---|---|---|---|---|
| City of McGregor | 4,856 | 2.7% | 21.8 | 223 | 1,815 | 14.0% |
| City of Oglesby | 426 | -7.0% | 0.5 | 852 | 157 | 23.6% |
| City of Waco | 122,731 | 7.9% | 95.5 | 1,285 | 51,130 | 13.1% |
| McLennan County | 228,369 | 7.0% | 1,060 | 215 | 91,931 | 11.0% |
| Coryell County | 72,617 | -3.1% | 1,057 | 69 | 23,544 | 15.7% |
| State of Texas | 23,819,042 | 14.2% | 268,581 | 89 | 9,407,692 | 12.1% |

Source: U.S. Census Bureau 2010a

### 3.10.2 Economy and Employment

Exhibit 3-11 below provides an overview of poverty, income, and employment statistics in the ROI at the city, county, and State levels. In general, the cities near the McGregor test site have a comparable income to the counties in which they are located, all of which have a slightly lower income than the state generally. The City of Waco has a significantly lower median household income than the other areas, but maintains a similar per capita income. The Cities of McGregor and Waco, as well as McLennan County, have a percentage of individuals living in poverty of around 20 percent, while Coryell County has a slightly lower percentage of around 15 percent, and the City of Oglesby has the lowest percentage of individuals living in poverty, around 8 percent. The unemployment rate is similar at the county and State levels (around 7 percent), but significantly lower for the Cities of McGregor and Oglesby (around 2 percent). The City of Waco has the highest unemployment rate of nearly 10 percent.

**Exhibit 3-11. Income, Poverty, and Employment Data in the Region of Influence (2005–2009 Average)**

| Location | Median Household Income[a] | Per Capita Income[a] | Percent of Population in Poverty | Total Number of People in Labor Force | Percent of Labor Force Unemployed |
|---|---|---|---|---|---|
| City of McGregor | $42,824 | $16,403 | 21.0% | 2,253 | 2.1% |
| City of Oglesby | $43,125 | $19,563 | 7.6% | 218 | 1.4% |
| City of Waco | $29,826 | $17,045 | 28.8% | 56,824 | 9.8% |
| McLennan County | $40,038 | $20,160 | 20.7% | 110,699 | 7.4% |
| Coryell County | $45,678 | $18,688 | 14.9% | 36,733 | 7.1% |
| State of Texas | $48,199 | $24,318 | 16.8% | 11,749,614 | 6.8% |

Source: U.S. Census Bureau 2010a

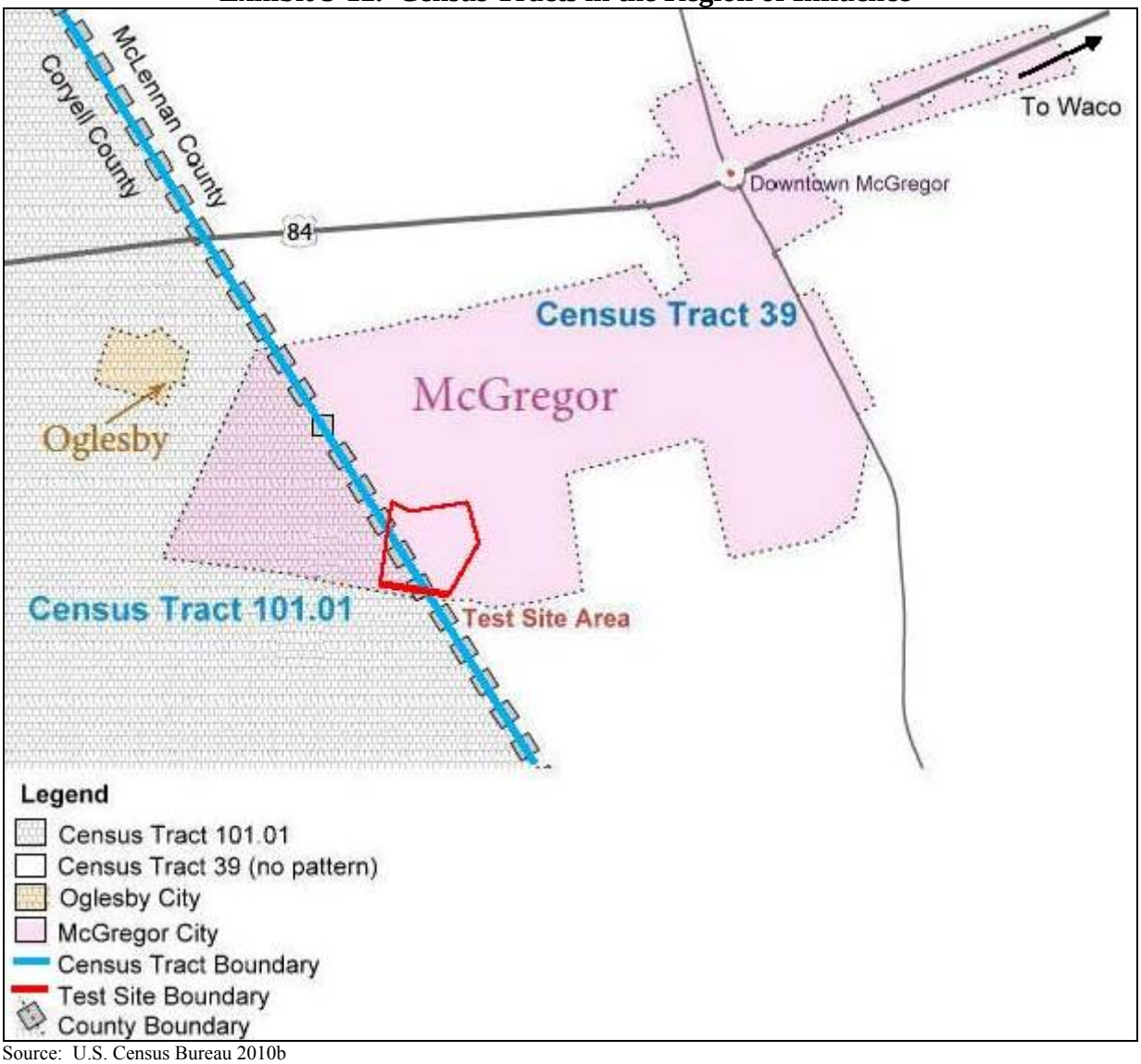
a. Shown in 2009 inflation-adjusted dollars

### 3.10.3 Environmental Justice

DOT Order 5610.2 requests that DOT agencies consider the population structure in the ROI to determine whether minority or low-income populations are present and, if so, whether there may be disproportionately high and adverse human health or environmental effects on either of these groups. The order requires that DOT continuously monitor its programs, policies, and activities to ensure that disproportionately high and adverse effects on minority populations and low-income populations are avoided, minimized, or mitigated.

