

Chapter 2
Affected Environment

2.1 Project Location

Potential impacts of the proposed Legacy Parkway project on wildlife were analyzed at two geographic levels: the project study area and the regional study area. These areas, lying within the GSLE, are spatially defined in Figures 2-1 and 2-2 and are described below.

2.1.1 Project Study Area

The study area for the project-level analysis encompassed the Final EIS wildlife study area, the proposed mitigation area, and additional lands included in the wetland delineation study (Baseline Data Inc. et al. 1998) (Figure 2-3). The project study area encompasses approximately 4,186 hectares (ha) (10,344 acres); it is the total area for which high-resolution GIS data were available for mapping wetlands and wildlife habitats. The project-level analysis was conducted using this high-resolution dataset. Each build alternative's footprint, or area of direct impacts, lies entirely within the project study area.

2.1.2 Regional Study Area

The regional study area was used to evaluate all project-related effects on wildlife beyond the project study area. Many migratory birds that use the project study area move seasonally along the Wasatch Front, stopping at other wetland areas from Utah Lake to the Bear River National Wildlife Refuge. Utah Lake was included in the regional study area because approximately 156 migratory bird species found around Utah Lake also use habitats around Great Salt Lake (Utah Department of Natural Resources and Energy, Division of Wildlife Resources 1982), and many of their populations are likely connected by regular movement between the two areas. It is recognized, however, that Utah Lake is a freshwater ecosystem, while Great Salt Lake is primarily saline. Bird species that rely heavily on brine shrimp and brine flies in their diet (e.g., Eared Grebe; Wilson's Phalarope; and various duck, gull, and shorebird species) naturally concentrate on Great Salt Lake, where these foods are exclusively located. Other migratory birds, including other waterbirds, raptors, and migratory songbirds not dependent on these foods, are likely to find needed resources in suitable habitats common to either Utah Lake or Great Salt Lake.

The study area for the regional-level wildlife analysis was defined by three parameters: (1) a subset of U.S. Geological Survey (USGS) hydrologic units in the eastern portion of the GSLE, (2) the extent of these units for which comprehensive regional GIS land-use data were available, and (3) the portion of these areas below 1,433 m (4,700 ft) in elevation. The 1,433-m (4,700-ft) elevational boundary was selected to include wetland habitats associated with Utah Lake that could potentially be used by migrating

birds that also use the project study area. A variety of migrating bird species are likely to use both areas despite the differences in ecology (Utah Lake is a freshwater lake, whereas the project study area is associated with Great Salt Lake's saltwater ecosystem). The geographic extent of the regional study area is shown in Figure 2-3. The regional study area was used to evaluate the direct, indirect, and cumulative effects on wildlife beyond the project study area.

2.1.3 Great Salt Lake Ecosystem

The proposed Legacy Parkway project is located on the southeast shore of Great Salt Lake. Technically, the GSLE encompasses all wildlife habitats within the full drainage basin of Great Salt Lake, including the ancient lakebed and drainages of Lake Bonneville and the complete watersheds of the Bear, Ogden/Weber, and Jordan Rivers (Figure 2-1). In this report, the GSLE refers to Great Salt Lake, its floodplains, and all wildlife habitats that are used by migratory bird species (Figure 2-2) as mapped in Aldrich and Paul (2002).

Alternatives analyzed in this study include modified versions of alternatives analyzed in the Final EIS. The alternatives were modified to accommodate a reduced median width, resulting in a 95-m (312-ft) total right-of-way width, which is reduced from the total right-of-way width of 100 m (328 ft) that was used to define the alternatives analyzed in the Final EIS. The following alternatives lie within the project study area for this wildlife impact analysis.

- Alternative A – 95-m (312-ft) right-of-way width.
- Alternative B – 95-m (312-ft) right-of-way width.
- Alternative C – 95-m (312-ft) right-of-way width.
- Alternative E – 95-m (312-ft) right-of-way width.

Alternative E follows the same alignment as Alternative D (the Final EIS Preferred Alternative), but Alternative E has a reduced median and narrower right-of-way width. Alternatives A, B, and C follow the same alignments as shown in the Final EIS.

2.2 Physical Setting

Great Salt Lake is one of the four largest terminal saline lakes in the world (Stephens 1990). It encompasses between 2,165 square kilometers (km²) (835.9 square miles [mi²]) and 6,361 km² (2,456 mi²), depending on the lake's surface elevation. It is located on the eastern edge of the Great Basin, which is characterized by a cold, high-desert climate. Average daily temperatures in the Great Salt Lake basin range between -2°C (28°F) in January and 25°C (78°F) in July. Winter lows may reach -18°C (0°F), and summer highs can exceed 38°C (100°F). Temperature inversions are characteristic of the basin. Precipitation variations around the lake are attributed to the local differences in temperature and local topography, with averages ranging from less than 25 centimeters (cm) (9.8 inches) along the xeric (drier) west side to 38 cm (14.9 inches) along the eastern shore at the base of the Wasatch Mountains. The Great Salt Lake area receives an average annual snowfall of 158 cm (63 inches) (National Weather Service 1997).

Great Salt Lake is a remnant of Pleistocene Lake Bonneville and is the lowest point in a 57,000-km² (22,008-mi²) drainage basin (Figure 2-1). The average annual freshwater inflow to the lake is approximately 0.4 million hectare-meters (3.25 million acre-feet (maf) (Stauffer 1980), with surface flow, precipitation, and groundwater discharge accounting for 65%, 28%, and 8%, respectively, of the total inflow. The Bear River contributes approximately 55% of the surface flow, the Weber River contributes 23%, and the Jordan River contributes 14%. An additional 8% comes from ungauged flows from sewage plants and other small tributaries (Aldrich and Paul 2002). Although precipitation contributes less water than does surface flow, it plays a vital part in Great Salt Lake hydrology by refreshing sediments in small nearshore playas and mudflats that are often isolated from other sources of water.

Great Salt Lake is a shallow, low-gradient playa lake, with an average depth of only 4 m (13 ft) when the surface elevation is 1,281 m (4,202 ft) above sea level (ASL) (Aldrich and Paul 2002). With variable seasonal inflow of water from the rivers and countervailing high levels of evaporation, the water depth of the lake fluctuates dramatically, creating a highly transitory shoreline. The average seasonal variation in Great Salt Lake's surface elevation is approximately 0.46 m (18 inches), but it may fluctuate as much as 1.5 m (5 ft) in a single year (Aldrich and Paul 2002). Consequently, some areas of the shoreline can migrate more than 800 m (2,625 ft) between spring and fall. This naturally shifting shoreline effectively creates a dynamic landscape of expansive mudflats, emerging and subsiding sandbars, and ephemeral saline pools that are important for many migratory shorebirds and waterfowl. Regional climate patterns typically result in overriding multi-year cycles in lake levels (up to 6 m [20 ft]) that dramatically affect the temporal and spatial nature of these annual shoreline changes. Figure 2-4 shows the lake level patterns of Great Salt Lake from 1840 to present. Relatively high lake levels in the late 1980s resulted in a 3.4-m (11-ft) rise of Great Salt Lake over 4 years and the inundation of approximately 80% of shoreline wetlands around the lake.

The shallow water and expansive surface area of Great Salt Lake also creates conditions favorable for wind-driven seiches that can elevate lake levels between 1.5 m (5 ft) and 2 m (7 ft) on downwind shores (Utah Department of Natural Resources 1999). The combined effects of this wind setup and wave action can push the saline waters of the lake over many thousands of acres of mudflats and into shoreline marsh areas, often disrupting established plant communities and/or the nesting areas of many waterbirds. While these events tend to be short lived, they are an important stochastic and integral part of the many dynamic changes constantly sculpting the shoreline of Great Salt Lake.

2.3 Regulatory Setting for Special-Status Wildlife

Several of the species discussed in this technical memorandum are considered *special-status species*, or species that are protected by one or more state or federal environmental laws (Table 2-1). In this technical memorandum, special-status wildlife includes species identified on the following lists and/or covered by the following regulations.

- Federal
 - Federally listed endangered and threatened species.
 - Federal candidate species.
 - Migratory Bird Treaty Act (MBTA) species (16 USC 703–711).
 - Fish and Wildlife Conservation Act species (16 USC 2901–2911).

- State of Utah
 - Utah wildlife species of concern (Utah Administrative Rule R657-48).
 - State of Utah conservation agreement species.

Table 2-1 summarizes the legal and protected status, habitat use, and seasonal occurrence of each special-status species. The table also describes each species' abundance within the GSLE and the project study area, as well as its migratory, breeding, and habitat use patterns in these areas. The abundance and residence status of each of these species is described in further detail in Tables 2-2 through 2-10, as well as in the comprehensive species-habitat matrix (Appendix A). Additional information on each species appears in Section 2.4.3 below. The occurrence in and use of specific habitats within the project study area by the special-status species is discussed under each habitat description in Section 2.4.1 below.

The following federal and state laws guide regulatory authority over special-status species that occur or could potentially occur in the regional and project study areas.

2.3.1 Federal

Endangered Species Act (16 USC 1531 et seq.)

Federally Listed Species

The federal Endangered Species Act (ESA) provides certain protections for species that are listed or proposed for listing as threatened or endangered under the ESA. Under Section 7 of the ESA, federal agencies are required to ensure that their actions do not jeopardize the continued existence of species listed as endangered or threatened, or result in destruction or adverse modification of designated critical habitats used by those species. Section 9 of the ESA makes it unlawful for a person to *take* a listed species, where *take* is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 USC 1532). Further, the term *harass* is defined as an intentional or negligent act that creates the likelihood of injuring wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns such as breeding, feeding, or sheltering (50 CFR 17.3). *Harm* is an act that either kills or injures a listed species. Such an act may include habitat modification or degradation that actually kills or injures a listed species by significantly impairing essential behavior patterns such as breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 217.12). Habitat degradation can cause take through either the *harm* or *harass* pathways outlined above. Acceptable levels of incidental take may be allowed under the authorities of Sections 4(d), 7(b), and 10(a) of the ESA.

USFWS is one of the federal agencies that administers the ESA and has primary responsibility for terrestrial and freshwater species. Bald Eagles are the only federally listed species known to occur in the GSLE and the project study area (Table 2-1). However, Peregrine Falcons, which were federally listed until recently (now delisted), also occur in the project study area.

