Chapter IX
Natural Environment Element

9.1 Background and Introduction

Cottonwood Heights is a primarily low-density residential community with several key undeveloped natural areas; including the Wasatch Mountain foothills, the entrances to Little and Big Cottonwood Canyons and the Little Cottonwood Creek and Big Cottonwood Creek stream corridors. These resources are at risk from encroaching development and other land use activities. Wasatch-Cache National Forest is located directly east of the Cottonwood Heights boundary and is under the jurisdiction of the National Forest Service. According to the Revised Forest Plan for Wasatch-Cache National Forrest, a large portion of the adjacent forest is designated National Wilderness Area, where the use of motorized vehicles is prohibited. Other sensitive natural resources throughout the City include mountain views, hillsides/slopes, prominent ridgelines/rock formations/outcroppings, gullies/ravines/draws, open space, soils, vegetation, wetlands, riparian corridors, and flood plains.

Additionally, Cottonwood Heights is subject to several natural hazards with the potential to cause loss of life and property. There are moderate to high liquefaction potential areas and 100-year floodplains generally located along the Little Cottonwood Creek and Big Cottonwood Creek stream corridors. The Wasatch fault, which is located along the eastern edge of the City, is seismically active and subject to fault rupture. There are

several classifications of slopes within the City defined as: (a) slopes greater than fifteen percent (15%), but less than or equal to thirty percent (30%); (b) steep slopes greater than thirty percent (30%) but less than or equal to forty percent (40%); and (c) very steep slopes, greater than forty percent (40%). Properties located on or adjacent to steep slopes or very steep slopes are potentially subject to landslides, rockfalls, debris flows, and high erosion. There is also the potential for damage from wildland fires where the developing foothills meet the undeveloped natural terrain (Urban Interface Wildfire Zone). There are also moderate soil constraints generally located along the Little Cottonwood Creek stream corridor, in the central portion of the City, and along portions of the foothills. The potential for the occurrence of natural hazards is critical in shaping how future development occurs within the City.

A balance must be maintained between development on private property, recreational activities, and the natural environment

Guiding Principles

A balance must be maintained between development on private property, recreational activities, and the natural environment for Cottonwood Heights to continue enjoying a viable and healthy economy and a desirable quality of life. Since our natural environment is interdependent with the larger community surrounding the City, it is also important to work with surrounding communities and landowners (public and private) to ensure that local efforts are successful on a broader scale. Preserving and enhancing the existing natural environment is highly desirable to maintain the quality of life and to remain economically competitive with other communities along the Wasatch Front. It is important to work cooperatively with state and federal governmental agencies to resolve these issues. Environmental considerations must be part of community land use planning, recreational development, and the planning of large-scale developments.

Therefore, the intent of the Natural Environment Element is to recommend methods to preserve, enhance, and protect the natural features and the aesthetic qualities they provide to residents and visitors alike. Such natural features are ridgelines, hillsides, stream corridors, flood plains, and areas with significant vegetation. These are all features that make Cottonwood Heights appealing as a place to visit and live. Success in developing this balance will include efforts to develop:

- innovative, fair and consistent land use regulations
- protection and restoration of the area's ecosystem
- ecological awareness and educational outreach
- environmental management

Additionally, the Natural Environment Element is intended to reduce the potential loss of property and life that could occur as a result of natural hazards and disasters. Consequently, the City has developed policies to:

- carefully regulate development in areas prone to natural hazards
- require studies to define the hazards prior to development, and
- require design features and mitigation to avoid or reduce the damage potentially caused by natural hazards

9.2 Goals, Objectives, and Policies

Goal 1: Risks to life and property as a result of natural hazards found in the natural environment should be minimized including risks associated with flooding, slope failure, seismic activity, unstable soils and wildfires.

OBJECTIVE: Minimize damage to life and property as a result of flooding.

POLICY: Require floodplain hazard studies for any development or construction in a 100-year floodplain (see Map 9.4) or whenever it will alter the natural drainage patterns of the land in such a way that it could induce flooding. Development in a floodplain shall specifically comply with all applicable Federal Emergency Management Agency regulations.

POLICY: Proposals for new construction or substantial improvements to existing structures within the floodplain hazard area should be designed or modified and anchored to prevent flotation, collapse, or lateral movement of the structure and should be constructed with materials and utility equipment resistant to flood damage.

POLICY: Adequate buffers from development should be provided along Big and Little Cottonwood Creeks to minimize flooding in Cottonwood Heights.

OBJECTIVE: Manage development, minimize damage and hazards, and protect life and property in areas subject to risk seismic activity.

POLICY: Review development proposals located in or immediately adjacent to areas potentially subject to seismically induced liquefaction ("high" or "moderate" liquefaction potential, see Map 9.6) and fault rupture hazard area (within 500 feet of the downthrown side and 250 feet of the upthrown side of the fault, see Map 9.6). Developers shall hire qualified personnel to prepare applicable seismic studies to determine if a significant constraint exists relative to these various issues and to determine appropriate site-specific mitigation. Fault studies should accurately locate all active faults and should recommend safe set-back distances for siting structures. Structures that must pass through the fault zone should either use special design techniques to withstand fault rupture (i.e., natural gas lines) or should have a minor consequence if damaged and be capable of being rapidly repaired and placed back in service (i.e., roads).

POLICY: Follow and enforce the State's Administrative Rule: R156-56-701. Specific Editions of Uniform Building Standards which formally adopts the 2003 edition of the International Building Code (IBC), including Appendix J promulgated by the International Code Council, and amendments adopted under these rules together with standards incorporated into the IBC by reference, including but not limited to, the 2003 edition of the International Energy Conservation Code (IECC) promulgated by the International Code Council and the 2003 edition of the International Residential Code (IRC) promulgated by the International Code Council shall become effective on January 1, 2004. This Code will be used to its maximum extent to preserve the environmental resources and protect life and property from the natural hazards of the city.

POLICY: All new and remodeled structures shall meet or exceed the International Building Code adopted by the State to meet earthquake resistant design standards.

POLICY: Critical facilities (i.e., fire stations, police stations, hospitals) should not be developed until detailed studies addressing seismic hazards are completed.

POLICY: Habitable structures and critical facilities should not be constructed across an active fault (defined as having greater than 4 inches of displacement along one or more traces during Holocene time—about 10,000 years ago to the present).

OBJECTIVE: Manage development, minimize damage and hazards, and protect life and property in areas where unstable soils or slopes are present.