"Minority populations," as defined by DOT Order 5610.2, are comprised of individuals from the following demographic groups: Black, Hispanic, Asian American, or American Indian or Alaska Native. "Low-income populations," also defined by DOT Order 5610.2, are comprised of households with annual income below the Department of Health and Human Services' poverty guidelines as reported by the Bureau of the Census. The Order identifies the presence of significant minority or low-income populations when there is a "readily identifiable group of [minority/low-income] persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy or activity." The ROI for this analysis refers to the census tracts in which the McGregor test site is located or adjacent to. As shown in Exhibit 3-12 below, the ROI includes Census Tract 39 in McLennan County and Census Tract 101.01 in Coryell County.

**Exhibit 3-12. Census Tracts in the Region of Influence[a]**




Source: U.S. Census Bureau 2010b

a. Census Tract 101.01 in Coryell County and Census Tract 39 in McLennan County are the only two census tracts located in the ROI. The boundaries of these census tracts are shown in blue and represent the same boundary as the county boundary for the extent shown in the exhibit. Note that the census tract boundaries extend beyond the limits of the exhibit. The McGregor test site boundary is approximate.

In order to determine if there are "readily identifiable" minority or low-income populations in the ROI, this analysis follows the CEQ guidance for identifying environmental justice populations (CEQ 1997a). According to CEQ, environmental justice populations are present if either: (1) the minority/low-income population exceeds 50 percent of the affected area population, or (2) the minority/low-income population percentage in the affected area is meaningfully greater than the minority/low-income population percentage in the general population or appropriate unit of geographical analysis. For purposes of the analysis, the term "meaningfully greater" refers to at least 10 percentage points greater, and the term "appropriate unit of geographical analysis" refers to the county in which the census tract is located. Thus, potentially affected minority or low-income populations are present in the affected area if either Census Tract 39 or 101.01 contains a proportion of minorities or low-income households which either (1) exceeds 50 percent or (2) is at least 10 percentage points greater than the corresponding percentage for McLennan or Coryell Counties, respectively.

As demonstrated in Exhibit 3-13, the ROI contains no potentially affected minority or low-income populations. All minority and low-income populations in both census tracts are under 30 percent of the total population, and neither census tract contains minority or low-income populations 10 percentage points higher than the county in which it is located. The same is true for county minority and low income percentages, when compared to those percentages for the State of Texas.

**Exhibit 3-13. Environmental Justice Statistics for the Region of Influence (percentage of population)**

| Demographic Group | Census Tract 101.01, Coryell County | Census Tract 39, McLennan County | McLennan County | Coryell County | State of Texas |
|---|---|---|---|---|---|
| White | 91.9 | 77.4 | 76.7 | 71.0 | 71.8 |
| Black or African American | 0.7 | 6.7 | 14.7 | 19.5 | 11.5 |
| American Indian and Alaska Native | 0.5 | 0.8 | 0.5 | 0.8 | 0.5 |
| Asian | 0.2 | 0.6 | 1.4 | 1.7 | 3.4 |
| Hawaiian/Pacific Islander | 0.0 | 0.0 | 0.0 | 0.5 | 0.1 |
| Some Other Race | 4.9 | 12.0 | 5.1 | 2.9 | 10.7 |
| Two or More races | 1.8 | 2.6 | 1.6 | 3.6 | 1.9 |
| Hispanic or Latino (of any race) | 9.4 | 25.3 | 21.5 | 13.8 | 15.1 |
| Families Below Poverty Level | 7.7[a] | 11.0 | 14.0 | 13.7 | 13.2 |

Source: U.S. Census Bureau 2010c (minority data); U.S. Census Bureau 2000 (poverty data)

a. Data for this cell is from Census Tract 101 in 2000. This Census Tract has since been divided into 101.01 and 101.02 and is reported as such in the 2010 Census. Minority data in this column is for Census Tract 101.01 in 2010.

### 3.10.4 Children's Environmental Health and Safety

The nearest locations containing high concentrations of children are five schools located approximately 3.5 to 4.5 miles from the McGregor test site within the McGregor and Oglesby School Districts. Exhibit 3-14 below indicates the name of these schools, along with the number of students and distance from the McGregor test site. There are no other schools, daycare facilities, playgrounds, or other places where children are concentrated within the vicinity of the McGregor test site.

**Exhibit 3-14. Schools Near the McGregor Test Site**

| School | Approximate Distance and Direction from Test Site | Number of Students |
|---|---|---|
| Oglesby School | 3.5 miles NW | 164 |
| McGregor Prep High School | 4.0 miles NE | unknown |
| McGregor High School | 4.5 miles NE | 365 |
| McGregor (T.H. Jenkins) Elementary | 4.5 miles NE | 570 |
| Isbill Junior High School | 4.5 miles NE | 437 |

Source: McGregor Independent School District 2011, Oglesby School District 2011

# 4. ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences of the Proposed Action and No Action Alternative. The FAA/AST evaluated the potential environmental consequences of the Proposed Action and the No Action Alternative in accordance with all relevant legal requirements, including 40 CFR 1502.16 and FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1*, which specifies significance thresholds for applicable resource areas.

## 4.1 Proposed Action

### 4.1.1 Air Quality

Air pollutant emissions would be generated during construction, operations (pre-flight operations; takeoff, flight, and landing; and post-flight operations), and launch failures. Impacts to air quality would be considered significant if analysis shows that the Proposed Action would cause pollutant concentrations to threaten to exceed one or more of the NAAQS. Because the proposed launch pad site is located in an air quality control region designated as attainment with the NAAQS, a Clean Air Act General Conformity evaluation is not required.

#### *4.1.1.1 Impacts from Construction*

Construction of the proposed launch pad would produce short-term (approximately 1–2 weeks) pollutant emissions from construction vehicle and equipment exhaust, and fugitive dust generated by material storage and handling and by vehicle and equipment travel on unpaved surfaces. Water trucks would be used to control dust generated during construction activities. Pollutant emissions from construction activities could have a minor, temporary impact on air quality in the local area but due to their short duration would not lead to pollutant concentrations in excess of any NAAQS.