Federal Candidate Species

The ESA also designates species that are candidates for listing as threatened or endangered. Candidate species are species that are being considered to be proposed for listing. State and federal agencies typically carry out conservation actions for candidate species to prevent their further decline and possibly

eliminate the need to list them in the future. Table 2-1 includes candidate species that occur or could potentially occur in the GSLE and the project study area.

Migratory Bird Treaty Act (16 USC 703–711)

The MBTA prohibits the *take* of any migratory bird, or any part, nest, or egg of any such bird, where *take* is defined as the attempt to “pursue, hunt, shoot, capture, collect, or kill.” This act applies to all persons and organizations in the United States, including federal and state agencies. The MBTA is administered by USFWS, with regulation of listed migratory birds delegated to the agency staff handling Section 7 of the ESA, and regulation of unlisted migratory birds delegated to USFWS’s Migratory Bird Division. A list of designated migratory bird species that occur or could potentially occur in the project study area is provided in Appendix A.

Fish and Wildlife Conservation Act (16 USC 2901–2911)

The 1988 amendment to the Fish and Wildlife Conservation Act (FWCA) mandates that USFWS identify migratory and nonmigratory birds of the United States and its territories that, without additional conservation actions, are likely to become candidates for listing under the ESA. These species are designated as Birds of Conservation Concern (BCC) and include ESA candidate, proposed endangered or threatened, and recently delisted species (U.S. Fish and Wildlife Service 2002).

BCC species are listed according to three different geographic scales: national, regional, and local. BCC species identified in this technical memorandum are part of the Great Basin Bird Conservation Region (BCR), representing the smallest and ecologically most relevant geographic scale for this analysis. BCC species that occur or could potentially occur in the project study area are identified in Table 2-1.

2.3.2 State of Utah

Conservation Agreement Species

Conservation agreement species are those wildlife species and subspecies that meet the UDNR criteria of endangered, threatened, or special concern. This category does not include species and subspecies that are currently listed under the federal ESA as threatened or endangered. Conservation agreement species are currently receiving sufficient special management under a conservation agreement developed and/or implemented by the state to preclude their federal listing. If a conservation agreement is not implemented, the species could be elevated to the appropriate category. A list of the conservation agreement species that occur or could potentially occur in the GSLE and the project study area is provided in Table 2-1.

Utah Wildlife Species of Concern (Utah Administrative Rule R657-48)

Utah wildlife species of concern (WSC), which are listed on *Utah’s Sensitive Species List* (Utah Division of Wildlife Resources 2003), are those species for which there is credible scientific evidence to substantiate a threat to continued population viability in the state of Utah. WSC designations are intended to promote conservation actions that will ultimately prevent the species from being listed as threatened or endangered under the ESA.

The Utah Division of Wildlife Resources (UDWR) is the state agency responsible for monitoring WSC. A list of the WSC species that occur or could potentially occur in the GSLE and the project study area is provided in Table 2-1.

2.4 Ecological Setting

This section describes the ecological setting of the proposed Legacy Parkway project. The following areas are discussed in detail.

- Existing wildlife habitats.
- Existing distribution and use of wildlife habitats.
- Special-status species.
- Existing habitat fragmentation.
- Status of existing habitat quality.
- Status of existing wetland hydrology.
- Existing artificial landscaping.
- Existing sources of direct wildlife mortality.
- Existing sources and levels of noise.
- Existing sources of artificial light.
- Existing sources of human disturbance.

2.4.1 Existing Wildlife Habitats in Project Study Area

Great Salt Lake and the wetlands surrounding its shoreline provide important habitat for a great variety of amphibians, reptiles, birds, and mammals, some of which are rare and have small geographical distributions.

The wetlands of Great Salt Lake account for 75% of all wetlands in Utah; only 1.5% of the state's total land area comprises wetlands (Jensen 1974). The shores of Great Salt Lake are internationally important because they constitute a link of the Pacific Flyway for migratory waterfowl and a link of the Western Hemisphere Shorebird Reserve Network (Figure 2-5). Between 2 million and 5 million birds use Great Salt Lake yearly; 90% of that use is concentrated on the eastern shore (Paul and Manning 2002).

The proposed Legacy Parkway project crosses portions of an intricate patchwork of wetlands, wetland-associated habitats, and uplands used by a broad diversity of wildlife species. The wetland habitats are formed and maintained by a complex interplay between surface and subsurface fresh water and the fluctuating dynamics of Great Salt Lake's lake level (Figure 2-4). Many of the habitats directly associated with the shoreline, such as mudflats, nearshore playas, and sedge cattail habitats, develop and subside with the rise and fall of the lake. Other more interior habitats, including hydric meadows, permanent and

ephemeral ponds, and riparian corridors, are more responsive to seasonal precipitation patterns and fluctuations in the water table. The upland habitats are more stable, providing important refuge, resting, and foraging habitat for many species, particularly when the lake level is high and the lower-elevation habitats are flooded.

This section provides descriptions of the habitats within the project study area and around Great Salt Lake and the wildlife species frequently associated with these habitats. Nine wildlife habitats—five wetland/riparian and four upland habitats—were identified within the project study area.

- Wetland/riparian wildlife habitats.
 - Open water.
 - Riparian.
 - Sedge cattail.
 - Hydric meadow.
 - Mudflat/Pickleweed.
- Upland wildlife habitats.
 - Pasture.
 - Cropland.
 - Salt desert scrub.
 - Developed (including urban landscaping).

Of the 4,186-ha (10,344-acre) project study area, 3,492 ha (8,628 acres) are considered wildlife habitat.¹ Figure 2-6 shows the areal extent of mapped habitat types in the project study area; Figure 2-7 is a map of these habitats. Information on how these habitats were delineated and mapped is presented in Appendix B. Wildlife species known to occur or that could potentially occur within each habitat in the project study area are summarized in Tables 2-2 through 2-10. Information on their seasonal occurrence and abundance within the project study area, their migratory and breeding status in the habitats, and their use of other habitats in the study area is also provided in these tables. It should be noted that individual bird species can be assigned to more than one seasonal abundance category. For example, in open water habitat (Table 2-2), Pied-billed Grebe has been documented both as an uncommon summer visitant and a rare winter visitant. A comprehensive species-habitat matrix of species that occur in the regional study area is provided in Appendix A. A list of scientific names of wildlife species discussed in this technical memorandum is provided in Appendix C. Table 2-1 lists all special-status species and their designations.

¹ The amounts of direct habitat loss of wildlife habitat quantified in this analysis differ from the extent of wetland loss specified in the Final EIS. These differences are primarily the result of a divergence between the habitat classification system developed by the WTT for this technical memorandum and the classification system used to identify jurisdictional waters (including wetlands) in the Final EIS. This matter is discussed in greater detail in Chapter 3 and Appendix B.

Open Water

Habitat Description

Open water habitat consists of inundated or flooded areas with no emergent vegetation. The water in these areas may be fresh (e.g., ponds, the Jordan River), brackish, or saline (e.g., Great Salt Lake). The amount of open water habitat can vary tremendously with the rise and fall of the lake level. If high-water inundation periods last long, the saline waters of the lake will denude the vegetated habitats they cover, thereby converting shoreline vegetated wetlands, mudflats, and uplands to saline open water habitat. Within the project study area, the majority of open water areas are located on the eastern edge of Farmington Bay Waterfowl Management Area.

Wildlife

Five fish species, 78 bird species, and one mammal species (muskrat) comprise the vertebrate species potentially associated with open water habitats within the project study area (Table 2-2). Forty-eight of the bird species have been documented as occurring within the project study area. Another 30 bird species could potentially occur there based on their general abundance in the GSLE and their known use of open water habitat. Nineteen of these 78 bird species, mostly waterfowl, are generally found exclusively in open water habitat (Table 2-2); of these 19, three (Common Goldeneye, Osprey, and Caspian Tern) have been documented within the project study area. Seven of the 48 documented bird species can usually be found year-round within the GSLE, 18 are common to uncommon during the summer, four are winter visitants, and 24 only migrate through the region. The bird species potentially associated with open water habitat in the project study area include up to 26 waterfowl species, 14 species of gulls and terns, seven shorebird species, five grebe species, five heron and egret species, and seven swallow species. Sixteen of the bird species, including American Avocet and Wilson's Phalarope, breed or could potentially breed within the project study area.

Five special-status species (American White Pelican, Peregrine Falcon, American Avocet, Marbled Godwit, and Wilson's Phalarope) use or could potentially use open water habitat in the project study area. Other common birds associated with open water habitat or the shoreline areas include Red-necked Phalarope, Eared Grebe, Marbled Godwit, Black-necked Stilt, and Long-billed Dowitcher. These species, like those listed above, depend largely on many of the food resources found in or around this habitat. Also, in areas where fresh water is sufficient to support fish, ephemeral fisheries provide food for a variety of fish-eating birds, including American White Pelican, Double-crested Cormorant, Western and Clark's Grebes, and Forster's and Caspian Terns. Wintering waterfowl, such as Common Goldeneye and Bufflehead, also use open water habitats extensively. Bald Eagle and Peregrine Falcon prey on the large flocks of shorebirds and waterfowl that concentrate in these areas.

Riparian

Habitat Description

Riparian habitat is the least abundant habitat type within the project study area. This habitat is generally severely degraded and is restricted to small patches of riparian vegetation along stream courses and irrigation canals. The Jordan River supports the majority of this habitat type in the project study area. Remnant native vegetation includes Fremont cottonwood (*Populus fremontii*), sandbar willow (*Salix exigua*), and narrowleaf cottonwood (*Populus angustifolia*). In many areas, however, these species have been replaced by Russian olive (*Elaeagnus angustifolius*), Siberian elm (*Ulmus pumila*), and salt cedar

(*Tamarix ramosissima*). No jurisdictional wetlands were delineated within these riparian areas (Baseline Data, Inc. et al. 1998).

Wildlife

While limited in extent, riparian habitat in the project study area provides food and shelter for one amphibian species, three reptiles, 107 birds, and 26 mammals (Table 2-3). Of these species, only beaver is generally found exclusively associated with this habitat. Seventy-eight of the bird species have been documented in riparian areas in the project study area. Another 29 species have the potential to occur there based on their general abundance in the GSLE and their common use of riparian habitats in the region. Seventeen of the 78 documented species occur year-round in the GSLE, 13 are common to uncommon during the summer, 14 are winter visitants, and 39 only migrate through the region. Of the 107 documented and potential species, 103 are migratory; most are Neotropical passerines that use the riparian trees and shrubs for food, shelter, and roosting. Twenty-nine of these bird species breed in riparian habitat.