POLICY: Strongly discourage any development or construction on any natural Steep Slopes greater than thirty percent (30%) but less than or equal to forty percent (40%) and prohibit development on very steep slopes, greater than forty percent (40%). Development on steep slopes shall require engineering measures to eliminate the slope instability hazard potential and to protect current and future citizens and landowners from heath, safety and welfare concerns.

POLICY: Review development proposals located in or immediately adjacent to areas of steep and very steep slopes (as defined in Section 9.1), landslide hazard areas (areas with a high or moderate potential for landslides as shown in Map 9.5), or rockfall/debris flow deposit areas (as shown in Map 9.5). Developers shall hire qualified personnel to prepare applicable geotechnical studies to determine if significant slope stability constraints exist and to determine appropriate site-specific mitigation.

POLICY: Prohibit any development on lands which, based on geotechnical studies, are found to be unsuitable for the proposed land use due to unstable soil conditions, where landslide, rockfall and debris hazards are excessive or can't be mitigated in a cost-effective and aesthetically pleasing manner.

POLICY: Develop hillside-grading standards, by ordinance, to minimize the hazards of erosion and slope failure.

POLICY: Ditches, berms, and fences should be constructed under rockfall hazard areas to reduce the damage caused by rockfalls.

POLICY: In areas with a moderate or high potential for landslides (see Map 9.5) where existing structures are located, excavation of the slope should be limited (except as recommended by an engineer), landscape irrigation should be minimized, water and sewer pipes should be maintained to prevent leaking, and drainage should be directed away from unstable slopes to reduce landslide risks.

POLICY: Review development proposals located in or immediately adjacent to areas of soil instability ("moderate" or "severe" soil constraints, see Map 9.8). Developers shall hire qualified personnel to prepare a geotechnical study to determine if significant soil constraints exist and to determine appropriate site-specific mitigation.

POLICY: Require that soils containing toxic or hazardous substances be cleaned up to the satisfaction of the agency having jurisdiction prior to development or redevelopment.

OBJECTIVE: Minimize the risks associated with wildfires along the Urban Interface Wildfire Zone.

POLICY: Coordinate minimum fire safety standards between the local fire districts and wild-land fire district to ensure consistent fire safety standards in the City.

POLICY: Incorporate subdivision standards and development requirements in the development codes that minimize the impact of developing in remote and environmentally sensitive parts of Cottonwood Heights, including requirements for water supply for fire fighting purposes, measures for clearing brush and vegetation from the area around the structure, access, infrastructure standards, and other appropriate regulations in high, moderate, and low fire hazard areas.

POLICY: Structures that are constructed in the foothills, within or near the Wildfire Hazard Area (see Map 9.2), should employ design measures to help prevent damage from wildland fires. Exterior wood surfaces (wood roof shingles, wood siding, wood fences) should be avoided. Structures should include a minimum 30-foot buffer around the perimeter of the structure where the vegetation has been modified to reduce the wildfire threat. Structures located on sloped lots should include a larger buffer. Landscaping should be broken up with sidewalks or other nonflammable pathways. New structures should incorporate fire resistant building materials.

Cottonwood Heights should minimize the risks associated with wildfires along the Urban Interface Wildfire Zone

Goal 2: Environmental resources of the City should be protected including water quality, wildlife habitat, scenic quality, hillsides, ridgelines, vegetation, and wetlands.

OBJECTIVE: Protect surface and ground water quality from wastewater discharges.

POLICY: All property owners within Cottonwood Heights where a building has been or is being constructed should connect the building to the sewer system. Property with boundaries located more than 300 feet from the sewer connection may construct alternative wastewater systems (i.e., septic tanks) after showing substantial and unusual hardship and an insignificant risk to public health.

POLICY: No septic tanks or other privately owned wastewater disposal systems shall be constructed on property that should be connected to the sewer system. All alternate waste disposal systems shall comply with the Utah State Department of Health Code of Waste Disposal Regulations, Parts IV and V.

POLICY: Cottonwood Heights should undertake a study of existing septic systems in Cottonwood Heights to determine whether there are any violations of environmental policies and standards.

POLICY: Cottonwood Heights should aggressively enforce any violations of City environmental health policies related to inadequate septic systems.

OBJECTIVE: Protect surface and ground water quality from point- and non-point effluent discharges.

POLICY: Any discharges into waters or wetlands of the United States shall comply with applicable state water quality standards and the applicable portions of the Clean Water Act. Map 9.3 Dominant Vegetation indicates the location of known wetlands.

POLICY: Any groundwater discharges shall comply with groundwater protection rules established by the Utah Water Quality Board.

POLICY: New point-source discharges of wastewater shall be prohibited in Big Cottonwood Creek, between Wasatch Boulevard and the headwaters. Projects in the vicinity of Big Cottonwood Creek that would discharge into Big Cottonwood Creek such as, but not limited to, construction of dams or roads, can only be considered where pollution will result only during the actual construction activity, and where best management practices will be employed to minimize pollution effects.

POLICY: Any activities occurring within the Salt Lake City Watershed shall comply with the Salt Lake City-County Health Regulation #14.

POLICY: Development that accelerates the erosion of soil shall require implementation of best management practices and potentially a stormwater protection plan in accordance with Utah Pollutant Discharge Elimination System permit requirements to reduce stream sedimentation.

OBJECTIVE: Protect the environmental and natural resources of the City by requiring development to occur in a fashion and location, which respects sensitive natural lands: wetlands, critical wildlife areas, and vegetation.

POLICY: Work with the Army Corps of Engineers and the Natural Resource Conservation Service to establish A Special Area Management Plans@ within Cottonwood Heights as a means to pro-actively work toward the protection of important wetland resources, and to establish mitigation strategies for unavoidable impacts.

POLICY: Prohibit any development in moderate or high quality wetlands as defined by the Clean Water Act and enforced by the US Army Corp of Engineers, unless appropriate mitigation is approved by the jurisdictional governmental agencies.

POLICY: Require the protection of all wetlands, streams, and other waterways and other environmentally sensitive lands from construction impacts and runoff from parking lots, roads and other impervious surfaces.

POLICY: Minimize the impact of major development on USFS wilderness area; any threatened, endangered or sensitive animal species; breeding habitat and birthing areas; and migration corridors.

POLICY: All development in areas where existing native vegetation stands are predominant shall retain the maximum amount of existing vegetation on a site. Areas that shall remain undisturbed shall be designated before construction on any site containing sensitive lands and vegetation. The edge of disturbance areas shall be made to look as natural as possible. Straight-line removal of vegetation is discouraged. Post-construction re-vegetation shall replace native vegetation.