#### *4.1.1.2 Impacts from Operations*

The air quality analysis for operations considers emissions in two categories: the lower troposphere from ground level to a nominal 3,000 foot altitude and the remainder of the atmosphere above this level. The Federal government uses a nominal 3,000 foot altitude for air quality regulatory purposes because this is the nominal height of the atmospheric mixing layer. Emissions that occur below this altitude can be mixed to ground level by diffusion and wind transport and affect ground-level ambient air quality. Emissions that occur above this altitude are not mixed to ground level. However, they can contribute to climate change and ozone depletion effects in the upper atmosphere.

Emissions from pre- and post-flight ground operations can occur from support equipment (e.g., the trucks used to transport the Grasshopper RLV and propellants). These emissions would be very small and would not lead to pollutant concentrations in excess of any NAAQS.

In the lower atmosphere, Grasshopper RLV launches would result in emissions associated with combustion of fuel during takeoff and landing. Emissions were estimated for carbon dioxide ($CO_2$), CO, hydrogen ($H_2$), and water ($H_2O$). No emissions data for nitrogen oxides ($NO_x$), volatile organic compounds (VOC), and PM are available for the Merlin engine. However, the very efficient combustion conditions that occur during engine operation would tend to minimize

the formation of these pollutants. Accordingly, emissions of $NO_x$, VOC, and PM are expected to be minimal. The estimated emissions per launch to the lower atmosphere during each launch phase are displayed in Exhibit 4-1. The estimated emissions per launch to the upper atmosphere (i.e., above 3,000 feet) during Launch Phase 3 are displayed in Exhibit 4-2. There would be no emissions to the upper atmosphere from Launch Phases 1 and 2, because the Grasshopper RLV would not fly above 3,000 feet during these phases. The estimated emissions per launch to all layers of the atmosphere during each launch phase are displayed in Exhibit 4-3.

**Exhibit 4-1. Estimated Emissions to the Lower Atmosphere (Below 3,000 feet) from Grasshopper RLV Launches (pounds/launch)[a]**

| Launch Phase | $CO_2$ | CO | $H_2$ | $H_2O$ |
|---|---|---|---|---|
| Phase 1 | 7,836 | 3,198 | 67 | 4,797 |
| Phase 2 | 8,014 | 3,271 | 69 | 4,907 |
| Phase 3 | | | | |
| 1,200 feet | 8,820 | 3,600 | 76 | 5,400 |
| 2,500 feet | 10,780 | 4,400 | 92 | 6,600 |
| 5,000 feet | 10,780 | 4,400 | 92 | 6,600 |
| 7,500 feet | 11,270 | 4,600 | 97 | 6,900 |
| 11,500 feet | 11,760 | 4,800 | 101 | 7,200 |

a. CO = carbon monoxide; $CO_2$ = carbon dioxide; $H_2$ = hydrogen; $H_2O$ = water

**Exhibit 4-2. Estimated Emissions to the Upper Atmosphere (Above 3,000 feet) from Grasshopper RLV Launches (pounds/launch)[a]**

| Launch Phase | $CO_2$ | CO | $H_2$ | $H_2O$ |
|---|---|---|---|---|
| Phase 3 | | | | |
| 5,000 feet | 3,430 | 1,400 | 29 | 2,100 |
| 7,500 feet | 6,370 | 2,600 | 55 | 3,900 |
| 11,500 feet | 11,992 | 4,895 | 103 | 7,342 |

a. CO = carbon monoxide; $CO_2$ = carbon dioxide; $H_2$ = hydrogen; $H_2O$ = water

**Exhibit 4-3. Estimated Emissions to All Layers of the Atmosphere from Grasshopper RLV Launches (pounds/launch)[a]**

| Launch Phase | $CO_2$ | CO | $H_2$ | $H_2O$ |
|---|---|---|---|---|
| Phase 1 | 7,836 | 3,198 | 67 | 4,797 |
| Phase 2 | 8,014 | 3,271 | 69 | 4,907 |
| Phase 3 | | | | |
| 1,200 feet | 8,820 | 3,600 | 76 | 5,400 |
| 2,500 feet | 10,780 | 4,400 | 92 | 6,600 |
| 5,000 feet | 14,210 | 5,800 | 122 | 8,700 |
| 7,500 feet | 17,640 | 7,200 | 151 | 10,800 |
| 11,500 feet | 23,752 | 9,695 | 204 | 14,542 |

a. CO = carbon monoxide; $CO_2$ = carbon dioxide; $H_2$ = hydrogen; $H_2O$ = water

The estimated emissions per year to the lower atmosphere from all Grasshopper launches are displayed in Exhibit 4-4. The estimated emissions per year from all launches to the upper atmosphere (i.e., above 3,000 feet) during Launch Phase 3 are displayed in Exhibit 4-5. There would be no emissions to the upper atmosphere from Launch Phases 1 and 2, because the Grasshopper RLV would not fly above 3,000 feet during these phases. The estimated emissions per year to all layers of the atmosphere from all launches are displayed in Exhibit 4-6.

**Exhibit 4-4. Total Estimated Emissions to the Lower Atmosphere from Grasshopper RLV Launches (pounds/year)[a]**

| Launch Phase | $CO_2$ | CO | $H_2$ | $H_2O$ |
|---|---|---|---|---|
| Phase 1 | 78,356 | 31,982 | 672 | 47,973 |
| Phase 2 | 80,144 | 32,712 | 687 | 49,068 |
| Phase 3 | | | | |
| 1,200 feet | 88,200 | 36,000 | 756 | 54,000 |
| 2,500 feet | 107,800 | 44,000 | 924 | 66,000 |
| 5,000 feet | 107,800 | 44,000 | 924 | 66,000 |
| 7,500 feet | 112,700 | 46,000 | 966 | 69,000 |
| 11,500 feet | 117,600 | 48,000 | 1,008 | 72,000 |
| Total (pounds/year) | 692,600 | 282,694 | 5,937 | 424,041 |
| Total (tons/year) | 346 | 141 | 3.0 | 212 |

a. CO = carbon monoxide; $CO_2$ = carbon dioxide; $H_2$ = hydrogen; $H_2O$ = water

**Exhibit 4-5. Total Estimated Emissions to the Upper Atmosphere from Grasshopper RLV Launches (pounds/year)[a]**

| Launch Phase | $CO_2$ | CO | $H_2$ | $H_2O$ |
|---|---|---|---|---|
| Phase 3 | | | | |
| 5,000 feet | 34,300 | 14,000 | 294 | 21,000 |
| 7,500 feet | 63,700 | 26,000 | 546 | 39,000 |
| 11,500 feet | 119,118 | 48,946 | 1,028 | 73,419 |
| Total (pounds/year) | 217,918 | 88,946 | 1,868 | 133,419 |
| Total (tons/year) | 109 | 44 | 0.9 | 67 |

a. CO = carbon monoxide; $CO_2$ = carbon dioxide; $H_2$ = hydrogen; $H_2O$ = water