Nine special-status species (Bald Eagle, Northern Goshawk, Swainson's Hawk, Solitary Sandpiper, Yellow-billed Cuckoo, Willow Flycatcher, Loggerhead Shrike, Virginia's Warbler, Brewer's Sparrow, and Townsend's big-eared bat) use or could potentially use riparian habitat in the project study area. However, Northern Goshawk, Yellow-billed Cuckoo, and Virginia's Warbler are rare migrants in the GSLE and their use of the project study area is infrequent.

The riparian habitats throughout the GSLE provide insects for many species of migrating/summer visitant insectivores such as warblers, kinglets, sparrows, flycatchers, swallows, and several species of bats. Although they are limited and widely dispersed in the project study area, these habitat patches provide links within a long network of similar patches along the Wasatch Front, a principal migratory corridor for these species. Russian olive trees also provide forage and shelter for a variety of fruit-eating species, such as Bohemian and Cedar Waxwings, Hermit Thrush, and American Robin, as well ground-foraging Ring-necked Pheasant and California Quail. Eleven rodent species, seven bat species, porcupine, red fox, raccoon, long-tailed weasel, striped and spotted skunks, and mule deer also use these riparian areas. All the reptiles found in this habitat are snakes, which feed on the abundance of rodents, fish, birds, amphibians, and various invertebrates in the area.

Sedge Cattail

Habitat Description

Sedge cattail habitats are wetlands dominated by herbaceous vegetation adapted to seasonally or semi-permanently flooded conditions. Water depth varies, but is not deep enough to restrict the growth of emergent plants. Vegetation commonly observed in these marshes include hard stem bulrush, (*Scirpus acutus*), alkali bulrush (*Scirpus maritimus*), three square bulrush (*Scirpus americanus* and *Scirpus pungens*), cattail (*Typha latifolia*), creeping spikerush (*Eleocharis palustris*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), blister buttercup (*Ranunculus scleratus*), water buttercup (*Ranunculus aquatilis*), and Nebraska sedge (*Carex nebrascensis*).

These marshes can be located in depressions where the ground surface lies below the level of the water table or in areas with sufficient surface water or groundwater discharge. For this reason, groundwater, runoff, and surface water may all contribute to the hydrologic regime of sedge cattail habitats. In the Great Salt Lake basin, these areas are generally inundated during spring, when the water table is high due

to snowmelt and seasonal rain. Within the project study area, sedge cattail is found in large tracts fringing the open water habitats along the eastern boundary of Farmington Bay Waterfowl Management Area, west of Centerville.

Agriculture and urbanization along the western edge of the Wasatch Mountains (Figures 2-7a–c) have greatly influenced the number and types of sedge cattail habitats in the area. Agricultural runoff has increased the frequency and duration of inundation and soil saturation in many locations. Sedge cattail habitats have also been created by impoundment of both ground and surface water by roads and dikes.

Wildlife

Sedge cattail provides suitable habitat for five fish species, six amphibians, two reptiles, up to 79 birds, and 16 mammals (Table 2-4). American Bittern and masked shrew are the only species considered to be exclusively associated with this habitat. Sixty-six of the bird species have been documented in the project study area; another 12 species could potentially occur there based on their typical use of this habitat in the GSLE. Seventeen of the 66 documented bird species stay within the GSLE all year, 22 are common to uncommon during the summer, nine (in addition to permanent residents) are winter visitants, and 25 only migrate through the region. All the bird species that use sedge cattail habitat are migratory, and 31 breed or could potentially breed in this habitat. The most common species that use this habitat include Canada Goose, Mallard, Gadwall, American Coot, and Red-winged Blackbird. Black-crowned Night Heron, White-faced Ibis, Virginia Rail, Sora, and Franklin's Gull are also common during the summer.

Nine special-status species (American White Pelican, Bald Eagle, Peregrine Falcon, American Avocet, Wilson's Phalarope, Short-eared Owl, Loggerhead Shrike, Preble's shrew, and Townsend's big-eared bat) use or could potentially use sedge cattail habitat in the project study area. Fish in these marshes, particularly carp, provide food for numerous fish-eating bird species in the area, including Western and Clark's Grebes, Great Blue Herons, Snowy and Great Egrets, American White Pelicans, Double-crested Cormorants, California Gulls, and Forster's Tern.

An abundance of aquatic and terrestrial insects produced in sedge cattail habitats provides food for a broad diversity of insectivorous birds including swallows, poorwills, swifts, warblers, sparrows, shrikes, and blackbirds, as well as up to seven species of bats. The shallow waters of the marshes provide suitable habitat for all six amphibian species that are represented in the project study area. Amphibians and reptiles common to sedge cattail in the project study area are also comparably common in hydric meadow habitat (see *Hydric Meadow* below). Common mammals in this habitat include voles, muskrat, and raccoon.

Hydric Meadow

Habitat Description

Hydric meadow habitats are the most abundant type of wetland in the project study area. They are typically found in areas with a high water table or groundwater discharge, where poorly drained soils cause seasonally saturated and sometimes flooded conditions. Surface water flows can contribute to or prolong seasonally wet conditions. Inundation occurs less frequently and for shorter duration in hydric meadows than in sedge cattail habitats. Agriculture and urbanization have modified the hydrologic regime of hydric meadows in the project study area much as they have affected sedge cattail. Plant species commonly observed in hydric meadows within the project study area include Baltic rush (*Juncus balticus*), clustered field sedge (*Carex praegracilis*), Nebraska sedge, rabbits-foot grass (*Polypogon*

monspeliensis), foxtail barley (*Hordeum jubatum*), little barley (*Hordeum pusillum*), curly dock (*Rumex crispus*), and saltgrass (*Distichlis spicata*).

Wildlife

Hydric meadows in the project study area provide food, shelter, and rest area resources for six amphibian species, three reptiles, 102 birds, and 13 mammals (Table 2-5). Insects and other invertebrates and vegetation are the principal food resources for birds in the meadows; the birds, amphibians, and rodents also provide food for the various reptilian, avian, and mammalian predators that use this habitat. Eighty-seven of the bird species have been documented within the project study area. Another 15 species could potentially occur there based on their general habitat use patterns and abundance in the GSLE. Twenty-seven of the 87 documented species remain within the GSLE all year, 21 are common to uncommon during the summer, 11 are winter visitants, and 35 only migrate through the region. Of the documented and potentially occurring bird species, 100 are migratory and 41 breed or could potentially breed in this habitat. All the bat species listed in Table 2-5 migrate seasonally or hibernate in local caves, mines, or abandoned buildings.

Seventeen special-status species (Bald Eagle, Swainson's Hawk, Ferruginous Hawk, Golden Eagle, Peregrine Falcon, Prairie Falcon, American Golden Plover, American Avocet, Solitary Sandpiper [rare], Long-billed Curlew, Marbled Godwit, Wilson's Phalarope, Short-eared Owl, Loggerhead Shrike, Brewer's Sparrow, Bobolink, and Townsend's big-eared bat) use or could potentially use hydric meadow habitat in the project study area. Many of the migratory bird species listed in Table 2-5 are the same as those that use the sedge cattail habitat (Table 2-4); however, a broader diversity of shorebirds are found in hydric meadows, including breeding Willet, Long-billed Curlew, Wilson's Phalarope, and Wilson's Snipe, as well as migrant Black-bellied Plover, American Golden-Plover (rare), Greater Yellowlegs, Lesser Yellowlegs, Solitary Sandpiper (rare), Marbled Godwit, and Pectoral Sandpiper. Three species of hummingbird, Rough-legged Hawk, and Cattle Egret have also been documented using this habitat within the project study area. Mountain Bluebirds may forage and rest in hydric meadows in the area on occasion.

Mudflat/Pickleweed

Habitat Description

Mudflats are typically barren or sparsely vegetated playas with deep or moderately deep, poorly drained to very poorly drained clay soils formed from Pleistocene lakebed sediments. In the project study area, mudflats are usually located in low areas along the Great Salt Lake fringe or depressional areas within scrub and hydric meadow habitats. After a rain or as snow cover melts, these playa/mudflats collect much of the runoff from surrounding areas and form ephemeral pools. Generally, the waters and substrate are strongly alkaline due to evaporation, which deposits salts in the water and brings salts in the soils to the surface. Vegetation found on mudflats within the study area includes western seepweed (*Suaeda occidentalis*), slender seepweed (*Suaeda depressa*), and pickleweed (*Salicornia europea*). This habitat type includes mudflats associated with the shoreline of Great Salt Lake, which are periodically covered with shallow water, as well as mudflats associated with deeper, ponded water.

Wildlife

Mudflat/pickleweed habitat provides an abundance of mudflat invertebrates and windrow concentrations of brine shrimp and brine flies that supply the energy needs of thousands of shorebirds and other

insectivorous species. This habitat can potentially be used by 1 amphibian species, 109 birds, and four mammals. Ninety of these bird species have been documented within the project study area; another 19 species could potentially occur there based on their general abundance and habitat use patterns in the region. Seven species of shorebirds are generally found exclusively associated with this habitat (Table 2-6). Twenty-five of the 90 documented bird species can be found year-round in the GSLE, 22 are common to uncommon during the summer, 11 are winter visitants, and 35 only migrate through the region. All of the 109 documented and potential species, with the exception of Ring-necked Pheasant, are migratory; 39 breed or could potentially breed within the project study area.

Nineteen special-status species (Bald Eagle, Swainson's Hawk, Ferruginous Hawk [rare], Golden Eagle, Peregrine Falcon, Prairie Falcon, American Golden-Plover [rare], Snowy Plover, American Avocet, Solitary Sandpiper [rare], Whimbrel [rare], Long-billed Curlew, Marbled Godwit, Sanderling, Wilson's Phalarope, Burrowing Owl, Short-eared Owl, Loggerhead Shrike, and Brewer's Sparrow) use or could potentially use this habitat within the project study area. Mudflats of Great Salt Lake are extremely important to shorebirds because of the abundance of invertebrates they provide during the shorebird nesting and migration periods.