POLICY: Protect the boundaries of the Little Cottonwood Creek Park natural area (north of Crestwood Park) from encroachment of development.

OBJECTIVE: Protect the visual and scenic resources of the City by requiring development to occur in a fashion and location, which respects key viewsheds. The City shall identify key viewsheds from strategic vantage points within and outside of the city.

POLICY: Discourage any development on mountain hillsides and ridgelines that allows a structure to protrude into the sky line, as viewed from key vantage and entry corridor points by establishing a provision in the development code regulating the placement of any structure in these sensitive areas.

POLICY: Clustering of development is one tool to preserve existing trees and vegetation coverage, preserve sensitive environmental areas, reduce hazards from development on steep slopes, preserve habitat, and preserve the natural terrain. Structures built on the foothills are visible to the whole City. Consequently, it is recommended that the architecture, height, building materials, and other design features of new development in the foothills blend with the surrounding natural landscape and be compatible with adjacent properties. Ridgelines are one of the most striking visual features of the foothills. Cottonwood Heights should designate significant ridgelines for protection from development.

9.3 Existing Natural Environment Conditions

Hydrology

Big Cottonwood Creek flows out of Big Cottonwood Canyon and flows in a northwesterly direction along the northwest boundary of the City. Little Cottonwood Creek flows out of Little Cottonwood Canyon and flows in a northwesterly direction along the southern boundary of the City. These creeks are the two key hydrologic features in Cottonwood Heights (see Map 9.4). They carry Wasatch Mountain runoff through the community and eventually to the Jordan River.

Cottonwood Heights should protect surface and ground water quality from point- and non-point effluent discharges.

Floodplains

The 100-year and 500-year floodplains within the City generally follow the stream corridors for Little and Big Cottonwood Creeks. Floodplains are potentially subject to periodic inundation, which may result in loss of life and property, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base.

Floodplain hazard areas within Cottonwood Heights have been established and identified by FEMA. The boundaries of the floodplain hazard areas are delineated in Map 9.4.

Both Big and Little Cottonwood Creeks have been channelized and culverted along several reaches to reduce the flooding potential and minimize erosion. However, sediment collecting in the stream channels has historically caused flooding problems along both creeks.

Big Cottonwood Creek has been dredged in some places and widened to increase its conveyance capacity. A detention pond in Old Mill Valley was completed in 1983 to help control peak flows. Little Cottonwood Creek has been improved to prevent bank erosion. These measures have substantially reduced flood hazards along the creeks.

Furgeson Canyon and Deaf Smith Canyon also have small intermittent streams; however, these streams do not pose a serious flooding risk.

The East Jordan Canal flows in the northerly direction crossing the extreme western part of the city. This canal is privately owned and maintained.

Water Quality

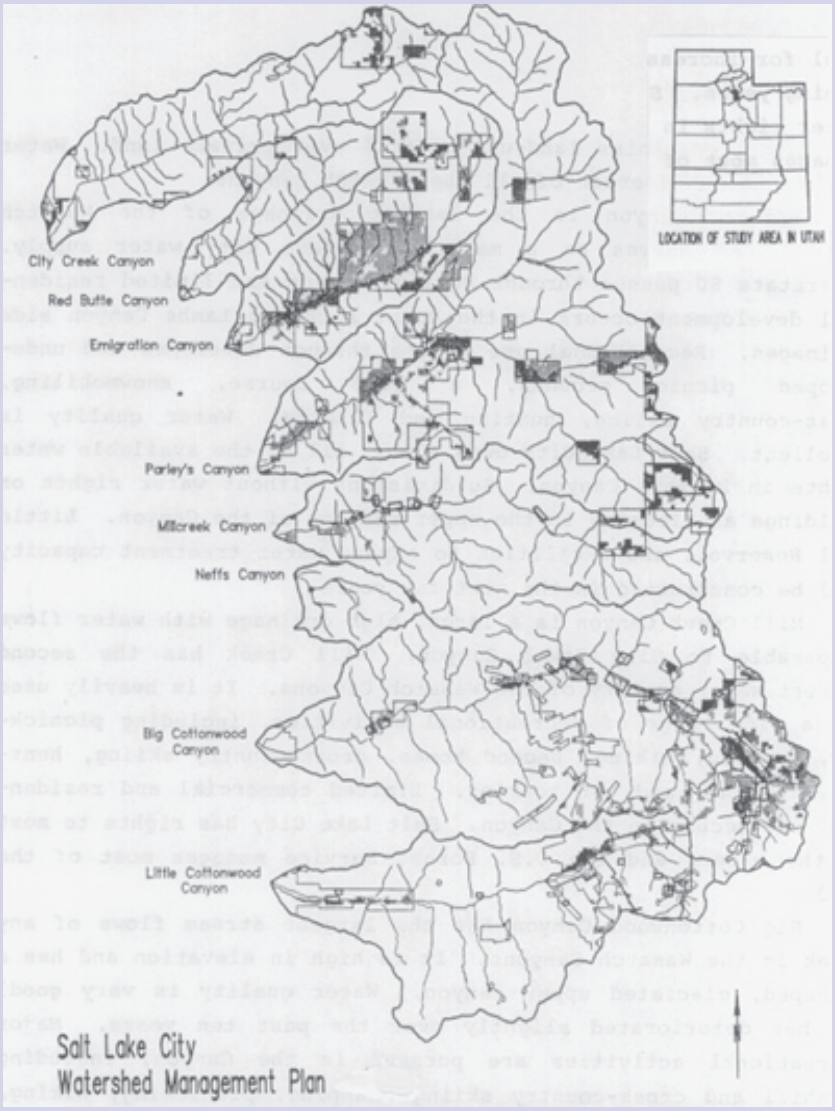
The health of the community's residents and environment depends on an adequate and safe supply of water. The Utah Water Quality Board (UWQB) is the agency that carries out the regulations, policies, and continuous planning necessary to prevent control or to abate surface and groundwater pollution.

Surface Water Quality Certification by the state is covered under Section 401 of the federal Water Pollution Control Act (1977) (Clean Water Act). This act requires state certification on any resulting discharge into waters and/or wetlands of the United States. These activities include, but are not limited to, the construction or operation of the discharging facilities. Any discharges must comply with applicable state water quality standards and the applicable provisions of the federal Clean Water Act.