**Exhibit 4-6. Total Estimated Emissions to All Layers of the Atmosphere from Grasshopper RLV Launches (pounds/year)[a]**

| Launch Phase | $CO_2$ | CO | $H_2$ | $H_2O$ |
|---|---|---|---|---|
| Phase 1 | 78,356 | 31,982 | 672 | 47,973 |
| Phase 2 | 80,144 | 32,712 | 687 | 49,068 |
| Phase 3 | | | | |
| 1,200 feet | 88,200 | 36,000 | 756 | 54,000 |
| 2,500 feet | 107,800 | 44,000 | 924 | 66,000 |
| 5,000 feet | 142,100 | 58,000 | 1,218 | 87,000 |
| 7,500 feet | 176,400 | 72,000 | 1,512 | 108,000 |
| 11,500 feet | 237,518 | 96,946 | 2,036 | 145,419 |
| Total (pounds/year) | 910,518 | 371,640 | 7,804 | 557,460 |
| Total (tons/year) | 455 | 186 | 3.9 | 279 |

a. CO = carbon monoxide; $CO_2$ = carbon dioxide; $H_2$ = hydrogen; $H_2O$ = water

The estimated emissions below 3,000 feet would not be expected to lead to concentrations that could exceed the NAAQS.

Under the Proposed Action, the emissions from Grasshopper RLV operations in the upper atmosphere could affect global climate change, because $CO_2$ and water are greenhouse gases. However, these emissions represent a very small fraction of national and global emissions and in this context would have a negligible impact on global climate change. By comparison, U.S. greenhouse gas emissions were estimated at 6,633.2 million metric tons of $CO_2$-equivalent[6] in 2009 (EPA 2011b). Global greenhouse gas emissions were estimated at 44,153 million metric tons of $CO_2$-equivalent in 2005 (WRI 2009).

#### *4.1.1.3 Impacts from Launch Failures*

A failure on the launch pad would have the greatest impact on the atmosphere near the ground. All or much of the loaded propellant would burn rapidly near the ground, and $CO_2$, CO, hydrogen, and water would be emitted to the atmosphere. The amounts of emissions at less than 3,000 feet altitude would be greater than the amounts listed in Exhibit 4-3 above, because all (or most) of the loaded propellant would be consumed. A failure in which the Grasshopper RLV explodes during ascent would release smaller amounts of emissions at the altitude of the explosion, because some of the propellant would have already been consumed during the ascent.

Atmospheric impacts from catastrophic failures would depend on the frequency of such failures. All reasonable and feasible measures would be taken by SpaceX personnel to minimize launch failures. To minimize the risk of failures, SpaceX would fully comply with the safety requirements set forth in 14 CFR Part 437, Experimental Permits, for pre-flight, flight, and post-flight operations, and any other applicable guidance from the FAA. Therefore, launch failures would not be expected to result in significant air quality impacts.

### 4.1.2 Noise and Compatible Land Use

A significant noise impact would occur if analysis shows that the Proposed Action would cause a noise sensitive area to experience an increase in noise of DNL 1.5 dB or more at or above the DNL 65 dB noise exposure level when compared to existing conditions. The DNL is the noise metric used by most Federal and State agencies to assess noise impacts and has been found to be the best noise metric for predicting human annoyance to noise. Activities associated with the Proposed Action that would affect ambient noise levels include noise generated by construction and noise generated by the Grasshopper RLV during takeoff, flight, and landing. Noise impacts are determined by comparing estimated noise levels associated with the Proposed Action with noise levels associated with existing conditions.

#### *4.1.2.1 Construction Noise*

Construction activities would include excavation, digging, and pouring of concrete. These activities would temporarily increase the ambient noise levels at the McGregor test site for approximately 1–2 weeks. Construction noise levels decrease with distance due to geometric spreading as well as other attenuation effects such as ground absorption and atmospheric

[6] Each greenhouse gas has a different level of radiative forcing ability, that is, the ability to trap heat. To compare their relative contributions, gases are converted to carbon dioxide equivalent using their unique global warming potentials (GWPs). Each gas has a unique GWP value which represents its radiative forcing ability relative to that of $CO_2$.

absorption. Exhibit 4-7 lists typical noise levels for common construction equipment. The table lists $L_{max}$ sound levels at 50 feet along with typical acoustic use factors. The acoustic use factor is the assumed percentage of time each piece of construction equipment would operate at full power (that is, at its noisiest). These values yield estimated $L_{eq}$ values from $L_{max}$ values. For example, the $L_{eq}$ value for a piece of equipment that operates at full power 50 percent of the time (acoustical use factor of 50) is 3 dB less than the $L_{max}$ value.

**Exhibit 4-7. Typical Construction Equipment Noise Levels at 50 Feet (dBA)**

| Equipment | Typical Maximum Noise Level ($L_{max}$) (dBA) | Acoustical Use Factor (percent) | Typical Equivalent Noise Level ($L_{eq}$) (dBA) |
|---|---|---|---|
| Compactor (ground) | 83 | 20% | 76 |
| Dozer | 82 | 40% | 78 |
| Dump truck | 76 | 40% | 72 |
| Excavator | 81 | 40% | 77 |
| Generator | 81 | 50% | 78 |
| Grader | 85 | 40% | 81 |
| Pickup truck | 75 | 40% | 71 |
| Warning horn | 83 | 5% | 70 |
| Crane | 81 | 16% | 73 |

Source: FHWA 2006

Construction equipment for the proposed project would include an excavator that would result in a noise level of about 77 dBA $L_{eq}$ at 50 feet. Assuming simple geometric attenuation of 6 dB per doubling of distance, the noise level at the nearest residence (approximately 1.3 miles from the site) would be 34 dBA $L_{eq}$. This noise level is relatively low and because construction noise would be temporary and intermittent during daytime hours, adverse effects from construction noise would not be likely. Construction would not involve highly dynamic equipment, such as a pile driver, that would produce heavy vibration. Consequently, there would be no adverse noise or vibration impacts from construction.