Pasture

Habitat Description

Much of the farmland in the project study area consists of pasture. It is the most abundant habitat type found in the project study area. Prior to conversion for agricultural purposes, pastures were typically hydric meadows or salt desert scrub habitats. Pastures are generally located on flat or gently sloping lands and are vegetated with a mix of perennial nonnative grasses. Typical forage species planted in pastures include meadow brome (*Bromus riparius*), smooth brome (*B. inermis*), tall fescue (*Festuca arundinacea*), meadow fescue (*F. pratensis*), perennial ryegrass (*Lolium perenne*), creeping meadow foxtail (*Alopecurus arundinaceus*), intermediate wheatgrass (*Elymus hispidus*), tall wheatgrass (*E. elongatus*), and timothy (*Phleum pratense*). The height of the vegetation varies according to season, level of irrigation, drainage, fertilization, mowing, and livestock stocking levels; it ranges from as little as 7–8 cm (3 inches) to 60 cm (2 ft) or more on fertile soils before grazing.

Wildlife

Pastures, like hydric meadows, are potentially used by a diverse assemblage of wildlife, comprising one amphibian species, four reptiles, 103 birds, and 32 mammals (Table 2-7). Ninety-four of the bird species that use pastures also use hydric meadows, which provide similar food and shelter resources. Eighty-nine of these 103 species have been documented within the project study area; the remaining 14 species could potentially occur there. Twenty-six of the 89 documented species can be found year-round in the Great Salt Lake basin, 23 are common to uncommon during the summer, 12 are winter visitants, and 35 only migrate through the region. All but three of the 103 bird species that use pastures are migratory, and 42 breed or could potentially breed within the project study area.

Nineteen special-status species (Bald Eagle, Swainson's Hawk, Ferruginous Hawk [rare], Golden Eagle, Peregrine Falcon, Prairie Falcon, American Golden Plover [rare], American Avocet, Solitary Sandpiper [rare], Whimbrel [rare], Marbled Godwit, Wilson's Phalarope, Burrowing Owl, Short-eared owl, Loggerhead Shrike, Brewer's Sparrow, Bobolink, spotted bat, and Townsend's big-eared bat) use or could potentially use this habitat within the project study area. Bald Eagles prey and scavenge on some of the larger bird species that use this habitat (Buehler 2000). Pastures are dry at times, but flood irrigation

of the fields provides rich foraging habitat for species such as White-faced Ibis, Franklin's Gull, California Gull, Short-eared Owl, and Bobolink (rare). Many common Great Salt Lake shorebirds, such as Greater and Lesser Yellowlegs, Least and Pectoral Sandpipers, Black-necked Stilt, and American Avocet, are opportunistic feeders and are commonly observed foraging in flooded pastures. Ground-nesting birds, including Ring-necked Pheasant, Killdeer, Black-necked Stilt, Willet, and Wilson's Snipe, use undisturbed pastures for nesting (Table 2-7). Common rodents (e.g., meadow voles and ground squirrels) and lagomorphs (rabbits and hares) provide prey for many raptors, including Red-tailed Hawk, Swainson's Hawk, Rough-legged Hawk, Golden Eagle, and Short-eared Owl. Many species of waterfowl also forage on the grasses in pasture habitat.

Cropland

Habitat Description

Large tracts of cropland are located within the project study area (Figures 2-7a–c). The major crops actively farmed on these lands include corn, wheat, sod, and alfalfa.

Wildlife

Because of the active rotation of crops, much of the cropland habitat is regularly disturbed, limiting the activities of wildlife species that occur there. Most species use these lands when the fields are fallow, but some find food and shelter in or along the periphery of planted cropland. Croplands within the project study area can potentially be used by one reptile species, 85 birds, and 15 mammals (Table 2-8). Seventy-one of the bird species have been documented as occurring within the project study area; another 14 species could potentially occur there. Twenty-three of the 71 documented species can be found year-round in the Great Salt Lake basin, 13 are common to uncommon during the summer, 13 are winter visitants, and 27 only migrate through the region. Eighty-one of the documented and potential species are migratory, and 31 breed or could potentially breed within the project study area.

Ten special-status species (Swainson's Hawk, Ferruginous Hawk [rare], Golden Eagle, Peregrine Falcon, Prairie Falcon, Burrowing Owl, Short-eared Owl, Loggerhead Shrike, Brewer's Sparrow, and Bobolink) use or could potentially use this habitat within the project study area. Ground-nesting birds (Ring-necked Pheasant, California Quail, Killdeer, Canada Goose, Northern Harrier, Short-eared Owl, and Western Meadowlark) commonly forage in planted fields but nest in non-crop vegetation around their periphery as well as in fallow fields. Meadow voles, gophers, ground squirrels, and rabbits occurring in these peripheral habitats are prey for a variety of raptors, foxes, coyotes, and gopher snakes. Waterfowl, including Canada and Snow Geese, Mallard, Northern Pintail, and American Wigeon, regularly forage in fallow croplands.

Salt Desert Scrub

Habitat Description

Salt desert scrub occurs primarily in the saline upland areas of the study area. It is characterized by shadscale (*Atriplex confertifolia*), Gardner saltbush (*Atriplex gardneri*), and greasewood (*Sarcobatus vermiculatus*). Within the project study area, this habitat has been heavily grazed by free-range livestock. Native grasses have been largely replaced by exotic grasses and forbs, including abundant cheatgrass (*Bromus tectorum*). Japanese brome (*Bromus japonicus*), wheatgrass (*Elymus* spp.), bulbous bluegrass

(*Poa bulbosa*), whitetop (*Caldaria draba*), storksbill (*Erodium cicutarium*), and gumweed (*Grindelia squarrosa*) are also abundant throughout the project study area.

Wildlife

Where limited disturbance has occurred, salt desert scrub habitat provides suitable nesting and foraging resources for one amphibian species, eight reptiles, 101 birds, and 36 mammals (Table 2-9). Eighty-one of the bird species have been documented within the project study area; an additional 20 could potentially occur there. Twenty of the 80 documented bird species can be found year-round in the GSLE, 13 are common to uncommon during the summer, 12 occur in the area throughout the winter, and 42 only migrate through the region. Ninety-nine of the 101 bird species are migratory, and 28 breed or could potentially breed in the project study area.

Eighteen special-status species (Bald Eagle, Northern Goshawk, Swainson's Hawk, Ferruginous Hawk, Golden Eagle, Peregrine Falcon, Prairie Falcon, Long-billed Curlew, Burrowing Owl, Short-eared Owl, Willow Flycatcher, Loggerhead Shrike, Virginia's Warbler, Brewer's Sparrow, Bobolink, Preble's shrew, spotted bat, and Townsend's big-eared bat) use or could potentially use this habitat within the project study area. Bald Eagles regularly prey and scavenge on some of the larger birds and small mammals that use this habitat (Buehler 2000). Many migratory birds find shelter and food resources (insects, fruit, and seeds) in this habitat, including various warblers, swallows, and sparrows. Characteristic mammals of the area include numerous desert-adapted rodents as well as carnivores that prey on them (e.g., foxes, coyotes, bobcats, weasels, badgers). A variety of bats forage for aerial insects at night. Salt desert scrub is the only habitat within the project study area that is likely to support populations of sagebrush and side-blotched lizards.

Developed/Urban Landscaping

Habitat Description

Developed/urban landscaping comprises areas that are used for residential, commercial, or industrial purposes. Most of these areas are covered by pavement and buildings. However, much of the urban landscaping (lawns, shrubs, and trees) provides food and shelter resources for a variety of wildlife.

Wildlife

While the more common wildlife species in developed areas are generally nonnative species (e.g., Rock Pigeon, House Sparrow, European Starling, house mouse, black rat) or highly urbanized native species (e.g., Mourning Dove), many other native species find much needed resources in the patchwork of urban forests and shrubbery scattered throughout housing areas and parks. Table 2-10 lists the 108 bird species and 11 mammals that occur in developed/urban landscaping in the project study area. Seventy-nine of the bird species have been documented in developed habitat within the project study area; another 29 are likely to occur there, at least infrequently. Of the 79 documented bird species, 22 occur within the Great Salt Lake basin all year, eight are common to uncommon during the summer, 16 occur in the area throughout the winter, and 37 only migrate through the region. One hundred four of the 108 bird species are migratory, and 28 breed or could potentially breed in developed habitat.

Five special-status species (Peregrine Falcon, Yellow-billed Cuckoo, Loggerhead Shrike, Virginia's Warbler, and Brewer's Sparrow) use or could potentially use this habitat within the project study area. Most of the bird species are migrant songbirds that occur sporadically in areas with trees and shrubs. Barn

and Cliff Swallows typically nest in large colonies in abandoned buildings and on bridges, often in developed areas. Mammals typical of developed areas include mice and rats that use buildings; opportunistic raccoons and muskrats that find habitat (often marginal) in parks, preserves, and scattered woodlots; and wide-ranging predators such as red foxes, coyotes, and bobcats that negotiate patches of remnant habitat in search of prey. Because much of the native vegetation that formerly occurred in developed areas is now gone, the replacement urban shrubbery and trees in housing areas and parks can provide food and roosting habitat for many species of migratory and resident wildlife.

2.4.2 Existing Distribution and Use of Wildlife Habitats

In this report, the relative abundance of different species is characterized by the following qualitative criteria.

- **Common:** Found consistently in moderate to large numbers in appropriate habitats and seasons.
- **Uncommon:** Found consistently in small numbers in appropriate habitats and seasons.
- **Rare:** Found infrequently, but regularly, in very small numbers in appropriate habitats and seasons.

The occurrence, breeding status, and habitat use patterns of the wildlife studied for this report are summarized in Tables 2-2 through 2-10. In total, 12 fish species, eight amphibians, 10 reptiles, 219 birds, and 50 mammals have been documented as occurring within the project study area, or are believed to have the potential to occur there based on the presence of suitable habitat and the general abundance of the species in the GSLE. Of these almost 300 species, 224 (216 birds and 8 bats) are migratory. One hundred thirty-six species are known to occur in the project study area, and an additional 139 species could potentially occur there. Up to 120 of these species could potentially breed within the project study area. The 28 special-status species comprise 24 migratory bird species, two migratory bats, one shrew, and one fox. The predominance of migratory birds that characterizes the project study area highlights the ecological importance of this area to these species (see *Regional Importance of the Great Salt Lake Ecosystem* below).