The UWQB also adopts and enforces groundwater protection rules. The three main regulatory objectives of the UWQB are to prohibit the reduction of groundwater quality, to prevent groundwater contamination to reduce the need for after-the-fact clean up, and to provide protection based on the differences in existing groundwater qualities. Groundwater protection rules contain a groundwater discharge permitting system that controls activities, which may affect groundwater.

Big Cottonwood Creek (from Wasatch Boulevard to its headwaters) has been designated as an anti-degradation area[1] according to Rule R317-2: Standards of Quality for Waters of the State. This designation is applied to waters of high quality, which have been determined by the UWQB to be of exceptional recreational or ecological significance or have been determined to be a state or national resource requiring protection. These waters

Figure 9.1



[1] Further classified as "High Quality Waters—Category 1."

are required to be maintained at existing high quality. New point-source discharges of wastewater, treated or otherwise, are prohibited in this segment of Big Cottonwood Creek. Diffuse sources (non-point sources) of wastes are required to be controlled to the extent feasible through implementation of best management practices or regulatory programs. Projects such as—but not limited to—construction of dams or roads can only be considered where pollution will result only during the actual construction activity and where best management practices will be employed to minimize pollution effects.

Little and Big Cottonwood Canyons are located within the Salt Lake City Watershed (see Figure 9.1). Portions of Cottonwood Heights at the mouths of the canyons are also located within the Salt Lake City Watershed. Salt Lake City has extraterritorial jurisdiction for protection of its watershed. All development in Cottonwood Heights that is also located within Salt Lake City's watershed areas requires review by Salt Lake City for compliance with its applicable watershed protection standards. The Salt Lake City watershed protection standards, as defined in Salt Lake City-County Health Regulation #14 (watersheds), prohibit dogs or any other domestic animal without a permit, pollution, operation of vehicles off-road, deposit of human excreta, camping outside of official campgrounds, bathing, swimming, washing, and breaking glass in the watershed. There are also special regulations governing construction, sewage work, livestock operations, underground wastewater systems, and water systems.

Proper treatment of sanitary and sewage within Cottonwood Heights is vitally important in preserving, safeguarding, and improving the public health and environmental health. It is necessary that the disposal of sewage is regulated and that proper disposal is assured in order to protect the public health, safety, and welfare; to prevent nuisances; and to prevent air and water pollution.

Soil Instabilities and Hazards

Soil characteristics are important factors in determining what type of development is appropriate for a site. Characteristics to be considered include:

Slope

Slopes generally above 30%[2] are more prone to hillside slippage, particularly when soils that have low values for internal friction and cohesion are present. Hillside slippage can result in major losses to property and life.

[2] The "safe" gradient for slope depends on the nature of the material; 30% slope is a very rough general planning guideline. Site specific geotechnical studies, as required for development on slopes greater than 30%, shall determine the hillside slippage potential.

Drainage

Soils that have high water runoff potential have low infiltration rates after prolonged wetting, and water that falls on these soils must move to others soils as runoff.

Soils that have high erosion potential are typically located on steep slopes. The steeper the slope, the higher the potential for erosion. Soil erosion not only affects the location where the soil occurs, but can also cause damage to other locations far removed to where the soil is deposited. Erosion can be minimized by ensuring that the soil is covered by vegetation, which holds the soil in place.

Soils with rapid permeability (loamy sands or sandy soils) may allow pollutants or effluents to travel great distances through the soil. These soils are a particular concern in the Little Cottonwood Canyon and Big Cottonwood Canyon areas of the Salt Lake City watershed.

Soils with slow permeability (clay, silty clay, silty loam) have weak structure and lack appreciable amounts of pores. These soils are susceptible to surface flooding during heavy rainfall or snowmelt.

Depth to Water Table

Development can be limited by soils in which the seasonal high water table ranges from 0 feet to 30 feet below ground surface. In these areas, it may be difficult to dig basements or install utilities.

Presence of Expansive Soils

These soils expand when wet and contract when dry. This volume change can cause enough pressure to crack foundations and cause substantial damage in improperly designed or constructed structures. Adherence to the International Building Code ensures that risks associated with expansive soils can be reduced.

Presence of Strong Alkali Soils

Soils that have a strong salt or alkali content cause the rapid deterioration of concrete and metals. Adherence to the International Building Code ensures that risks associated with expansive soils can be reduced.

Cottonwood Heights has many types of soils (shown in Map 9.9). Table 9.1 shows the development constraints of each of the soil types in the City. Sites with one soil constraint are generally considered suitable for development. Sites with two or three overlapping constraints are generally considered moderately suitable for development. Soils with four

or more overlapping constraints are generally considered least suitable for development (see Map 9.8). Most of Cottonwood Heights is considered suitable for development. In the areas where soils pose "moderate" constraints, development should occur only after careful planning and engineering. In the locations with "severe" soil constraints, development should only occur after special engineering to mitigate problems and make development feasible. Soils with "severe" development constraints are typically impractical for supporting building foundations or roads.

Slope Instabilities and Hazards

The steep foothill slopes above Wasatch Boulevard and in other locations in the community (see Map 9.4) are potentially susceptible to landslides, rockfalls, and debris flow events that can result in serious damage to property and life. Development on steep slopes (above 30%) can result in degradation of fragile soils and water quality though increased erosion.

Landslides

Landslides occur when gravitational forces exceed the strength of material in a slope. In terms of geologic time, landslides tend to produce a stable landscape, but in the short term, landslides can be a significant concern to structures. Landslides most often occur as groundwater builds up in a slope due to rain, snowmelt, or landscape irrigation. This water increases the weight of the material in the slope, increases the pore pressure, hydrates and expands clay minerals, dissolves minerals that may hold particles together, and decreases the strength of the material, all of which weaken the slope. Steepening of a slope or removal of support at the toe by stream erosion or excavation also decreases slope stability. Stress increases in a slope that is loaded with embankments, fills, buildings, or waste dumps, particularly when loads are near the top of the slope. Also, the pore pressure from groundwater in a slope increases during vibration of large machines or earthquakes. Rapid changes of water level in reservoirs or streams also may trigger landslides along shorelines or stream banks. Landslides that have not moved for years commonly reactivate if groundwater levels change dramatically, particularly when water penetrates old ground cracks, or construction activity creates slope modification that reduces stability. Landslides in Utah typically move during the months of March, April, and May during the winter snowmelt and runoff.