#### *4.1.2.2 Engine Noise*

Noise levels generated by Grasshopper RLV launches were estimated to be approximately 138 dBA at the launch pad and approximately 97 dBA 3 miles from the launch pad. Grasshopper RLV launches would last approximately 45–160 seconds each launch and would be expected to occur a maximum of 70 times annually. DNL values were calculated assuming that no launches would occur between 10 p.m. and 7 a.m. Given these assumptions, the noise level associated with Grasshopper RLV launches would be 54 DNL 4 miles from the test site. At this distance, the Proposed Action would only increase noise level from 65 DNL by 0.4 dBA, which falls below the FAA's significance criteria. Therefore, the Proposed Action would not cause significant noise impacts.

#### *4.1.2.3 Human Exposure to Launch Noise*

Grasshopper RLV launches are short events (approximately 45–160 seconds), and therefore workers at the McGregor test site would not be exposed to high noise levels for long periods of time due to launch events. Additionally, the noise levels would quickly attenuate as the vehicle moves away from the launch point, and therefore workers would not be exposed to the highest

noise levels for the entire duration of the launch event. All personnel would be required to wear adequate hearing protection to comply with OSHA's standards for noise exposure.

#### *4.1.2.4 Compatible Land Use*

The construction of the proposed launch pad and installation of water lines, as well as operation of the Grasshopper RLV, would be consistent with current land use. The McGregor test site lies within the City of McGregor's industrial park and is zoned "heavy industrial" (City of McGregor 2003a). The McGregor test site is currently used to conduct engine testing, including tests of the Falcon 9 Stage 1. Also, the land adjacent to the McGregor test site is used for agriculture. Therefore, the Proposed Action would not result in significant compatible land use impacts.

### 4.1.3 Land Use (Including U.S. Department of Transportation Section 4(f) Properties)

The Grasshopper launch pad and installation of water lines would be constructed within the boundaries of the McGregor industrial park in an area zoned by the city as "heavy industrial." No changes to current land use within the project area would be needed to accommodate the Proposed Action, nor would the existing land use for the surrounding areas need to be altered. Construction of the launch pad would result in the permanent loss of approximately 0.5 acre of grassland/rangeland for cattle grazing. Because there is a large amount the land within and adjacent to the McGregor industrial park used for agricultural activities, the Proposed Action would not result in a significant loss of land available for cattle grazing within the broader area. Furthermore, the loss of land available for agricultural activities would not result in a change in land use designations or result in a use of the land inconsistent or incompatible with its zoning designation. Therefore, no significant impacts to land use would occur as a result of the Proposed Action.

Land use impacts also are analyzed in terms of unique and sensitive properties protected under Section 4(f) of the DOT Act. Before approving a project that uses[7] Section 4(f) property, the FAA/AST must either (1) determine that the impacts are *de minimis*, or (2) undertake a Section 4(f) evaluation. For publicly owned public parks, recreation areas, and wildlife and waterfowl refuges, a *de minimis* impact is one that will not adversely affect the activities, features, or attributes of the property. For historic sites, a *de minimis* impact means that the FAA/AST has determined (in accordance with 36 CFR Part 800) that either no historic property is affected by the project or that the project will have "no adverse effect" on the historic property.

The construction of the proposed launch pad and installation of water lines would occur approximately 4.3 to 5.5 miles away from the parks and wildlife management area identified as Section 4(f) properties in Section 3.3 above. Therefore, potential impacts on these Section 4(f) properties resulting from construction would be *de minimis*. As mentioned in Chapter 3 and described below in Section 4.1.5, there are no historic sites located within the proposed operating area, which includes the area where the proposed construction would occur. Therefore, the Proposed Action would have *de minimis* impacts on these Section 4(f) properties.

The Proposed Action would not change the existing land use of the parks, the wildlife management area, or the historic sites considered to be Section 4(f) properties. Therefore, there would be no direct use of Section 4(f) properties as a result of the Proposed Action and impacts

[7] Use of a Section 4(f) property occurs when (1) land is permanently incorporated into a transportation facility; (2) when there is a temporary occupancy of land that is adverse in terms of the DOT Act's preservation purpose; or (3) when there is a constructive use (i.e., a project's proximity impacts are so severe that the protected activities, features, or attributes of a property are substantially impaired).

would be *de minimis*. Although increased noise levels do not constitute a direct use of a Section 4(f) property, significant increases in noise level have the potential to limit the use or diminish the quality of an area, such that its value as a recreational area, wildlife refuge, or historic site is impaired. In such cases, activities that increase noise levels significantly are considered a "constructive use" of a Section 4(f) property. As described in Section 4.1.2 above, Grasshopper RLV test launches are expected to generate noise levels that would be audible miles from the launch pad at many of the Section 4(f) properties. However, these areas are already exposed to audible noise from current SpaceX activities (as described in Section 2.2) and other noise sources (e.g., trains). Furthermore, as discussed above in Section 4.1.2.2, the noise level associated with Grasshopper RLV launches would be 54 DNL 4 miles from the test site. At this distance, the Proposed Action would only increase noise level from 65 DNL by 0.4 dBA which is less than FAA's 1.5 dBA increase criteria. Therefore, potential noise-related impacts on Section 4(f) properties would be *de minimis*.

Neither construction nor operations associated with the Proposed Action would result in a direct or constructive use of Section 4(f) properties. Therefore, the Proposed Action would not result in significant impacts to resources and properties considered pursuant to Section 4(f) of the DOT Act.

### 4.1.4 Biological Resources (Fish, Wildlife, and Plants)

#### *4.1.4.1 Vegetation*

Under the Proposed Action, permanent vegetation loss of less than 1 acre would occur within the open grassland and rangeland areas through vegetative removal and construction of the proposed launch pad. There could also be minor short-term impacts to vegetation from installation of the water lines. Any disturbed areas that are not converted to permanent infrastructure (i.e., the launch pad) would be naturally revegetated over time by grass species located at the test site. Impacts on vegetation from launch operations would generally be comparable with the current operational conditions at McGregor test site. The Proposed Action would not result in significant impacts on vegetation.

#### *4.1.4.2 Wildlife*

Under the Proposed Action, minor impacts on terrestrial wildlife species would occur from the permanent conversion of less than 1 acre of grassland/rangeland habitat. This minor loss in habitat likely would not result in long-term displacement of terrestrial species, if any species use this area of the McGregor test site. Impacts on aquatic species are not expected because there are no waterbodies in the area where the proposed launch pad would be constructed.