Wildlife habitats occur in a patchwork distribution across the project study area (Figures 2-7a-c). All habitat types in the project study area support a variety of amphibians, reptiles, birds, and mammals, and open water habitats support some fish species (Table 2-11). Because most species occupy many different habitats, it is important to consider these multiple habitat associations when addressing impacts on species in any single habitat. Tables 2-2 through 2-10 show which wildlife species use each habitat and what other habitats they also use in the project study area. Table 2-12 illustrates the degree that bird communities overlap in habitat use. For example, 78 bird species occur in open water habitat, 15 of which also occur in riparian habitat; 48 of the same 78 species occur in sedge cattail habitat. Furthermore, 14% of the 107 bird species that occur in riparian habitat also occur in open water. Table 2-12 illustrates that some habitats support very similar communities of bird species; this is most evident in pasture, hydric meadow, and mudflat/pickleweed habitats, which have more than 90% of their species in common. This does not mean that the habitats are used equally, however. Each species uses each habitat in proportion to the availability and suitability of resources in that habitat.

Birds use habitats for breeding, foraging, resting, and cover. Some habitats support the same species because the habitats fulfill similar needs; other habitats support the same species because the habitats fulfill different needs for different groups of species. Table 2-13 summarizes the diversity (species richness), seasonal abundance, and breeding patterns of migratory species that use each habitat. This

overlap in habitat use may, however, mask the relative importance for each habitat to each species. Some species primarily occupy one habitat but will opportunistically use another habitat in response to changes in conditions, such as a population outbreak of prey or flooding of upland habitats. These relationships underscore the fact that species often rely on a variety of habitats for different aspects of their natural history and in different seasons.

Regional Importance of Great Salt Lake to Migratory Birds

Great Salt Lake, with its unique mosaic of wetland, upland, mudflat, river delta, brackish and freshwater marshes, and ephemeral pond habitats, has long been recognized for its importance to migratory birds (Behle 1958; Knopf 1975; Jehl 1988; Paton 1994; Shuford et al. 1995; Paul and Manning 2002). These habitats, and the ecological features of this large inland oasis, provide important refuge and resources for more than 5 million birds a year. The many thousands of tons of brine shrimp (*Artemesia franciscana*) and brine flies (*Ephydra cinerea*) produced each year in the saline waters provide a key food source for millions of migratory shorebirds and waterfowl that pass through the area annually. Many of these species travel more than 3,000 km (1,860 mi) from their breeding grounds in the Arctic to Great Salt Lake (Aldrich and Paul 2002). This distance is commonly only the halfway point in their biannual migrations, making Great Salt Lake a critical refueling site for many long-range migrants. For example, more than a third of the world's population of Wilson's Phalaropes arrive at Great Salt Lake from their breeding grounds and typically double their weight on Great Salt Lake brine flies and brine shrimp before flying 8,800 km (5,400 mi) to wintering grounds in central South America (Colwell and Jehl 1994; Aldrich and Paul 2002).

Great Salt Lake provides important resources for some of the continent's largest congregations of migrating Eared Grebes, American Avocets, Black-necked Stilts, and Red-necked Phalaropes to molt, fatten, court, and stage for migration. Smaller but nonetheless substantial populations of Eared Grebes, American Avocets, and Black-necked Stilts also migrate to the GSLE to reproduce and rear their young (Aldrich and Paul 2002). The GSLE supports the largest breeding population of Snowy Plovers in North America (Aldrich and Paul 2002). Additionally, the GSLE is a major wintering area for a variety of species, particularly raptors, including a wintering population of more than 500 Bald Eagles (Aldrich and Paul 2002). Many of these migratory species rely on the abundance and diversity of ecological resources available in the GSLE, including those found in the Farmington Bay Waterfowl Management Area immediately adjacent to the project study area (Appendix A).

Because of its ecological importance to migratory birds, Great Salt Lake has been designated as a Western Hemisphere Shorebird Reserve Network (WHSRN) site of hemispheric importance (hemispheric site). The requisite screening criteria for the three categories of WHSRN sites are described below.

- **Hemispheric Sites** support at least 500,000 shorebirds annually, or 30% of a species' flyway population. Hemispheric sites are intended to include areas supporting major concentrations of shorebirds, with daily totals reaching about 50,000 birds during migration.
- **International Sites** support at least 100,000 shorebirds annually, or 15% of a species' flyway population.
- **Regional Sites** support at least 20,000 shorebirds annually, or 5% of a species' flyway population.

Each WHSRN site (Figure 2-5) is situated at an important location along the migratory pathways of these shorebirds. Table 2-14 shows that Great Salt Lake meets all the population size criteria for its hemispheric

classification. Conservation of the ecologically important features of Great Salt Lake is integral to the National and Intermountain Region Shorebird Plans, the North American Waterfowl Plan, and the Great Salt Lake Comprehensive Management Plan (Paul and Manning 2002).

Migratory Bird Use of the Project Study Area and the Great Salt Lake Ecosystem

Habitat-Based Analysis

A principal objective of this technical study is to determine the potential impacts on migratory species that could result from construction of a highway within the project study area. Fundamental to this determination is an understanding not only of what species use the project study area, but also how these species use other areas of the GSLE. To have a clear understanding of the potential impacts of habitat loss within the project study area, it is necessary to have a firm understanding of which other areas within the GSLE provide the same or similar habitat for special-status species. An assessment of the wildlife use patterns of the project study area is presented above. The following discussion provides information on how these same species use other areas within the GSLE; this discussion provides a regional perspective of the ecological significance of the project study area relative to total wildlife habitat availability throughout the GSLE.

A 5-year survey and monitoring program (1997–2001), which determined the abundance and habitat use patterns of migratory waterbirds in the GSLE, shows site-specific differences in importance to overall bird populations as well as to individual species (Figures 2-8 and 2-9) (Paul and Manning 2002). Figure 2-8 shows the survey locations; Figure 2-9 illustrates the relative importance of each survey area for large populations of waterbirds as well as the broad distribution of most species throughout the southern and eastern sections of the GSLE. Figure 2-9 also includes each species' seasonal abundance data and seasonal status in the project study area.

The project study area does not support high abundances of many of the waterbird species that are common in the GSLE. Of the 47 waterbird species included in this survey, only Canada Goose (year-round), Killdeer (year-round), White-faced Ibis (summer only), Black-crowned Night Heron (summer only), Eared Grebe (migrant only), and Franklin's Gull (migrant only) are common in the project study area (Paul and Manning 2002). The remaining 41 species on the survey list are uncommon, rare, or do not occur in the project study area. By contrast, 34 of the 47 species are common in the GSLE. Of the six USFWS Birds of Conservation Concern, Snowy Plover, American Avocet, Wilson's Phalarope, Marbled Godwit, and Long-billed Curlew are seasonally common in the GSLE; Sanderling is uncommon. None of these species are common in the project study area. Wilson's Phalarope, Marbled Godwit, and Long-billed Curlew are rare migrants in the project study area; American Avocet is uncommon; and there are no records for Sanderling or Snowy Plover (Figure 2-9).

The numbers of birds using the project study area vary with season, year, and lake level. Table 2-15 shows the mean and peak values for species common to the project study area surveyed at site 42 (East Farmington Bay), which includes part of the project study area. The average surface elevation during the 5-year study period was 1,280.7 m (4,201.9 ft) (range: 1,280.0–1,281.5 m [4,199.3–4,204.6 ft]). Comparison of the numbers of these species throughout the full survey area indicates that numbers counted at high lake level (1999 elevation of 4,204.6 ft [1,281.6 m]) were generally less than those at low lake level (2001 elevation of 4,199.3 ft [1,279.9 m]) (Paul and Manning 2002). Although specific surveys of the project study area were not conducted at these times, it is presumed that bird use of the project study area would reflect a similar relationship to lake level as that indicated by the Paul and Manning study results.

The different abundance values for each species at each survey site in the GSLE undoubtedly reflect local differences in the availability and quality of important food and shelter resources in the wetland areas (Paul and Manning 2002). Certain sites, such as Bear River Refuge (29), South Bear River (27), Farmington Bay Waterfowl Management Area (12), Ogden Bay Wildlife Management Area (20), and Bear River Bay (37), support high densities of a large number of species (Figures 2-8 and 2-9). Other sites support high densities of fewer species, as shown below.

- Ogden Bay (38) – Eared Grebe and California Gull.
- Magcorp (40) – Wilson’s Phalarope, Least Sandpiper, Red-necked Phalarope.
- Interstate 80 North (a) (5a) – California Gull, Killdeer.
- Stansbury Island South (a) (3a) – Least and Baird’s Sandpipers.

Bird Population Density and Abundance Analysis

The preceding habitat-based analysis provides an evaluation of how the proposed action would affect wildlife within the project and regional study areas on the basis of changes in habitat availability and quality. They do not, however, provide information on associated changes that are likely to occur in the numbers of each species in these areas. To examine this effect, UDWR survey data for migratory waterbirds were analyzed to estimate local and regional densities and abundances of these species. Estimates for the project study area were based on recent bird surveys conducted within the proposed Legacy Nature Preserve (i.e., the proposed wetlands/wildlife mitigation area) (Dolling 2003), which is some of the best wildlife habitat available in the project study area. These data were compared with the regional abundances for each species around the GSLE as determined by Paul and Manning (2002).

Densities of each species in the project and regional study areas were estimated by dividing the species-specific abundance measures by the area surveyed at each survey site. The relative abundances and densities for each species were then determined by comparing the average values for the project study area with those for the GSLE survey area. This measure provided a proportional estimate of the relative magnitude and upper limit of impact (i.e., complete loss of all birds within the project study area) that could be compared directly to the habitat-based impact analysis.

Table 2-16 summarizes and compares the waterbird survey data for the Legacy Nature Preserve (from Dolling 2002, 2003) and the GSLE (from Paul and Manning 2002). Summary statistics are provided for the Legacy Nature Preserve for both 2001 and 2002 to show inter-year variation in bird densities and abundances within the project study area. The GSLE study summarizes the results of a 5-year survey around Great Salt Lake. The mean densities of bird species within the Legacy Nature Preserve are significantly lower than those within the GSLE (an average of 0.003 birds/ac contrasted with 0.92 birds/ac, respectively). Similarly, the average maximum densities are much lower for the Legacy Nature Preserve (0.033 birds/ac contrasted with 13.15 birds/ac, respectively).