Areas that are generally prone to landslides include existing landslide areas, steep natural slopes (especially in weak geologic materials), steep construction-related cut or fill slopes, areas at the mouth or canyons, developed hillsides where septic tank soil absorption systems are used and landscapes are irrigated, and below cliffs or hills with outcrops or fractured rock. Much of Cottonwood Heights is classified as having a low potential for landslides. However, steep slopes in the eastern portion of the city have a moderate to high potential for landslides (see Map 9.5).

Debris Flows

Debris flows may be generated when hillside colluvium or landslide material becomes rapidly saturated with water and flows into a channel. Intense rainfall, rapid snowmelt, or high levels of groundwater flowing through fractured bedrock triggers the movement. Debris flows and floods also occur when heavy rains on slopes cause extensive hillside erosion and channel scour.

Repeated debris flows and/or floods deposit sediment at the mouth of a canyon, forming an alluvial fan. The fan shape is a result of periodic diversion of the main channel back and forth across the fan. Flows may travel farther down the fan from the mouth of the canyon if the channel becomes entrenched and the flow is confined. Alluvial fans are risky places for homes because it is difficult to predict where flooding or debris flows will occur.

Debris flows may start as shallow landslides on colluvial slopes that are steeper than approximately 50% as a result of intense thunderstorm precipitation or rapid infiltration of snowpack melt. Debris flows associated with intense thunderstorm rainfall typically occur in July.

Rockfalls

Rockfalls are a natural process of cliff and hillside erosion. They consist of large rock fragments from a cliff or boulders from a slope that bounce, roll, and slide down a hillside and come to rest in a "runout" zone at or near its base. Many different processes cause rocks to become unstable and fall, including gradual weathering and erosion, tree-root growth, and weakening of supporting rock by saturation from groundwater. Excavation for a road cut or building may weaken bedrock support. Rockfalls are commonly triggered by earthquake ground shaking, rapid snowmelt, wide diurnal temperature changes, and intense storms.

Debris flows and floods also occur when heavy rains on slopes cause extensive hillside erosion and channel scour.

Rockfalls can occur any time of the year, but are most frequent in the spring when there is a repeated freezing and thawing of water in the rock joints. After dislodging from the outcrop, the rockfall blocks travel rapidly downslope generally in a relatively straight line by a series of leaps and bounces.

Seismic Instabilities and Hazards

Ground Shaking

Cottonwood Heights is located near the center of the Intermountain Seismic Belt (ISB), a broad band of seismic activity extending from near Las Vegas, Nevada, to north into Yellowstone and Montana. Within the ISB, there are many active faults, including the Wasatch fault, that are capable of generating large-magnitude earthquakes. Damaging waves from large earthquakes are capable of traveling long distances. However, seismic waves diminish over large distances; therefore, the most damaging seismic shaking would likely be a result of an earthquake along the Wasatch fault. On average, the recurrence interval of major seismic events on the Wasatch fault is approximately 444 years. The last major seismic event occurred near Nephi 300 to 500 years ago. This suggests that another major seismic event along the Wasatch fault is expected and could occur at any time.

Table 9.2
Liquefaction Potential Rating System

Liquefaction	Approximate Probability
High	> 50%
Moderate	10% - 50%
Low	5% - 10%
Very Low	<5%

The most effective way to reduce damage from seismic shaking is to build structures in accordance with the current International Building Code (IBC). All new construction in Cottonwood Heights is required to comply with the current IBC. Older unreinforced masonry buildings are likely to experience the most damage in a seismic event.

Liquefaction

Liquefaction is a common earthquake hazard related to ground shaking that accompanies earthquakes, typically magnitude 5.0 or greater. The term “liquefaction” refers to the actual physical change that occurs when certain soils are shaken and transformed from solid ground capable of supporting a structure to a quicksand-like liquid that has a greatly reduced ability to bear the weight of a building.

There are three critical factors that must be present for sediments to be prone to liquefaction. The sediment must be saturated with groundwater, composed of sand or silt-sized particles, and compacted fairly loosely.

Table 9.3 Is a Liquefaction Report Required?		
Proposed Land Use (Type of Facility)	High and Moderate Liquefaction Potential	Low and Very Low Liquefaction Potential
Critical Facilities (Essential hazardous facilities and special occupancy structures)	Yes	Yes
Industrial and Commercial Buildings (>2 stories or >5,000 square feet)	Yes	No
Multi-Family Residences (4 or more units/acre) and All Other Industrial and Commercial buildings	Yes	No
Residential Subdivisions, Single Lots, and Multi-Family Dwellings (less than 4 units/acre)	No*	No
* Although no special study is required, disclosure is required.		

Liquefaction poses a real, identifiable hazard to structures built along the ground or buried beneath the surface. Damage to buildings caused by liquefaction can result in structural collapse and loss of life or injuries. The risk of liquefaction-related damage can be addressed through appropriate engineering design of structures.

The majority of Cottonwood Heights is located in an area where the probability of liquefaction occurring is very low. Soils moderately prone to liquefaction in Cottonwood Heights are found primarily along tributary stream channels (i.e., Little and Big Cottonwood Creeks). (See Map 9.6.[3]) Table 9.2 shows the probability of liquefaction occurring in a 100-year period for each classification shown in Map 9.6.

[3] This map is based on a regional-scale investigation of the Salt Lake Valley and not every parcel in the county was sampled. Therefore, while the map serves as a good reference tool for pointing our areas that warrant further investigation prior to building, the liquefaction potential at a specific site may be different than what is shown on the map.

A site-specific liquefaction report should be prepared based on the land-use/liquefaction potential matrix shown in Table 9.3.

Surface Fault Rupture

The eastern portion of Cottonwood Heights is located within the active Wasatch fault Zone, which is subject to surface fault rupture. Surface fault rupture is fault-related offset or displacement that may occur due to an earthquake. If a fault were to break the ground surface beneath a building, significant damage could occur, perhaps resulting in injuries or loss of life.