Impacts on wildlife from operations would be similar to those that occur under current operations at the McGregor test site. As discussed in Section 4.1.2.2 above, there would be no significant noise impacts from operations. If aquatic species are present near the proposed launch pad, there might be minor impacts to these aquatic species from acidification of surface waters from launch exhaust. However, launch exhaust would be rapidly dispersed due to the mechanical and thermal turbulence of the exhaust gases, the movement of the launch vehicle, and wind action. Terrestrial wildlife might be startled during a Grasshopper RLV launch (e.g., launches might cause birds to flush from cover). However, Grasshopper RLV launches would be infrequent (up to 70 launches per year). Although some individuals might be affected, no changes in wildlife

populations are expected to occur on a regional scale. Thus, the Proposed Action would not result in significant impacts on terrestrial or aquatic wildlife species.

#### *4.1.4.3 Special Status Species*

In 1998, the U.S. Navy informally consulted the USFWS to determine if there were any protected species potentially located at or near the NWIRP (U.S. Navy 1998). This informal consultation resulted in the identification of listed species that could occur within McLennan and Coryell Counties, but not necessarily at or in the immediate vicinity of the McGregor test site. The list of species included all of the species listed in Exhibit 3-9 in Section 3.4, except for the State-listed red wolf, smooth pimpleback, false spike mussel, and Texas fawnsfoot. Through field observations, it was determined in 1998 that the potential for occurrence of any of the listed species as year round residents at the NWIRP was unlikely due primarily to the absence of preferred habitat, on-going agricultural activities, and facility operations and maintenance activities (U.S. Navy 1998). Of the listed species identified, preliminary information indicated that potential habitat for the golden-cheeked warbler may have been present at the NWIRP. However, further review during the field reconnaissance revealed that primary elements of the species' preferred habitat did not occur at the NWIRP. Specifically, the mixed-oak woodlands component for the golden-cheeked warbler's preferred habitat is non-existent (U.S. Navy 1998). The TPWD, through the Texas Biological and Conservation Data System, also indicated that there were no known occurrences of special status species or natural communities in the immediate vicinity of the NWIRP (U.S. Navy 1998).

The land use at and surrounding the McGregor test site is still similar to what it was in 1998. The majority of the property and adjacent areas are used for agricultural activities, and operations and maintenance activities still occur. In preparing this Draft EA, the FAA/AST contacted the USFWS Ecological Services Field Office in Austin, TX, to determine if the USFWS is aware of any protected species occurring at or near the McGregor industrial park (USFWS 2011c). The Austin fish and wildlife biologist indicated he was not aware of any federally listed species occurring in the area. Therefore, based on the lack of historical presence of special status species at the McGregor test site, a review of the habitat requirements outlined in Exhibit 3-9 in Section 3.4, and communication with the USFWS Austin field office, the Proposed Action would have no effect on federally or state-listed species. The potential for occurrence of any of the listed species in Exhibit 3-4 at the McGregor test site is unlikely due primarily to the absence of preferred habitat, on-going agricultural activities, and maintenance (e.g. mowing) and operation activities (e.g., engine testing). If a special status species was discovered at the McGregor test site during operations covered under the experimental permit, SpaceX would cease operations and consult the TPWD and/or USFWS.

### 4.1.5 Historical, Architectural, Archaeological, and Cultural Resources

The area where the proposed launch pad would be constructed does not contain historic properties listed or eligible for listing on the NRHP (U.S. Navy 1998, NPS 2011). The only two historic properties (Buildings 1201 and 1237) that were previously located in the area where the proposed launch pad would be constructed were demolished prior to SpaceX leasing the property in 2003. All other existing properties/buildings that have been determined to be eligible for listing on the NRHP are located outside of the proposed operational area, which includes the area where the proposed launch pad would be constructed. Furthermore, the U.S. Navy incorporated

protective covenants for historic properties into the MOA (U.S. Navy 1998). As a lessee of the city-owned property, SpaceX is required to comply with the protective covenants identified in the MOA. Therefore, the Proposed Action would have no significant impacts on historic properties.

Similarly, there are no archeological sites that are listed or eligible for listing on the NRHP located in the area where the proposed launch pad would be constructed (THC 2011). The U.S. Navy incorporated protective covenants for archeological resources into the MOA (U.S. Navy 1998), and SpaceX is required to comply with the protective covenants. Therefore, the Proposed Action would have no significant impacts on the 14 archaeological sites that were determined to be eligible for listing on the NRHP.

### 4.1.6 Hazardous Materials, Pollution Prevention, and Solid Waste

Hazardous materials associated with the Proposed Action include the propellant (RP-1 and LOX) used in the Grasshopper RLV. The McGregor test site has an existing capacity to store 260,000 gallons of LOX and 102,000 gallons of RP-1. The Grasshopper RLV requirements would be a very small percentage of the site's storage capacity. All of the propellant would be shipped to the McGregor test site from central Texas in DOT-certified tanker trucks. The propellant would be stored and used in compliance with Federal regulations at 14 CFR §420.67 for liquid propellants. Additionally, the Grasshopper RLV would contain a 2.3-lbm canister of hypergolic fluid, triethylaluminum and triethylborane (or TEA/TEB), which is necessary to relight the engine. Additional hazardous materials associated with the Proposed Action include oil and spent batteries from maintenance or transport vehicles.

When chemicals are used, proper engineering and administrative controls would be implemented to avoid spills and uncontrolled releases. However, should the intended controls fail to prevent a spill or uncontrolled release of chemicals, a Chemical Emergency Response Plan is in place to minimize hazards to employees and the environment. The Chemical Emergency Response Plan incorporates the requirements of and serves as the Hazardous Waste Operations and Emergency Response Plan (29 CFR Part 1910.120(q)), RCRA Hazardous Waste Contingency Plan (40 CFR 265, Subpart D), and Sanitary Sewer Accidental Release Prevention Plan.

Solid waste would be produced during construction of the proposed launch pad. This solid waste would be disposed of according to existing practices. No substantial amount of additional solid waste would be produced under the Grasshopper program.

Because activities associated with the Proposed Action would comply with all relevant and applicable Federal, State, and local regulations related to hazardous materials, environmental pollution, and solid waste, there would be no significant impacts.

### 4.1.7 Light Emissions and Visual Resources

Because the McGregor test site is an industrialized area already used for single engine testing and Falcon 9 Stage 1 testing, the visual sensitivity is low. Although current SpaceX activities do not include vehicle launches (i.e., vehicles that takeoff and leave the ground), the Proposed Action does involve a vehicle launch. Grasshopper RLV launches and landings would be visible for several miles around the McGregor test site up to 70 times per year. As mentioned in Chapter 2, the Grasshopper RLV could be launched up to 11,500 feet AGL. The Grasshopper RLV would leave a contrail as a result of the fuel mixture being combusted. The Grasshopper

RLV would emit a white exhaust plume of smoke and steam and a combustion light source (flame). These light emissions would be smaller in visual impact compared to light emissions produced by Falcon 9 Stage 1 tests. Grasshopper RLV launches might have the potential to be seen from the nearby cities of McGregor and Oglesby. Visual impacts from Grasshopper RLV operations would be short-term and infrequent, because the launches are expected to last only for 45–160 seconds (depending on launch phase) and all launches would occur during daylight hours.