Extrapolating the Legacy Nature Preserve average density across the entire Legacy Nature Preserve area (approximately 2,000 acres) provides a conservative estimate of total abundance for each species within the Preserve. Comparing these values with the GSLE total mean abundances for each species and calculating the percentage mean abundance for the Legacy Nature Preserve (i.e., extrapolated Legacy Nature Preserve abundance / GSLE total mean abundance *100 = Legacy Nature Preserve % mean abundance) indicates that the average number of birds of each species within the Legacy Nature Preserve represents only a small percentage (0.44% [2001]), 0.22% [2002]) of the estimated total abundance of

each species within the GSLE. The largest values were for Killdeer (17.5% in 2001) and Lesser Yellowlegs (5.4% in 2002). The highest value for any special-status species was 0.01 % for American Avocet (2001 and 2002) and Wilson's Phalarope (2001 only). No other special-status species were documented on site during the Legacy Nature Preserve surveys.

The habitat-based impact analysis presented above indicates that the amount of wildlife habitat within the project study area is approximately 0.1% of that available throughout the GSLE. The estimated proportional abundances of waterbirds in the Legacy Nature Preserve are comparably small (0.22%–0.44% overall; 0.01% maximum for special-status species). These results demonstrate that the use of the habitat-based analysis provides a reasonable quantitative representation of the proportional impacts the proposed action would have on migratory wildlife populations within the project study area.

2.4.3 Special-Status Species

Federally Listed Species

Bald Eagle (Threatened)

Bald Eagles are federally listed as threatened (68 FR 34585 34586). They are common winter visitants but rare summer breeders in the GSLE (Table 2-1). One of the top 10 wintering areas for Bald Eagles in the contiguous United States, the GSLE supports a population of more than 500 eagles during this season (U.S. Geological Survey 2001). No critical habitat has been designated in Utah for Bald Eagle (U.S. Fish and Wildlife Service 1999).

Bald Eagles move regularly from roosts in the Wasatch Mountains down to the wetlands of the project study area and vicinity to forage. They are opportunistic feeders that prey on a variety of mammals (including carrion), birds, reptiles, amphibians, and crustaceans. However, they generally prefer fish, when available, to other food types (Buehler 2000). Bald Eagles eat a great variety of aquatic and terrestrial mammals, including muskrats, jackrabbits, and ground squirrels, as well as many species of waterfowl, gulls, and even Great Blue Herons (Buehler 2000). All these prey types are available within the project study area. Hunter-induced waterfowl mortality in and around the duck clubs west of the project study area also provide a reliable supply of waterfowl carcasses for scavenging eagles (Griffin et al. 1982, as cited in Buehler 2000). The shallow waters of Great Salt Lake, especially along the shore and in delta bays, also provide good habitat for the eagles to prey on a variety of fish, including carp, suckers, and catfish.

Federally Delisted Species

Peregrine Falcon

Peregrine Falcons are rare permanent residents and breeders in the GSLE. They are aggressive, on-the-wing predators that take avian prey, most commonly by blunt force attacks in full flight or during high-speed stoops. Prey species include most medium-sized passerines, shorebirds, game birds, doves, and pigeons, but species the size of geese have been killed (Johnsgard 1990). Peregrine Falcons typically nest on inaccessible cliffs or utility structures relatively near water and prey.

Federal Candidate Species

Yellow-Billed Cuckoo

Yellow-billed Cuckoo in the western United States is classified as a federal Candidate Species (67 FR 71193 71194). Yellow-billed Cuckoos historically bred along the riparian corridors of the Great Salt Lake basin (U.S. Fish and Wildlife Service 2002). The Jordan River and Delta once provided large areas of habitat suitable for cuckoos (Mitigation Commission and U.S. Fish and Wildlife Service 2000). However, habitat loss and fragmentation from dewatering, stream canalization, encroachment by nonnative tamarisk, grazing, and oil and gas development have removed most of this species' historical habitat. The current breeding range for Yellow-billed Cuckoos in Utah includes Salt Lake, Tooele, and Washington Counties. Preferred breeding habitat in this area includes riparian woodlands characterized by willow, Fremont cottonwood, and dense mesquite. (Walters 1983; Hughes 1999.) Nests are commonly placed in willows, but cottonwoods are used extensively for foraging. In other areas of the United States, Yellow-billed Cuckoos occupy human-modified habitats including abandoned farmlands, overgrown fruit orchards, successional shrubland, shade trees, and gardens. The principal foods of this species are large insects including caterpillars, cicadas, grasshoppers, and crickets (Hughes 1999). Small frogs, the eggs and young of other birds, and fruit and seeds are also eaten on occasion.

Conservation Agreement Species

Northern Goshawk

Northern Goshawks are rare migrants in the GSLE (Table 2-1), but are more abundant in the higher forested reaches of the watersheds of the GSL and elsewhere in Utah. Ryser (1985) noted that in the Great Basin during winter there is some altitudinal migration of goshawks from mountain forests down into the foothills and valleys, as well as immigration of individuals into the Great Basin from the north. Goshawks have been observed foraging in open sagebrush areas in Nevada where they prey on ground squirrels (Younk and Bechard 1992). Also, wintering goshawks use cottonwood riparian areas in the Rocky Mountains and Intermountain Region (Squires and Ruggiero 1995) as well as adjacent open areas (Hughes 1999). Northern Goshawks prey mostly on large passerine birds, grouse, woodpeckers, corvids, squirrels, rabbits, and hares (Squires and Reynolds 1997).

U.S. Fish and Wildlife Service Birds of Conservation Concern

Swainson's Hawk

Swainson's Hawks are rare summer breeders and uncommon migrants in the GSLE (Table 2-1). They typically breed in riparian habitat but forage in more open habitats such as grassland, shrubland, and agricultural landscapes (England et al. 1997). In agricultural areas of the Central Valley in California Swainson's Hawks forage in row, grain, and hay crop agriculture, particularly during and after harvest when prey animals are both numerous and conspicuous. These birds are also attracted to areas with flood irrigation (especially alfalfa fields); flooded conditions can concentrate rodents in field margins where they are more exposed to predation. During the breeding season, Swainson's Hawks prey mainly on vertebrates (small mammals, birds, and reptiles) (Schmutz et al. 1980; Bednarz 1988; England et al. 1997). Ground squirrels, pocket gophers, voles, and deer mice comprise most of the mammalian prey; however, Swainson's Hawks routinely take rabbits in Utah and New Mexico (Smith and Murphy 1973; Bednarz 1988). The diet of nonbreeders consists largely of insects, particularly grasshoppers and dragonflies (Sherrod 1978; Jarmillo 1993).

Ferruginous Hawk

Ferruginous Hawks are uncommon summer visitants and rare migrants to the GSLE (Table 2-1). These hawks typically occur in flat and rolling terrain in grassland or shrub-steppe regions (Bechard and Schmutz 1995), including grasslands, sagebrush country, saltbush-greasewood shrublands, and along the periphery of western pinyon and other forests (Olendorff 1993). Nest sites tend to be at elevated sites such as boulders, knolls, low cliffs, trees, large shrubs, and utility structures. While foraging, these hawks commonly perch in trees; on telephone and powerline poles, farm buildings, fence posts, or outcrops; or on the ground. Their principal prey comprises jackrabbits, cottontail rabbits, ground squirrels, and gophers (Olendorff 1993; Bechard and Schmutz 1995).

Golden Eagle

Golden Eagles occur in nearly all habitats of the western states from desert grasslands to above timberline (Johnsgard 1990). They are most common in grass-shrub and young woodland habitats, or in forests with open lands nearby for hunting. Golden Eagles favor hilly terrain over flat country because updrafts in such settings facilitate soaring. The prey species commonly taken include jackrabbits, cottontail rabbits, ground squirrels, and game birds, but Golden Eagles may also eat insects, snakes, juvenile ungulates, and carrion. Individual eagles range over large areas while hunting; they are likely to pass only occasionally through the project study area. Habitats in the project study area that are most suitable for foraging are hydric meadow, mudflat/pickleweed, pasture cropland, and salt desert scrub.

Prairie Falcon

Prairie Falcons prefer open habitat (e.g., shrub-steppe desert, grassland, mixed shrub and grassland, alpine tundra) at elevations up to 3,350 m (11,000 ft). In Utah, they prefer open grassland habitats and nest mainly near areas of cheatgrass and mixed shrubs (Peterson 1988). During the winter they frequently hunt in grassland flats and dry-farm wheat fields (White and Ruseneau 1970). Ground squirrels comprise the majority of the diet, with horned larks and western meadowlarks as secondary prey (Steenhof 1998). Mourning doves, lizards, and various open-land passerines are also taken.

American Golden-Plover

American Golden-Plovers forage in hydric meadow, mudflat, or pasture habitats. The primary foods taken by this species include various terrestrial invertebrates, leaves, seeds, and berries (Johnson and Connors 1996). Common invertebrates taken include grasshoppers, beetles, bees, ants, flies, weevils, spiders, cutworms, grubs, small molluscs, slugs, and earthworms (Johnson and Connors 1996).

Snowy Plover

Snowy Plovers typically breed on barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, and ponds (Page et al. 1995). They are closely tied to the dynamic nature of the Great Salt Lake shoreline and mudflats (Aldrich and Paul 2002). Snowy Plovers rely heavily on the tremendous abundance of insects, mostly brine flies, associated with the saline soils of the open shorelines and mudflats. They breed and feed in the same habitat, but breeding and feeding areas are often separate locations. Nests are built on the ground, usually in open or sparsely vegetated areas near water (Page et al. 1995). Nesting locations often change relative to the rise and fall of the Great Salt Lake shoreline (Aldrich and Paul 2002). Accordingly, Snowy Plovers are considered pioneer species, often establishing new

nesting sites in areas recently exposed by receding waters of Great Salt Lake during dry cycles. The Great Salt Lake population of Snowy Plovers is the largest known concentration of the species in interior North America, numbering approximately 10,000 individuals (Patton and Edwards 1992 in Aldrich and Paul 2002). In contrast with the resident Pacific coast population, the Great Salt Lake population migrates to the beaches of the Gulf of California during the winter.