Investigations of the Wasatch fault by Black and others (1996) concluded that this fault has a late-Holocene average recurrence interval of surface faulting earthquakes of 1,350 ("200) years, with the last major event approximately 1,300 years before the present. An earthquake along the Salt Lake City segment of the Wasatch fault could result in as much as 8 feet of displacement of the ground surface. Habitable structures and critical facilities should not be constructed across an active fault, which is defined as having greater than 4 inches of displacement along one or more traces during Holocene time (about 10,000 years before the present). It is generally less expensive to set a structure back from the fault than to design a structure to withstand the serious damage that significant surface fault rupture can cause. Because fault rupture tends to recur along existing fault traces, placing structures a safe distance from the nearest fault minimizes the threat of life loss, injury, and structural damage. The safe distance for setbacks should be determined as part of a site-specific fault investigation. Fault setbacks can also provide the community with an opportunity to integrate greenbelts/open space and recreation areas into the Wasatch Foothills. A site-specific fault investigation should be conducted prior to approval of any land use at sites that lie within a fault study area (see Map 9.6). The fault study area shown in Map 9.5 is 500 feet wide on the downthrown side and 250 feet wide on the upthrown side of the fault (in accordance with the Utah Geological Survey's Guidelines for Evaluating Surface-Fault-Rupture Hazards in Utah).

Biological Resources

Wildfires

The areas in Cottonwood Heights that could experience the most significant amount of destruction due to a wildland fire include the foothills of the Wasatch Mountains, especially where the residential areas meet the natural undeveloped vegetation (Urban Interface Wildfire Zone), see Map 9.2. Vegetation in these areas is typically comprised of sagebrush, mountain brush, and pinyon and juniper trees. Sagebrush and mountain brush catch fire relatively easily and burn hot and fast. Pinyon and juniper trees do not catch fire as easily, but will burn during prime burning conditions (hot, dry, and windy). Wildfires pose

immediate danger to life and property, and longer-term threats associated with flooding, landslides, and erosion after the vegetation on hillsides has been burned and is no longer capable of holding soils in place. In Cottonwood Heights, wildland fires are most likely to occur during the summer months (May through October) in areas affected by drought and/or in areas that are heavily overgrown with dry brush and debris. Wildland fires burn faster upslope because the fuels are closest to the flames. Fires are more likely to occur on west- and south-facing slopes because the sun dries out the fuels. Fire protection on the border of developed areas and undeveloped wildlands is difficult because tactics used for wildland-fire suppression cannot be used for structure protection and suppression.

Table 9.4
Draper Quadrangle Threatened, Endangered, and Sensitive Animal Species Occurrences

Scientific Name	Common Name	State Status	Federal Status	Date Observed
Haliaeetus leucocephalus	Bald Eagle	Federally Listed Threatened Species	Listed Threatened Species	4/1/1928
Oncorhynchus clarki utah	Bonneville Cutthroat Trout	Conservation Agreement Species	Not Listed	1981, 1998
Corynorhinus townsendii	Townsend's Big-eared Bat	Species of Concern	Not Listed	1951-05-18, 1998
Centrocercus urophasianus	Greater Sage-grouse	Species of Concern	Not Listed	7/4/1932
Coccyzus americanus	Yellow-billed Cuckoo	Federal Candidate Species	Candidate Species	1942-PRE
Asio flammeus	Short-eared Owl	Species of Concern	Not Listed	6/24/1999
Iotichthys phlegethontis	Least Chub	Conservation Agreement Species	Not Listed	1953
Margaritifera falcata	Western Pearlshell	Species of Concern	Not Listed	1929-PRE

Wetlands

To be classified as a wetland, an area must have a specific combination of soils, plants, and presence of water. The soil in a wetland must be hydric, or saturated with water, for at least part of the growing season. Plants found in wetlands are called hydrophytic. They have adaptations that allow them to live in a water-saturated environment where oxygen is hard to obtain. Water in a wetland can come from many places, including rain,

groundwater, surface water runoff or floodwaters. Water in a wetland does not need to be above the surface all the time; it only needs to be there part of the year. The type of wetland that develops (wet lake margins, wet meadows, ponds, etc.) depends on when the water is present, elevation, site topography, and other factors. Potential wetlands within Cottonwood Heights are shown in Map 9.4. Activities that would disrupt wetland habitats should be avoided, where feasible. The biggest threats to wetlands include: filling of wetlands for development and pollution from runoff.

Habitat

Cottonwood Heights is a densely developed community. Undeveloped areas are scattered throughout the community and are typically too small to provide critical habitat for special designation species. The Little Cottonwood Creek and Big Cottonwood Creek stream corridors and the undeveloped foothills of the Wasatch Mountains provide the most high quality habitat within Cottonwood Heights. Wasatch-Cache National Forest is located east of Cottonwood Heights. According to the Revised Forest Plan for Wasatch-Cache National Forrest, a large portion of the adjacent forest is designated National Wilderness Area, where the use of motorized vehicles is prohibited. The national forest provides habitat for several threatened and endangered species and is a regionally significant wildlife corridor.

Cottonwood Heights is located within the United States Geological Survey Draper Quadrangle. Table 9.4 lists all of the threatened, endangered, and sensitive animal species that may occur in this quadrangle. These species have special state and federal protection and should not be disturbed by human activities.

Agricultural Land

Cottonwood Heights does not contain any prime farmland. There are several parcels of land that are used for pasture or that are idle agricultural properties (see Map 9.3). These parcels are relatively small and isolated and do not have high value for agricultural purposes.

Aesthetics

The most significant aesthetic resource in Cottonwood Heights is views of and from the Wasatch mountain foothills. It is important to preserve the visual and aesthetic qualities of the foothills, including prominent ridgelines and existing vegetation, which are vital to the attractiveness and economic viability of the City. Ridgelines are one of the most striking visual features of the foothills.

9.4 Tools and Implementation Strategies

- Stronger ordinances for land development, home construction and other land uses in sensitive areas including regulations on roads, housing, commercial, recreation, and trails:
  - Construction Mitigation Plans for all construction in environmentally sensitive areas.
  - Prohibitions and/or controls on graded or filled slopes, benching and terracing, streets and roads on steep or very steep slopes, retaining walls, landscaping and re-vegetation, private development design standards.
  - Foot hill maintenance for wildfire, rock slide, mudslide, avalanche and re-vegetation
  - Maintain large lot zoning on foothill areas
  - TDRs, PDRs
  - Clustering
  - Consistency doctrine to practice linkage between the General Plan and development code and ordinances
  - Partnerships with lands trusts and conservation groups
  - Inter-local agreements with US Forest Service and adjacent cities and the county to jointly protect sensitive natural environmental areas.
  - Develop a Sensitive Lands Overlay Zone covering areas of the City with environmental or aesthetic concerns. This Ordinance or Chapter of the land development code would use a sensitive lands determination process. The purpose of this ordinance or chapter would be to require dedicated open space in aesthetically and environmentally sensitive areas, encourage preservation of large expanses of open space and wildlife habitat, cluster development while allowing a reasonable use of property, prohibit development on ridge line areas, steep slopes, and wetlands; and protect and preserve environmentally sensitive areas.