Though the Proposed Action would require the construction of a launch pad and installation of water lines, these additions to the McGregor test site would be consistent with existing infrastructure and would not represent a visually significant impact to the area. Construction under the Proposed Action would not substantially degrade the existing visual character or quality of the site and its surroundings. Therefore, the Proposed Action is not expected to have significant impacts related to light emissions and visual resources.

### 4.1.8 Natural Resources and Energy Supply

Energy and natural resource use under the Proposed Action would be minimal. The Proposed Action would not result in the development of new facilities or notable changes in local energy demands or consumption of other natural resources.

In terms of energy use, an additional 50 kW-hr would be needed for Grasshopper RLV launches in order to run data acquisition/control and vehicle power. This energy would be provided through the use of a diesel powered generator. SpaceX would also use diesel generator-powered lighting for nighttime construction or repairs, if necessary. Total propellant use during Grasshopper RLV launches conducted under an experimental permit would depend on the number of tests conducted during each launch phase. However, the amount of propellant required for an individual launch would be a very small percentage of the site's propellant storage capacity.

During construction of the launch pad, water trucks would be used to dampen the work area in order to control dust. During operations, water from the 10,000 gallon water tank would be used to periodically wash the launch pad and control fires, as needed. These activities represent the only water requirements associated with the Proposed Action. Minimal additional natural resources would be required as part of the Proposed Action, including approximately 242 cubic yards of concrete for the proposed launch pad. Overall, the Proposed Action would not have significant impacts related to natural resources and energy supply.

### 4.1.9 Water Resources (Surface Waters and Wetlands, Groundwater, Floodplains, and Water Quality)

#### *4.1.9.1 Surface Waters and Wetlands, and Water Quality*

The Proposed Action would require the construction of a concrete launch pad and installation of water lines. The launch pad would require approximately 0.5 acre of clearing vegetation. Construction activities would include excavating, grading, and filling in preparation for constructing the launch pad.

There would be no direct impacts to wetlands or streams as a result of constructing the launch pad, and no in-water work would be required. However, clearing, grading and excavation during

construction of the launch pad could temporarily expose soil to erosive forces such as rain and surface runoff, which could potentially affect water quality of wetlands and other surface waters in the area. Common impacts to water quality could include nutrient loading with sediments and small petrochemical spills and leaks from construction equipment. Because there would be less than 1 acre of ground disturbance, no TPDES construction permit would be needed.

During project operations, storm water discharges from new impervious surfaces of the launch pad could potentially convey storm water with low levels of pollutants to adjacent wetlands and other surface waters. Typical pollutants could include sediment and petrochemicals. However, the Proposed Action would not substantially alter existing stormwater runoff patterns. Vegetated buffers surrounding these features, which help prevent indirect impacts to or degradation of the wetlands and streams, would be maintained.

In the event of a launch failure (for which the probability is low), any potential impacts to surface waters would be minimized by emergency response and clean-up procedures. Therefore, there would be no significant impacts on surface waters, wetlands, or water quality.

#### *4.1.9.2 Floodplains*

Approximately 12.5 acres of FEMA 100-year floodplain is mapped in the southeast portion of the operating area. However, no construction would occur in this floodplain and any potential impacts to floodplains during operations would be minimized by emergency response and clean-up procedures. Therefore, no adverse impact to floodplain resources from construction or operation would result from the Proposed Action.

#### *4.1.9.3 Groundwater*

Water is currently supplied to the McGregor test site from the City of McGregor. There is a well at the city water plant and overland supply from distant wells. Currently, SpaceX uses about 125,000 gallons of water per month to support test operations. The Grasshopper water requirements would be minimal to none. Up to 10,000 gallons would be periodically required to fill a tank for occasional washing of the launch pad or fire suppression.

Impacts to groundwater quality would be minimal. Hazardous materials used as part of the Proposed Action include LOX and RP-1 (see Section 4.1.6 above). The propellant would be stored and used in compliance with Federal regulations at 14 CFR § 420.67 for liquid propellants. Additionally, the Grasshopper RLV would contain TEA/TEB, which is necessary to relight the engine. There would be no other hazardous or toxic materials associated with the Grasshopper RLV. In addition, all use, storage, and handling of chemicals and fuel would follow SpaceX's Spill Response Procedure.

New impervious surfaces from the launch pad could reduce the area of recharge for groundwater, but the area of impervious surface compared to the recharge area of the aquifer is not significant.

### 4.1.10 Socioeconomics, Environmental Justice, and Children's Environmental Health and Safety

#### *4.1.10.1 Impacts to Demographics and Housing*

Impacts to demographics and housing are evaluated in terms of changes in population and local supply of and demand for housing. The Proposed Action would require no additional SpaceX

employees and no relocation of existing employees; current personnel at the facility would be used to conduct all testing activities. Construction of the launch pad and water lines would be contracted to local companies, requiring no additional temporary relocation of construction workers. Accordingly, there would be no short- or long-term change in population under the Proposed Action, and therefore no change in supply of or demand for housing.

#### *4.1.10.2 Impacts to Economy and Employment*

Impacts to economic activity include changes in employment and its related multiplier effect, as well as any additional economic activity expected to result from the project. The current SpaceX staff at the McGregor test site would run the Grasshopper program and there would be no new hires and no staff relocation under the Proposed Action, and therefore no changes to long-term employment. Short-term additional economic activity resulting from construction of the proposed launch pad may result in an increase in short-term, minor revenue to the local economy. Construction activities would last approximately 1–2 weeks.

#### *4.1.10.3 Impacts to Environmental Justice Populations*

Impacts to environmental justice populations are evaluated in terms of the presence of minority and low-income populations in the affected environment and the potential for high and adverse environmental consequences resulting from the project to disproportionately affect these populations. As discussed in Section 3.10.3, there are no minority or low-income populations, as defined by DOT Order 5610.2 and CEQ (CEQ 1997a), located in the vicinity of the project area. Additionally, no adverse effects are expected to disproportionately impact any populations. Accordingly, no disproportionate high or adverse impacts to environmental justice populations would be expected as a result of the Proposed Action.