American Avocet

American Avocets are common breeders in the GSLE; the breeding population around the lake can reach 53,000 individuals (Aldrich and Paul 2002). Single-day counts at Great Salt Lake have reached 250,000 (including nonbreeders), the highest count of any wetland area in the Pacific Flyway (Shuford et al. 1995; Aldrich and Paul 2002). Mean annual counts of avocets in the Farmington Bay wetlands adjacent to the project study area exceed 9,000 birds (Paul and Manning 2002). Around Great Salt Lake, American Avocets breed primarily in salt ponds, potholes, and shallow alkaline wetlands, where they place nests on barren mudflats, dikes, or islands with sparse vegetation (Robinson et al. 1997). In mudflat and shallow-water habitats, they forage mostly on (midge) larvae (CHIRONOMIDAE); in the water column, they forage on brine flies and waterboatman nymphs and adults (HEMIPTERA: CORIXIDAE) while wading in open water 0–20 cm (0–7.9 in) deep (Aldrich and Paul 2002). While on shore, they consume brine flies concentrated in windrows along the shore, as well as grasshoppers, caterpillars, and spiders. The abundance and distribution of American Avocets around Great Salt Lake is closely tied to the fluctuating lake levels, following the shoreline as it changes with and during the seasons (Aldrich and Paul 2002).

Solitary Sandpiper

Solitary Sandpipers are rare migrants in the GSLE. During spring and fall migration they are generally found around enclosed wet or muddy habitats along riparian corridors, drainage ditches, hydric meadows, mudflats, and pastures. Major food items include mosquito larvae, grasshoppers, beetles, dragonfly nymphs, water boatman, spiders, and worms (Moskoff 1995).

Whimbrel

Whimbrels are rare migrants in the GSLE. Migrant Whimbrels typically forage and rest in meadows, fields, river deltas, estuaries, salt marshes, and sandy beaches. The principal foods taken by this species during migration are crayfish, where available; otherwise grasshoppers and similar insects constitute the mainstay (Skeel and Mallory 1996).

Long-Billed Curlew

Long-billed Curlews are uncommon breeders and common migrants in the GSLE. They typically forage in higher and drier meadowlands than many other shorebirds, preferring areas with mixed short grass cover and bare ground components. Long-billed Curlews breed and/or forage in mudflat/pickleweed, shallow open water, cropland, pasture, and hydric meadow habitats. Uncultivated rangelands and pastures as well as rice and alfalfa fields support most of the Long-billed Curlew populations throughout the West (Dugger and Dugger 2002). Curlews feed on a variety of crustaceans, molluscs, worms, frogs and toads, various insects, and berries.

Marbled Godwit

Marbled Godwits are common migrants in the GSLE. During migration, godwits tend to congregate around sedge cattail habitats, lake and pond shorelines, open fields, mudflats, and sandy beaches. Marbled Godwits in the GSLE forage in shallow open water along the lakeshore, hydric meadows, mudflats, and pasture. They feed on insects, aquatic invertebrates, plant tubers, and small fish (Gratto-Trevor 2000).

Sanderling

Sanderlings are uncommon migrants and rare winter visitants in the GSLE. During migration they are most likely to be found along the beaches and mudflats around the lakeshore. Principal foods likely comprise invertebrates (e.g., brine flies, brine shrimp) washed up on the beaches.

Wilson's Phalarope

Wilson's Phalaropes annually form enormous aggregations (up to 600,000) around Great Salt Lake from mid-June to September as they stage during migration (Colwell and Jehl 1994). Wilson Phalaropes are salt lake specialists and rely heavily on the brine shrimp and brine flies in Great Salt Lake to provide sufficient fuel for migration. While staging at Great Salt Lake and Mono Lake, these birds may double their body mass with stored fat (Colwell and Jehl 1994; Aldrich and Paul 2002). The extensive open water and shallow shorelines of Great Salt Lake's south arm provide the primary foraging habitats for Wilson's Phalaropes. During high-water periods, former uplands become shoreline habitats that tend to concentrate food resources for this species. It is largely because of the tremendous concentrations of Wilson's Phalaropes at Great Salt Lake and their strong dependence on the abundant food resources of the lake that the GSLE has been designated an internationally important WHSRN site. Wilson's Phalarope is the only shorebird species that molts at Great Salt Lake. Some individuals nest in Great Salt Lake wetlands.

Burrowing Owl

Burrowing Owls are rare breeders in the GSLE. During the breeding season they prefer dry, open shortgrass habitats, generally without trees. They are typically associated with burrowing mammals such as ground squirrels. Across their range, Burrowing Owls nest in burrows in pastures, agricultural fields, vacant lots in residential areas, golf courses, cemeteries, university campuses, and fairgrounds. Burrowing Owls are generally opportunistic feeders and prey upon arthropods, small mammals, birds, amphibians, and reptiles (Haug et al. 1993).

Loggerhead Shrike

Loggerhead Shrikes are uncommon residents and breeders in the GSLE. They breed in short trees and shrubs and forage primarily in pasture, salt desert scrub, and cropland habitats. Shrikes prey upon a variety of arthropods, amphibians, reptiles, small mammals, and birds (Yosef 1996); they also feed on carrion. They forage in open landscapes characterized by well-spaced, often spiny shrubs and low trees, usually interspersed with short grasses, forbs, and bare ground. Shrikes impale prey on spines on shrubs and/or barbed wire for storage or to secure it during feeding.

Virginia's Warbler

Virginia's Warblers are rare migrants in the GSLE. During fall and spring migration they forage and rest in cottonwood- and willow-dominated riparian areas. These insectivores forage by gleaning insects from plant foliage or by "hawking" insects from the air (Olson and Martin 1999).

Brewer's Sparrow

Brewer's Sparrows are common breeders and migrants in the GSLE. They favor sagebrush shrublands and salt desert scrub habitat, especially areas dominated by saltbush and creosote species, occasionally mixed with grasses (Rottenberry et al. 1999). During spring and summer, they are often the most abundant birds in these habitats. Brewer's Sparrows are largely insectivorous, gleaning insects from the foliage and bark of shrubs and small trees; they also forage for seeds on the ground.

Utah Division of Wildlife Resources Wildlife Species of Concern

American White Pelican

American White Pelicans are common breeders on islands in the GSLE. They are found almost exclusively in open water habitat and occasionally in the open water areas of sedge cattail. Pelicans feed on fish that concentrate in shallow water areas around the lake. The only breeding colony of American White Pelicans in Utah is on Gunnison Island in Great Salt Lake's north arm (Aldrich and Paul 2002). Exceeding 20,000 in some years, this colony is one of the largest breeding populations in North America. However, this colony is some distance from reliable fisheries, most of which are associated with freshwater outflow from the streams and rivers on the east side of the lake (especially Bear River National Wildlife Refuge and Farmington Bay). Consequently, pelicans must commute from Gunnison Island to these areas, a minimum 90-km (60-mi) round trip for foraging adults (Aldrich and Paul 2002).

Short-Eared Owl

Short-eared Owls are common breeders throughout the GSLE. They are commonly associated with open country (e.g., grasslands and shrub-steppe habitat) (Holt and Leasure 1993). Short-eared Owls breed and/or forage in mudflat/pickleweed, sedge cattail, cropland, pasture, salt desert scrub, and hydric meadow habitats. Nest sites are typically on slight ridges in areas with enough vegetation to conceal the incubating female. During the nonbreeding season these owls commonly forage and roost in large open woodlots, stubble fields, and shrub thickets. They feed primarily on small mammals (e.g., voles, deer mice, rats, shrews, rabbits, and pocket gophers), as well as on a variety of birds (e.g., shorebirds, rails, gulls, terns, and passerines).

Bobolink

Bobolinks are rare migrants in the GSLE. Isolated breeding populations of this species occur in northern Utah. These populations occur in or near Centerville, Logan, Brigham City, Kamas, Heber, Morgan, Mountain Green, West Layton, and Provo. Bobolinks nest and forage in hydric meadows, wet grasslands, and irrigated areas (primarily pasture and hay fields). Although historically common in northern Utah, Bobolinks are now rare in the area, and they often exhibit unpredictable fluctuations in population numbers. During the breeding season, their diet includes weed and grain seeds, a variety of larval and adult insects, spiders, and harvestmen. The young are exclusively fed invertebrates. During migration and

winter periods, grain seeds are the staple diet, supplemented occasionally with insects (Martin and Gavin 1995).

Grasshopper Sparrow

Grasshopper Sparrows occur in the Great Basin region of Utah (McIvor 1998) (Appendix A). They breed in shrub steppe habitats in Utah and may nest and/or forage in hydric meadow, cropland, and pasture habitats as well. Their preferred habitats in the western United States comprise lush portions of open grasslands that also include a sparse shrub component. Grasshopper Sparrows consume mostly large insects, such as grasshoppers, in the summer. They capture insects exclusively on the ground; exposed, bare areas are required for successful foraging (Vickery 1996).

Preble's Shrew

Very little is known about the distribution of Preble's shrew in Utah. Its range, as it is currently understood, includes much of Montana, central Idaho, eastern Oregon, and surrounding areas in semiarid to arid habitats. Records of its occurrence in Timpie Springs along the southern shore of Great Salt Lake indicate its presence in this region. The known habitat of this species includes marshy areas such as creeks and bogs bordered by willows and other brushy plants. Preble's shrews have recently been found in a montane sagebrush community in northern California, suggesting that the species may also use drier habitats (Zevuloff and Collett 1988). Because similar habitats are found within the project study area the species may occur there; however, until comprehensive surveys are conducted, its status in the project study area is unknown. Habitats with the highest potential for supporting this species include sedge cattail and remnant riparian areas.

Spotted Bat

Very little is known about the distribution or biology of spotted bats in Utah. This species is considered one of North America's rarest mammals (Zeiner et al. 1990). While Great Salt Lake is well within the known distribution of this species (Zevuloff and Collett 1988), virtually nothing is known about its local distribution. The species occurs in a variety of habitats, commonly rough, desert-like terrain characterized by vertical cliffs suitable for roosting. Spotted Bats often roost in caves and occasionally in buildings. Radiotelemetry studies of this species at the Grand Canyon in Arizona indicate that individuals can travel long distances to forage. One bat was tracked 38.5 km (24 mi) from its roosting cliff at the bottom of the canyon to foraging areas in the forests on the North Rim (Rabe et al. 1998). This long-range commute capability suggests that individuals roosting in cliffs in the Wasatch Mountains could commute to foraging grounds around Great Salt Lake. However, because no local studies have been conducted, it is not known whether spotted bats visit the project study area.