    This process would begin upon submission of a development application (to be defined in the new ordinance or chapter). These developments must identify the property's sensitive environmental and aesthetic areas such as steep slopes, ridgeline areas, wetlands, stream corridors, and wildlife habitat areas. The required analysis would include: slope/topographic map, ridgeline areas, vegetative cover, designated entry corridors and vantage points, wetlands, stream corridors, wildlife and habitat areas, visual assessment, soil investigation, geotechnical report, fire protection report, hydrological report, and wetland/

stream corridor resource evaluation.

Upon receipt of a complete application, the staff would review the required analysis conducted by competent professionals and render a sensitive areas determination. This determination would determine if the application of the natural environmental overlay applies to these environmentally sensitive areas. The staff would then guide the applicant through a site development suitability review and assist the applicant in determining those areas appropriate for development. The City recognizes the need for hardship relief if the applicant demonstrates that the regulations would deny all reasonable use of the property. The Planning Commission would be able to modify application of these regulations to provide the applicant reasonable use of the property.

- The City, through a Sensitive Lands Overlay Zone, will implement slope protection, ridgeline protection, wetlands and steam protection, wildfire protection, seismic and other natural hazards zone protection, and wildlife and habitat areas protection.

9.5 Citizen Comments

During this General Planning process a significant effort was placed on encouraging public participation and involvement in development of the plan. A series of six public workshops were held to solicit input from the public on which topics should be included in the General Plan. Hundreds of citizens participated in these workshops, providing written and graphic comments concerning the future of the city. A separate workshop was organized specifically for business owners in the city. Data collected from these workshops was compiled into a series of maps and written documents.

Citizens were asked at these workshops to help identify goals and issues to be considered in the General Plan process. Comments gathered through these workshops and through an unscientific survey served as a "wish list" for Cottonwood Heights that did not consider financial, political, or physical feasibility.

The key issues identified in community workshops for the natural environment are:

1) Hydrology and Water Quality.
   A. Protecting Big and Little Cottonwood Creeks stream corridors.
   B. Keeping the Old Mill Area, retention ponds, and creek natural.

2) Soil Instabilities and Hazards.
   A. Reducing erosion in the foothills.
   B. Restrict hillside development.
   C. Restricting development on the mountain southeast of the gravel pit.

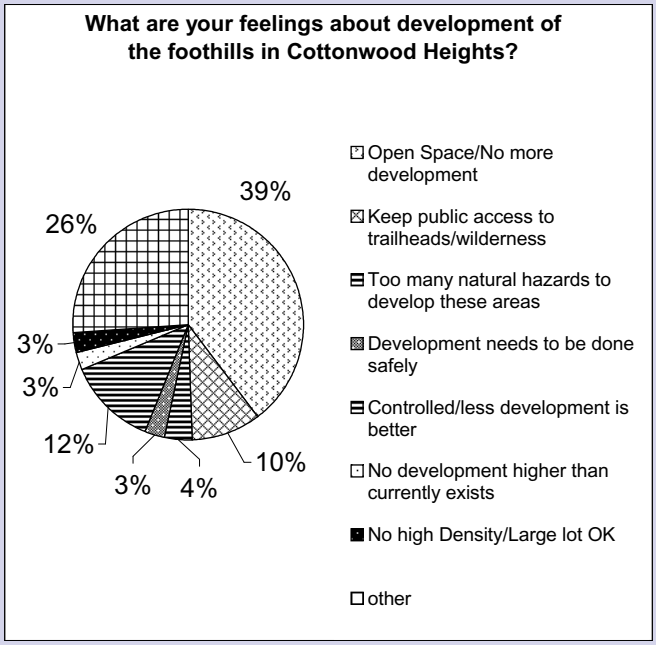
3) Seismic Hazards.
   A. Surface fault rupture.
   B. Groundshaking.
   C. Liquefaction and other types of seismically induced ground failure.
   D. Seismically induced landsliding.

4) Biological Resources.
   A. Revegetating the hillsides.
   B. Keeping Wasatch-Cache National Forest undeveloped.
   C. Preserving the agriculture and open spaces around Danish Road and Wasatch Boulevard.
   D. Protecting wildlife habitat.

5) Aesthetics.
   A. Protecting the hillside at Mill Hollow Park.
   B. Protecting lands north of Mountain View Memorial Estates.
   C. Protecting the hillsides southeast of Willow Creek Country Club and north of water treatment plant.
   D. Preserving the integrity of the canyons and canyon entrances with as little development as possible.
   E. Protecting and preserving the Little Cottonwood Creek park north of Crestwood Park.

Figure 9.2

Cottonwood Heights residents feel strongly about maintaining trail access and preserving open space along the foothills of the Wasatch Mountains.



Appendix A
Open Space Preservation Tools

A variety of regulatory and land use tools area available to help the city achieve its parks and open space preservation goals. These tools have been used successfully in a number of other communities along the Wasatch Front and across the nation. However, every tool may not be applicable in every situation. Cottonwood Heights should evaluate the following tools to determine whether they may be of assistance in setting aside additional land for parks or open space.

Parks and Open Space Master Plan

The Cottonwood Heights community has expressed interest in acquiring additional parks and open spaces within the city. A Parks and Open Space Master Plan could serve as a guiding tool for the city as future developments are proposed, schools close or are built, or as open spaces are annexed. A Parks and Open Space Master Plan would provide the city with an inventory of the existing park and open space opportunities within the city, assist in identifying areas of the city in need of more open spaces or parks, and assist in identifying existing open space preservation priorities for the city.

Sensitive Lands Ordinance and Overlay Zone

Cottonwood Heights' residents have expressed that they would like to preserve existing open spaces. One tool that the city should consider is a sensitive lands ordinance. If implemented, this ordinance could be used to guide development within sensitive lands in a manner that appropriately addresses any environmental

constraints of the land and the community's desire to preserve open spaces.

This ordinance could require clustered development or consideration of other tools such as a transfer of development rights program to ensure that as much of the remaining open spaces within the city is preserved as possible. A sensitive lands overlay zone would work in tandem with this ordinance to identify the areas that have sensitive lands characteristics or environmental constraints.