#### *4.1.10.4 Impacts to Children's Environmental Health and Safety*

Impacts to children's environmental health and safety are evaluated in terms of the potential for high and adverse environmental consequences resulting from the project to disproportionately affect children. As discussed in Section 3.10.4, the locations where children are concentrated in the vicinity of the project area are five schools located approximately 3 to 5 miles from the proposed launch pad location. As a result of the schools' vicinity to the proposed launch pad location, children attending these schools may be exposed to increased noise and air pollutant levels associated with the Proposed Action. As discussed in Section 4.1.2.2, no significant noise impacts are expected from the Proposed Action. The Proposed Action would result in emissions of CO, which is a criteria air pollutant. As discussed in Sections 3.1 and 4.1.1.2, Coryell and McLennan Counties have been designated by the EPA to be in attainment for the NAAQS, and estimated emissions produced by Grasshopper RLV launches would not lead to pollutant concentrations in excess of any NAAQS. Therefore, because both noise and air pollutant emissions would be less than significant, the Proposed Action would not pose disproportionate high or adverse impacts to children's environmental health or safety.

### 4.1.11 Secondary (Induced) Impacts

FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1*, requires the FAA to identify any induced impacts to surrounding communities which may result from a Proposed Action. Examples of induced impacts, as defined by the Order, include shifts in

patterns of population movement and growth, public service demands, and changes in business and economic activity to the extent influenced by the Proposed Action. Because no significant impacts are expected for any of the resource areas discussed above, no induced impacts would be expected to result from the Proposed Action. Shifts in development patterns, economic activity, and other secondary factors associated with the Proposed Action would be anticipated to be negligible.

## 4.2 No Action Alternative

Under the No Action Alternative, the FAA/AST would not issue an experimental permit to SpaceX for operation of the Grasshopper RLV at the McGregor test site. Existing SpaceX activities would continue at the McGregor test site, including daily single engine tests and periodic Falcon 9 Stage 1 tests. The potential environmental impacts of the Proposed Action as described above in Section 4.1 would not occur. The existing conditions at the McGregor test site would remain unchanged and would be as described in Chapter 3.

# 5. CUMULATIVE IMPACTS

Cumulative impacts are defined by the CEQ in 40 CFR 1508.7 as:

> Impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

The CEQ regulations further require that NEPA environmental analyses address connected, cumulative, and similar actions in the same document (40 CFR 1508.25).

Additionally, the CEQ further explained in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997b) that "each resource, ecosystem and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, a cumulative effects analysis normally will encompass geographic boundaries beyond the immediate area of the Proposed Action, and a time frame, including past actions and foreseeable future actions, in order to capture these additional effects.

Past, present, and reasonably foreseeable future actions at McGregor test site and the surrounding area include ongoing single engine tests and Falcon 9 Stage 1 tests. Additionally, as part of the Grasshopper program, SpaceX would conduct static fire engine tests of the Merlin-1D engine; these static fire tests do not require an FAA permit or license. Additional activities in the area include agricultural practices (which comprise the bulk of the leases at the McGregor industrial park) and operation of small (less than 100 people) manufacturing businesses within the McGregor industrial park. The largest building at the McGregor industrial park can employ up to 500 people. This building is currently vacant, but may soon be occupied. Reasonably foreseeable future SpaceX actions at the McGregor test site include construction of another test stand for ground-based system testing. These actions, considered in conjunction with the Proposed Action, formed the basis for the cumulative impacts analysis.

In accordance with FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures, Change 1,* and the CEQ NEPA implementing regulations, the FAA analyzed the potential cumulative impacts to the resources that would be adversely affected by implementation of the Proposed Action or the No Action Alternative. Based on the findings and potential impacts described in Chapter 4, the cumulative impacts analysis focuses on air quality and noise, which would be expected to be the most affected resource areas. The FAA has determined that the potential impacts for all other resource areas described in Chapter 4 would not meaningfully interact in time and space with the potential effects of other past, present, and reasonably foreseeable future actions. Therefore, no cumulative impacts are anticipated on resource areas other than air quality and noise.

As discussed in Section 4.1.1.2, Grasshopper launch operations would result in an increase in air emissions in the vicinity of the McGregor test site. Exhibit 5-1 displays the estimated cumulative emissions to the lower atmosphere from Grasshopper launch operations combined with emissions from existing and future operations at the McGregor test site. No other existing or planned emissions sources were identified in the vicinity of the McGregor test site that would contribute notably to cumulative air quality impacts. Cumulative emissions would not be expected to lead to concentrations that could exceed the NAAQS. Cumulative emissions to the upper atmosphere would be the same as for the Proposed Action (see Section 4.1.1.2) because

**Exhibit 5-1. Total Estimated Emissions to the Lower Atmosphere (Below 3,000 feet) from SpaceX Operations (pounds/year)[a]**

| Launch Phase | $CO_2$ | CO | $H_2$ | $H_2O$ |
|---|---|---|---|---|
| Static Fire Tests | | | | |
| Short Burn | 4,410 | 1,800 | 40 | 2,700 |
| Mission Profile | 33,080 | 13,500 | 280 | 20,250 |
| Single Engine Tests | 2,083,640 | 850,460 | 17,940 | 1,275,820 |
| Falcon 9 Stage 1 Tests | 52,920 | 21,600 | 456 | 32,400 |
| Total Other Than Proposed Action | 2,174,050 | 887,360 | 18,716 | 133,1170 |
| Proposed Action | 692,600 | 282,694 | 5,937 | 424,041 |
| Total Cumulative Emissions (pounds/year) | 2,866,650 | 1,170,054 | 24,653 | 1,755,211 |
| Total Cumulative Emissions (tons/year) | 1,433 | 585 | 12.3 | 878 |

a. CO = carbon monoxide; $CO_2$ = carbon dioxide; $H_2$ = hydrogen; $H_2O$ = water

SpaceX operations other than the Proposed Action do not produce emissions above 3,000 feet altitude. In addition, while Grasshopper launch operations would produce emissions of greenhouse gases as discussed in Section 4.1.1.2, these emissions when combined with emissions from other SpaceX operations would be extremely small in the context of national and global emissions. As a result, the incremental contribution to cumulative air quality and climate impacts from Grasshopper launch operations would be negligible.

The noise generated from Grasshopper launch operations would be infrequent and would be similar to the types of noise routinely generated at the McGregor test site. When combined with other noise producing activities in the vicinity of the McGregor test site, no significant impacts would be expected.

# 6. REFERENCES

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Texas Historical Commission
Texas Parks and Wildlife Department

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