Townsend's Big-Eared Bat

Townsend's big-eared bats are common in the highlands of the West, often found in scrub plant communities, pinyon-juniper and pine forests, and deciduous woodlands (Zevuloff and Collett 1988). However, they appear to be generally uncommon in dry regions. Local distribution is closely tied to the presence of roosting caves, mines, or buildings within reasonable commute distances (up to 32.2 km [20 mi]) of foraging areas (Pearson 1952). Prey items include small moths, flies, lacewings, dung beetles, and sawflies (Davis and Schmidly 1994). In Utah, this species frequently hibernates in mines and caves

(Zevelloff and Collett 1988). Such features are likely present in many locations around Great Salt Lake, especially in the Wasatch Mountains and nearby desert hills.

Kit Fox

Great Salt Lake is located on the northeastern edge of the known distribution of kit fox (Zevelloff and Collett 1988). Kit foxes are found throughout Utah in desert and semiarid regions with flat shrub or shrub-grass communities with little ground cover. Where these foxes occur in the Great Basin, shadscale, greasewood, and sagebrush communities are common. Major prey items include desert rodents, jackrabbits, cottontail rabbits, groundnesting birds, reptiles, and insects.

2.4.4 Existing Habitat Fragmentation

Habitat fragmentation, by definition, results in the formation of smaller patches of habitat where larger, more contiguous patches once existed (Meffe et al. 1997). As a result of fragmentation, a larger population of a species that inhabited the original patch may become divided into several smaller subpopulations that are connected only by migrating individuals rather than by contiguous habitat (Primack 2000). Habitat fragmentation results not only in direct habitat loss, but also in changes in the geometry and biological connectivity between patches (Meffe et al. 1997). Each of these changes can result in modifications of the availability and suitability of habitat to extant wildlife in an affected area. Over time, extinction rates in smaller, more isolated populations are generally higher than those in larger populations because of loss of genetic variation, inbreeding, genetic drift, and greater susceptibility to random population fluctuations and environmental changes, all of which ultimately affect the long-term viability of wildlife populations (Soulé 1987; Forman 1995; Primack 2000). In general, such results are most likely to affect relatively sedentary species with low dispersal capabilities (e.g., amphibians, reptiles, small mammals, and many invertebrates).

Roadway construction can divide the landscape, resulting in local and regional habitat loss and fragmentation (change in spatial pattern) and disrupting animal movement patterns. The existing habitats within the project study area have already experienced extensive fragmentation due to previous construction of railroad corridors (Union Pacific Railroad [UP] and Denver & Rio Grande Railroad [D&RG]), I-15, and many smaller roads, as well as other forms of disturbance (e.g., farming, grazing, dikes, fences) in many areas in the project vicinity. Consequently, the wildlife populations present in the area may already have experienced population changes that are often associated with habitat fragmentation (e.g., reduced carrying capacity, lower reproductive success, higher susceptibility to predation). These populations will continue to respond to changes in habitat quality and quantity that have already occurred and that could occur as a result of the proposed Legacy Parkway project and future development in the GSLE. Figure 2-10 illustrates the size and number of habitat patches currently extant in the project study area.

2.4.5 Status of Existing Habitat Quality

Water Quality

The water quality status of the project study area is described in the Final EIS (Federal Highway Administration et al. 2002). Since publication of the Final EIS, the Jordan River has been listed as an impaired water that does not meet Class 3B (warmwater species of game fish) and Class 3C (non-game

fish) standards under the Clean Water Act due to low dissolved oxygen (Toole 2002; HDR Engineering, Inc. 2004).

Air Quality

Air quality in the region is considered to be generally good. The air quality monitoring site nearest the project study area is in Bountiful (65 West 300 South). Levels of ozone, sulfur dioxide, carbon monoxide, and particulate matter (PM10 and PM2.5) are monitored at the site. Salt Lake and Davis Counties are designated maintenance areas for ozone (1-hour average). Salt Lake County is in moderate nonattainment for PM10. PM10 monitoring data indicate that the PM10 standard has not been exceeded in Salt Lake County since 1994 (Bird pers. comm.).

2.4.6 Status of Existing Wetland Hydrology

The hydrology of the project study area is a function of both seasonal and spatial patterns of water flow, both on the surface and underground. The surface water bodies within the study area include the Jordan River, nine creeks, and wetlands associated with Great Salt Lake and along ditches and canals.

The Jordan River meanders for approximately 93 river km (58 river mi) from the outlet of Utah Lake north to Great Salt Lake. Each of the Jordan River's seven major tributaries (Little Cottonwood Creek, Big Cottonwood Creek, Mill Creek, Parlyw's Creek, Emigration Creek, Red Butte Creek, and City Creek) originates in the western side of the valley. The watershed drains a total area of about 2,085 square km (805 square mi).

The wetlands respond to a shallow water table associated with groundwater discharge and periodic precipitation. The project study area is located over a multilayered groundwater flow system consisting of a shallow unconfined aquifer and a deeper principal aquifer that is part of a larger east shore aquifer system. The depth of the shallow groundwater varies between 0 and 3 m (9 ft).

The principal aquifer lies at a depth of approximately 60 m (200 ft) and is separated from the shallow groundwater by a layer of fine-grained soil of varying thickness. It is recharged primarily by precipitation at the base of the Wasatch Mountains, outside the project study area. Subsurface groundwater flow generally moves from this recharge area west toward Great Salt Lake, but there is also an equal or greater component of vertical flow from deeper confined zones of the principal aquifer (Forster and Neff 2002).

2.4.7 Existing Artificial Landscaping in Project Vicinity

Portions of the project study area have been artificially landscaped in residential, commercial, and industrial areas. Some of this landscaping also exists in rural residential areas, particularly around ranch houses and other ranch buildings. Artificial landscaping incorporates many nonnative and native trees, shrubs, and other vegetation.

2.4.8 Existing Sources of Direct Wildlife Mortality in Project Vicinity

There is little information on existing sources of wildlife mortality within the project study area. Aside from natural causes of death (e.g., predation, disease, old age), there is undoubtedly some roadkill associated with existing roads in the area, particularly for amphibians, reptiles, and small mammals found in adjacent habitats, as well as predatory birds and mammals that may be attracted to the carcasses.

2.4.9 Existing Sources and Levels of Noise in Project Vicinity

The noise levels within the project study area were measured to determine existing conditions. This analysis included both short-term (1-hour) and long-term (3-day) measurements at various locations within the project study area and up to approximately 6 km (3.7 mi) beyond the project study area. Existing noise levels in the project study area are elevated by traffic noise from I-15 and aircraft overflight.

Short-Term Noise Measurements

Table 2-17 summarizes the sound levels for the short-term measurements at each sampling location in the project study area (Figure 2-11). The loudest noise values (L_{max}) ranged between 53 and 79 decibels (A-weighted) (dB[A]); the lowest noise values (L_{min}) ranged between 31 and 45 dB(A). During the measurement periods, the sound levels on average exceeded 51 dB(A) 10% of the time, 43 dB(A) 50% of the time, and 39 dB(A) 90% of the time. The highest sound levels were generally associated with plane overflights; the highest wildlife signals (duck vocalizations) were approximately 52 dB(A) (at approximately 30 meters from the microphone). The mean equivalent steady state sound level (L_{eq}) across the entire study area was 48.6 dB(A) (S.D. = +/- 6.6), with a minimum value of 37.1 dB(A) and a maximum value of 59.9 dB(A).

Long-Term Noise Measurements

Figure 2-12 shows the long-term hourly sound levels and the local wind speeds measured at survey location L1 in the project study area. The wind speed profile shows the wind speeds recorded at Salt Lake City International Airport for July 1–3, 2003.

Table 2-18 presents the average, minimum, and maximum sound levels measured at the three long-term measurement stations in the project study area (Figure 2-11). The highest noise level (81 dB[A]) was recorded at location 1 (L1), closest to I-15; the lowest value (32 dB[A]) was recorded at location 2 (L2). The average sound level across the entire area surveyed was 50 dB(A), with a minimum value of 36 dB(A) and a maximum value of 78 dB(A) (L_{eq}, L1-L3).

Overall, sound levels exceeded 51 dB(A) 10% of the time, 45 dB(A) 50% of the time, and 40 dB(A) 90% of the time. There were no differences in the average values between the long-term sound level measurements (Table 2-18) and the short-term measurements (Table 2-17). However, the ranges of sound levels recorded for these values were larger for the long-term measurements. On average, the noise levels recorded at L2 were lower than those recorded at L1 and at L3.

2.4.10 Existing Sources of Artificial Light in Project Vicinity

Increased lighting and glare can affect wildlife in a variety of ways, both positive and negative. Some species, such as bats and foxes, benefit from artificial light because it attracts aerial insects or small mammals, their primary prey. Other species, including some fish, amphibians, birds, mammals, and invertebrates, may have their diurnal or reproductive cycles interrupted or may experience direct mortality and increased predation rates because of artificial light and glare (Appendix D).

The project study area is affected by artificial lighting from residential and commercial developments in the greater Salt Lake City region. Some of the major industrial sources of artificial light and glare in the project vicinity are listed below.

- Chevron USA, Inc., petroleum refinery in Salt Lake City.
- Amoco Oil Company petroleum refinery in Salt Lake City.
- Tesoro petroleum refinery in Salt Lake City.
- Flying J petroleum refinery in North Salt Lake.
- Portland Cement plant in North Salt Lake.
- Phillips 66 petroleum refinery in Woods Cross.
- Crysen Refining petroleum refinery in Woods Cross.
- Utah Auto Auction in Woods Cross
- Golden Eagle Refinery, Inc., petroleum refinery in Woods Cross.
- Utah Power and Light substation in Centerville.
- Salt Lake City International Airport, located just west of the project's southern terminus (runway, building, and control tower lights, as well as aircraft lights).

2.4.11 Existing Sources of Human Disturbance in Project Vicinity

Human disturbance can have adverse effects on wildlife, and many bird species are sensitive to some level of direct disturbance of their nest sites or intrusions into their nesting territories. Portions of the project study area have already been converted to residential, commercial, and industrial uses; wildlife using these areas often experiences frequent disturbance from human activities and domestic pets. Human and domestic pet access to the wildlife habitat adjacent to the highway could result in some level of habitat degradation and wildlife mortality; cats pose a particular threat to wildlife (especially avian) mortality. Other portions of the project study area are currently low-density, rural residential areas or ranches. In those areas, potential human sources of wildlife disturbance include vehicle traffic on the unsurfaced roads and off-highway vehicle use in unroaded areas. The actions of horses and cattle (e.g., grazing, trampling) are likely to remove cover and alter species habitat. In addition, unauthorized hunting and shooting that may occur in some areas can result in direct wildlife mortality.