Hillside/Ridgeline Protection Ordinance

The community has indicated that it is interested in preserving the view corridors into and out of the city. A hillside protection ordinance is a tool for ensuring that the visual qualities of hillsides and ridgelines are preserved. This type of ordinance can be used to limit development on ridgelines and hillsides that are highly visible from key vantage points within the city. Protection of the visual quality of Cottonwood Heights is also addressed in the Natural Environment section of this General Plan (see Chapter IX.).

Large Lot Zoning or Density Reduction

Zoning of identified preservation areas can be modified to require large lot sizes (e.g. five to 10 acres) that will presumably conserve substantial amounts of the open space. However, such regulations run the risk of being considered down zoning and may not be popular with landowners, or may be politically challenging. And, although large lot zoning does reduce the number of homes that can be built, it also can spread out homes in such a way that limits the ability of the remaining land to be used for recreation or wildlife habitat. It is best used in conjunction with cluster development or cluster zoning to preserve as much contiguous open space as possible for recreation, aesthetics and wildlife habitat.

Performance Zoning

Performance based zoning requires developers to show evidence that they can meet regulations (a specified level of performance) prior to the approval of their project. One common performance zoning measure is the requirement to maintain minimum open space ratios in a development. Developers could be awarded points for going above and beyond what is required by the city. For example, points could be awarded to developers for not impacting and/or leaving an open space intact. These points could translate to density bonuses, which may be used on or off site.

Cluster Development

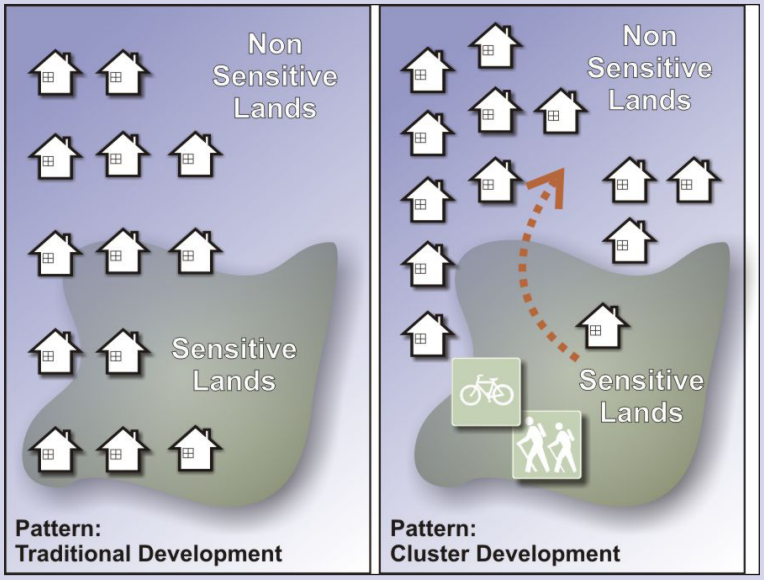
Cluster development requirements are often part of a performance-zoning program (as described above). Cluster development is a strategy to maximize the amount of open space within a development plan. Development is clustered in less sensitive areas rather than evenly spread out at a lower density. The cluster development strategy can also involve

providing density bonuses to developers in exchange for not building in sensitive areas. By granting density bonuses to developers, they can achieve a profitable development level without having to build in sensitive areas. Through clustering, an undeveloped preserve is created that may be jointly owned by the homeowners, or sold as a very large tract to a single owner. Usually this remaining open space is placed under a conservation easement. Such easements are usually assigned to non-profit such as an open space preservation organization or a local government entity. A third party holding prevents the easement from being removed without appropriate approval. The easement prevents further subdivision or construction. Conservation easements are discussed in a following section.

Figure A.1

Cluster Development

Clustering is a mechanism for concentrating development on lands appropriate for development while preserving and protecting those which are least suited to development. Developers can receive density bonuses, and open spaces can be preserved in this way.



Exactions, Dedications, and Impact Fees

Exactions may provide alternatives for local governments strained by the impacts of growth. Where new development creates a need for increased public services and infrastructure, such as park space, this proactive approach is intended to ensure that the new development pays for the needed increase in level of service. When used for open space acquisition a developer is typically required to leave a certain percentage of land undeveloped. Exactions are best used in conjunction with a flexible zoning code that allows for planned unit developments and clustering.

Impact fees are another option for local communities. Typically the fee is charged to developers for the purpose of financing increased facility needs or improvements. Capital improvement or project improvements that qualify for funding generation by impact fees include parks, recreation facilities, open space and trails.

Transfer of Development Rights

Transfer of development rights (TDR) is a land use management tool designed to direct development away from areas that a municipality wants to preserve (i.e. wetlands, hillsides, agricultural land, etc.) to locations that are more appropriate for development. Land to be preserved is designated as a sending area, while developable land is reserved as a receiving area. Under a TDR system, sending area landowners are allowed to transfer or sell their right to develop for fair market value to owners of receiving area properties. This sale or transfer allows the receiving site developer to build a project with increased density in the receiving zone. This can be a useful tool for farmland owners who wish to maintain their operation, property and lifestyle but are finding it increasingly difficult because of increase property values and taxes.

The concept of TDR is based on the assumption that title to real estate is actually a bundle of individual rights, which may be isolated and transferred to someone else (as is the case with water rights). One of the components of this bundle of rights is the right to develop land. After the original owner sells his development rights, he/she still retains whatever rights have not been transferred away.

TDR offers communities an alternative to expensive acquisition or more restrictive regulations. TDR is a new option, in a sense, a new property right that can be sold in a private market transaction with another property owner. Few programs seem to offer so much for so little—the community retains the critical resource without the acquisition costs, the property owner receives compensation in addition to property tax relief, and a developer can achieve a variety of densities generally not available within the community.

Specific state enabling legislation is not required prior to the utilization of a TDR program. However, this practice can only work within the right economic environment, and with careful analysis and designation of sending and receiving areas. Although not widely practiced in Utah, this technique is quickly gaining popularity since a TDR program has the ability to bring a large amount of open space into public ownership for preservation without a corresponding significant cost to the city.

West Valley city, Mapleton, and Summit County are local examples of successful TDR programs. Davis and Cache Counties are exploring the use of TDR to create public open space by offering additional density incentives to dedicate the reserved land as permanent, publicly accessible open space.

Figure A.2

Transfer of Development Rights

TDR is a tool to encourage development in areas identified for growth while protecting areas identified for preservation. Using this tool, the right to develop a parcel of land is transferred off-site to another parcel and the landowner retains all other rights to the property.